

A Fixed-Effects Multilevel Analysis of How Community Family Structure Affects Individual Mortality in Norway*

Øystein Kravdal

**Department of Economics
University of Oslo, Norway**

Author's address:

Department of Economics
University of Oslo
P.O. Box 1095 Blindern
N-0317 Oslo

e-mail: okravdal@econ.uio.no
fax: (47) 22855035

* The financial support from the Health Economic Research Program at the University of Oslo (HERO) is greatly appreciated. Some of the data have been extracted from the Municipality Data Base operated by the Norwegian Social Science Data Services. That institution is not responsible for the analysis or interpretations.

A Fixed-Effects Multilevel Analysis of How Community Family Structure Affects Individual Mortality in Norway

Abstract

Using register data for the entire Norwegian population aged 50-89 in 1980-1999, in which there are $\frac{3}{4}$ million deaths, it is estimated how the proportions who are divorced or never-married in the municipality affect all-cause mortality, net of individual marital status. The data include individual histories of changes in marital status and places of residence, and provide a rare opportunity to enter municipality fixed-effects, capturing the time-invariant unobserved factors at that level, into the models. The positive health externality of marriage that has been suggested in the literature is supported by some of the estimates for women, while other estimates, and especially those for men, point in the opposite direction. These findings may indicate that a high level of social cohesion is not as beneficial as often claimed, at least not for both sexes, that marriage perhaps undermines rather than strengthens social cohesion, or that other mechanisms are involved, for example related to people's perceptions of their health relative to that of others. Estimates from models without such municipality fixed-effects are markedly different, but these also shed doubt on the notion that a high proportion not married generally increases individual mortality. (191 words)

Running title: Effects of community family structure on individual mortality

Key words, alphabetically sorted: Census, Cohesion, Community, Divorce, Education, Family, Fixed-effects, Income, Marriage, Migration, Mortality, Multilevel, Municipality, Never-married, Register, Socio-economic

Word count of text, excluding references and notes: 7837

It has been demonstrated repeatedly that those who are married have better health than those who are not, although the causal pathways are inadequately explored (e.g. Hu and Goldman 1990; Waite and Lehrer 2003). There are even indications of an increasingly protective effect of being married (Valkonen, Martikainen and Blomgren 2004). In addition, some studies have suggested positive health externalities of marriage. For example, Cubbin, LeClere and Smith (2000) reported that, given individual marital status, those who lived in areas where a high proportion were divorced had relatively high homicide rates. With Finnish register data, it was shown that people in communities with many one-parent families and divorcees suffered high alcohol and suicide mortality (Blomgren et al. 2004; Martikainen, Mäki and Blomgren 2004). Moreover, there is similar evidence about more common diseases and causes of death. In one study, the proportion of women who were lone parents and the proportion of households that were female-headed were found to influence self-rated health (e.g. Stafford et al. 2004), and LeClere, Rogers and Peters (1998) reported that women in communities with high concentrations of female-headed families were more likely to die of heart disease.

A common idea behind these multilevel studies is that the community family structure may be a determinant of, or at least linked with, social cohesion. “Social cohesion” is a contextual characteristic (as opposed to the social support that each individual person may benefit from) that has received much attention in recent investigations. It is usually considered a somewhat wider concept than “social capital” (e.g. Coleman 1988), and may be loosely defined as the degree of mutual trust and support among people in the community and the density of membership in civic organizations – in short, the extent of connectedness and solidarity (e.g. Kawachi and Berkman 2000). Evidence about the health effects of social cohesion has come from surveys where people have been asked about their perceptions of the neighbourhood and their ties with others (e.g. Patterson et al. 2004), although it should be noted that such cohesion effects do not always show up statistically (e.g. Mohan et al. 2005; Veenstra 2005). In addition, more easily available data on voting behavior, migration and family structure have been used as indicators of social cohesion. For example, the proportion of men with a partner was one of three variables used in a Finnish study to produce a cohesion index, which had a modest effect on some causes of death (Martikainen, Kauppinen and Valkonen 2003).¹

The possible impact of community family structure deserves more attention. The issue is important because of the sharp drift away from marriage in many countries, and because the current evidence is not overwhelmingly strong. After all, the studies addressing this relationship are rather few, although pointing in the same direction, and the theoretical arguments for a beneficial effect of a high prevalence of marriage may be questioned. For example, it is not obvious that those who are married are those who involve themselves most strongly with others, which has been suggested as one causal pathway (see below). It is not impossible that the statistical associations appearing in earlier studies are entirely spurious, i.e. that they are a result of factors that are inadequately controlled for and that produce, say, both a high divorce rate in the community and high individual mortality.

The objective of this investigation is to use extraordinarily rich Norwegian register and census data and appropriate multilevel methods to check whether the proportion divorced and the proportion never-married have harmful effects on adult mortality in 1980-1999, above and beyond that of the person’s own marital status. No attention is paid to the proportion widowed, which to a large extent is determined by

the level of mortality. The municipality, of which there are 435 in Norway, is the level of aggregation.

The data cover the entire national population and include biographies of individual characteristics, such as education, income and marital status. Besides, all municipalities in which a person has lived during the period under investigation are identified, and there is information about these municipalities for the relevant years. Because of the longitudinal character of the data, both at the individual and municipality level, it is possible to include municipality fixed-effects to pick up unobserved time-invariant factors at that level. This has rarely, if ever, been done in other multilevel mortality studies. The focus is on mortality in the age group 50-89, in which $\frac{3}{4}$ of all deaths occur, and on the effects of the proportions divorced or never-married in that age group, with a side-view to the effects of the corresponding proportions among younger adults.

THE SETTING

Norway has a public health care system, and is strongly influenced by an ideology places emphasis on equality in opportunities (e.g. Kautto et al. 1999). Nevertheless, there are substantial socio-economic differentials in mortality (e.g. Kunst et al. 2004), perhaps even sharper than in many other European countries (Mackenbach et al. 1997). Besides, there are marked differences between the 19 counties, and apparently not only because of the socio-economic composition (e.g. Kristofersen 1990). Men's life expectancy at birth currently ranges from more than 76 years in some counties in Western Norway to less than 73 years in the northern county of Finnmark (Statistics Norway 2005a), with the corresponding figures for women being 82 and 80 years, respectively.

A large proportion of those born early in the 20th century never married, but the period marriage rates increased from the mid-1930s to the mid-1960s, followed by a sharp decline (Statistics Norway 2000b). Consequently, the proportion who are never-married at age 30-49 has increased during the period under analysis (from 11% in 1980 to 30% in 1999; calculated from the data used in this analysis), while there has been a decline among those aged 50-69 (from 10% to 7%) or 70-89 (from 15% to 8%). Informal cohabitation has become more common, but the proportion of the non-married who are cohabitants is rather low in the ages considered here (about 20% in the age group 50-79 in 2002 (Statistics Norway 2005c) and far less in the early 1980s).

As in other European countries, the divorce rates have increased strongly over the last four decades.² In the age group 50-89, the proportion divorced has risen smoothly from 4% in 1980 to 11% in 1999. Women and men of age 30-49 have seen an increase from 7% to 13%.

THEORETICAL CONSIDERATIONS

Effects of Individual Marital Status

The person's own marital status is generally associated with mortality, although more clearly for some causes of death than others (e.g. Gove 1973; Joung et al. 1996). These effects reflect family members' care and support, and perhaps the additional knowledge and information-processing capacity they contribute. Moreover, the better

financial circumstances among the married (Lillard and Waite 1995) and the control of behavior that a spouse exerts (e.g. Umberson 1992) may be important. Such factors may influence both the ability to cope with a disease and its prevention. As an example of the latter, smoking and alcohol abuse have been reported to be more common among the non-married, and in particular the divorced, than among the married (e.g. Rosengren, Wedel and Wilhelmsen 1989). Finally, reactions to changes in marital status, such as the death of a spouse, may affect mortality through other mechanisms (e.g. Smith and Zick 1996).

On the other hand, the positive relationship between marriage and health may also be due to selection (e.g. Goldman 1993; Lillard and Panis 1996). When choosing a partner, people tend to prefer healthy individuals, and divorces do not hit randomly with respect to health and life style either.

