Marital status and health

Descriptive and explanatory studies

Inez Joung

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Marital status and health

Descriptive and explanatory studies

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Aan mijn ouders

Atque horrenda dies quia tunc meta merendi
Clauditur illa dies leta ve dira ve dies

La mort
Femme veufve venez avant
Et vous avancez de venir
Vous voyez les autres devant
Il convient une foiz finir
Cest belle chose de tenir
Lestat ou on est appellee
Et soy tousiours bien maintenir
Vertu est tout par tout louee

La femme veufve
Depuis que mon mary mourut
Jay eu affaire grandement
Sans ce que aucun me secourut
Si non de dieu gard seulement
Jay des enfans bien largement
Qui sont ieunes en non pourueux
Dont iay pitie mais nullement
Dieu ne laisse aucuns despourveux

(The verse accompanying the cover illustration. Danse Macabre des Femmes, Bibliothèque Nationale fonds français 995, Bibliothèque Nationale, Paris.)

Contents

Publications

Chapter 3-10 are based on the following articles and manuscripts:

3. Joung IMA, Mheen H van de, Stronks K, Poppel FWA van, Mackenbach JP. Differences in self-reported morbidity by marital status and by living arrangement. International Journal of Epidemiology 1994;23:91-97.[1]

4. Joung IMA, Meer JBW van der, Mackenbach JP. Marital status and health care utilization. International Journal of Epidemiology 1995;24:569-575.[1]

5. Joung IMA, Glerum JJ, Poppel FWA van, Kardaun JWPF, Mackenbach JP. The contribution of specific causes of death to mortality differences by marital status in The Netherlands. European Journal of Public Health (in press).[1]

6. Joung IMA, Kardaun JWPF, Poppel FWA van, Glerum JJ, Mackenbach JP. Trends in total and cause-specific mortality by marital status in The Netherlands, 1950-1990. Submitted.

7. Joung IMA, Mheen H van de, Stronks K, Poppel FWA van, Mackenbach JP. A longitudinal study of health selection in marital transitions. Submitted.

8. Joung IMA, Stronks K, Mheen H van de, Mackenbach JP. Health behaviours explain part of the differences in self-reported health by partner/marital status. Journal of Epidemiology and Community Health 1995;49:482-488.[2]

9. Joung IMA, Stronks K, Mheen H van de, Poppel FWA van, Meer JBW van der, Mackenbach JP. Contribution of psychosocial factors, material circumstances and health behaviours to marital status differences in self-reported health. Submitted.

10. Joung IMA, Mheen H van de, Stronks K, Poppel FWA van, Mackenbach JP. Survival differences by marital status in a longitudinal study: the role of health behaviours and material circumstances. Manuscript.

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Chapter 1

Introduction

During the last 30 years social factors have become increasingly important in the evolution of concepts of disease etiology (1). In the beginning of this century the germ theory and its monocausal orientation, attributing single diseases to single causes (i.e. infectious agents), dominated medical thinking (2,3). However, the germ theory failed to explain why only some of those persons exposed to pathogens actually contracted the disease. In addition, the germ theory was less appropriate for the explanation of degenerative causes of death such as cardiovascular diseases and malignant neoplasms, which have replaced infectious diseases as the main causes of death in this century (2,4). The monocausal concept of disease etiology was followed by a multicausal orientation, which emphasized the presence of several interacting causal factors. Multicausal research initially focused on biological risk factors, such as high serum cholesterol, high blood pressure and cigarette smoking in the development of coronary heart disease. However, this approach also proved to be only partly successful in pinpointing the causes of disease (1). For instance, only a relatively small proportion of all persons with high serum cholesterol and high blood pressure who smoke cigarettes, develop coronary heart disease and many persons who lack most of these risk factors do develop coronary heart disease (1). Thus, other factors must be involved in the etiological process. Groups differentiated by social factors have long been found to exhibit characteristic mortality and morbidity patterns. These health differences between social groups (e.g. differences in coronary heart disease) were independent of traditional risk factors (e.g. high serum cholesterol, high blood pressure, cigarette smoking, obesity) (5,6). The idea that these differences in health must be attributable to specific group characteristics has led to the incorporation of social factors in research of disease etiology (1,7-9). One of the social factors for which intriguing differences in health status have been found is marital status, which is the focus of this thesis.

Mortality differences between marital status groups have already been described in the previous century. For instance, William Farr examined age specific death rates for never married, married and widowed persons in France in 1853 and Von Baumhauer reported mortality differences between marital status groups in The Netherlands between 1850 and 1859 (10,11). Since then numerous researchers in many countries have looked at mortality differences between marital status groups (12-25). Especially in the last decades a considerable amount of studies has been performed on this subject. Results from these studies very consistently have indicated that married people have lower mortality rates than unmarried people[1]. The sizes of the mortality differences between the married and the unmarried and the ranks of the death rates of the three unmarried groups, however, have changed over time. For instance, in The Netherlands in the period 1869-1872 the differences in total mortality between married and unmarried women were rather small, and under the age of 40 unmarried women had even

lower mortality rates than married women (26). This was mainly caused by the high maternal mortality among married women. In the following decades the differences in total mortality between married and unmarried women increased as, among others, maternal mortality decreased (26). The relationship between marital status and mortality also differs between countries. Hu and Goldman explored the mortality differences between marital status groups in 16 industrialized countries for the period 1950-1980 (27). They found that in the majority of countries, the divorced experienced the highest mortality among men, and in about half of the countries the same pattern existed for women. In Japan, however, the death rate of never married men was as high as the rate of divorced men and never married women had much higher death rates than divorced women. Also, the mortality differences between the never married and married in Japan far exceeded the largest mortality differences by marital status in the other countries (15,27).

