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Sex differences in mortality at the local level: An analysis of Belgian municipalities

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Abstract

Explanations for the consistent female mortality advantage have ranged from the biological, through the behavioural to the social, but we are still far from a satisfactory explanation. The current mortality advantage, which women enjoy in almost all societies and age groups, is not a historical universal, indeed, it may even be a unique development of the 20th century. Even if this is the case, however, this does not make it a necessary corollary of low mortality. Human mortality reflects the pattern of social relationships, standards of living, living arrangements, and patterns of power and inequality in the society, and although it is similar for men and for women, there are, nonetheless, important differences. These differences, in their turn, reflect the pattern of relationships between men and women in the society.

The present analysis looks at mortality differences between men and women in Belgium over almost six years, from the census of March 1, 1991, to 31st December 1996. We focus on aggregate effects at the municipality level (the smallest level of local government), and compare patterns of male and female mortality at various ages, and the differences between them. The municipalities are identified in terms of the regional division in which they reside (Antwerp, Brussels, Flanders, Wallonia); the density of habitation (urbanisation); and their particular social characteristics: Belgian national homogeneity; family centeredness; cohabitation; and social status. We conclude that social patterns and characteristics play an important part in explaining differences in mortality between the municipalities, and any attempt to explain mortality, its level and male-female differences, strictly in terms of individual biology and behaviour does so at the risk of ignoring an important component in the explanation of the specific mortality risks to which individuals are exposed.

Sex differences in mortality at the local level:
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Introduction

The female mortality advantage is so commonplace as to warrant almost no justification. Just as mortality past childhood increases with increasing age, so also do men have higher mortality than women. There is, however, nothing intuitively obvious about this association. Men are physically stronger than women, they are taller, they have more social power and they have lesser morbidity, all of which are indicative of *lower* mortality. Furthermore, the historical record does indeed indicate that the female advantage becomes unambiguous and universal only in the second part of the twentieth century (Vallin, 1989; Johannson, 1991).

One reflection of this view that females have a natural mortality advantage, can be seen in the literature which, with few exceptions, seeks only to explain *excess* female mortality (see, e.g. Das-Gupta & Mari-Bhat, 1997; Cohen, 2000) and rarely attempts to analyse theoretically the more usual excess *male* mortality (for two important exceptions, see Johannson, 1991; McIntyre and Hunt, 1997). Yet, as Johannson (1991) notes, the variations and inversions in the male:female mortality ratios, over time and between different societies and population groups, are too great to be simply written off as a biological advantage occasionally marred by particular threats such as childbirth or selective malnutrition.

In the present analysis, we consider local-area variations in male and female mortality within a low mortality population (Belgian municipalities). By identifying the circumstances under which male mortality is particularly high or low, relative to female mortality (and *vice versa)*, we hope to contribute to a more theoretically oriented analysis of the relations between male and female mortality, and in particular, of the interplay between genetic advantage and its realisation under specific circumstances.

Theoretical Background

Biological and Behavioural Models

The current demographic literature has difficulty conceptualising the male-female mortality gap in social terms. The issue is not one of observation, it is one of interpretation. In 1984 Stillion pointed out that while both male and female mortality in the United States had been declining for the previous fifteen years, the female decline had been faster leading to a growing male-female mortality gap. She suggested that the reason for this lay in females' innate greater sturdiness (biology); males' greater exposure to life threatening situations and males' greater tendency to life-endangering behaviour. Sixteen years later Waldron (2000) argued again that the male mortality disadvantage stemmed mainly from biological and behavioural causes. Material and social structural conditions, she suggested, had little effect on sex mortality ratios.

Carey and Lopreato (1995) have presented this argument in evolutionary terms. They suggest that the bio-origins of the female advantage are twofold: an evolutionary process which on the one hand favoured robust females who could withstand the rigours of pregnancy and childbirth, and on the other favoured aggressive males who were not averse to risk-taking behaviour. In today's more developed countries reduced fertility and medical control have overcome the threats of childbearing allowing female robustness to reach its full expression. However, male risk taking behaviour has not been overcome culturally, and the result, as Waldron (2000) and others have documented, is surplus male mortality, particularly from causes associated with violence, alcohol and cigarette consumption.

Supportive evidence for this approach comes from a variety of studies: Dutton (1979) and Chenet (2000), twenty years apart, both point to excessive alcohol consumption as the main cause of increasingly higher male mortality in the Soviet Union and the (European) states which replaced it. Verbrugge (1989), too, has argued that "men and women die from fundamentally the same causes, even though their rates differ," (p.33), the cause of the different pace of male and female mortality being partly biological, and mainly behavioural; and Smith (1992) has shown that most of the difference between male and female mortality in Tayside (England) derives from behavioural causes, specifically accidents and injuries. Ladbrook (1990a,b), on the other hand, has presented evidence that senior female professionals in Wisconsin have higher mortality than their male counterparts, largely as a result of their taking on male behaviour patterns..

However, this biological-behavioural explanation is limited in its ability to explain variations in relative mortality levels of males and females, except in so far as men and women do behave differently and benefit differentially from medical advances (Gee & Veevers, 1983). In Canada, for instance, over the twentieth century, mortality rates declined later and slower for males than they did for females, so that sex mortality ratios have varied considerably by both age and time (Andreev, 2000). Waldron (2000) shows a similar pattern for the United States. Yet in both Canada and the United States, male:female mortality ratios were *rising* just as behaviour patterns (smoking, drinking) were drawing closer. A number of studies have indicated that male mortality levels are more sensitive to differences in standards of living than are female levels (Park & Clifford, 1989; Wanner, 1996; MacIntyre & Hunt, 1997; Schalick et al., 2000). This could be a reflexion of female robustness under sub-optimal physical conditions, but it could also (as many have suggested) be indicative of the different meanings social conditions have for males and females, meanings which are reflected in their different mortality rates, irrespective of their particular behavioural-response patterns. Even these gradients, however, vary over time and space. For instance, whereas in western studies this differential gradient generally leads to a decreasing male-female mortality differential as we go up the social scale, in post-transition Russia the differential is greatest at the *top* of the social scale (Chenet, 2000).

Sociological Models

Even if male female mortality differences are proximately attributable to biology and to behaviour, these must necessarily be located within the social situations in which people live. As Waldron (2000) points out (while yet denying a sociology of mortality), the particular patterns of male and female behaviour, the differences between them and their partial convergence over the past quarter century or more, are reflective of male and female roles. In other words, of the social constructions of gender in any given society. Furthermore, we must be wary of a tendency to attribute all gender-specific behaviour to genetic tendencies to greater aggressiveness, particularly when there is a growing tendency for women to adopt so-called male behaviour patterns. A predominant proportion of male excess mortality is attributed to smoking, yet it is difficult to see smoking as an expression of aggressiveness, in and of itself. Indeed, a clear, though probabilistic, connection between smoking and cancer has been common knowledge (at least in literate, western societies) for the past quarter century or more. We should, perhaps, view smoking more as suicidal behaviour (in the Durkheimian sense of behaviour undertaken in the knowledge that it is liable to lead to death, see Durkheim, 1951) than as directly aggressive behaviour. The question then arises, which social conditions give rise to this form of behaviour, and in particular, in what ways has the so-called female emancipation of the past quarter century created similar conditions, giving rise to a growing female tendency to undertake such suicidal behaviour?

