

Mortality of Single and Married Persons in Norway 1960—1962

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The Central Bureau of Statistics has carried out a study of some aspects of mortality conditions in the Norwegian population at the beginning of the 1960's based on data from the 1960 Census of Population and the continuous registration of vital events. We have concentrated on describing differences in mortality by occupation and marital status. In this article, the most important results concerning the mortality of single and married persons are presented.

It is well known that single persons have higher mortality than married persons at most ages. This is particularly marked for males. Attempts to explain this concentrate on two hypotheses, viz. *the selection hypothesis* and *the life style hypothesis*: It is assumed that those who marry are the strongest in terms of health and that the life style in marriage is more healthy than the life style of single persons. In our data, we see distinct selection effects, but we have not succeeded in exposing the cumulative effects one would expect if the life style hypothesis were important.

1. A Brief Description of the Study and its Main Results

1.1. Background

A rather comprehensive study of mortality conditions in the Norwegian population at the beginning of the 1960's was carried out in the Central Bureau of Statistics, primarily in 1971. The original intention was to limit the study

¹ The project was originally initiated by Svein Nordbotten. I am grateful to him and to my colleagues in the Socio-Demographic Research Unit for their valuable advice during this study.

to possible connections between occupation and mortality for males, but the sphere of interest was gradually extended, first by including females in the study and later by utilizing information concerning marital status.

In this article we shall provide a rather extensive report on the background of the study and the data used, but only include some of the empirical results. We shall concentrate on the comparisons which were made between the mortality of single and married persons, and accordingly we exclude widowed and divorced/separated persons.

1.2. *Two hypotheses to explain why single persons have higher mortality than married persons*

It is an almost universal rule in demography that in any population the mortality of single persons is found to be higher than that of married persons of same age. This is often explained as the effect of the following two complementary types of factors, both of which have been assumed to be important.

The selection hypothesis: First, it is assumed that marriage is selective and that those who marry do not constitute a random sample of all who reach a marriagable age. It is thought that there will be a clear overrepresentation of persons possessing a good physical constitution and high social adaptability among the married. Conversely, one expects to find a relatively high number of single persons with poor physical and mental health.

The life style hypothesis: Secondly, it is customary to assume that the life style in marriage is more healthy than the life style practised by single persons. One can conceive of many reasonable explanations as to why this should be the case. Married persons may have a more balanced and regular diet than single persons, or perhaps the difference may be ascribed to different habits in the use of tobacco and alcohol. It is also conceivable that single persons lead a more exposed daily life than the married. One possibility is that single persons are those who, relatively often, are chosen to carry out dangerous assignments on the job; another that single persons are more often killed in car accidents and other types of accidents. This can, for example, be due *inter alia* to the fact that single persons have relatively few obligations at home and are thus possibly found in hazardous surroundings more frequently than the married.

Some of the factors cited above, and others which we have not mentioned, will yield an effect which is cumulative if the life style hypothesis is correct. If a healthy diet, healthy smoking and drinking habits, etc. are closely related to the marital life style, this should result in making the supermortality of single persons (as compared with married persons of the same age) increasingly more prominent as the duration of the marriage gradually increases. We shall call this *the hypothesis of a cumulative effect* of the marital life style.

Other factors, such as a high percentage of accidents among the single, may

also have a certain cumulative effect. Health will probably be unfavourably influenced when one constantly leads a relatively hazardous life. Here, however, it is possible that the result is greatest in special age groups. Perhaps those who lead a particularly hazardous life are *young single persons*.²

An objective of this study is to shed some light on the validity of the hypotheses mentioned above by controlling for the effect of different age and occupational distributions of single and married persons through standardization and specification with regard to these two factors.

1.3. Empirical results and main conclusions

Our most important empirical results were the following:

At the beginning of the 1960's, single males under the age of approximately 70 and single females under the age of approximately 65 had a markedly higher mortality than corresponding groups of married persons. No noteworthy differences could be established for those who were older. Some of the observed differences for males can be explained by the fact that the proportion not gainfully occupied was greater among single males than for the married. In addition, single males under the age of about 44 had a somewhat »more hazardous» occupational distribution than the married.