More recently, differences in morbidity, short-term disability and health care utilization between marital status groups have been studied too (13,28-35). Results from these studies have shown that morbidity differentials largely have similar patterns as mortality differentials: married persons have the lowest rates, divorced persons have the highest rates and never married and widowed persons have rates in between. These morbidity differentials are by and large reflected by the patterns for health care utilization and short-term disability: widowed and divorced persons have higher rates for physician contacts, hospital admissions and use of medicines and report more bed days and days of restricted activity than married persons (13,28,30,33,34). Never married persons, however, seem to have a lower health care utilization and less bed disability days than married persons, despite their higher morbidity rates (13,28,30,33,34).

1.1. Theories about the explanation of health differences by marital status

Several explanations have been suggested for the association between marital status and health. Firstly, it has been put forward that the association might be due to data errors and thus be an artefact (22,36). Others believed the association between marital status and health to be genuine and have proposed various explanations (10,17,27,33,34,37-39). These explanations can be grouped in two main theories: the marital selection theory and the social causation theory. According to the marital selection theory the relatively good health of married persons is the result of the selection of 'healthy' persons into, and 'unhealthy' persons out of the married state (17,23,27,37,40,41). According to the social causation theory marriage has a health promoting or a health protective effect, while the unmarried state

would have adverse health effects (10,14,34,35,38). Thus, in the marital selection theory health status precedes marital status and in the social causation theory marital status precedes health status. The selection and social causation theory are not mutually exclusive and most researchers maintain that a combination of selective and causal factors are responsible for the observed patterns in health between marital status groups (33,35,37-39,42). The explanations of the association between marital status and health will now be discussed in more detail.

1.1.1. Data errors

Mortality rates are computed by dividing the number of deaths in a marital status group (the numerator) by the person time which has been spent in that marital status group (the denominator). A variety of errors in the data could distort mortality differentials between marital status groups, for instance, misreporting of marital status on death certificates and differential undercount of the population by marital status (37). This might especially be the case when population data are based on census outcomes, in which marital status is derived from self reports. Sheps suggested that the association between marital status and mortality could be largely attributed to errors in the population and mortality data (22). With regard to the latter he concluded that there seemed to be very good reason for doubting the data on marital status by age and sex of the U.S. Census of Population 1950, given the possibility of "incorrect answers, mistakes made by interviewers and errors in coding, punching or tabulating age, sex or marital status" (22, p.550). In The Netherlands population data are based on municipal population registers, in which changes in marital status are recorded by the local registrar (43). The amount of errors will be substantially less in population size estimates which are based on such population registers than in those based on censuses.

Data errors especially might have unpredictable effects on mortality differentials between marital status groups if the information on marital status of the numerator and denominator is obtained from different sources. This is, for instance, the case in the United States and United Kingdom, where population data are derived from censuses, while mortality data are derived from death certificates (36,44). Berkson mentioned this so-called problem of numerator denominator bias as a probable cause for the association between marital status and mortality: "the computed rates for specific classes will be in considerable error ... if there is considerable disagreement in any of these data. For instance, if numbers of people who are in fact widowed or divorced record themselves as married on the census schedule but who, if they die, are generally correctly recorded as widowed or divorced on the death certificates, the effect will be to increase falsely the reported death rate for the widowed and divorced classes and

falsely to decrease the reported death rate for the married class" (36, p.1327). In The Netherlands, however, mortality and population statistics have the same municipal population registration system as their basis (43). Thus, numerator denominator bias will not distort estimates of mortality differentials by marital status in The Netherlands.

The general belief among researchers of mortality differentials between marital status groups is that, although data errors might explain some of mortality differences, these are insufficient to account for the association as a whole (37,42, 44,45). Studies of the contribution of data errors to mortality differentials by marital status are rare. Kitagawa and Hauser evaluated the effect of discrepancies in the reporting of marital status on death certificates and census records on marital status differentials in mortality in the United States for 1959-1961 (46). They concluded that, although discrepancies in the reporting of marital status introduced substantial errors in marital status differentials, sizeable differentials remained after corrections for discrepant reporting of marital status. Besides this scarce empirical evidence of the contribution of data errors, several other reasons make it improbable that data errors can account for the total of mortality differentials by marital status. To be able to account for the association between marital status and mortality, similar errors should have occurred in the census data and mortality data of many different countries over many years. Also, the fact that mortality differentials by marital status have been found in longitudinal studies and that comparable differentials have been demonstrated for morbidity in both cross-sectional and longitudinal studies, shows that the association between marital status and mortality is not a mere artefact (45).

1.1.2. Marital selection theory

According to the marital selection theory the relatively good health of married persons is the result of the selection of 'healthy' persons into, and 'unhealthy' persons out of the married state, thus increasing the relative amount of unhealthy persons in the unmarried states (13,17,23,27,37,41). In the literature on selection processes a distinction is made between direct selection and indirect selection (41). In the case of direct selection health itself would be the selection criterion. In the case of indirect selection, determinants of health (factors associated with health and illness such as socioeconomic status or alcohol consumption) would be selection criteria. The process of marital selection could occur with regard to first marriages as well as other marital transitions (divorce, bereavement, remarriage). We will start our discussion of the marital selection theory with direct selection.