There are also clear indications that patterns of social relations have different meanings for men and for women. Strawbridge et al. (1997) show that in the Alameda County study religiosity (church attendance) has a greater effect in reducing mortality for women than it does for men. Indeed, when other covariates (physical, social and behavioural) are taken into account, the religiosity effect for men effectively disappears. Anson and Anson (2000, 2001), on the other hand, report that, for Jews in Israel, there is a more pronounced mortality dip at the weekends for men than for women. Shye et al. (1995) also report different effects of social support for men and women, with men showing lesser sensitivity to network size. However, the most dramatic differential effect of social relations undoubtedly concerns marriage, which has consistently been found to benefit men (in terms of mortality reduction vis à vis other, unmarried, states) more than it benefits women (Gove, 1973; Gove et al. 1990; Zick & Smith, 1991; Rogers, 1995). Here, too, however, the size of the relative effect varies from one population to another (Goldman & Hu, 1993; Wanner, 1996).

As Johannson (1991) argued, the biological advantage alone is insufficient to account for the variations, even the inversions, in male-female mortality differences over time and place. Mortality is a "*socially influenced* biological process" (Hummer et al., 1998:565, emphasis added) and any attempt to explain male-female mortality differences must frame these within the particular social environment in which people live. It is this environment which determines the vital threats to their existence, and in which they die. This environment is physical, in the sense of nutritional provision, control of public health threats and ability to provide cures for physical ailments; it is social, in the sense of relations with other people, including relations of power and inequality; and it is cultural, in the sense of the sets of beliefs and behaviours which are supported and encouraged (or discouraged). Except for the greater frailty of male foetuses, the biological differences between male and female mortality risks are always mediated by the social conditions in which people live, which include the structuring of relations between men and women. A sociology of male and female mortality is thus necessarily a sociology of males and females as they live their lives, and not only as they end them.

The Shape of the Difference – A Difference in Shape

Mortality differences vary by age, that is, populations differ in the shape of their mortality curve, and there are consistent "shape" differences between the curves for male and female populations (Coale & Demeny, 1966; Anson, 1993; Vassin, 1994). As mortality declines, the typical mortality curve moves from a reversed-J shape (high infant-child mortality, declining then gradually rising) to a U-shape and then to a J-shape curve, with low infant and child mortality and rising senescent mortality. However, the rate at which male and female curves change their shape varies. As Vassin (1994) describes it in terms of the Brass coefficients, for females, α increases and β stays relatively constant, whereas for males α stays relatively constant while β increases. Differently put, for females there is a consistent increase in survivorship (in logit terms) across all of the life span whereas for males there is a shift in mortality concentration. The result is that, for females more than for males, there is a growing breadth of the mortality curve, a broader age range over which mortality is minimal and a later age at which mortality begins to rise (Siler, 1983; Anson, 1988). If we consider mortality at ages 35-60 to be *premature* mortality, in the sense that age 60 is a minimum to which most individuals should survive under ideal conditions, then for any given level of overall mortality males will show a greater level of premature mortality and females of mature mortality (Anson, 1992). However, these differences in the shape of the mortality curve do not just reflect biological differences between male and female levels of robustness and frailty, they are also moulded by the social conditions, and patterns of social relations, which directly and indirectly through behavioural patterns) condition male and female behaviour.

METHOD

Data

We analysed sex-specific Standardised Mortality Ratios (SMR) for the 589 Belgian municipalities (communes). Using data from the census, we constructed composite measures of the social conditions in each of the municipalities and used these measures as predictors of the level of male and female mortality, overall and in the 35-60 and 60+ age groups.

Data were taken from the Belgian National Mortality Dataset (Deboosere & Gadeyne, 1999) which links records from the national census of March 1st 1991, with the population register of deaths and population movements from the census date to 31st December 1996, a total of 70 months. The register records all deaths and migrations out of the country, thus enabling an exact definition of exposure time, to death or to censuring, either because the person left the country, or because they were still alive at the final date of follow-up. For each individual the following information was extracted in the form of dichotomous variables (exists=1, other=0):

1. *Demography*
- a. gender (sex): male=1;
- b. outcome: dead=1;
- c. duration: years (days/365.25) to last event (death, migration or censuring);

2. *Population origins*
- a. nationality: Belgian or non-Belgian;
- b. origin groups: Moroccan, Turk or African origin;

3. *Economic status*
- a. working at time of census;
- b. household receiving social security income ;
- c. completed secondary education (Belgian or foreign equivalent);
- d. completed higher education (Belgian or foreign equivalent);

4. *Household status*
- a. single (unmarried and not cohabiting);
- b. married ;
- c. cohabiting (sharing household with same status person of opposite sex but not formally married);
- d. single parent (single head of household with child(ren));
- e. lifetime number of births (women only);

Organisation of data

Data were organised by sex and municipality:

1. We computed the proportion of the male and female population in each status, by age group: (0, 1-4; 5-9; . . . 90+), with the exception of:
   Births: average number of births = total lifetime births / total number of women in age group;
   Deaths: mortality rate = total deaths / total duration in age group, males and females combined. Mortality rates are thus computed by age *at the beginning of the follow-up* and not by age at death;
2. For each of the 589 municipalities, we computed the log standardised ratio, that is, the total number of events in the municipality divided by the number expected according to the national age-sex specific proportions or rates and the local age specific populations. Log ratios were used in order to create symmetry above and below equivalence to the national rate.
3. The social indicators were combined, by principal components analysis, to form social indicators of municipality characteristics (details below);
4. For mortality, we also computed the standardised ratio limited to ages 35-59 (mid life, or premature mortality); and ages 60+ (later, or mature mortality). There is necessarily a certain arbitrariness in the delimitation of these ages, the specific cut-

off points follow Anson's (1992) analysis of critical ages in the life table. By standardising on the rates for the male and female population combined, we created a natural difference between the municipality specific standardised mortality rates for men and women, though the actual values computed correlated almost perfectly (r = 0.985) with the rates computed on gender-specific standard rates;

5. All measures used in the analysis (mortality and social indicators) were scaled to a standard deviation of 1;
6. The municipalities ranged in size from 467,518 (Antwerp) to 93 (Heerstappe in Limburg) with a median of 10,721 and a mean of 16,942. In view of this wide disparity (the log of population is normally distributed) with implications for the stability of the computed rates, all analyses were performed weighting for the size of the total population;
7. The municipalities were organised into four regional divisions. Using data on migration patterns, Willaert (1999) has identified 17 migration "basins", areas within which internal migration was focussed around a particular large town or group of towns. There are two large centres, focussed around Brussels and Antwerp, with 24 percent and 19 percent of the total population respectively. These two basins, between them, thus contain close to half of the total population. All the other migration basins hold less than ten percent of the population each, and most hold less than five percent. These smaller basins were thus regrouped into Flemish and Walloon basins by their location north and south of the language border, and comprising 30 percent and 27 percent of the population respectively (see Table 1).

Table 1 about here

Findings

a. Location type and level of mortality

Figure 1 about here

As a rough measure of the level of urbanisation we used the (logged) density, census population divided by the area of the municipality. Figure 1 compares the distribution of the population, by density of habitation, between the four divisions. There are clear differences between them, with Brussels having the highest population density, particularly in the 19 municipalities which make up the Brussels Capital Region, and Wallonia the lowest, particularly in the rural areas of the Ardennes. The Antwerp and Flanders divisions lie between these two.