After adjustment for employment and occupational distribution, the pattern of excess mortality for single males was still the same. We still found the greatest differences in the youngest groups while the differences for the oldest groups were very small.

The selection hypothesis: The results suggest that at least some selection effect was present. Males not gainfully occupied had considerably higher mortality than those of the same age who were gainfully occupied, and a larger proportion of the single males than the married males were not gainfully occupied. An obvious way of explaining this must be that among the unemployed single males there was a relatively high number who, due to physical and/or mental handicaps, had limited possibilities both in finding a spouse and obtaining employment.

Selection appeared to have an effect on mortality in all age groups, with the possible exception of the oldest group.

The exclusion of males not gainfully occupied is, however, an imperfect way of testing the validity of the selection hypothesis. Some single males with health problems dating back to childhood *are* gainfully occupied, while some of the unemployed are single or married males who became ill or were injured after reaching adulthood. It is therefore possible that the selection effect which in reality was present, was weaker (or stronger) than what would appear in our findings.

² One will generally not see the cumulative effect hypothesis so clearly formulated in the literature. Cf., for example Thompson & Lewis (1965 pp. 364—368).

The relatively low number of women in the labour force made it difficult to carry out for females calculations corresponding to those for males described above. We can therefore not draw so clear conclusions concerning the presence of a selection effect in the case of females as we have done for males.

The life style hypothesis: Our possibilities on this front have primarily been limited to studying the extent of the support of the cumulative effect hypotheses in our data. As we mentioned above, no noteworthy excess mortality could be demonstrated for the oldest age groups. A possible cumulative effect would have led towards increasingly more pronounced excess mortality for older single persons. We have not found this. If a cumulative effect, despite these results, has been present nevertheless, there must have been other and stronger counteracting effects.

It is, of course, conceivable that we would have arrived at a different conclusion if we had knowledge of and had adjusted for the effect of further background factors in addition to age and occupation. This type of uncertainty will always be present in empirical studies, however.

It is difficult to discuss whether the fragments of the life style hypothesis, which cannot be included in the cumulative effect hypothesis, appear reasonable based on our data. If we had had access to information concerning cause of death, our vague observations concerning a possibly high percentage of accidents for single persons in some age groups might have proved correct.

One important element necessitates some caution in drawing too firm conclusions from our data: We have used period or cross-sectional data and not cohort or longitudinal data. Our hypotheses are formulated as statements on cohort effects. In principle, therefore, they should have been investigated on the basis of cohort data.

2. The Data Base

2.1. The information used

We utilize the following information concerning individuals:

Obtained from the 1960 Census of Population:	{	Data of birth Sex Occupation Industry Marital status
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From the Central Population Register of the Central Bureau of Statistics:	{	Dated register status as of December 31, 1967. (Shows possible date of death or date of emigration.)
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2.2. Under-registration

Population censuses are not without errors. Some individuals are registered twice while others are not registered at all. We shall, however, disregard this type of imperfection in the data in this connection, and shall concentrate instead on investigating to what extent the figures used in this study agree with official figures in the 1960 Census of Population publications (cf. for example Norges offisielle statistikk XII 117 (1963): Folketelling 1960. Hefte II), and figures from the continuous registration of vital events (cf. for example Norges offisielle statistikk XII 146 (1964): Folkemengdens bevegelse 1962.)

The reason why we must make comparisons with both these data sources is that relative mortality figures include a number exposed to risk in the denominators (with the Census of Population as its source) and a number of deaths in the numerators (from the continuous registration of vital events). An analysis of under-registration must therefore be divided into two because it is not automatically certain that the under-registration in »the numerators» is the same as in »the denominators».

It turns out that almost all of those who were counted in the 1960 Census of Population have been included in the study, but that among the few percentages missing there was a relatively high number who died between 1960 and 1962, which is undeniably unfortunate since we are carrying out a study of mortality.

We found that 97.6 % of the males who in 1960 were between the ages of 30 and 81, were included in the study, while the corresponding figure for females was 97.9 %.

The correction for under-registration was made in the following manner: For each age, both sexes, and each of the groups of *all* unmarried, *all* married, *all* widows and widowers and *all* divorced/separated persons, the death rate calculated on the basis of official statistics was divided by the corresponding death rate in our data. This was done for each group. These correction factors, specific for sex, age and marital status, were then multiplied by the relevant observed death rates in individual occupational groups and that for all the gainfully occupied taken together.