Possible Causal Effects of the Proportions Who are Not Married

Transmission of behavior. There are several reasons why also the community family structure may influence individual mortality, in either direction. First, it is possible that any harmful health behavior linked to individual marital status may be passed on to others, because norms are changed, or because people learn health behavior from each other through social interaction (e.g. Montgomery and Casterline 1996).

The level of earnings as a causally intermediate factor. Second, those who have poor health, perhaps as a result of not being married, may contribute relatively little to the economy. They may work less, or earn a lower wage because of lower productivity. In some countries, but to a lesser extent in Norway, a reduced work activity may also be seen among lone parents because of obvious practical obstacles (e.g. Stafford et al. 2004). Lower incomes in the municipality may have health consequences for everyone, for example through the quality of health services³, efforts to prevent accidents, and the prevalence of social disorder (loitering, fighting, prostitution, robberies, violence). In fact, effects of low average income, high unemployment rate, or outright poverty, have been documented both in Europe and North America (e.g. Pickett and Pearl 2001; Robert 1999; Sampson, Morenoff and Gannon-Rowley, 2002; Wen, Browning and Cagney, 2003), and even in the supposedly egalitarian Nordic countries (e.g. Blomgren et al. 2004; Martikainen et al. 2003; Kravdal 2005; Osler et al. 2003; Sundquist, Malmström and Johansson 2004). However, there are also studies where such effects have failed to show up (e.g. Sloggett and Joshi 1994).⁴

Involvement with others. The third type of mechanism is that other people's marital status may have a bearing on their tendency to involve themselves with others. This involvement may include practical assistance or simply an inter-personal contact that helps others get a sense of value and belonging. If there is a generally high degree of mutual connectedness in the community, there may also be taken more initiatives and be stronger willingness to establish associations and institution that may be beneficial for everyone. (For an analysis of the importance of being socially integrated, see Berkman et al. 2004.) Moreover, connectedness may have the consequence that information diffuses more easily throughout society, for better or worse.

However, it is not obvious that people who are married are those who engage themselves most strongly with others, at an individual basis or through organizations. The evidence is mixed. Let us start with the reasons why there should be a *positive*

relationship between marriage and social cohesion: First, the married may have good opportunities to take part in various community activities because they tend to have more resources and perhaps are less pressed for time than especially the divorced women, who may have experienced severe drops in household income and be alone with child care responsibilities (e.g. Kalmijn, van Groenou and Terhell 2001). Second, it has been suggested that men are generally less interested in developing and maintaining social networks, and need to be married to be well integrated in the community. Third, parenthood, which is linked with being ever-married, may help people get into contact with others. Fourth, a particular reason why divorces may weaken networks is that old friends may be torn between the partners and tend to shy away to avoid complicated situations (e.g. Terhell, van Groenou and van Tilburg 2004).

On the other hand, there may be expectations among the married, and perhaps especially the men, that a spouse should focus the attention on the couple rather than friends (e.g. Gerstel 1988). Besides, many divorced people may actively seek the company of others as a means of coping with the disruption.

Anyway, even with a positive association between marriage and social cohesion, there is not necessarily a harmful effect of the proportions divorced or never-married on mortality. As suggested by some authors, it is not impossible that social cohesion actually *undermines* health, by overburdening people with obligations (e.g. Martikainen et al. 2003).

Other explanations. A “crowding-out” argument may also be relevant: If those who are not married have poorer health and lower incomes than others, they may also use health and other social services relatively frequently, which may reduce other people’s opportunities to draw advantage from such services.

Finally, relative income and health may be implicated. It is a common idea that, given a person’s own income, he or she may feel better if the average income in the community is low (e.g. Kawachi, Subramanian and Almeida-Filho 2002). A low average income may, in turn, be partly a result of the community family structure. Similarly, one might speculate whether a personal health problem would be perceived as smaller, and thus be more successfully coped with, if many others in the community have poor health, as a result of not being married or for other reasons. In support of this proposition, Kaplan and Baron-Epel (2003) argued that perceptions about other people’s health are a key ingredient in the judgments about one’s own health.

Effects of the proportion divorced versus those of the proportion never-married, and effects of the family structure among the young adults versus those of the family structure among the older. For simplicity, the non-married have been largely considered as one group in the discussion above. However, the effects of a high proportion divorced are not necessarily the same as the effects of a high proportion never-married, and it may well be that the family structure among the relatively young adults has another effect than that among the older. The latter distinction has not been made in earlier empirical studies, which have typically considered only one broad age group, for example all adults.

Unfortunately, theoretical arguments point in different directions. For example, if individual health is a key mediator, as in some of the mechanisms reviewed, one might expect the proportion divorced to have the sharpest effect, because divorced men in Norway have poorer health, as judged from their all-cause mortality, than the never-married (Kravdal 2001; confirmed by estimates in this study). On the other hand, the divorced are more likely to have children, which could

make them contribute more positively to social cohesion (but also have opposite effects).

Prediction is no easier when it comes to the age distinction. One type of argument is that being never-married as a middle-aged or elderly person may be quite different from being never-married in the 30s. Most importantly, many never-married or divorced young adults may be cohabitants. Another relevant issue is that, although many non-married, and especially the divorced, have children, only the youngest of them have so young children that care is a major burden. Finally, one should note that some of the causal mechanisms reviewed above involve a direct social interaction, in which case the behavior and resources of people of roughly the same age may be particularly relevant, while other mechanisms involve more general societal processes for which the family structure at all ages may be important. One cannot readily conclude what all this adds up to.

Possible sex and age variations. An entirely different question is whether community family structure affects mortality for men and women, and for different age groups, similarly. Some authors have drawn attention to the possibility of such age- and sex-variations in community effects more generally (e.g. Roberts 1999), but no one has checked this with respect to family structure. While the causal mechanisms reviewed above seem plausible for all ages and both sexes, they are not necessarily equally important for all groups. In support of that, a British study by Stafford et al. (2005) indicated that social cohesion was more beneficial for women's self-rated health than for men's, and this was suggested to reflect differences in social roles and responsibilities, leading to differences in the exposure and vulnerability to the local environment. Similarly, Molinari, Ahern and Hendryx (1998) reported from the United States that the social qualities of the neighbourhoods were most important for the perceived health of women. Moreover, a Swedish study showed that men were hardest hit by a low relative income (Yngwe et al. 2003). Assuming a positive effect of a high proportion married on the level of social cohesion, and a negative effect on relative income, these two findings would suggest that a high proportion divorced or never-married would be more harmful or less beneficial for women than for men. However, the patterns are by no means well established. For example, an Israeli investigation showed that low relative income affected mortality only among men, but in an unexpected favorable way (Jaffe et al. 2005), and another British study suggested a more positive link between social cohesion and mental health among men than among women (Ellaway and Macintyre 2001).

It would not be difficult to construct hypotheses about age variations also. One possibility might be that social cohesion perhaps has more influence at the lowest ages, because the causes of death for which psychosocial factors are generally reckoned to be most important are relatively more common among the youngest. On the other hand, the elderly may be more dependent on the local environment. No empirical conclusion can be drawn from the literature. For example, in analyses of separate causes of death in Finland, no clear age pattern in the effects of social cohesion appeared (Martikainen et al. 2003, 2004). The evidence from studies of other community factors is inconclusive (e.g. review in Wen, Cagney and Christakis 2005).

Sources of Spuriousness

In addition to the causal effects just reviewed⁵, there are several factors that may affect both the community family structure and individual mortality, and thus need to

be controlled for. One such factor is community income, whose possible importance for health was briefly addressed above. It is also likely to influence the family structure, although the direction is not easily predicted. While it is widely assumed that an economically successful man will be relatively early married, have a low chance of remaining single and experience a low divorce rate, all other characteristics given, there are different views about the effects of a woman's earnings, linked to ideas about specialization (Becker 1991) versus pooling of resources (Oppenheimer 1994). Besides, individual earnings are not the only economic factor of importance for marital behavior (e.g. Lichter, LeClere and McLaughlin 1991; South and Lloyd 1995). The economic attractiveness of a man may also depend on his earnings relative to that of other men (the latter reflecting what the woman might achieve with continued searches) and relative to women's own economic resources, and a woman may be compared with others in a similar way. This means that, if the pooling-of-resource model holds and marriages (very hypothetically) are confined to occur within the borders of a municipality, it is far from obvious that marriage rates would go up and divorce rates down if the earnings of all men and all women in the municipality increase by the same amount.⁶ Without the geographic restriction, it would be more reasonable to expect an increase in the popularity of marriage in the richer municipalities, though. Assuming instead that specialization is the key factor (especially likely for the oldest cohorts in this study), one might expect the highest proportion married in the municipalities where men are rich and women have poor earning potentials. Adding to the ambiguity, other types of mechanisms, for example related to community norms and parental supervision, may be responsible for low as well as high marriage rates in rich communities (e.g. South and Crowder 2000).