Figure 2 about here

Table 2 about here

Figure 2a maps commune-level male and female total mortality ratios above and below the national average, and Table 2 analyses male and female mortality by division and level of urbanisation (population density). For both males and females, mortality increases as we move from Flanders through the major centres of Antwerp and Brussels, and is considerably higher in Wallonia. However, as Table 2 shows, there are clear differences in the patterning between the male and female levels of mortality, with considerably greater differences for male than for female mortality. For men, mortality is consistently lower in the Antwerp and Flanders than in the Brussels and Wallonia division, whereas for women there are no consistent baseline differences between the divisions. On the other hand, in the three divisions outside Brussels, mortality declines as density (urbanisation) increases. For women, there is a consistent (but much smaller) negative relation between mortality and population density, and this is steeper in Wallonia than in the other divisions. The total variation, and the variance explained, however, are considerably greater for male than for female mortality The net effect, given the lesser population density in Wallonia, is that, in general, mortality is higher in Wallonia than in the rest of the country. . Figures 2b and 2c present similar mappings of mortality at ages 35-60 and over 60. However, as their distribution does not differ in great detail from that of total mortality, we shall forego further discussion until the detailed statistical analysis.

b. Municipality Characteristics

Table 3 about here

As may be expected, the socio-economic variables are highly inter-correlated, so that any attempt to regress the mortality measures directly on these variables leads to multiple solutions whose distinction is more apparent than real. We commence, therefore, by aggregating the variables into factors. Table 3 analyses correlations among these variables for the male and female populations, from which it may be seen that the variables do, indeed, factor out as we anticipated, with the exception of the cohabitation variable, which stands alone as a separate factor.

The first two factors, national origins and family structures, are very closely correlated, in fact they could technically be combined to form one factor, but have been separated here to bring out their particular contents. For males, the proportion working could well have been incorporated into either the national origin or the social status factor, but has been retained with the social status factor because of content, and to maintain comparability with the female factor. Origins correlates positively with the family factor (high proportion married) and the social status factor, but for females these last two are negatively correlated. Cohabitation correlates negatively with the three other factors, for both men and women.

Figure 3 about here

Figure 3 maps these factors by municipality, bringing out some important differences between them:

a. Immigrants are concentrated in and around Brussels, in the old industrial centres of Wallonia and Limburg in the east of Flanders, and in the Antwerp-Ghent area of Flanders. Overall, urban areas are less homogeneously Belgian than are the rural and suburban municipalities, and national homogeneity is higher in Flanders than in Wallonia, with the greatest concentration of new immigrants in the urban municipalities making up the Brussels capital region.

b. We have already noted the close relation between family structures and population origin, so it is no surprise to see that Flanders is the most family-centred and Brussels the least of the four divisions. However, whereas for the other factors the correlation between male and females scores are all over 0.9, for family centredness the correlation is much lower, only 0.723. The result can be seen particularly in Wallonia, where many municipalities have a high (above average) female score, and a low (below average) male score.

c. Cohabitation shows an interesting divisional pattern, being concentrated in the more urban area of Wallonia and the southern (Francophone) part of the Brussels division. Indeed, the northern edge of the high cohabitation area almost exactly matches the language border dividing the Francophone from the Flemish regions of Belgium. Thus, as we move from Flanders through Antwerp and Brussels to Wallonia, the level of cohabitation rises consistently.

d. Two main details are salient in the patterning of social status. First, social advantage clearly lies in Flanders, on the Brussels-Antwerp and the Brussels-Ghent-Coast axes. From the map, we can see that the Walloon disadvantage is particularly concentrated in the urban centres of the old industrial belt, between Namur and Mons, more than in the rural Ardennes to the East.

c. The Analysis of Mortality

Table 4 about here

Table 4 analyses the standardised mortality ratios, for males and females in three sections:
i. total mortality,
ii. premature mortality (age 35-60) and
iii. mature mortality (60 and over).

Variables with non-significant coefficients have been removed from the equations. These analyses are performed using a Seemingly Unrelated Regression (SUR) procedure (Felmlee and Hargens, 1988), which adjusts the usual regression coefficients to allow for the fact that we are regressing on multiple outcomes from the same set of cases. The coefficients are very similar to those obtained in simple weighted regression analysis, but the standard errors are typically smaller, and we obtain an estimate of the correlation between the residuals of the dependent variables. The R^2 measures should be seen as general expressions of goodness of fit, rather than the ususal squared multiple correlations (see StataCorp. 2001: **sureg, reg3**)

i. *Total Mortality*: Naturally, the intercept is positive for the male mortality (and non-significant for female mortality) reflecting the generally higher level of mortality for females. Much of the pattern of Table 3 is maintained and in particular, among the divisions, for males Antwerp and Flanders maintain their lower mortality than Brussels and Wallonia, even after allowing for the different social characteristics of the divisions. Indeed, for Antwerp and Flanders the coefficients indicate a net *lower* level of predicted mortality for men than for women. For females, Wallonia has the same higher mortality than Brussels, but the Flanders effect is muted and Antwerp does not differ significantly from the Brussels level of mortality. For males, population density is negatively associated with mortality in all except Wallonia, but for females there is a small negative association throughout, with no geographic differentiation. Socio-economic status drastically reduces mortality, for males and for females, as, to a lesser extent, does family centredness (a high propensity to marriage and children), whereas municipalities with a high cohabitation index have higher mortality, all else being equal. A concentration of Belgian nationality (low migration) is associated with an increase in mortality for both women (but note this variable is closely associated with family and population density, so that the positive effect for males is largely "swallowed up" by these variables). It is to be noted, also, that the goodness of fit (R^2) is considerably higher for males than for female mortality, again bringing out the greater sensitivity of male mortality levels to social conditions.

ii. *Premature Mortality:* We estimate premature mortality (and subsequently mature mortality) allowing for the level of total mortality, in order to see the particular circumstances affecting excess mortality in this age group. In general, the conditions which lower overall mortality also operate to lower premature mortality *net* of the overall level, so that, as mortality declines the decline is relatively greater in the premature age group. Nonetheless, some important and interesting differences between male and female mortality remain. The intercept is positive for men and non-existent for women, indicating the greater tendency for men to die prematurely. For both men and women Antwerp and Flanders divisions have lower premature mortality than Brussels and Wallonia, with slight difference in the coefficients, and in Antwerp and Flanders premature mortality declines with population density. Social conditions operate in the same direction as for total mortality, but differ quite considerably in their relative importance. Migration and cohabitation have no effect on female premature mortality, but on the other hand, the negative effects of family centredness and social status are both greater for females than for males, and the correlation between the residuals (0.112) is considerably lower than in either of the other two pairs of parallel regressions. Thus, although premature male mortality is far more closely tied to the overall level than is premature female mortality, and the higher R^2 value shows it to be more consistent, the latter is far more sensitive, and is much lower, in municipalities with high social status and, in particular, those with a family-centred pattern of living. The lower correlation between the error terms is also indicative of a far greater disparity between the levels of premature than of overall mortality.

iii. *Mature Mortality:* Mature mortality, where most mortality is concentrated, is closely allied with total mortality, not surprisingly, hence the very high levels of goodness of fit. However, the control for overall mortality means that the analysis is looking here at *delayed* mortality, the obverse of the premature mortality analysed in the previous panel. Not surprisingly, many of the coefficients in this panel are the inverse of those for premature mortality. Antwerp has a higher level of delayed mortality than do Brussels or Flanders, and Wallonia slightly less. Population density is positive in the Antwerp division and, for men, slightly negative in Wallonia. A Belgian concentration (low migration) and cohabitation both reduce the level of delayed mortality, which now increases with family centeredness and social status. Taking the two panels together, we can see that the greatest delay in the timing of mortality, for any specific overall level, comes from the household living arrangements, with municipalities notable for their level of family living and low cohabitation having the greatest delay in mortality.