2.3. Further details on the choice of the data base

In almost all mortality studies which have been carried out thus far, both in Norway and in other countries, one has been forced for practical reasons to obtain information on, for example, marital status and occupation from death certificates. The statements on the death certificate are necessarily collected from friends or relatives of the deceased. Such persons may be unacquainted with the precise details, and this represents a serious source of error. It was only after population registers had been established in some countries that it was possible to base such information on more reliable data.

The entire life history of an individual plays a role in determining the death risk to which he or she is submitted at any point of time. Therefore, the picture we obtain must be incomplete if we have a single registration only of marital status and occupation. Nevertheless one *reliable* registration will reveal important characteristics of the pattern of mortality, and this is generally considered sufficient.

Marital status is registered on the census data, while information on occupation is collected on the basis of the «usual activity» principle. This means that only those who had gainful employment as their most important source of subsistence in the census year were classified as gainfully occupied. This has created considerable problems for the purpose of this study since relatively few married females had (and have) paid employment spread over such a long period that they may be designated as gainfully occupied on the basis of this criterion. It was difficult, therefore, to make comparisons between different groups of gainfully occupied females.

3. The Mortality of Single Persons as Compared with the Mortality of Married Persons by Aggregated Measures

3.1. Standardizing for age alone

We shall first compare the death rates of *all* single persons and *all* married persons after standardizing for age. In this manner we adjust for possible difference in the age distribution for single and married persons. However, we are not able to consider possible other differences in the composition of the two groups. This represents the most primitive form for comparison we shall use in this article.

The standardization technique chosen can be briefly described as follows:

For each age group we calculate the ratio between the observed number of deaths of single persons and the number of deaths of single persons which one would expect if the death rate for *married persons* had prevailed in that group. The final index is a weighted total of these age-specific ratios with the relative number of single persons in each age group as weights.

Note that in this way we emphasize the age groups where the *number* of single persons is largest and not, for example, the age groups where the *mortality* is high.³

We found the following index values when we compared the mortality of *all* single persons with *all* married persons: *Males* 1.72, *females* 1.43.

Comparisons between *all* single persons and *all* married persons are not really suitable, however, for solving the problem we have set, viz. to investigate the validity of the hypotheses concerning the existence of a selection effect and a life style effect.

We shall initially concentrate on the selection effect and would therefore

like to exclude from the analysis as many as possible of the persons who in 1960 were single because they had serious mental and/or physical handicaps from birth or childhood. There is no information in our data which makes this possible straightaway. By including information on who was gainfully occupied and who was not, however, we obtain a certain indication of groups with health problems. We shall make comparisons, therefore, between gainfully occupied single and married persons.

The comments above primarily relate to males since in our society males will generally be gainfully occupied (or in school) if they are not barred from this by health deficiencies.

Excluding those who are not gainfully occupied does not enable us to eliminate those and only those persons who were single because of health problems. Some people with considerable handicaps have gainful employment, and some originally healthy employed persons withdraw from the labour force because sickness or injury occurs. The latter group makes our problems of interpretation more difficult since health problems occurring in adulthood possibly affect single persons more frequently than the married.

The calculations showed an *index value* of 1.58 for employed single males compared with employed married males, and correspondingly 1.64 for females.

As expected, the figures for males dropped somewhat, viz. from 1.72 to 1.58. Some of the excess mortality of single males can thus be ascribed to those not gainfully occupied.

We see that the figures increased for females from 1.43 when we compared all the single with all the married, to 1.64 in the group of the gainfully occupied. Based on these calculations it may appear as though employed married females at the beginning of the 1960's accounted for a relatively greater proportion of the married females than was the case for the single. In paragraph 4.2. we shall see, however, that this is a rather dubious conclusion.