The better-educated have relatively high wage potentials, but also other resources that may be positive in a marriage. Thus, one may argue just as above under the assumption of a pooling-of-resource model: All else equal, individuals with high educational level may be the first to marry and have a low chance of divorce, and it is possible, but by no means obvious, that high average education enhances the prevalence of marriage. However, family behavior is also driven by norms. Whereas the better-educated perhaps may be considered attractive, they may also be the ones who are most inclined to accept the "untraditional", such as informal cohabitation and divorce, so prediction of effects is indeed difficult.

Community education may also affect health, through, for example, transmission of good health behavior from better-educated individuals, or a higher quality of health services.⁷ Such effects have received much less attention in the literature than those of community income, but in one of the few studies that have addressed the impact of both factors, community education was clearly the most important for health (Wen et al., 2003). A recent analysis of cancer survival in Norway revealed sharp effects of community education (Kravdal 2005).

For simplicity, and in lack of clearer theoretical guidance, only averages of current income and educational level, pooled across sexes, are entered into the models in this study. Sex-specific measures of community income were not available in the data. The education among women divided by that among men was included in some preliminary models, but that had no effect on the other estimates.

People's values may also be important in creating a spurious relationship between family structure and mortality. Conservative family values, perhaps associated with religiosity, may inhibit some couples from splitting up and others from choosing informal cohabitation (while a high proportion who are never-married at the highest ages is less likely to be an indication of liberal values). The prevailing

values in the community may also affect individual mortality through, for example, local policies to alcohol and drug abuse, as well as the general health behavior, which is further transmitted to the individual. In support of this, religiosity is often found to promote a healthy life-style (Hummer et al., 1999; Waite and Lehrer, 2003).⁸

To make this even more complex, the prevalence of poor health and health behavior in the community, whether determined by values or other factors, may affect the marriage and disruption rates. For example, just as individuals who drink much are more divorce-prone than others, a high level of alcohol abuse in the community may be partly responsible for a high proportion divorced.

Also the degree of urbanization is a potential confounder. The non-economic gains from marriage may be weaker in cities, which offer many attractive and partly competing activities, and it may also be easier to find alternative partners there (e.g. Lichter et al. 1991). Besides, an urban environment is widely thought to produce poor health behavior, perhaps partly compensated by easier access to high-class health services.

The sex balance is another possible determinant of the family structure. For example, if many young women move from a community because of a lack of jobs (while there are more jobs for men, perhaps because of a dominant primary sector), it is possible that relatively many men never marry. On the other hand, there may be few never-married women. Anyway, an effect of the sex balance on mortality does not seem very plausible.

Finally, the level of social integration in the community has been suggested as a determinant of the family structure, in addition to perhaps being influenced by it, as discussed above. At the individual level, Booth, Edwards and Johnson (1991) found that people with few organizational affiliations and close friends had high divorce rates, while South and Scott (1995) showed in a multilevel analysis that geographic mobility, which may be linked with social cohesion, pushed divorce rates up.

The community characteristics that are available in the data (see below) cannot possibly capture all these potentially confounding factors adequately. For example, the relevant economic background factors may be poorly tapped by the current average income, and the political variable at hand is likely to be a very crude proxy for people's values. While some of the remaining unobserved factors are time-varying, others are constant. To continue with the example, there may be certain economic structures, perhaps linked to the physical characteristics of the municipalities, that change little over time, and there is probably also a large stable component in people's value orientation. These constant municipality characteristics can be picked up by including fixed-effects, i.e. 0/1 dummies for each municipality.

Another main reason for a spurious relationship between individual mortality and community family structure is selective migration (e.g. Oakes 2004). In principle, people with certain unobserved characteristics of importance for their health may tend to move into or remain in a municipality because of the family structure there, or because of the factors that have created this family structure. No attempt is made here to model this selection, which is notoriously difficult.

DATA AND METHODS

Data

The data include life histories through 1999 for all men and women with a Norwegian identification number (i.e. everyone who has lived in Norway for some time after

1960), and is an updated version of the data used in several previous studies (e.g. Kravdal 1995, 2000, 2001). In these life histories, there is information about date of death, all migration across municipality borders 1964-1999, annual income in 1970, 1980 and 1990, and the highest educational level attained as of 1960, 1970, 1980 and 1990. All this has been taken from the Population Censuses of 1960, 1970, 1980 and 1990 and the Norwegian Population Register. In addition, characteristics of the municipalities have been extracted from the Municipality Data Base operated by the Norwegian Social Science Data Services (NSD), or produced by aggregation of the individual data.

The study is restricted to age 50-89 and the years 1980-1999. The total exposure time is about 27 million person-years, and there are about 720000 deaths.

Statistical Approach

Discrete-time hazard regression models are estimated, with a follow-up from January the year the person turns 50 or, for those born before 1930, from January 1980. Each person contributes a series of 12-month observations.⁹

Some individual variables are included in the models, in addition to individual marital status. They are likely to have a bearing on marital status, except perhaps the income and migration variables, as well as mortality. Individual income may pick up factors that are causally behind marital status, but it may also be influenced by it. Recent in-migration (whether moved to the municipality within the last 5 years) is an individual-level counterpart of a social-cohesion indicator.

All individual variables are time-varying and refer to the situation at the start of the 12-month observation interval or (for education and income) the time of the most recent census before that, which is 1970 for observations in 1980, 1980 for observations in 1981-1990, and 1990 for observations in 1991-1999. If a higher income is recorded at an earlier census, that income is used instead. If no income is found in any census (occurring for <1% of the observations), a missing-income indicator is set to 1 (otherwise 0), and income is set to 0 (any number would do).¹⁰ A similar indicator is used for missing education (2%). The municipality variables (defined below) describe the situation in the year that includes the start of the observation interval in the municipality in which the person lived at that time.

It is experimented with a variety of models. They all include year of observation, individual age, individual education, individual marital status, and the proportions divorced or never-married. The difference between them lies in the other individual and municipality variables included. Most of the attention is focused on a model with all individual variables included along with municipality fixed-effects and a few other municipality variables.

The models are estimated separately for men and women and for 4 10-year age groups. This is primarily because of the size of the material (e.g. 4.3 million one-year observations and 30000 deaths among men aged 50-59, 1.3 million observations and 130000 deaths among men aged 80-89, and as many as 470 variables in the most complex models). In addition, such stratified modeling easily reveals whether the effects vary across sex and age.

Family Structure Variables

The *proportion divorced* (mean=0.082, s.d.=0.044) is calculated for each year by aggregating from the individual data on marital status. Data for both sexes and all

ages 50-89 are used. The figures are age standardized, using the age distribution from 2000, although that turned out not to be important. The proportion is defined as the number of divorced and separated divided by the number of married, divorced and separated. Excluding the separated, or including the widows in the denominator, did not change the estimated effects appreciably.

The *proportion never-married* (mean=0.089, s.d.=0.030) is calculated similarly. A few other studies have included measures of single motherhood. The Norwegian data do not allow this, as full birth histories are only available for those born after 1935.

The effects of the proportions divorced or never-married at age 30-49 are also briefly addressed.

Other Municipality Variables

The *proportion who have lived in the municipality less than 5 years* (mean=0.046, s.d.=0.018) is considered an indicator of social cohesion, and thus perhaps linked with the family structure, in addition to being potentially important for health. The proportion is calculated for each year by aggregating from the individual data, just as described above for community family structure (although there is little migration among the oldest of those aged 50-89). The same effects were seen when a 10-year rather than 5-year limit was set.