The analysis thus indicates that while the levels of male and female mortality – overall and at specific ages – are in the main sensitive to the same issues, there is a clear difference in the way these influences work. Male mortality is, at the overall level, more sensitive than is female mortality to location, patterns of living (solidarity, social innovation) and in particular to the material standard of living. On the other hand, for males the overall level of mortality far more directly controls the shape of the mortality curve, and the relative distribution of deaths between the premature (ages 35-60) and the mature or delayed deaths (ages 60 and above) than it does for females. For females, there are considerably greater differences in the shape of the mortality curve, and a greater tendency to premature mortality in those municipalities which are less family-centred.

d. *Mortality differences*

Table 5 about here

To see the difference between male and female mortality levels, Table 5 analyses the male and female mortality scores in a non-recursive model, allowing for their mutual effects at each level (overall, premature, mature) as well as the effects of total mortality on the other two. The coefficients for division, density, and the social factor scores thus represent the *net* effect of these variables on the various mortality ratios. As before, only significant predictors are entered into the analysis.

i. *Total Mortality:* There is a close, positive, interdependence between the male and female mortality levels, but clearly a paucity of net social effects on female mortality. Female mortality declines slightly as density increases, is higher in municipalities with low immigration, and in those with a high cohabitation index. For males, all the effects noted in Table 4 above are maintained, with mortality being lower in the Antwerp and Flanders divisions, and decreasing as density increases, particularly in Flanders and Antwerp. SES and family centredness are both associated with lower overall levels of mortality, and cohabitation with higher levels. High social status thus continues to have a direct negative effect on male mortality, but not on female mortality so that at high SES levels the female advantage will effectively disappear, or even be turned around.

ii. *Premature Mortality:* Both male and female mortality in this age group are reflective of overall mortality, the male more so than the female mortality, and there is a positive interdependence between male and female premature mortality, indicating a community level effect making for a delay – or non-delay – in the timing of mortality. Premature mortality is lower in the Antwerp and Flanders divisions than in Brussels, but in Wallonia, and to a lesser extent, in the Brussels division, male premature mortality is also positively associated with higher rather than lower population density. Premature mortality remains low in municipalities with a high standard of living, particularly for men, and there is a direct positive relation, for men, between premature mortality on the one hand, and Belgian homogeneity, and cohabitation, on the other.

iii. *Mature Mortality*: Both male and female mortality in later life (which we have termed mature mortality) is directly related to the overall level of mortality, but the relation between the two within the age group is asymmetrical: there is a net *negative* effect of female on male mortality, but not vice versa, indicating that the more female mortality is delayed, the less this is true for male mortality. As can be expected, the coefficients are largely the obverse of those for premature mortality, with increased delayed mortality in Antwerp, and less in Wallonia, than in Brussels or Flanders. There is a positive effect of increasing population density in Antwerp, but elsewhere, for men, the effect is negative. As may be expected, municipalities with high family-centredness have a greater tendency to delayed mortality, whereas, for men, a high cohabitation index is associated with less delayed mortality.

iv. The goodness of fit statistics indicate a much better fit for the male mortality models, less so for the female models, indicating, as before, a greater sensitivity of male mortality to social conditions.

Table 6 about here

Table 6 regresses mortality differences, total, premature and mature, on average mortality and (for the premature and mature models) total mortality differences, division, urbanisation, average and difference factor scores. Differences are in all cases male score minus female score, so we are estimating the male mortality disadvantage in terms of higher male scores on social factors. The results very much confirm the previous analysis:

i. There is a weighted mean male disadvantage of 0.232, with a standard deviation of 0.843, but this varies considerably between the geographic divisions, from a low in Flanders to a high in Wallonia and Brussels, but this is mediated by its sensitivity to various social conditions. The disadvantage is lower in urban areas (high population density) and in municipalities with a *higher* average mortality. However, this is offset by a lower disadvantage in municipalities with a high SES and a high degree of family centredness. The disadvantage is also lower the greater men's social advantage over women (SES difference). However, the disadvantage is somewhat higher in municipalities with higher levels of cohabitation and is higher where the male cohabitation index is greater than the female index (although it takes two to cohabit, the index for each sex is based on their respective age distributions, so that, despite the close correlation between the two indices, there ae small differences between them).

ii. Male disadvantage in premature mortality is higher the higher average mortality, but also rises with total mortality difference, and declines with average premature mortality. It is lower in Antwerp, and higher in Wallonia, than in brussels and Flanders, and rise (slightly) with population density, except in Antwerp where it declines. The male disadvantage in this age group is higher where cohabitation is higher, and in the more homogeneously Belgian municipalities, and, as with total mortality, the disadvantage is lower where SES is higher, and where men's social advantage is higher.

iii. At the baseline there is no net male disadvantage in mature mortality, but the difference is very closely tied to the overall difference. The disadvantage goes up slightly as average mortality increases, but, beyond that, is not directly tied to the level of mature mortality. Mature mortality is lower in Wallonia and is slightly lower, too, in Flanders, it tends to be slightly lower in urban municipalities, especially in Flanders, and in municipalities with lower average cohabitation indices.

Summary and Conclusions

The present analysis has focussed on male and female mortality levels, and their differences, in Belgian municipalities (communes) over 70 months following the census on 1st March 1991. Despite its small size and apparent homogeneity, there are, as we have seen, considerable social differences between its 589 municipalities. They are divided between the French (Walloon) south an the Flemish north; between sparse rural communities and densely populated urban centres; and they also show considerable social variation: agriculture, old industrial cities and new service centres; a population that is homogeneously Belgian to one with a high proportion of non-European immigrants; traditional to innovative forms of household composition; and low to high degrees of family centredness. As we have seen above, all of these differences affect directly the general level of mortality in the population, the age distribution of that mortality, and the differences between the mortality of males and of females. Specifically, looing at overall mortality and mortality in the age ranges 35-59 and 60 and above as a function of area level aggregate characteristics of the municipalities we have found:

1. mortality is lower in areas of high social class (as measured by employment and education patterns) and in areas with a family-centred pattern of living. It is higher in municipalities with a high cohabitation index;
2. the same variables which are associated with lower mortality are also associated with the delay in mortality from what we have termed premature ages (below 60) to more mature ages (over 60), so that the mortality curve not only changes as mortality declines, but also as a function of these social and cultural variables;
3. Net of these social var iables, there are important mortality differences between the different regions of Belgium, and by level of urbanisation:
    a. for both men and women, mortality tends to be higher in Wallonia than in Flanders (including Antwerp), with Brussels holding an intermediate position;

b. mortality is lower in urban (high density) than in rural municipalities;4. there are important *social* differences between the patterns of male and female mortality:

a. male mortality is more sensitive than female mortality to social conditions. This is reflected both in considerably higher goodness of fit measures for regressions on male mortality, but also in the higher absolute values for most of the coefficients;

b. thus, even though male and female mortality levels *respond* in similar directions (positive or negative) to the same social variables, there are far clearer differences between male patterns by type of locality, than between female mortality patterns;

c. differences between male and female mortality thus reflect these differences and the greater sensitivity of male mortality to social conditions: the male mortality disadvantage is lower in Flanders than in Wallonia, lower in urban than in rural municipalities, and lower in areas of traditional living patterns: family centredness and low cohabitation. The male disadvantage is greater, however, the greater women's relative social status;

5. an important implication of these results relates to the cross-currents affecting mortality in general, and male-female differences in particular. As standards of living increase, and the population becomes more urbanised, mortality declines and male and female mortality levels draw closer together. However, if , at the same time, household living arrangements are becoming less traditional, this will act as a brake on mortality decline, and in particular, on the reduction in the male mortality disadvantage.