Direct selection

In direct selection health status precedes marital status (41). Direct selection might be operative with regard to the transition from the never married to the married state (17). According to the direct selection hypothesis small health differences are expected between the never married and married at the younger ages, when the group of never married people consists of many healthy persons who still have to make the transition to married life. From the younger ages to the middle ages the health differences between the never married and married are assumed to increase, as more and more healthy never married persons are getting married. After the middle ages health differences are expected to decrease as the frailest persons in both the never married and married population have died (17).

Direct selection could also operate with regard to divorce. Illness of one of the partners could be a cause of, or contribute to, divorce (40,47). In this way unhealthy persons are selected out of the married state. Within the group of divorced people further health selection might operate. The healthiest persons among the divorced might be more likely to find a partner and remarry than the less healthy, leaving an even higher percentage of unhealthy persons in the remaining group of divorced people (40,47).

The concept of health selection is more complicated for the widowed state. Just as was the case with the divorced, it could be assumed that the healthiest widowed persons are more likely to remarry than the less healthy (48,49). Direct selection could also occur with regard to the transition from the married to the widowed state, although the mechanism might be different from that in the other marital transitions. In the other marital transitions health selection can be seen as part of the process of partner choice: 'unhealthy' persons might be less attractive marriage partners and thus might either not be chosen or might be discarded as a marriage partner. However, when selection is seen as a concept opposed to social causation, selection refers to the general process through which health differences precede marital status. Selective partner choice is only one of the mechanisms through which health selection might cause health differences between marital status groups. With regard to the transition from the married to the widowed state, the risk of becoming widowed might be larger among those who have been exposed to larger health risks for reasons such as a joint unfavourable environment.[2] For instance, unhealthy eating habits or material deprivation might have contributed to the premature mortality of the deceased spouse and both factors are likely to have been shared by the surviving spouse. Thus, the event of becoming widowed might identify a group which has an excessive mortality risk compared to those who remained married.[3] If this is the case, increased mortality will be found among widowed persons in comparison with married persons. However, the mortality differences between the married and widowed would not be caused by the conditions of widowhood itself (social causation), but would be

based in already existing health differences between those who became widowed and those who remained married (selection).

Indirect selection
Marital selection might not only operate through exclusion of unhealthy persons from marriage (direct selection), but also through selection on a wide range of determinants of health (indirect selection). Determinants of health which have been suggested to operate in this way are, for instance, socioeconomic status, physical appearance (e.g. body length, obesity) and health-related habits (e.g. alcohol consumption) (41). If (potential) spouses are selected or turned down on the basis of such determinants of health, eventually health differences will arise between the marital status groups. The health differences will then be caused by differences in determinants of health which existed prior to marital status, and will not be caused by marital status as such.

1.1.3. Social causation theory

According to the social causation theory health depends on marital status (10,34, 35,38,50). Marital status might affect the etiology of health problems: the married state would prevent one from becoming ill, while the unmarried state might be the cause of a decline in resistance to diseases. Marital status might also, once health problems have developed affect course and outcome of the disease (51). The effect of marital status on health is generally assumed to be intermediated by psychosocial factors (e.g. stress and social relationships), material circumstances (e.g. financial situation, housing conditions) and health behaviours (e.g. smoking, alcohol consumption) (20,35,42,47,52-57). These intermediary factors will now be discussed in more detail.

Psychosocial factors
Psychosocial stress is causally related to illness and mortality (7,58,59). Lazarus and Folkman defined psychosocial stress as "a particular relationship between the person and the environment that is appraised by the individual as taxing or exceeding his or her resources and endangering his or her well-being" (60). Psychosocial stress varies between marital status groups. Firstly, bereavement and divorce are stressful life events themselves. On the social readjustment rating scale of Holmes and Rahe, a scale of 43 life events ordered on the basis of the assumed intensity and length of time necessary to accommodate to the life event, bereavement and divorce rank first and second respectively (61). Understandingly, the loss of a beloved person is an important source of stress itself. The feelings of failure, lowered self-esteem, and sense of incompetence, which are often experien-

ced by divorced persons, also evoke stress (40). Furthermore, the many concurrent changes in the lives of bereaved or divorced persons, such as lowered income, change in parental responsibilities, forced move to other housing or the loss of familiar activities and habit systems, also highly contribute to the total amount of stress experienced (40,49).

Secondly, differences in psychosocial stress between marital status groups are also caused by mechanisms other than the stressful character of bereavement and divorce itself. Negative societal attitudes towards the marital status one occupies can be a source of stress. Although societal attitudes towards alternatives of marriage have become more liberal in recent years, prejudices and stereotyped images of never married persons and divorced persons still exist (62,63). Uncertainty about social roles is also a source of stress and clearness about social roles differs by marital status. Marriage provides persons with clear and socially acceptable roles. Divorce, however, as Price-Bonham et al. put it, "lacks clearly defined norms resulting in divorced persons moving from a structured, defined, and institutionalized marriage to a noninstitution in which few ideals and expectations are present. This phenomenon is assumed to add to the stress created by divorce" (64, p.142).