As explained above, the *average income* (in 100000 NOK per year, inflation-adjusted; mean=0.92, s.d.=0.25) may capture economic factors of importance for family structure as well as mortality, in addition to perhaps being causally intermediate. It is calculated for each year as the total annual income of the residents in the municipality (from NSD data) divided by the total population size (from NSD data).¹¹ For 32 municipalities, the total income is unavailable for a period of 1-14 years (about 3% of the observations). A missing-value indicator is set to 1 for these observations (otherwise 0). Dropping these observations gave the same results. The missing indicator was also set to 1 for the years 1998-1999 because of slightly different definitions of average income those years. However, using the reported values gave almost the same results.

Average education in the municipality (in years; mean=10.3, s.d.=0.55) is also a potential confounder, and is calculated for each year by aggregating from the individual data on education at the time of the most recent previous census. As above, data for both sexes and the entire age span 50-89 are used.

There are two indicators of urbanization. One is whether the municipality is reckoned as *urban*, and the other is a distinction between *peripheral* areas (defined as municipalities that, according to Statistics Norway's standard classification of 1990, are not near any town or city), *central* areas (including or near a quite large city, in addition to being within a 3-hour travel of one of the 6 largest cities), and other areas, denoted as *semi-central*. These variables have no individual-level counterparts, of course.

Proportion voting for the Christian Democratic Party in the municipality (mean = 0.098, s.d.=0.063) is taken from the NSD database and refers to the most recent previous Parliamentary election. From a social liberal or social democratic platform, the party tries to promote Christian values and argues, for example, for a strengthening of the family as an institution and restricted access to alcohol and tobacco.¹² This variable probably picks up to some extent the religious attitudes in the community and the general values associated with them.

Fixed-Effects

In some models, *county fixed-effects* (0/1 dummies for all the 19 counties, except one arbitrarily chosen reference county) are included to pick up remaining characteristics of the municipality that are constant over time and shared by all municipalities in a county, in addition to being potentially important both for family structure and mortality.

In other models, *municipality fixed-effects* (0/1 dummies for each of 435 municipalities, except one reference municipality) are included to control for time-invariant unobserved municipality characteristics. This approach requires observations for at least two different times for a substantial number of municipalities, which is probably an important reason why it is so little used.¹³

Of course, the county dummies and urbanization are constant over time and must be left out when municipality fixed-effects are included. Besides, the proportion voting with the Christian Democrats is left out, because the changes over time (i.e. from one election to the other) may reflect responses to specific issues on the political agenda or strategic voting more than real trends in values.

Municipality-Level Random Effects

In the models without municipality fixed-effects, a municipality-level random term might have been added to the intercept, to take into account that those who live in a municipality have something in common that is not captured by the available variables. This is standard procedure in multilevel modeling (e.g. Goldstein 1995). However, it is not considered worthwhile here, given the modest attention paid to these models. One should merely keep in mind that the community effects estimated from those models are actually less significant than indicated in the tables.

RESULTS

Effects of Control Variables and Differences Between Models

Estimates from seven models are shown in Table 1 for men aged 70-79 to illustrate the importance of various control factors and the similarities and differences between the models. These findings are now reviewed, along with some results for other ages and for women (see Appendix Table 1).

According to the simplest model (Model 1), the proportion divorced increases mortality among men aged 70-79 significantly. The proportion never-married has the opposite effect. Inclusion of individual income and recent in-migration, which to some extent may be a consequence rather than a determinant of individual marital status, gives very similar effects of both the individual and the community family variable (Model 2), and that is the case also for other ages and for women.¹⁴

(Table 1 about here)

In the next step, various other municipality factors are included. For men aged 70-79, mortality is found to be higher in urban municipalities than elsewhere, while there is no difference between the central, semi-central and peripheral municipalities (Model 3). This pattern is also seen in some other groups, while in others, the central-

peripheral variable is more important than urbanization. Moreover, mortality is lowest in municipalities where relatively many vote with the Christian Democratic party, except among the youngest men. Because there is no corresponding individual-level political variable in the model, there is particularly strong doubt about the interpretation of these estimates. Several positive effects of a high proportion recent in-migrants are seen. The effect of average education is negative for most groups, while the effect of average income is positive for some groups, especially the men. On the whole, inclusion of these municipality variables has little impact on the effects of proportions divorced or never-married.

When the county dummies are included, the effect of the proportion divorced is attenuated, but still significant (Model 4). Such attenuation is also seen for some other groups.¹⁵

In the two simplest fixed-effects models for men aged 70-79, the proportion never-married remains negatively associated with mortality, but the effect of the proportion divorced is now negative (Models 5-6). When three other community variables are entered into the model, however, the effect of the proportion divorced is only significant at the 10% level (Model 7). This is because of a positive relationship between average education and proportion divorced, and a low mortality in the communities with a high average educational level. This effect of education is only seen among men younger than 80. For the other groups, community education does not affect mortality, and the effects of the proportions divorced or never-married are essentially the same in all three models. No significant effects of average income are seen in these fixed-effects models (and there was only one indication when education was left out; not shown). Moreover, there are no significant effects of the proportion recent in-migrants, as opposed to the significant effects in the simpler models (but the estimates are largely positive).

The lack of a negative income effect is itself an important finding. Several earlier studies, none of which have included fixed-effects at the same level as the aggregate income variable, have reported beneficial health externalities of high income. Given individual income, a community income variable picks up both the effect of economic resources to be used, for example, to establish good public services, and that of a person's relative income. The result here may suggest that both types of effects are unimportant in Norway, or that they outweigh each other. Anyway, these estimates are "convenient": If the effects of average income were sharp, and inclusion of this variable had changed the effects of family structure markedly, one would not know whether part of the causal effect had been tapped out, or a source of spuriousness had been captured.

The effect of community education in the fixed-effects model for men aged 70-79 is much stronger than that estimated with the simpler model. Sharp effects are also seen for the younger men. On the other hand, the effect is not significant for the other groups (whereas a significant effect appeared more generally in the simpler model). For those who suspect that the strong effects indicate problems related to the small variations in the education variable¹⁶, it should be reassuring that other effects are relatively little influenced by the inclusion of this variable. In its absence, effects of the proportion divorced would have been more clearly negative for some groups of men, which would only have strengthened the main conclusion of the analysis (see below). Anyway, taken at face value, the result is important, as few others have seen, or even looked for, community education effects, and certainly not in a fixed-effects approach. (Some possible explanations of such effects were reviewed above.)

Effects of Family Structure in the Municipality

Effects of community family structure for all ages and both sexes, according to Models 3 and 7, are shown in Table 2. Even the estimates from the simplest model (Model 3) signal that there is no generally harmful effect of a high proportion who are not married. Although positive effects of the proportion divorced are seen for both sexes and all age groups (and they are so strongly significant that they would most probably remain significant even if municipality-level random terms were included), a high proportion never-married has a *protective* effect, although primarily for men.

(Table 2 about here)

The pattern is markedly different once the municipality fixed-effects are included. In these models, the positive effects of the proportion divorced are almost wiped out (Model 7), which means that the estimates from the simpler models must have been biased because of some stable municipality characteristics that both stimulate divorce and push mortality up. For women, there are no effects of the proportion never-married in the fixed-effects model, while the effects of the proportion divorced are mixed: a positive one appears at age 70-79 and there are indications in the opposite direction at age 50-59. For men, there are some negative effects of the proportion never-married, and there are indications of a negative effect of the proportion divorced at age 70-79. In addition, negative estimates appear at age 50-59, and they are almost significant at the 10% level. In other words, it seems that men *benefit* in terms of health from being surrounded by many who are not married, while the picture is more blurred for women, with effects tilting more towards the opposite.

Unless we are faced with a completely spurious relationship, even with the fixed-effect models, these estimates might reflect a combination of the following: (i) a high proportion who are not married undermines social cohesion, as commonly expected, but this increases mortality largely or only among women, and (ii): a high proportion who are not married improves a person's income and health relative to others and thus reduces mortality, perhaps more so among men than women (see details about these mechanisms above). The findings would be consistent with (i) and (ii) almost outbalancing each other for women and (ii) being dominant for men. Because community income is not found to have any impact (and is also included in the model), relative health may be a more plausible intermediate factor in (ii) than relative income.