Mortality, the rate at which people of different ages die, is clearly a social phenomenon, and needs to be interpreted through its relations with other social variables. These variables relates to both the material conditions in which people live, and to the patterns of social relations within which they live their lives. However, the social indicators used in the analysis should not necessarily be read at face value: if a low family centredness index, or a high cohabitation index, are associated with higher mortality, this is not to say that divorce or cohabitation are necessarily risk factors at the *individual* level. Indeed, an ecological-level analysis such as this can say nothing about individual risks and risk factors, nor should it. Rather these measures should be read as indicators of general social conditions, of social solidarity and regulation, indicators of whose importance we have long been aware. Their theoretical conceptualisation, and their measurement, however, still require considerable development, before we shall be in a position to compare, adequately, social conditions within and, certainly, between countries. This is not to say that individual biology and behaviour are irrelevant, only that they take on their particular form, and express themselves, in a social context. The consistency of these results does indicate that any attempt to explain mortality, its level and male-female differences, strictly in terms of individual biology and behaviour does so at the risk of ignoring an important component in the explanation of the specific mortality risks to which men and women are exposed.

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Table 1: Migration Basins – Provinces, Communes and Populations

Migration Basin	Provinces	Number of Municipalities	Proportion of Total Population
Antwerpen	Antwerp/ E.Flanders/ Brabant (Flanders)	83	0.189
Arlon[W]	Luxemburg/ Namur	27	0.0150
Brugge[F]	W.Flanders	12	0.0287
Brussel	Brussels/ Brabant (Wallonia)/ Brabant (Flanders)/ East Flanders/ Hainaut/ Liege/ Namur	121	0.243
Charleroi[W]	Hainaut/ Namur	33	0.0589
Gent[F]	E.Flanders/ W. Flanders	41	0.0748
Hasselt-Genk[F]	Limburg/ Brabant (Flanders)	46	0.0797
Kortrijk[F]	W. Flanders/ Hainaut	22	0.0417
La Louvière[W]	Hainaut	7	0.0178
Leuven[F]	Brabant (Flanders)	19	0.0296
Liège[W]	Liege/ Limburg/ Luxemburg/ Namur	79	0.0853
Mons[W]	Hainaut	14	0.0274
Namur[W]	Luxemburg	21	0.0253
Oostende[F]	W.Flanders	14	0.0207
Roeselare[F]	W.Flanders	15	0.0209
Tournai[W]	Hainaut/ W. Flanders	10	0.0180
Verviers[W]	Liege	25	0.0243

Key: F indicates basins in Flanders
W indicates basins in Wallonia

Table 2: Total mortality by Regional Division and Population Density

Male	Variable	Female
−2.00***	Antwerp	−0.758
−1.98***	Flanders	−0.499
0.383	Wallonia	0.264
0.00137	log (Density)	−0.105***
−0.539**	Antwerp* density	−0.279
−0.591***	Flanders* density	−0.0784
−0.312**	Wallonia* density	−0.269*
0.501	**R^2**	**0.269**

Note: In this and subsequent regressions:
Omitted division: Brussels
† indicates $0.1 \geq p > 0.05$
* indicates $0.05 \geq p > 0.01$
** indicates $0.01 \geq p > 0.001$
*** indicates $p < 0.001$

Table 3: Factor Definitions of Commune Characteristics

a. Males

	Origins	Family	Cohabiting	Social Status
Belgians	**0.916**	*0.624*	*-0.212*	*0.475*
Immigrants	**-0.916**	*-0.542*	*0.326*	*-0.304*
Single	*-0.485*	**-0.892**	*-0.103*	*0.0818*
Married	*0.668*	**0.959**	*-0.348*	*0.134*
Single parent	*-0.470*	**-0.696**	*0.406*	*-0.358*
Working	*0.825*	*0.721*	*-0.306*	**0.566**
Social Security	*-0.390*	*-0.0873*	*0.241*	**-0.857**
Secondary Education	*0.328*	*0.0877*	*-0.125*	**0.907**
Higher Education	*0.0131*	*-0.234*	*-0.0515*	**0.856**
Origins	1.00	0.637	-0.294	0.425
Family	0.637	1.00	-0.238	0.139
Cohabiting	-0.294	-0.238	1.00	-0.195
Social status	0.425	0.139	-0.195	1.00
Eigenvalue / k	1.68 / 2	2.20 / 3	1.00 / 1	2.61 / 4
Percent	84.0	73.3	100	65.3

b. Females

	Origins	Family	Cohabiting	Social Status
Belgians	**0.912**	*0.588*	*-0.161*	*0.319*
Immigrants	**-0.912**	*-0.604*	*0.279*	*-0.169*
Single	*-0.468*	**-0.832**	*-0.0615*	*0.476*
Married	*0.703*	**0.981**	*-0.377*	*-0.105*
Single parent	*-0.704*	**-0.848**	*0.493*	*-0.158*
N Births	*0.402*	**0.844**	*-0.506*	*-0.340*
Working	*0.515*	*0.140*	*-0.111*	**0.699**
Social Security	*-0.206*	*0.0534*	*0.227*	**-0.762**
Secondary Education	*0.176*	*-0.274*	*-0.0628*	**0.898**
Higher Education	*0.0524*	*-0.421*	*-0.070*	**0.908**
Origins	1.00	0.653	-0.241	0.267
Family	0.653	1.00	-0.377	-0.212
Cohabiting	-0.241	-0.377	1.00	-0.137
Social status	0.267	-0.212	-0.137	1.00
Eigenvalue / k	1.66 / 2	3.08 / 4	1.00 / 1	2.70 / 4
Percent	83.1	77.1	100	67.5

Note: Values in the tables are correlations between variables and factors. Factors are defined by variables in **bold type** and hence are not orthogonal. Correlations weighted by total population in each commune. For variable definitions, see text.