Other psychosocial factors may also contribute to the effect of marital status on health. Several aspects of social relationships are associated with health status and differ between the marital status groups. Firstly, *social integration*, referring to the existence and quantity of social relationships, has been found to be directly related with health (58,65-68). "[P]sychological and sociobiological theories suggest that the mere presence of, or sense of relatedness with, another organism may have relatively direct motivational, emotional, or neuroendocrinal effects that promote health" (66, p.544). Married persons might be more socially integrated for several reasons. They at least have one social tie in their spouse; their children constitute additional social ties which most never married persons lack; and their social network is expanded with the social ties of their spouse. Consequently, the loss of a spouse means a break in the social network.

Secondly, *social support*, which refers to the functional nature or quality of social relationships, has been found to be directly and indirectly related to health (58,66,67). With regard to the latter, social support is assumed to buffer the negative health effects of stress, thus to modify the relationship between stress and health: social support has no beneficial effect on health among persons who experience little stress, but the beneficial effects of social support increase with increasing stress (58). Social support is the aid that is transmitted between social network members. An often made distinction is between emotional and instrumental support. "Emotional support includes expressions of affection, admiration, respect or affirmation. Instrumental support is the provision of advice, information

or practical assistance" (69, p.8). The availability and quality of social support differ by marital status, e.g. partner relationships are found to be more supportive than other types of relationships (70). This also means that in case of bereavement or divorce an important provider of social support is lost.

Finally, the differences in social relationships between the marital status groups result in differences in *social regulation and control.* With regard to social control it has been found that married persons experience more social control: wives in particular try to influence their spouses' health behaviours (56,57). Furthermore, married persons have a more regulated life, which facilitates "health promoting behaviours such as proper sleep, diet, or exercise, appropriate use of alcohol, cigarettes, and drugs, adherence to medical regiment, or seeking appropriate medical care" (66, p.543).

Material circumstances

Differences in material resources between the marital status groups could constitute another intermediary of the relationship between marital status and health (35,42,52-54). People who share a household profit from economies of scale in purchase and use of housing and other goods and services (20). Additionally, changes in marital status are often associated with large changes in material resources. Bereavement and divorce are, especially among women, often accompanied by a decline of their financial situation, and, consequently a deterioration in other structural living circumstances (e.g. housing) (52,54,71-76). This is most obvious in situations where the husband is the sole wage-earner. However, also in case of double incomes, the wife is likely to be worse off financially after divorce or bereavement. Women are generally married to men of higher or equivalent educational level (77-79). A recent study in The Netherlands showed that men earn on average more than women of equivalent educational level (80). The fact that the material situation of women generally deteriorates after a divorce, however, does not necessarily imply that men gain materially from a divorce. In a divorce, possessions are divided between the former spouses, the ex-husband might be obliged to pay alimony and economies of scale are lost. This might put divorced men in a materially disadvantaged position compared to married men.

Health behaviours

Differences in health behaviours between marital status groups are also seen as an intermediary of the association between marital status and health (35,56,57,66,81). Several studies have found indications that marriage has a deterrent effect on negative health behaviours, such as smoking, excessive alcohol consumption, substance use and other risk taking behaviour, and that marriage promotes an orderly lifestyle (56,57,82-85). Only the outcomes of studies concerning the relationship between marital status and obesity have been inconsistent (86).

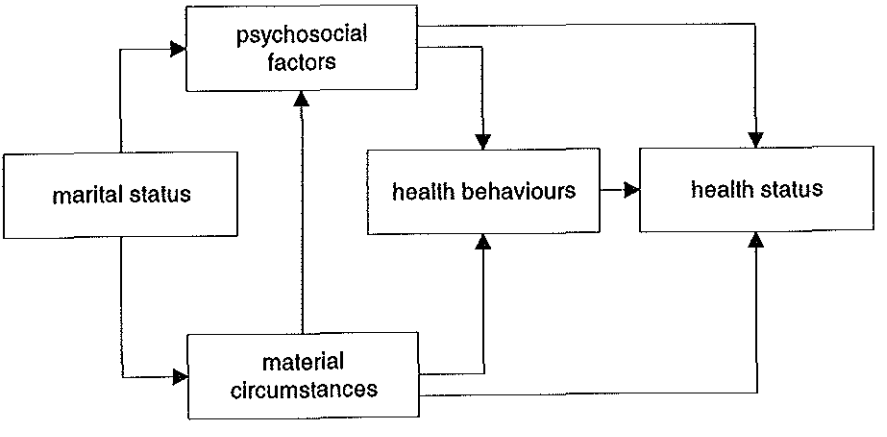
Differences in sexual and reproductive behaviour between the marital status groups have been mentioned as explanations for differences in mortality from several malignant neoplasms: the excess mortality from cancer of the breast, corpus uteri and ovary among never married women, the lower mortality among never married women and higher mortality among divorced women from cancer of the cervix uteri, and the lower mortality of cancer of the prostate among never married men (87-90).

Finally, differences have been mentioned in the use of health services (for instance, married people would be more inclined to use preventive health services) and in compliance with required prolonged and methodological treatment (married people would be more willing to undertake the required treatment for diabetes mellitus and tuberculosis) (14,53).