A second possible explanation of the findings might be that a high proportion who are not married undermines social cohesion, just as assumed above, but that this actually has a *beneficial* health effect, although restricted to men. The fact that the other common cohesion indicator, proportion recent in-migrants, is unimportant for all groups in the fixed-effects models sheds some doubt on the idea that social cohesion promotes good health. More importantly, effects of social cohesion have not appeared in all earlier studies either. However, it may be more difficult to believe that social cohesion has an outright adverse effect. So far, there has been mere speculation about this in the literature.

A third possibility might be a combination of (i) the non-married rather than the married are especially important in producing social cohesion, contrary to the underlying idea in most earlier studies (reasons for that were suggested above), and (ii) social cohesion does reduce mortality, but only among men. There is very little

knowledge about the sex differences in the effects of social cohesion, but as mentioned above, there are both studies lending support to (ii) and studies suggesting the opposite.

In the next step, the proportions divorced or never-married at age 50-89 are substituted with the corresponding proportions at age 30-49. For men, the pattern in the estimates largely remains (Model 8, Table 2): There is still a negative effect of the proportion never-married, although for only one age groups, while there are no significant effects of the proportion divorced (but weak indications of a negative effect). For women, living in municipalities with a high proportion not married among the young adults is generally more harmful or less of an advantage than it is for men. This corresponds well with the pattern in the effects of family structure at age 50-89. More precisely, the effects of a high proportion divorced at age 30-49 are mixed (one positive estimate at age 60-69 and one negative at age 50-89). Among the oldest women, a relatively high mortality is seen in municipalities with many never-married at age 30-49. The results do not change much if the average education and proportion in-migrants at age 30-49 are included instead of the corresponding measurements at age 50-59 (not shown).

As mentioned above, one should not be surprised to see other effects of the proportions not married at age 30-49 than of the proportions not married at age 50-89, although the direction of the differences would be hard to predict. The estimates do reveal a difference when it comes to the effects of the proportion never-married on women's mortality, but other differences are small or even in the opposite direction, so on the whole, one cannot conclude that the family structure at age 30-49 is generally more or less important than that at age 50-89.

There is some evidence that a high proportion divorced has a more positive or less negative effect than a high proportion never-married. Such a pattern appears both for men and women when the focus is on family structure at age 50-89, and for men when the focus is on family structure at age 30-49, while the opposite is seen for women.

There is no clear age structure when the estimates both from Models 7 and 8 are considered. The community family structure is neither more nor less important at the higher than at the lower ages.¹⁷

SUMMARY AND CONCLUSION

Some studies have suggested that, given individual marital status, mortality is relatively high in communities where many people are not married, perhaps partly because of a lower degree of social cohesion. Assuming causal effects, this would mean that the current drift away from marriage in contemporary Western societies would not only harm the health of those directly involved, but all others as well.

However, such health externalities do not appear clearly in this investigation. Even the simplest models shed doubt on the idea that a high proportion who are not married generally increases mortality, because there are only positive effects of the proportion divorced, and not of the proportion never-married. In the most complex models, where unobserved constant municipality characteristics are controlled for, there is even less support for the idea. On the contrary, mortality among men older than 50 is particularly *low* in municipalities where many people in this age group are never-married, and there are indications of a similar beneficial impact of divorce. An adverse effect of the proportion divorced *is* seen among women, but only in one 10-year age group, while there are indications of a beneficial effect in another. No effects

of the proportion never-married appear among women. Thus, one may also conclude that the evidence against the proposed health externality is stronger among men than among women, and stronger as judged from the effects of the proportion never-married than as judged from the effects of the proportion divorced. The same sex pattern shows up in models including the family structure among people at age 30-49 instead of that among people at age 50-89. However, there are otherwise some differences between the estimates from these models, which may deserve further exploration. The modeling has been stratified by age throughout the investigation, for practical reasons, but no clear age pattern appears in the estimates.

In view of these findings, one may question the idea that social cohesion generally constitutes a health advantage, for men and women alike, or the idea that a low prevalence of marriage, either as a result of many never-married or many divorcees, is negatively associated with social cohesion. It is also possible that other mechanisms than those involving social cohesion are important in producing an association between family structure and individual mortality. In particular, it was speculated above that a person's health relative to that of others in the community might be an intervening factor, just as relative income has been found to be important in many other studies.

One should keep in mind that even the estimates from the most complex models in principle may be biased, because of unobserved municipality factors that are time-varying (the stable being picked up by the fixed-effects) or selective migration. For example, it is not impossible that certain time-varying economic or ideational factors that are inadequately captured by the included variables may drive divorce rates up and mortality rates down, so that the real effect of the proportion divorced is actually more adverse. However, the results in this study suggest at least that one should be careful in the future to assume generally harmful effects of a high proportion not married. A quite different issue is, of course, whether such effects might have shown up clearer for specific causes of death that are thought to be relatively strongly influenced by psychosocial factors in general, or if smaller units of aggregation had been employed. It is also possible that the effects would be different in a country with less generous welfare policies.

On the methodological side, the analysis has illustrated the importance of including municipality fixed-effects. Without these fixed-effects, one would have arrived at rather different conclusions. The investigation has also illustrated that it may be worthwhile to consider the family-structure in more than one broad age group in future statistical investigations or theoretical discussions, and that the possibility of sex variations in the effects of community factors may deserve more attention.

REFERENCES

- Becker, G. 1991. *A Treatise on the Family*. Cambridge, MA: Harvard University Press.
- Blomgren J., P. Martikainen, P. Mäkelä, and T. Valkonen. 2004. "The Effects of Regional Characteristics on Alcohol-Related Mortality—A Register-Based Multilevel Analysis of 1.1 Million Men." *Social Science and Medicine* 58: 2523-2535.
- Berkman, L., M. Melchior, J.-F. Chastang, I. Niedhammer, A. Leclerc, and M. Goldberg. 2004. "Social Integration and Mortality: A Prospective Study of French Employees of Electricity of France – Gas of France. The GAZEL Cohort." *American Journal of Epidemiology* 159: 167-174.
- Booth, A., J.N. Edwards, and D.R. Johnson. 1991. "Social Integration and Divorce." *Social Forces* 70: 207-224.
- Coleman, J.S. 1988. "Social Capital in the Creation of Human Capital." *American Journal of Sociology* 94: S95-120.
- Cubbin, C., F.B. LaClere, and G.S. Smith. 2000. "Socioeconomic Status and Injury Mortality: Individual and Neighbourhood Determinants." *Journal of Epidemiology and Community Health* 54: 517-524.
- Ellaway, A. and S. Macintyre. 2001. "Women in Their Place. Gender and Perceptions of Neighbourhoods and Health in the West of Scotland." Pp. 265-281 in *Geographies of Women's Health*, edited by I. Dyck I, D.N. Lewis, and S. McLafferty. London: Routledge.
- Gerdtham, U.-G. and M. Johannesson. 2004. "Absolute Income, Relative Income, Income Inequality, and Mortality." *Journal of Human Resources* 39: 228-247.
- Gerstel, N. 1988. "Divorce, Gender, and Social Integration." *Gender and Society* 2: 343-367.
- Goldman, N. 1993. "Marriage Selection and Mortality Patterns: Inferences and Fallacies." *Demography* 30: 189-208.
- Goldstein, H. 1995. *Multilevel Statistical Models*, 2. edition. London: Arnold.
- Gove, W.R. 1973. "Sex, Marital Status and Mortality." *American Journal of Sociology* 79: 45-67.
- Hu, Y. and N. Goldman. 1990. "Mortality Differentials by Marital Status: An International Comparison." *Demography* 27: 233-250.
- Hummer, R.A., R.G. Rogers, C.B. Nam, and C.G. Ellison. 1999. "Religious Involvement and U.S. Adult Morality." *Demography* 36: 273-285.