Table 4: Total Mortality and Mortality in Mid adult and Later Adult Life Seemingly Unrelated Regressions

Total mortality			Mortality 35-60		Mortality 60+	
Male	Female	Variables	Male	Female	Male	Female
1.41***		Intercept				
−2.15***	−0.0226	Antwerp	−2.01***	−1.08†	0.842***	0.676***
−2.81***	−0.281**	Flanders	−1.14**	−1.39**	0.299	0.27
0.0485	0.416***	Wallonia	0.120	−0.109	−0.242*	−0.119
−0.418***	−0.0468†	log Density	0.0769***	−0.0189	−0.0272**	−0.00295
−0.616***		Antwerp* Density	−0.573***	−0.329†	0.226**	0.208**
−0.910***		Flanders* Density	−0.349**	−0.482**	0.0821	0.100
−0.0964		Wallonia* Density	0.101	−0.00220	−0.0972*	−0.0537
	0.169***	Belgian Homogeneity	0.108**		−0.0540**	−0.0445***
−0.121***	−0.0973†	Family Centredness	−0.222***	−0.489***	0.153***	0.228***
0.220***	0.268***	Cohabitation	0.160***		−0.111***	−0.0284***
−0.546***	−0.344***	SES	−0.163***	−0.229***	0.0698***	0.0917***
		Male mortality	0.555***		1.11***	
		Female mortality		0.360***		1.01***
0.738	**0.389**	**R^2**	**0.778**	**0.538**	**0.925**	**0.940**

Correlation matrix of residuals

		Total mortality		Mortality 35-60		Mortality 60+	
		Male	Female	Male	Female	Male	Female
Total mortality	Male	1					
	Female	0.375	1				
Mortality 35-60	Male	0.0125	0.006	1			
	Female	0.0204	−0.0093	0.116	1		
Mortality 60+	Male	−0.0143	−0.036	−0.855	−0.135	1	
	Female	−0.0105	0	−0.195	−0.833	0.264	1

Table 5: Total Mortality and Mortality in Mid adult and Later Adult Life Three Stage Regressions

Total mortality			Mortality 35-60		Mortality 60+	
Male	Female	Variables	Male	Female	Male	Female
0.912***		Intercept			0.235*	
1.80***		Antwerp	1.19**	0.716	0.580**	0.541**
2.22***		Flanders	0.223	1.22**	0.0805	0.124
0.0815		Wallonia	0.600*	0.577*	0.381**	0.0689
0.229***	0.0653***	log Density	0.0768***	0.0278	0.106***	0.0132
0.510***		Antwerp* Density	0.328**	0.218	0.146**	0.170*
0.726***		Flanders* Density	0.0446	0.435*	0.0335	0.0568
0.0392		Wallonia* Density	0.247**	0.150	0.157**	0.0106
	0.145***	Belgian Homogeneity	0.0526**			
0.117***		Family Centredness	0.107***	0.318***	0.138***	0.172***
0.101***	0.122***	Cohabitation	0.116***		0.0835***	
0.425***		SES	0.150***	0.0630*		
	0.660***	Male Total Mortality	0.405***		1.09***	
0.421***		Female Total Mortality		0.343***		.807***
		Male Parallel Mortality		0.278***		
		Female Parallel Mortality	0.378		0.152***	
0.756	**0.454**	**R^2**	**0.732**	**0.539**	**0.903**	**0.914**

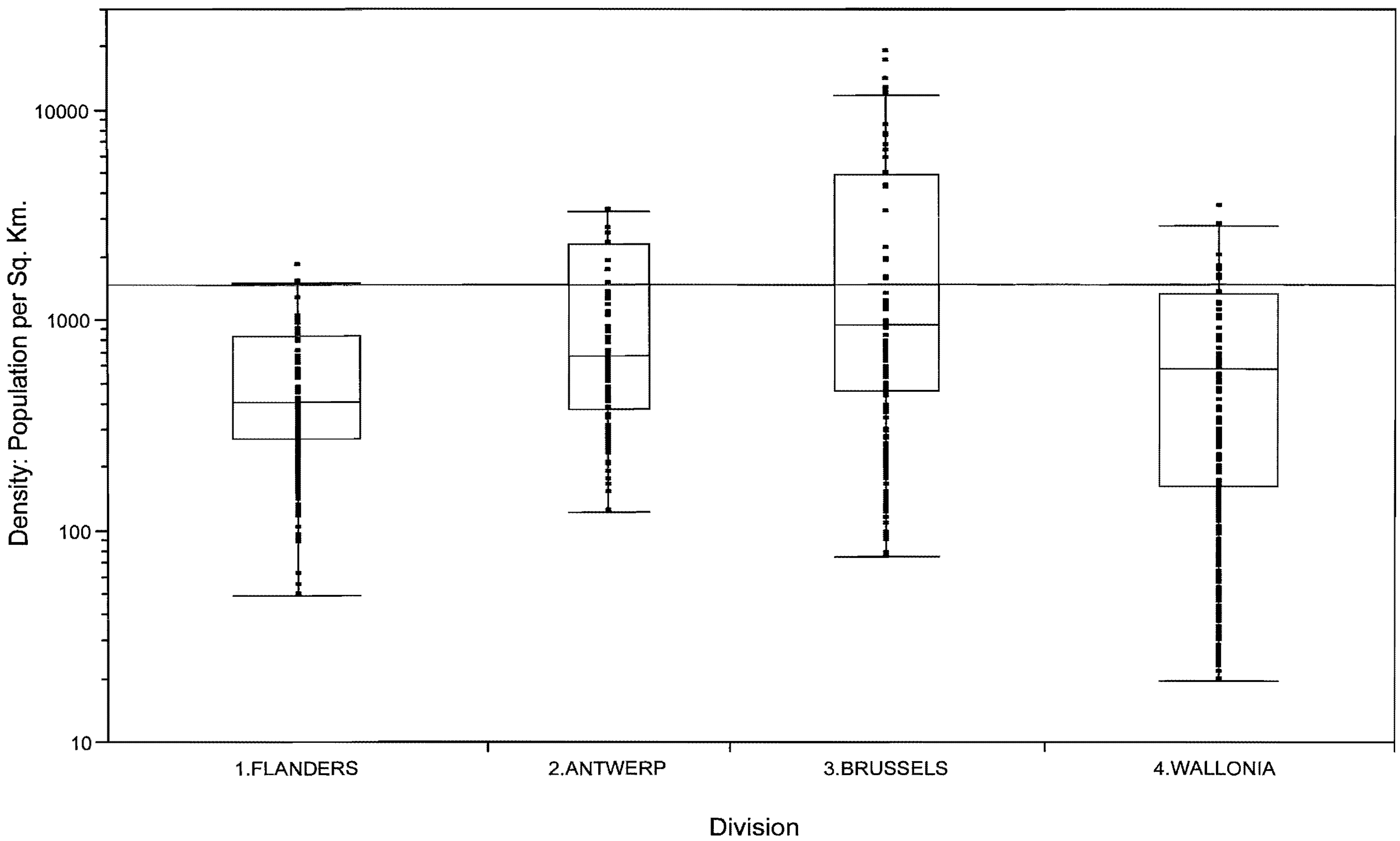
Table 6: Mortality Differences: Total Mortality, Mid Adult and Later Adult Life Seemingly Unrelated Regressions

Variables	Total Mortality	Mortality 35 60	Mortality 60 and over
Intercept	1.91***		
Average Mortality	0.609***	0.442***	0.0820***
Total Difference		0.461***	1.07***
Av. 35 60		0.498***	
Av. 60 +			
Antwerp	2.64***	0.999†	0.284
Flanders	3.47***	0.354	0.492*
Wallonia	0.264	0.742**	0.405***
Log density	0.531***	0.0877***	0.107
Antwerp * Density	0.763***	0.266	0.117
Flanders * Density	1.19***	0.169	0.189*
Wallonia * Density	0.104	0.302**	0.142**
Average Belgian Homogeneity		0.119***	
Average Family Centredness	0.203***		
Average Cohabitation	0.0941*	0.112**	0.0382*
Cohabitation Difference	0.925*		
Average SES	0.568*	0.0736*	
SES Difference	0.311*	0.186**	
R^2	**0.351**	**0.386**	**0.900**