³ The index is constructed mathematically in the following manner: Let aN^e designate the number of males in age group a with marital status e ($e = u$ for single and $e = g$ for married) who were present at the time of the 1960 Census of Population. Further, let aD^e designate the number of those who died during the period up to December 31, 1962, which is the end of our observation period. We write:

$$a\hat{q}^e = aD^e/aN^e \quad \text{og} \quad N^e = \sum_a aN^e$$

We introduce the following index:

$$(1) \quad I = \sum_a \frac{aN^u}{N^u} \cdot \frac{a\hat{q}^u}{a\hat{q}^g} = \sum_a \frac{aN^u}{N^u} \cdot \frac{aD^u}{aN^u \cdot a\hat{q}^g}$$

In formula (1) $aD^u/(aN^u \cdot a\hat{q}^g)$

is the ratio between the observed number of deaths of single males in age group a , and an estimate for the number of deaths of single males to be expected in the same age groups had the death rate of the married prevailed. These ratios are then weighted with the relative number of single males in each age group as weights. Cf. in addition, Kitagawa (1964, p. 304, formula 13).

3.2. Standardizing for age and occupation

Julie E. Backer mentions (Backer 1961) the desirability of including information on occupation in mortality studies, so that adjustments can be made for possible occupational differences for the groups being compared.

The calculations gave the following results:

Table 1. The death rate of the gainfully occupied and all single persons compared with the death rate of the gainfully occupied and all married persons. Standardized for age and occupation.

	All the single compared with all the married Standardized for age	The gainfully occupied single compared with the gainfully occupied married	
		Standardized for age	Standardized for age and occupation
Males	1.72	1.58	1.50
Females	1.43	1.64	

The index figure for males is lowest when we standardize for *both* age and occupation (for those who are gainfully occupied). We shall see later that occupation explains much of the excess mortality of single persons in the youngest age groups. Even though it is relevant therefore to include information on occupation, the reduction in the index (from 1.58 to 1.50) was rather small. This is related, of course, to the fact that the index calculations are based on a summation over all age groups.

4. More Details on the Individual Age Groups

4.1. All single persons compared with all married persons

We shall limit ourselves to presenting diagrams which show *the ratio between the death rate of single persons and the death rate of married persons in the different age groups*.⁴ Since we shall concentrate on ratios, we must be cautious in thinking that a high (or low) ratio in one age group means that mortality was correspondingly high (or low). The highest ratios are found for persons 30—40 years of age because the percentage of *excess* mortality of single persons was greatest in these age groups, while the *level* of mortality is, of course, low in these age groups compared with other age groups.

We recall that the calculation of the corresponding index (all single/all married and standardized for age) gave the result 1.72 for males. We have previously mentioned that the method of weighting used here gives relatively

⁴ Expressed in terms of the symbols in footnote 2, a^u/a^g for different values of a and for both sexes has been plotted in diagram 1.

greatest weight to those age groups where the number of single persons is highest. We see from Diagram 1 that 1.72 is considerably higher than what we would have obtained by, for example, computing an unweighted average of the age-specific ratios. The choice of weights is therefore rather decisive in determining the index figures.

Further, we see that the percentage excess mortality of single persons of both sexes was relatively evenly diminishing with increasing age. This is partially a result of *mortality* increasing with age. If the *difference* between relative mortality for the single (for example, males) and the married is the same in all age groups, the *ratio* between the death rates will decline with age.

Increasing mortality alone, however, cannot explain why the ratios for older males and females are equal to 1. This can, of course, only occur if the rates are equal. For males over approximately 70 and for females over approximately 65 there were thus no noteworthy differences. On the other hand, mortality among single males and females under approximately 50 was considerably higher for the married — in some age groups more than twice as high.

The discussion as to whether this confirms or invalidates the two hypotheses described in paragraph 1.2. shall be postponed until section 5.

4.2. Employed single persons compared with employed married persons

An aggregated approach, such as index calculations based on a summation of all ages, showed that some of the differences in mortality could be explained

Diagram 1. Females and males. Ratio of death rates of all single persons and all married persons in some age groups, 1960—1962. Age point mid-points are marked off.