Pathways to health

In the literature on the effects of marriage on health, psychosocial factors, material circumstances and health behaviours are mentioned as possible intermediary factors. However, the effects of marriage on health through the intermediary factors cannot be viewed as three independent pathways. Several interrelationships could exist between the three intermediary factors. Our conceptual model of the effect of marital status on health is shown in figure 1.

Figure 1. **A graphical representation of the pathways through which marital status is assumed to affect health status**



In this model marital status is not assumed to have a direct effect on health behaviour but to influence health behaviour only indirectly through psychosocial factors and material conditions. The psychosocial factors thus might either have direct health effects or might operate through an effect on health behaviours. Unmarried persons experience higher levels of psychosocial stress. Cigarette smoking and alcohol consumption are palliative coping responses to psychosocial stress (57,91). Additionally, social support is important in health behaviour changes. Partner support, for instance, is beneficial to smoking cessation maintenance (92-95). Finally, the more regulated life of married persons facilitates healthy behaviours and married persons attempt to influence the health behaviours of their spouses (56,57,67). Also, the material circumstances associated with marital status might either have direct health effects, increase psychosocial stress or operate through changes in health behaviours. With regard to the latter, unhealthy eating habits and a lack of recreation possibilities could in part be determined by an individual's financial position (96).

Thus, the differences in health behaviours between marital status groups are, in fact, intermediaries of the effect of the psychosocial factors and material circumstances on health. The effects of health behaviours such as smoking, alcohol consumption, obesity and physical activity on health are relatively well known. For instance, smoking is, in the long term, associated with cardiovascular diseases, chronic obstructive lung diseases and many malignant neoplasms such as cancer of the lung, bronchus, trachea, larynx, pancreas and bladder (97). Excessive alcohol consumption is associated with diseases of the liver, stomach and central nervous system and is related to external causes of death, such as traffic accidents and suicide (97,98). Obesity and physical exercise are both associated with cardiovascular diseases and conditions of the locomotor system, while obesity is also associated with the development of non-insulin-dependent diabetes mellitus (97,99).

There is also a considerable amount of research on the relationship between psychosocial stress and health (7,58,59). Stress might cause direct physiological changes in the endocrine, immune and autonomic nervous system (59,65,100,101). There is evidence that the physiological changes increase susceptibility to infectious diseases, cancer and cardiovascular diseases (59,102). It has also been suggested that marital status, mediated by psychosocial stress, would enhance susceptibility to diseases in general, rather than having specific etiological effects (2,7,65). This theory of generalized susceptibility, which is a departure from the previous mentioned monocausal and multicausal orientation (see p.1), might explain why marital status is associated with many apparently different causes of disease and death (2).

The direct links between social relationships and health are more speculative. Evidence suggests that biological and psychological mechanisms are involved (67). "A variety of studies of animals and humans suggest that the mere presence of,

and especially affectionate physical contact with another similar or nonthreatening organism can markedly reduce cardiovascular and other forms of physiological reactivity" (67, p.307). The psychological mechanisms would be related to, but partially independent of the biological mechanisms and might, for instance, be affective in nature (if there is a basic human need for relationships or attachments, people will feel better psychologically when that need is fulfilled, with physiological consequences) (58,67).

Finally, the direct health effects of material circumstances (i.e. health effects not mediated by psychosocial stress or health behaviours) are also of a more speculative nature. In previous centuries poverty might have been the cause of starvation, death from hypothermia or increased susceptibility to infectious diseases because of undernourishment. However, the contribution of these causes of death to overall mortality will be minimal in current Western societies. On the other hand, it is conceivable that unfavourable material circumstances still increase risks for respiratory infections or transmission of infectious agents through effects on living conditions (damp houses, presence of fungal mould, crowding). Results of studies on this subject are inconclusive, however (103-105). The health effects of material circumstances are presumably mainly mediated by changes in psychosocial stress and health behaviours.

A final comment on the social causation theory, is that one should keep in mind that marital relationships are not always health enhancing. Marital relationships even might have negative health effects, while divorce could have positive health effects. Marital problems are a source of stress, and social control in an environment in which hazardous health behaviours are valued could have unfavourable consequences. With regard to the positive health effects of divorce, Kraus, for instance, found that persons improved their health after divorce, depending on the stress of the marriage (106). Additionally, several studies have reported that unhappily married people are less healthy than divorced people and happy married people (50,55,107). On the average, however, marriage is favourably associated with the intermediary factors and with health.

1.2. Research of the explanation of health differences by marital status

In contrast to the many descriptive studies about the association between marital status and health, relatively few studies have examined the explanation of this association. Explanatory studies have generally focused on verifying or rejecting only one of the two theories, either the selection theory or the social causation theory. However, the selection and social causation theory are not mutually

exclusive. In addition, the majority of studies have been based on cross-sectional data. A problem with such studies is, as will be described later, that similar hypotheses concerning cross-sectional associations between marital status and health status can be derived from the selection and social causation theory. Therefore, it is impossible to make inferences about the validity of the selection theory or the social causation theory solely on cross-sectional data. Longitudinal data are required to determine the sequence of marital status and health status in time.

The results of studies on the explanation of the association between marital status and health will now be reviewed shortly.