Correlation Matrix of Residuals

	Total Difference	Difference 35 60	Difference 60+
Total Difference	1		
Difference 35 60	0.0016	1	
Difference 60+	0.0051	0.830	1

Figure 1: Distribution of population in major geographic divisions, by population density



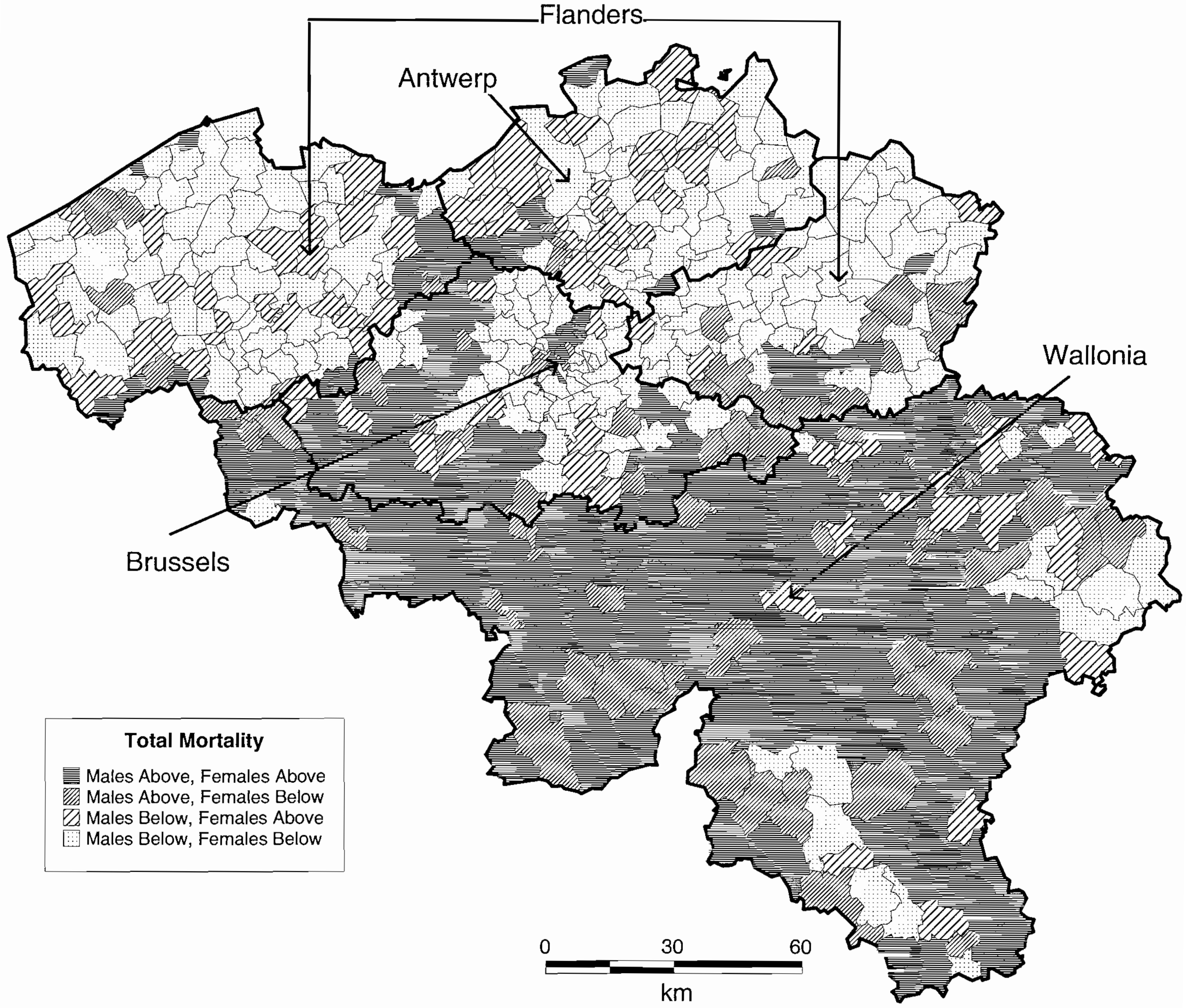


Figure 2a: Total Mortality in Municipalities, above and below National Average

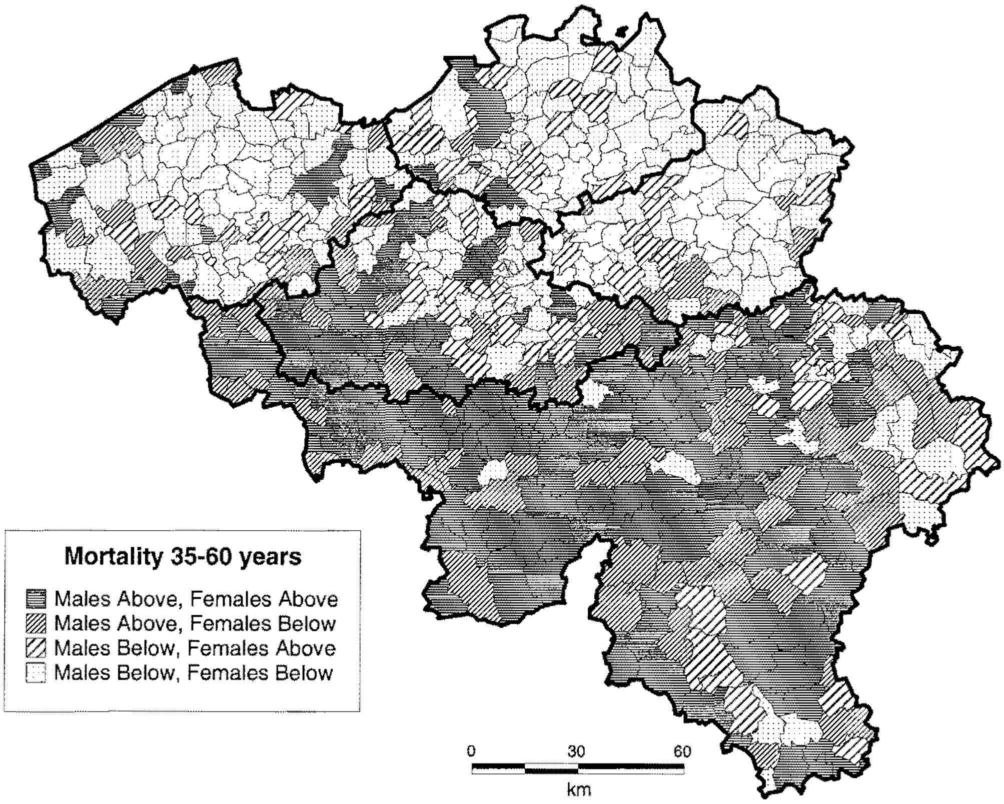


Figure 2b: Mortality Ages 35-60 in Municipalities, above and below National Average