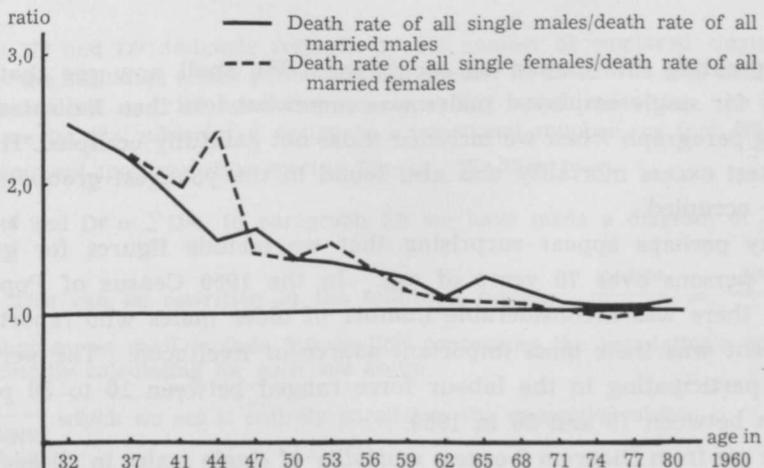
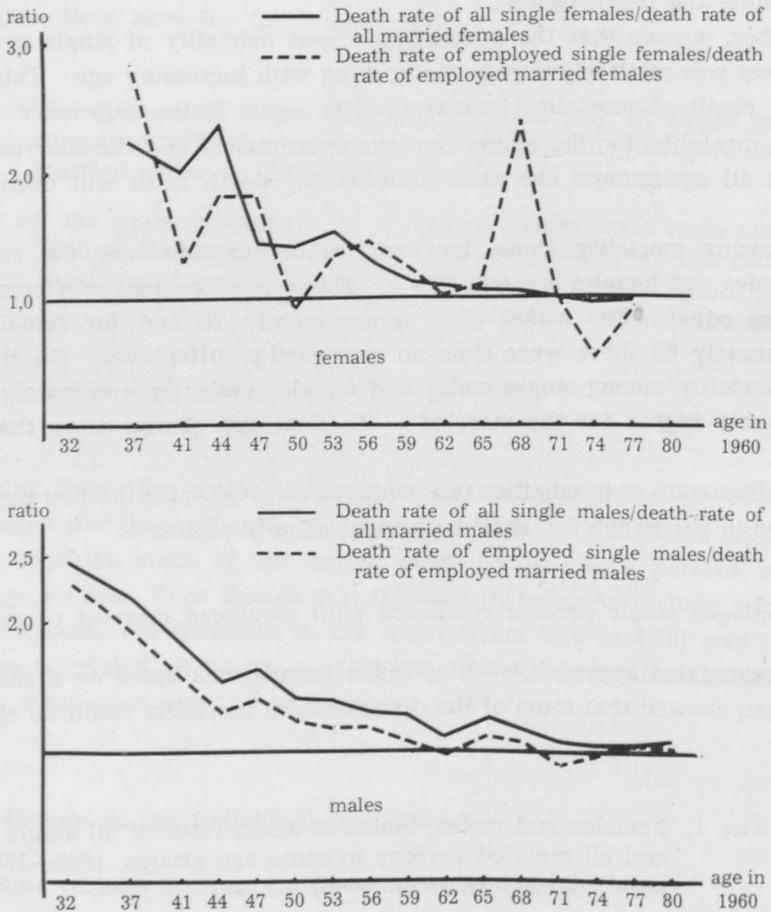


Diagram 2. Females and males. Ratio of death rates of all single persons and all married persons and ratio of death rates of employed single persons and employed married persons in some age groups, 1960—1962. Age group mid-points are marked off.



by incorporating information on occupation. We shall now see that excess mortality for single employed males was somewhat less than indicated in the preceding paragraph when we included those not gainfully occupied. However, the greatest excess mortality was also found in the youngest groups of those gainfully occupied.

It may perhaps appear surprising that we include figures for gainfully occupied persons over 70 years of age. In the 1960 Census of Population, however, there was a considerable number of older males who reported that employment was their most important source of livelihood. The percentage of those participating in the labour force ranged between 10 to 30 per cent for males between 70 and 80 in 1960.

As we see from Diagram 2 excess mortality of single males in all age groups

(except for the age group 79—81) is reduced by excluding those not gainfully occupied. The decline is rather evenly distributed among all age groups.

We have previously mentioned that single and married males over approximately 70 years of age had approximately equally high death rates. As we see from the diagram, this limit can be fixed at approximately 60 for gainfully occupied males. We see that the really pronounced differences for males are found in those under approximately 45 years of age in 1960.