1.2.1. Research of the marital selection theory

Evidence for direct selection

Several approaches have been used to test the validity of the marital selection hypothesis. In two of these approaches aggregate patterns of mortality by marital status, derived from cross-sectional data, have been used. The first hypothesis was based on the age patterns of mortality differentials. It was hypothesized that if marital selection was operative, the mortality differentials of never married people compared to married people would increase throughout the marriageable ages (from age 20 to age 35-40), and decrease thereafter (from age 40 onwards as first marriage become rare). Observations consistent with this age pattern, which can be found in many countries (see for example Hu and Goldman (27)), have been taken as support for the selection theory (17,22,27,108). Observation of contrasting patterns have been used as evidence against the selection theory (109).

The second approach using cross-sectional mortality data was based on the correlation between the relative size of the unmarried population and the magnitude of the mortality differentials between the unmarried and married (17,27,37). It was hypothesized that, if health selection is the main explanation for the mortality differences between marital status groups, populations in which only a small proportion of the population remains never married should be characterized by larger mortality differences between the married and never married than populations in which larger proportions remain never married. This correlation between the relative size of never married and divorced populations and magnitude of mortality differentials has indeed been demonstrated across countries and within countries over time and has been taken as evidence of the importance of the marital selection theory (17,27,37).

The results of these studies seem to be supportive of the marital selection theory. However, there are several problems with the legitimacy of these approaches. Firstly, the hypotheses derived from the marital selection theory can

be criticized (41,110,111). Goldman developed a simulation model of the marriage selection process, with which she showed that, under the assumption of health selection, mortality differentials between never married and married persons could show many contrasting age patterns: the predicted pattern, the opposite pattern as well as many other patterns (41,110). "How do these unanticipated RMR [relative mortality risks] take place? As hypothesized, once marriages no longer take place, both the married and the single populations 'improve' their composition as they lose their frailest members (through death) more quickly than their healthy members. Consequently the death rates of the married and of the single eventually begin to approach one another, and the relative death rate ... ultimately converges to unity. Mathematical analysis, however, reveals that the age at which the convergence begins depends on the relative rates of change of the two death rates and is not predictable: convergence need not begin at the end of the marriage span or even within the human life span" (41, p.198).

With regard to the correlation between the relative size of the unmarried population and the magnitude of the mortality differentials between the unmarried and married, Goldman's simulation model demonstrated that increasing proportions of married persons in the population could be associated with both larger and smaller health differences between marital status groups (41). The underlying assumption of the negative relationship between the proportion never married persons and the magnitude of the relative mortality risks, is that differences in the proportion of never married persons result entirely from differing marriage rates among the healthy: only healthy persons enter marriage and when the proportion of never married persons is relatively large more healthy persons have chosen not to marry (i.e. different rates of voluntary singlehood). However, when differences in the proportion of never married persons result predominantly from varying degrees of discrimination against unhealthy persons (e.g. a decrease in the proportion of never married persons might result from an increased entrance of unhealthy persons into marriage), increasing marriage rates might be associated with decreasing mortality differences between the never married and married (41).

Secondly, even if the hypotheses derived from the marital selection theory were legitimate, they would only be supportive of the selection theory at the expense of the importance of the social causation theory, if hypotheses deducted from the social causation theory would predict contrasting, or at least other, age patterns of the mortality differential, or another (a non-negative) correlation between the relative size of the never married population and the magnitude of the mortality differentials. The problem is that several social causation theories predict similar associations. For instance, social integration theories also predict decreasing mortality differentials of marital status groups after ages 35-40. Social integration has been found to be positively associated with health (58,65-68) and social

integration of married persons is likely to be largest under age 40, when children are present in the household (14,109). Additionally, the status integration theory, which assumes that the amount of psychosocial stress varies with the level of a person's status integration in the population, predicts both increasing mortality differentials between ages 20 and 40 and a negative correlation between the size of the never married population and magnitude of the mortality differentials (4,112). Persons with low status integration, i.e. persons in infrequently occupied configurations of marital, parental or employment statuses, would be less able to maintain stable social relationships and to conform to societal expectations, and thus would be more likely to experience role conflict. Reasoning from the status integration hypothesis being never married at a young age is not stressful, but when one is middle aged or even older and still never married, this (rare) situation would cause stress and subsequently illness. The status integration theory also predicts that declining proportions of a certain unmarried group are associated with higher levels of stress. Thus, the results of previous studies using aggregate patterns in cross-sectional mortality data cannot be used as evidence for the selection theory.

Kraus and Lilienfield used another approach (48). They examined whether the mortality difference between the married and widowed could be explained by selective remarriage of healthy widowed persons, under the assumption that the mortality rate of all those who became widowed did not differ from that of those of the same age who remained married. Using data of 1950, Kraus and Lilienfield calculated for the widowed population in the age range 20-24 years, how large the remarried widowed population would have to be in order to attain similar mortality rates for the total widowed population as for the married population. The estimated size of remarried widowed population was compared with the actual size of the widowed population that had remarried. Their results indicated that the size of the remarried widowed population, necessary to attain similar mortality rates for the total widowed population as for the married population, was nine times as large as the actual size of the remarried widowed population. Kraus and Lilienfield concluded that the maximum effect of selectivity in the explanation of mortality differences between married and widowed people was small. The approach of Kraus and Lilienfield gives some insight in the relevance of selection effects. However, the results only relate to the widowed group in a rather specific age group and the possibility that health status of those who became widowed might differ from that of those who remained married was not taken into account.