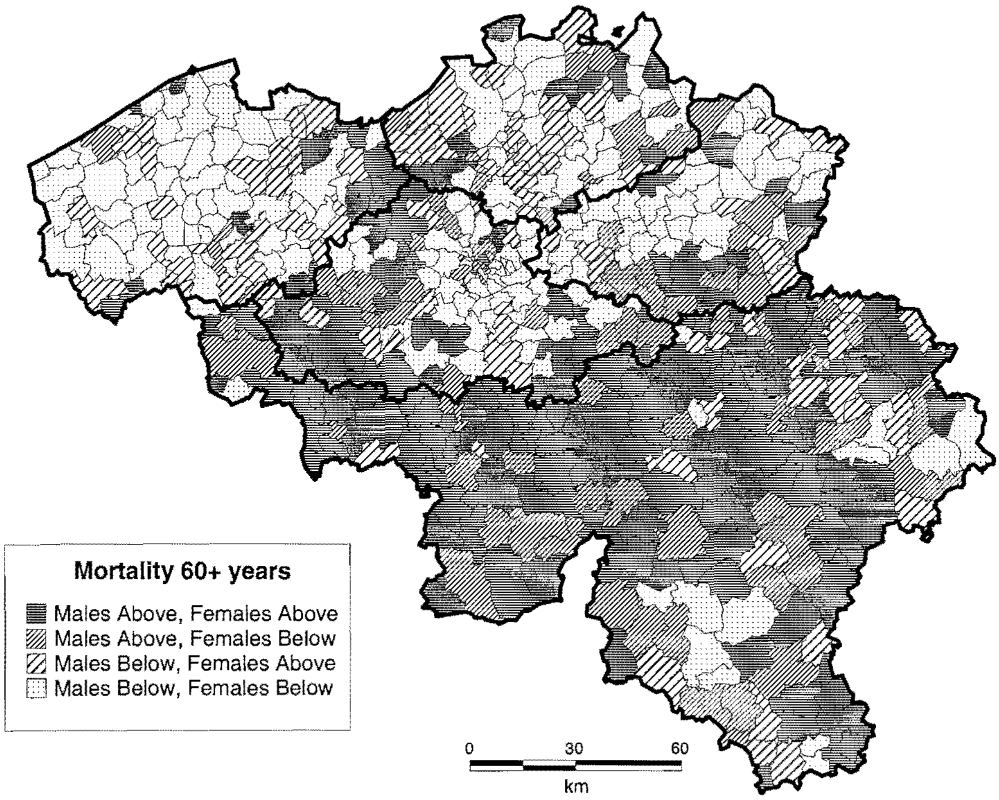


Figure 2c: Mortality Ages 60 and Above in Municipalities, above and below National Average

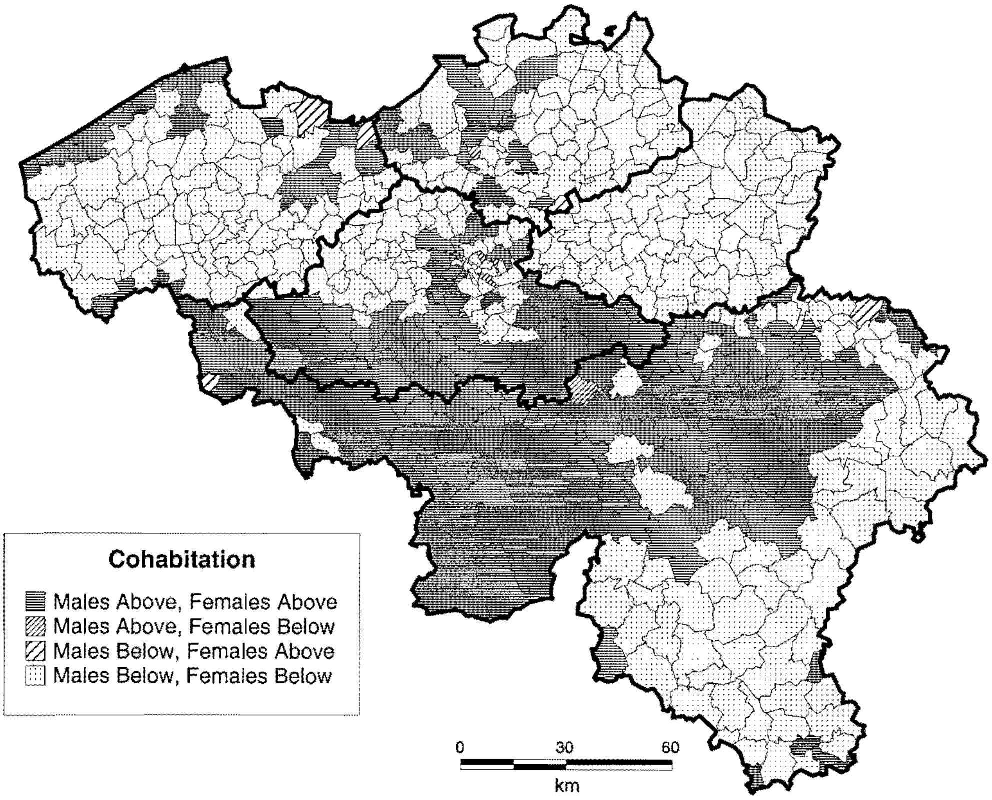


Figure 3c: Cohabitation, by Municipality, above and below National Average

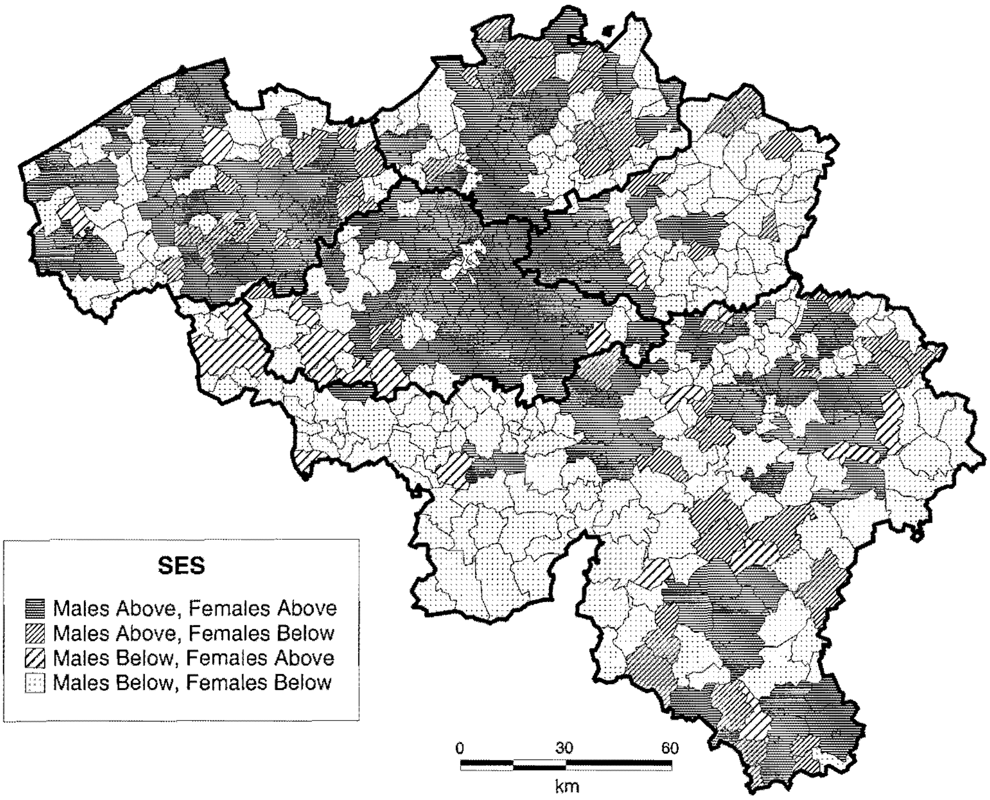


Figure 3d: Socio-Economic Status, by Municipality, above and below National Average