The curve for gainfully occupied females in Diagram 2 shows such great variations that it is difficult to see any definite pattern. We recall that the index calculations showed that the weighted sum of the points which are marked in the diagram was somewhat *larger* when we excluded those not gainfully occupied than when they were included (1.64 and 1.43). We see from the diagram that the variations in the different age groups were so sizable that we shall be very cautious in drawing firm conclusions on this basis. It is probably not correct to say that employed *married* females accounted for a relatively healthier proportion of all married females than employed *single* females as a percent of all single females. Moreover, this again illustrates that the calculations of ratios which are highly aggregated can conceal important conditions in the body of data.

4.3. Standardizing for occupation in each age group for males

In the two preceding paragraphs we have focused on calculations of the ratio between the death rates of single and married persons respectively. In this paragraph we shall, for each age group, examine the ratios between observed number of deaths of single persons and estimated number of deaths of single persons to be expected when the death rate of single persons for each occupation is fixed equal to the corresponding occupational mortality of the married. This method of calculation corresponds entirely to that used in the two preceding paragraphs.⁵ It is therefore relevant to compare the age-specific mortality ratios calculated here with those presented in Diagrams 1 and 2.

⁵ Let N^u and D^u designate respectively the number of employed single persons present at the beginning of the period and the number of those who died in the course of the period. N^g and D^g symbolize corresponding magnitudes for the married. Further, we let the subscript y designate occupational number, so that N_y^u , D_y^u , N_y^g and D_y^g represent the occupation-specific figures. We then have

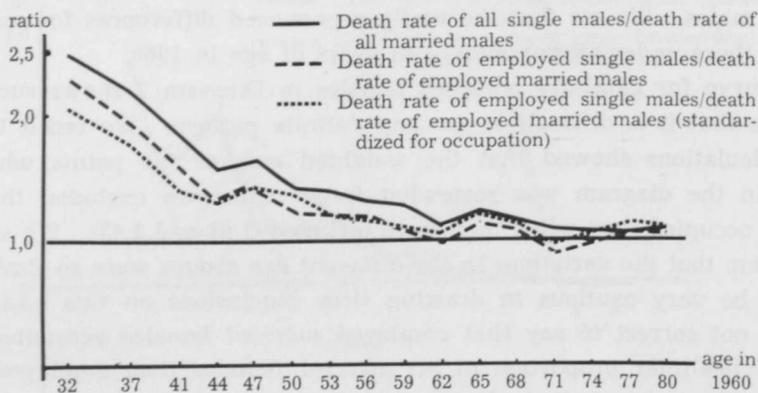
$$N^u = \sum_y N_y^u \quad \text{and} \quad D^u = \sum_y D_y^u. \quad \text{In paragraph 3.2 we have made a diagram of } \frac{(D^u/N^u)}{(D^g/N^g)}$$

by age. This can be rewritten in the following manner: $\frac{D^u/N^u}{D^g/N^g} = \frac{N^u \cdot D^g/N^g}{D^u}$

In this chapter we shall include information concerning the population's occupation. This is done by calculating for each age group

$$\frac{D^u}{\sum_y N_y^u \cdot D_y^g/N_y^g} \quad \text{which we see is entirely parallel to the expression above.}$$

Diagram 3. Ratio of death rates of all single males and all married males, ratio of death rates of employed single males and employed married males and ratio of death rates of employed single males and employed married males standardized for occupation in some age groups, 1960—1962. Age group mid-points are marked off.



We see from Diagram 3 that the occupation of gainfully occupied males in 1960 contributed somewhat in explaining the high mortality of persons who were under approximately 44 years of age. Expressed somewhat imprecisely we may say that young single males had a somewhat »more hazardous» occupational distribution than corresponding groups of the married.

In the second part of this study we investigate differences in mortality for different occupational groups. We then find that the death rate was particularly high for seamen, fishermen and miners, but there were also some other occupational groups with mortality above the average. Our results showed that the percentage of men younger than 42 years of age in those dangerous occupational groups was about 6 % lower among married than among unmarried.

Because of the low percentage of married females in the labour force it was not possible to carry out the same calculations for females as we have done above for males.

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