- Jaffe, D.H., Z. Eisenbach, Y.D. Neumark, and O. Manor. 2005. "Individual, Household and Neighborhood Socioeconomic Status and Mortality: A Study of Absolute and Relative Deprivation." *Social Science and Medicine* 60: 989-997.
- Joung, I.M., J.J. Glerum, F.W. van Poppel, J.W. Kardaun, and J.P. Mackenbach. 1996. "The Contribution of Specific Causes of Death to Mortality Differences by Marital Status in the Netherlands." *European Journal of Public Health* 6: 142-149.
- Kalmijn M., M. B. van Groenou, and L. Terhell. 2001. "Differential Effects of Divorce on Social Integration." Unpublished paper from Tilburg University and Free University of Amsterdam.
- Kaplan, G. and O. Baron-Epel. 2003. "What Lies Behind the Subjective Evaluation of Health Status?" *Social Science and Medicine* 56: 1669-1676.
- Kautto, M., M. Heikkilä, B. Hvinden, and S. Marklund S, eds. 1999. *Nordic Social Policy. Changing Welfare States*. London: Routledge.
- Kawachi, I. and L. Berkman L. 2000 "Social Cohesion, Social Capital and Health." Pp. 174-190 in *Social Epidemiology*, edited by L. Berkman and I. Kawachi. New York: Oxford University Press
- ___, S.V. Subramanian, and N. Almeida-Filho. 2002. "A Glossary for Health Inequalities." *Journal of Epidemiology and Community Health* 56:647-52.
- Kravdal, Ø. 1995. "Is the Relationship Between Childbearing and Cancer Incidence Due to Biology or Lifestyle? Examples of the Importance of Using Data on Men." *International Journal of Epidemiology* 24: 477-484.
- ___ . 2000. "Social Inequalities in Cancer Survival." *Population Studies* 54: 1-18.
- ___ . 2001. "The Impact of Marital Status on Cancer Survival." *Social Science and Medicine* 52: 357-368.
- ___ . 2005. "Does Place Matter for Cancer Survival in Norway? A Multilevel Analysis of the Importance of Hospital Affiliation and Municipality Socio-Economic Resources." Forthcoming in *Health & Place*.
- Kristofersen L. 1990. "Sosiale Ulikheter i Dødeligheten i Fylkene 1981-1985." Regionale trender. Norsk institutt for by- og regionforskning, Oslo.
- Kunst A.E., V. Bos, O. Andersen, M. Cardano, G. Costa, S. Harding, Ö Hemström, R. Layte, E. Regidor, A. Reid, P. Santana, T. Valkonen, and J.P. Mackenbach. 2004. "Monitoring of Trends in Socioeconomic Inequalities in Mortality. Experiences From a European Project." *Demographic Research* S2-9 online at www.demographic-research.org/special/2/9/s2-9.pdf
- LeClere, F.B., R.G. Rogers, and K. Peters. 1998. "Neighborhood Social Context and

- Racial Differences in Women's Heart Disease Mortality." *Journal of Health and Social Behavior* 39: 91-107.
- Lichter, D.T., F.B. LeClere, and D.K. McLaughlin. 1991. "Local Marriage Markets and the Marital Behavior of Black and White Women." *American Journal of Sociology* 96: 843-867.
- Lillard, L.A. and C.W.A. Panis. 1996. "Marital Status and Mortality: The Role of Health." *Demography* 33: 313-327.
- and L.J. Waite. 1995. "Till Death do us Apart: Marital Disruption and Mortality." *American Journal of Sociology* 100: 131-156.
- Lochner, K., E. Pamuk, D. Makuc, B.P. Kennedy, and I. Kawachi. 2001. "State Level Income Inequality and Individual Mortality Risk: A Prospective, Multilevel Study." *American Journal of Public Health* 91: 385-391.
- Mackenbach, J.P., A.E. Kunst, A.E. Cavelaars, F. Groenhouf, and J.J. Geurts. 1997. "Socioeconomic Inequalities in Morbidity and Mortality in Western Europe. The EU Working Group on Socioeconomic Inequalities in Health." *Lancet* 349:1655-1659.
- Martikainen, P., T.M. Kauppinen, and T. Valkonen. 2003. "Effects of the Characteristics of Neighbourhoods and the Characteristics of People on Cause Specific Mortality: A Register Based Follow-up Study of 252000 Men." *Journal of Epidemiology and Community Health* 57: 210-217.
- , N. Mäki, and J. Blomgren. 2004. "The Effects of Area and Individual Social Characteristics on Suicide Risk: A Multilevel Study of Relative Contribution and Effect Modification." *European Journal of Population* 20: 323-350.
- Mohan, J., L. Twigg, S. Barnard, and K. Jones. 2005. "Social Capital, Geography and Health: A Small-Area Analysis for England." *Social Science and Medicine* 60: 1267-1283.
- Molinari, C., M. Ahern, and M. Hendryx. 1998. "The Relationship of Community Quality to the Health of Women and Men." *Social Science and Medicine* 47: 1113-1120.
- Montgomery, M.R. and J.B. Casterline. 1996. "Social Learning, Social Influence and New Models of Fertility." *Population and Development Review* 22 (suppl), 151-175.
- Oakes, J.M. 2004. "The (Mis)estimation of Neighborhood Effects: Causal Inference for a Practicable Social Epidemiology." *Social Science and Medicine* 58: 1929-1952.
- Oppenheimer, V.K. 1994. "Women's Rising Employment and the Future of the Family in Industrial Societies." *Population and Development Review* 20: 293-

342.

- Osler M., U. Christensen, R. Lund, M. Gamborg, N. Godtfredsen, and E. Prescott. 2003. "High Local Unemployment and Increased Mortality in Danish Adults; Results From a Prospective Multilevel Study." *Occupational and Environmental Medicine* 60: e16.
- Patterson, J.M., L.E. Eberly, Y. Ding, and M. Hargreaves. 2004. "Associations of Smoking Prevalence With Individual and Area Level Social Cohesion." *Journal of Epidemiology and Community Health* 58: 692-697.
- Pickett K.E. and M. Pearl. 2001. "Multilevel Analyses of Neighbourhood Socioeconomic Context and Health Outcomes." *Journal of Epidemiology and Community Health* 55: 111-122.
- Robert, S.A. 1999. "Socioeconomic Position and Health: The Independent Contribution of Community Socioeconomic Context." *Annual Review of Sociology* 25: 489-516.
- Rosengren, A., H. Wedel, and L. Wilhelmsen. 1989. "Marital Status and Mortality in Middle-Aged Swedish Men." *American Journal of Epidemiology* 129: 54-64.
- Sampson, R.J., J.D. Morenoff, and T. Gannon-Rowley. 2002. "Assessing "Neighborhood Effects": Social Processes and New Directions in Research." *Annual Review of Sociology* 28: 443-478.
- Sloggett, A. and H. Joshi. 1994. "Higher Mortality in Deprived Areas: Community or Personal Disadvantage?" *British Medical Journal* 309:1470-1474.
- Smith, K.R. and C.D. Zick 1996. "Risk of Mortality Following Widowhood: Age and Sex Differences by Mode of Death." *Social Biology* 43: 59-71.
- South, S.J. and K.M. Lloyd 1995. "Spousal Alternatives and Marital Dissolution." *American Sociological Review* 60: 21-35.
- _____. and K.D. Crowder. 2000. "The Declining Significance of Neighbourhoods? Marital Transitions in Community Context." *Social Forces* 78:1067-1099.
- Stafford, M., P. Martikainen, E. Lahelma, and M. Marmot. 2004. "Neighbourhoods and Self Rated Health: A Comparison of Public Sector Employees in London and Helsinki." *Journal of Epidemiology and Community Health* 58: 772-778.
- _____, S. Cummins, S. Macintyre, A. Ellaway, and M. Marmot. 2005. "Gender Differences in the Association Between Health and Neighbourhood Environment." *Social Science and Medicine* 60: 1681-1692.
- Statistics Norway 2005a. Online at <http://www.ssb.no/emner/02/02/10/dode/tab-2004-29-11.html>