We are only aware of one study which examined the effects of health differences on subsequent chances of marital transition using a longitudinal study design. Mastekaasa studied whether never married persons with differences in psychological well-being were differentially selected into marriage, while adjusting for physical health (113). Two measures of physical health were used: disease

restricting daily activities and self-assessed health. Mastekaasa found that having a restricting disease reduced the probability of marriage of never married men, but not of never married women. The effect was statistically significant in the 20-25 age category, but did not reach statistically significance in the age category 26-39 (113).

In summary, most research of direct selection (i.e., selection on health) as the explanation of the association between marital status and health has used cross-sectional data. This hampers causal inferences since similar hypotheses can be derived from the selection theory and the social causation theory. The scarce longitudinal research of selection effects suggests that direct selection effects might be operative (at least with regard to some marital transitions and specific age ranges). Effects of direct selection on the association between marital status and health status seem rather small.

Evidence for indirect selection

In cross-sectional studies it has indeed been found that health related factors are differentially distributed among the marital status groups. For some health related factors, such as length and level of education which generally precede marital status transitions, it is plausible that differences in distribution by marital status are induced by selection effects. Taller people have lower mortality rates than short people (9,114). Taller men are more likely to be married than other men, while never married women are taller than currently or previously married women (9,114). Educational level is positively related to health. Higher educated men are more likely to become married, to keep their marriages together and to remarry after a divorce than lower educated men (77,78,115). Higher educated women are less likely to marry or to remarry after divorce than lower educated women (77,78,115). Women at the lower and higher extremes of the educational distribution are most likely to divorce (77,78).

Conversely, differences in alcohol consumption, obesity and smoking between marital status groups might either result from selection effects or from social causation effects. In order to determine whether these determinants of health precede marital status or whether marital status precedes these determinants of health longitudinal data are preferable. The association between alcohol consumption and health is U-shaped: more health problems are found among teetotallers and those with excessive alcohol consumption. The alcohol consumption of married persons is generally more moderate than that of other marital status groups. Miller-Tutzauer et al. in a 3-year follow-up study of persons of 18-25 years of age found that individuals 2 years prior to marriage did not differ in drinking behaviour from those who remained single (84). She therefore concluded that the findings did not suggest preexisting differences in alcohol consumption between those who marry and those who do not (84). Magura and Shapiro, in a macro-

level study of U.S. data for the period 1933-1984, found that divorce was highly significant as a cause of problem drinking but that problem drinking was not significant as a cause of divorce and concluded that the link from divorce to alcohol seemed 'stronger' than the link from alcohol to divorce (116). The association between body mass index (a measure for body weight relative to body height) and health is also U-shaped: more health problems are found among those with a low and a high body mass index. Sobal found that in his study on the association between marital status and obesity, married men were more likely to be obese than unmarried men, while no differences among women were found (86). Since it was expected that married men would be less obese than unmarried if selection on fatness was involved, but would be more obese if social causation effects were operative, Sobal concluded that social causation was more likely to explain the association between marital status and obesity (86). However, the results of studies on the relationship between marital status and obesity are inconclusive: married persons have been reported to be more but also less obese than unmarried persons. Finally, several longitudinal studies of mortality risks following conjugal bereavement have shown that control for health behaviours (smoking, alcohol consumption and body mass index), measured while respondents were still married, did not lower the increased mortality risks of widowed men (117,118). This implies that excess mortality of widowed men cannot be explained from indirect selection (unfavourable health behaviours, which already existed during marriage).

In summary, length and educational level appear to play a role in the selection of a marriage partner. Among men this selection process is consistent with the health differences between the marital status groups, while among women the opposite is observed. With regard to the determinants of health which might either be involved in indirect selection processes or social causation processes, there is some evidence, although far from conclusive, that social causation might be more important.

1.2.2. Research of the social causation theory

Evidence for causal effects of marital status on health

In many cross-sectional studies of the association between marital status and health is has been assumed that social causation was a much more likely explanation for the detected differentials than selection without any real efforts for justification of this assumption. The study of Gove constitutes an early exception to this pattern (14). Gove assumed that differences in marital roles in society could explain the mortality differences between marital status groups (14). These marital roles would be associated with specific psychological states and life-styles: because

of the lack of close interpersonal ties, unmarried people would be emotionally less stable and more willing to take risks. Gove hypothesized that large mortality differences would be found for those causes of death that were affected by the psychological states and life-styles, namely causes due to 'overt social acts' (e.g. suicide and homicide), causes associated with the use of socially approved 'narcotics' (e.g. cirrhosis of the liver and cancer of the lung) and causes requiring prolonged and methodical care (e.g. diabetes and tuberculosis) (14). However, only small mortality differences were expected from causes being largely unaffected by these 'social factors' (e.g. leukaemia). Since his results were in agreement with his hypotheses, Gove concluded that mortality differences between marital status groups could be attributed to marital roles in society, although tentatively, since little was known how variables as emotional instability and physical disability affected the likelihood of marriage (14).

In recent years, results of several longitudinal studies of survival differentials have come available, initially on survival differentials by social environment (81,119,120) and later on survival differentials by marital status (12,21,42,121). Berkman and Syme were the first to conduct a longitudinal study on social relationships and mortality (81). Their study supported the hypothesis that social ties, measured by the Berkman Social Network Scale (a scale built from subscales and individual items such as marital status) were related to mortality risks. This association was independent from baseline health status, which indicates that the influence of social ties on health is causal. Despite problems with the validity of the composite measure of social network employed in the study of Berkman and Syme and variables from other studies modelled on it, "there is no longer any doubt that social support or social network variables predict health outcomes" (122).