- _____. 2005b. Online at <http://www.ssb.no/histstat/tabeller/3-3-28t.txt>
- _____. 2005c. Online at <http://www.ssb.no/emner/02/01/20/samboer/>
- _____. 2005d. Online at <http://www.ssb.no/emner/02/02/30/ekteskap/tab-2005-09-01-14.html>
- Sundquist, K., M. Malmström, and S.-E. Johansson. 2004. "Neighbourhood Deprivation and Incidence of Coronary Heart Disease: A Multilevel Study of 2.6 Million Women and Men in Sweden." *Journal of Epidemiology and Community Health* 58: 71-77.
- Terhell, L., M.I.B van Groenou, and T. van Tilburg. 2004. "Network Dynamics in the Long-Term Period After Divorce." *Journal of Social and Personal Relationships* 21: 719-738.
- Umberson, D. 1992. "Gender, Marital Status and the Social Control on Health Behaviour." *Social Science and Medicine* 34: 907-917.
- Valkonen, T., P. Martikainen, and J. Blomgren. 2004. "Increasing Excess Mortality Among Non-Married Elderly People in Developed Countries." *Demographic Research* S2-12 online at www.demographic-research.org/special/2/12/s2-12.pdf
- Veenstra, G. 2005. "Location, Location, Location: Contextual and Compositional Health Effects of Social Capital in British Columbia, Canada." *Social Science and Medicine* 60: 2059-2071
- Wagstaff, A. and E. van Doorslaer. 2000. "Income Inequality and Health: What Does the Literature Tell Us?" *Annual Review of Public Health* 21: 543-567.
- Waite, L.J. and E.L. Lehrer. 2003. "The Benefits From Marriage and Religion in the United States: A Comparative Analysis." *Population and Development Review* 29: 255-275.
- Wen, M., C.R. Browning, and K.A. Cagney. 2003. "Poverty, Affluence, and Income Inequality: Neighborhood Economic Structure and its Implications for Health." *Social Science and Medicine* 57: 843-860.
- Wen, M., K.A. Cagney, and N.A. Christakis. 2005. "Effects of Specific Aspects of Community Social Environment on the Mortality of Individuals Diagnosed With Serious Illness." *Social Science and Medicine* 61: 1119-1134.
- Wilkinson, R.G. 1996. *Unhealthy Societies: The Afflictions of Inequality*. London: Routledge.
- Yngwe, M.Å., J. Fritzell, O. Lundberg, F. Diderichsen, and B. Burström 2003. "Exploring Relative Deprivation: Is Social Comparison a Mechanism in the Relation between Income and Health?" *Social Science and Medicine* 57: 1463-1473.

Table 1. Effects (With Standard Errors) on the Log-Odds of Mortality Among Men Aged 70-79, 1980-1999, According to Discrete-Time Hazard Models Estimated From Register Data for the Entire Norwegian Population. ^a

	Model 1	Model 2	Model 3	Model 4
Education				
9 years ^b	0	0	0	0
10-12 years	-0.15*** (0.01)	-0.10*** (0.01)	-0.10*** (0.01)	-0.10*** (0.01)
13-16 years	-0.33*** (0.01)	-0.18*** (0.01)	-0.18*** (0.01)	-0.18*** (0.01)
17- years	-0.47*** (0.02)	-0.19*** (0.02)	-0.18*** (0.02)	-0.18*** (0.02)
Marital status				
Never-married	0.29*** (0.01)	0.20*** (0.01)	0.20*** (0.01)	0.20*** (0.01)
Married ^b	0	0	0	0
Divorced	0.45*** (0.01)	0.39*** (0.01)	0.39*** (0.01)	0.39*** (0.01)
Widowed	0.22*** (0.01)	0.20*** (0.01)	0.20*** (0.01)	0.20*** (0.01)
Income (100000 NOK)		-0.14*** (0.004)	-0.14*** (0.004)	-0.14*** (0.004)
Moved to municipality within last 5 years (ref=no)		0.11*** (0.02)	0.11*** (0.02)	0.11*** (0.02)
Urban municipality (ref=no)			0.05*** (0.01)	0.05*** (0.01)
Central ^b			0	0
Semi-central			0.00 (0.01)	0.00 (0.01)
Peripheral			0.01 (0.01)	0.01 (0.01)
Average income (in 100000 NOK)			0.04* (0.02)	0.04 (0.03)
Average education (in years)			-0.04*** (0.01)	-0.04*** (0.01)
Proportion moved to municipality within last 5 years			0.17 (0.19)	0.18 (0.24)
Proportion voting with Christian Democratic Party			-0.14** (0.06)	-0.50*** (0.09)
County				
Østfold ^b				0
Akershus				-0.01 (0.02)
Oslo				0.05** (0.02)
Hedmark				-0.05** (0.02)
Oppland				-0.07*** (0.02)
Buskerud				-0.03** (0.02)
Vestfold				-0.01 (0.02)
Telemark				0.01 (0.02)
Aust-Agder				0.04** (0.02)
Vest-Agder				0.09*** (0.02)
Rogaland				0.01 (0.02)
Hordaland				0.00 (0.02)
Sogn og Fjordane				-0.07*** (0.02)
Møre og Romsdal				0.00 (0.02)
Sør-Trøndelag				0.01 (0.02)
Nord-Trøndelag				-0.08*** (0.02)
Nordland				-0.01 (0.02)
Troms				0.03** (0.02)
Finnmark				0.13*** (0.02)
Proportion divorced	2.19*** (0.08)	2.80*** (0.08)	2.54*** (0.15)	1.60*** (0.23)
Proportion never-married	-1.53*** (0.10)	-1.84*** (0.10)	-1.78*** (0.12)	-1.83*** (0.15)

^a Age (continuous) and calendar year (one-year groups) are also included, along with three indicators for missing individual education, missing individual income, and missing average income.

^b Reference category

* p<0.10; ** p<0.05; *** p<0.01

Table 1 continued. Effects (With Standard Errors) on the Log-Odds of Mortality Among Men Aged 70-79, 1980-1999, According to Discrete-Time Hazard Models Estimated From Register Data for the Entire Norwegian Population. ^a

	Model 5	Model 6	Model 7
Education			
9 years ^b	0	0	0
10-12 years	-0.15*** (0.01)	-0.10*** (0.01)	-0.10*** (0.01)
13-16 years	-0.32*** (0.01)	-0.18*** (0.01)	-0.18*** (0.01)
17- years	-0.45*** (0.02)	-0.18*** (0.02)	-0.18*** (0.01)
Marital status			
Never-married	0.29*** (0.01)	0.20*** (0.01)	0.20*** (0.01)
Married ^b	0	0	0
Divorced	0.46*** (0.01)	0.39*** (0.01)	0.39*** (0.01)
Widowed	0.22*** (0.01)	0.20*** (0.01)	0.20*** (0.01)
Income (100000 NOK)		-0.14*** (0.004)	-0.14*** (0.004)
Moved to municipality within last 5 years (ref=no)		0.12*** (0.02)	0.12*** (0.02)
Average income (in 100000 NOK)			0.03 (0.04)
Average education (in years)			-0.30*** (0.06)
Proportion moved to municipality within last 5 years			0.35 (0.42)
Municipality fixed-effects	x ^c	x ^c	x ^c
Proportion divorced	-1.29*** (0.40)	-1.42*** (0.41)	-0.77* (0.45)
Proportion never-married	-1.24*** (0.44)	-1.20*** (0.43)	-1.13** (0.43)

^a Age (continuous) and calendar year (one-year groups) are also included, along with three indicators for missing individual education, missing individual income, and missing average income.

^b Reference category

^c Municipality fixed-effects are also included (0/1 dummy for each municipality, except one reference municipality), but estimates not shown

* p<0.10; ** p<0.05; *** p<0.01

Table 2. Effects (With Standard Errors) of Proportion Divorced and Proportion Never-Married on the Log-Odds of Mortality, 1980-1999, According to Discrete-Time Hazard Models Estimated From Register Data for the Entire Norwegian Population.

		Model 3 ^a	Model 7 ^b	Model 8 as Model 7, except that the family structure is measured at age 30-49 rather than 50-89
<u>Men</u>				
50-59	Proportion divorced	2.47*** (0.34)	-1.49 (0.93)	-0.52 (0.55)
	Proportion never-married	-1.41*** (0.25)	-1.43 (0.92)	-0.49 (0.34)
60-69	Proportion divorced	2.98*** (0.22)	-0.13 (0.61)	-0.47 (0.36)
	Proportion never-married	-1.78*** (0.16)	-2.61*** (0.60)	-0.59*** (0.22)
70-79	Proportion divorced	2.54*** (0.16)	-0.77* (0.45)	-0.12 (0.26)
	Proportion never-married	-1.78*** (0.12)	-1.13** (0.43)	-0.08 (0.16)
80-89	Proportion divorced	1.51*** (0.17)	-0.10 (0.48)	0.12 (0.28)
	Proportion never-married	-1.23*** (0.12)	-0.05 (0.46)	-0.05 (0.18)
<u>Women</u>				
50-59	Proportion divorced	1.87*** (0.47)	-2.26* (1.32)	0.60 (0.76)
	Proportion never-married	-0.25 (0.35)	0.41 (1.31)	-0.09 (0.47)
60-69	Proportion divorced	2.64*** (0.30)	0.02 (0.86)	1.13** (0.50)
	Proportion never-married	-0.25 (0.23)	-0.46 (0.86)	-0.41 (0.31)
70-79	Proportion divorced	1.82*** (0.19)	1.66*** (0.53)	0.09 (0.31)
	Proportion never-married	-0.32** (0.14)	0.11 (0.53)	0.41** (0.20)
80-89	Proportion divorced	0.86*** (0.14)	0.31 (0.44)	-0.57*** (0.24)
	Proportion never-married	-0.14 (0.11)	0.01 (0.42)	0.53*** (0.16)

^a Specified as Model 3 in Table 1

^b Specified as Model 7 in Table 1

* p<0.10; ** p<0.05; *** p<0.01

Appendix Table 1. Effects on the Log-Odds of Mortality, 1980-1999, According to Discrete-Time Hazard Models Estimated From Register Data for the Entire Norwegian Population^a

	Men				Women			
	50-59	60-69	70-79	80-89	50-59	60-69	70-79	80-89
Model 3								
Education								
9 years ^b	0	0	0	0	0	0	0	0
10-12 years	-0.15***	-0.10***	-0.10***	-0.08***	-0.16***	-0.20***	-0.17***	-0.13***
13-16 years	-0.30***	-0.17***	-0.18***	-0.18***	-0.28***	-0.27***	-0.30***	-0.20***
17+ years	-0.38***	-0.23***	-0.18***	-0.19***	-0.18***	-0.13*	-0.17**	-0.12**
Marital status								
Never-married	0.58***	0.33***	0.20***	0.16***	0.82***	0.52***	0.34***	0.17***
Married ^b	0	0	0	0	0	0	0	0
Divorced	0.70***	0.51***	0.39***	0.21***	0.56***	0.49***	0.38***	0.23***
Widowed	0.45***	0.32***	0.20***	0.12***	0.27***	0.25***	0.15***	0.08***
Income (100000 NOK)	-0.23***	-0.22***	-0.14***	-0.07***	-0.35***	-0.31***	-0.21***	-0.09***
Moved to municipality within last 5 years (ref=no)	0.07***	0.13***	0.11***	0.15***	0.07***	0.09***	0.15***	0.23***
Urban municipality (ref=no)	0.05***	0.03***	0.05***	0.03***	0.00	0.02	0.02*	0.01
Semi-central (ref=central)	0.00	-0.01	0.00	0.00	-0.05*	-0.05***	0.00	0.00
Peripheral (ref=central)	-0.02	0.00	0.01	-0.03***	0.00	-0.04***	-0.04***	-0.05***
Average income (in 100000)	0.08*	0.07**	0.04*	0.06**	0.04	0.10**	-0.01	-0.02
Average education (in years)	-0.05***	-0.05***	-0.04***	-0.06***	0.00	-0.07***	-0.08***	-0.09***
Proportion moved to municipality within last 5 years	0.07	0.10	0.17	0.70***	1.14***	0.60*	0.83***	1.04***
Proportion voting with Christian Democratic Party	0.12	0.08	-0.14**	-0.32***	-0.57***	-0.74***	-0.66***	-0.56***
Model 7^c								
Average income (in 100000)	0.05	0.00	0.03	0.05	-0.09	0.09	0.00	0.03
Average education (in years)	-0.33***	-0.25***	-0.30***	-0.08	-0.10	-0.10	-0.08	0.01
Proportion moved to municipality within last 5 years	0.08	-0.15	0.35	0.30	1.68	0.23	0.92	0.65

^a Only some of the effects are shown. See Table 1 for specification of the models

^b Reference category

^c The individual-level effects are very similar to those in Model 3 and are not shown

* p<0.10; ** p<0.05; *** p<0.01

¹ In the other Finnish study mentioned earlier, three family structure variables were combined into a “family cohesion index” (Martikainen et al. 2004).

² Almost half of the marriages will be dissolved if the divorce rates remain at their current level (Statistics Norway 2005d).

³ In Norway, almost all hospitals and many other health services are public. The private health services receive substantial public subsidies, and are subject to control from the national health administration, but it is possible that the establishing of these services may be stimulated by a high local income level.

⁴ Likewise, there are different views about the importance of income *inequality* (e.g. Gerdtham and Johannesson 2004; Lochner et al. 2001; Wagstaff and van Doorslaer 2000; Wilkinson 1996).

⁵ If there really are such effects, a hypothetical increase in the proportions never-married or divorced would influence mortality of the individual man and woman, and a person moving to a place with a different family structure would experience a change in mortality (probably not immediately).

⁶ Both men and women would have more to gain in an absolute sense by entering or remaining in a partnership when everyone is richer, but not *relative* to how they would manage on their own.

⁷ The same formal qualifications are required for nurses and physicians throughout the country. However, some municipalities struggle with vacancies or find it difficult to attract experienced personnel, and such problems may to some extent be a consequence of the level of education in the community.

⁸ Religiosity may also be linked with social cohesion because of the strong support from others that one may enjoy by taking part in various congregational activities.

⁹ These intervals are sufficiently short, because a length of 6 months gave the same results. It is censored when the person emigrates, at the end of 1999, or at the end of the year when the person turns 89.

¹⁰ The income variable is 0 for some individuals (varying from 1% for the youngest men to 43% for the oldest women). Taking this out as a separate category made the effect of income weaker, but still significant.

¹¹ One might also have aggregated over individual data, but these have the limitations that income is only known for the years 1970, 1980 and 1990.

¹² It receives most support in the ‘Bible belt’ in the South and West.

¹³ An intuitive explanation of this model with municipality fixed-effects, based on an example, may be helpful: If a positive effect of the proportion divorced among people at age 50-89 is estimated, it means that mortality for a person who lives in a certain

municipality M at time $T+t$ minus mortality for a similar person who lives in the same municipality at time T is most markedly positive if there has also been a relatively sharp increase in the proportion divorced in M between these two periods. (This increase in the proportion divorced, for example within a period of $t=5$ years, has two main components: new divorces among these middle-aged and elderly over the 5-year period, and the difference between the proportion divorced at the start of the period among people of any given age within the interval 50-89 and that among those 5 years younger - e.g. those aged 45-49 at T have “moved” into the interval at $T+t$, while others have “moved up” or “out” . In addition, mortality and migration are involved, although less so than without the age standardization). The possibility of a bias cannot be eliminated even with this fixed-effects approach, of course. An increase in the proportion divorced over the period t may be a result of structural *changes* that also influence mortality.

¹⁴ A significant negative effect of income is estimated both for men aged 70-79 and all other groups. The income effect is weakest at the highest ages, for which the income variable typically refers to a situation far back in time. The effects of recent immigration are generally positive. This may reflect a harmful impact of a relatively weak level of integration in the community that is not entirely counterbalanced by the typically positive health selection of migrants.

¹⁵ Note that the effects of county are rather weak. The difference between the county with the highest and that with the lowest mortality is 0.22. When only age and year are included along with the county dummies, however, this maximum difference is 0.44 (not shown).

¹⁶ Average education changes much less over time than the other variables, and there is less variation in this change across municipalities (reflecting the pervasive expansion of education throughout the country in earlier decades and that few people take more education after about age 30).

¹⁷ In additional model runs, the community variables were substituted with corresponding variables for the municipalities where people lived 10 years earlier, but this lag gave the same pattern in the estimates (not shown).