The longitudinal studies of survival which were specifically aimed at health differences between marital status groups, all found that marital status significantly was related to mortality outcome (12,21,42,121). However, only in the studies of Ben-Shlomo and Goldman there was (some) control for baseline health status (12,42). Thus only in these two studies can absence of selection effects be assumed. Ben-Shlomo used data of the Whitehall study (men, aged 40-64 years) and found that after control for baseline cardiovascular disease and biological risk factors and health behaviours which are associated with cardiovascular disease, both widowed and divorced men had increased risks for all cause mortality. The differences in all cause mortality resulted among widowed men from increased risks of mortality from cardiovascular disease and among divorced men from increased risks of mortality from cancer. Goldman et al. studied survival differentials by marital status among men and women aged 70 years and over. In the analyses there was extensive control for baseline health status: disability, several chronic conditions and self-assessed health. Only the differences between widowed and married men

were statistically significant, which might be due to the fact that mortality differences between marital status groups decrease with increasing age.

Several longitudinal studies have been conducted with regard to mortality following conjugal bereavement, in which measures of baseline health status were available (117,118,123). Jagger and Sutton studied whether mortality risk was increased after marital bereavement (123). Their study population consisted of 344 persons of 75 years and older who were married at baseline (226 couples and 118 married persons who's spouse was younger than 75 years). There was a follow-up of some 7 years (1981-1988). After adjustment for age and baseline health status (physical disability, perceived health status, cognitive impairment, use of hypoglycaemics, use of diuretics, incontinence) significantly increased relative mortality risk were found for widowed women during the first six months after bereavement. Mendes de Leon et al. followed 1046 married persons of 65 years and older from 1982 to 1988 (117). After adjustment for age, race, educational level, health behaviours (smoking, body mass index) and health status at baseline (functional status, high blood pressure, heart disease, cancer, diabetes), both widowed men and women had increased mortality risks compared to those still married. However, statistical significance was only reached for the differences among women. Schaefer et al. followed 12522 married couples aged 40 years and over during a period of 14 to 23 years (118). Mortality following bereavement was significantly elevated in both men and women after adjusting for age, educational level, health behaviours (alcohol consumption, smoking), morale and health status (index of number and seriousness of chronic conditions and symptoms). Thus, bereavement appears to decrease survival chances.

We only know one longitudinal study of morbidity differences by marital status. In the previously mentioned study of Goldman on survival differentials among men and women aged 70 years and over, changes in disability were also an outcome measure (42). After extensive control for baseline health status (disability, several chronic conditions and self-assessed health) widowed men and women had increased risks of disability compared to married men and women, while never married women had lower risks than married women.

In conclusion, the longitudinal studies on survival differences and the one study on morbidity differences provide evidence that marital status is causally related with health outcomes. Though it should be noted that the evidence is only partial. Just one study has addressed morbidity in a longitudinal design and this study was aimed at an older age group. Additionally, only a small number of studies has examined the effects of being never married and divorced on mortality in a longitudinal design with adequate control for initial health status.

Contribution of intermediary factors to the effects of marital status on health
To our knowledge there is only one study which has studied simultaneously the contributions of psychosocial factors, material circumstances and health behaviours to differences in physical health between marital status groups. Wyke and Ford studied the separate contributions of stress, structural/available support, actual/companionship support, quality/intimacy of support, car ownership and smoking and alcohol consumption to health differences between marital status groups using baseline data of 1042 fifty-five year old persons (the oldest cohort of the "West of Scotland Twenty-07 Study") (35). They found that "material resources (measured as car ownership), felt distress/eustress and quality/intimacy of support could individually account for the effect of being married compared to no longer married in health measures; whereas smoking, drinking and the more 'objective' measures of social support - available/structural support and actual/companionship support - could not" (35, p.531).

Goldman studied the contribution of socioeconomic status (health insurance type, income, home ownership, years of education) and social environments (contacts with friends, participation in social or religious activities) on differentials in survival and disability in a longitudinal study of men and women aged 70 years and over (42). Only the mortality risk of widowed men differed significantly from the mortality risk of married men. Differences in socioeconomic status and social environment accounted only for a modest part of the mortality differences (approximately 15%). Both widowed men and women had significantly elevated risks of disability when compared to their married counterparts. The contribution of differences in socioeconomic status and social environment to differences in disability was also modest (20-25%).

Hahn studied the effect of economic marital acquisitions (home ownership, children, income above personal income, private insurance) on self-reported general health status of women aged 18-64 (53). Economic marital acquisition explained, after prior adjustment for other factors (age, education, personal income, obesity, physical activity, smoking and health care utilization), 40-50% of the health differences between never married, divorced, widowed and married women. Hahn concluded that much though not all of the variation in women's health is explained by economic factors (53).

Ben-Shlomo et al. and Rosengren et al. have controlled for health behaviours in their studies (12,21). Ben-Shlomo studied survival differences by marital status among men in the age range 40-64 years. Rosengren studied survival differences by marital status among men in the age range 48-58 years. Unfortunately, the contributions of the health behaviours cannot be determined from their results as presented. However, in the study of Ben-Shlomo et al. the association between marital status and all cause mortality remained significant after control for smoking and body mass index (together with age, educational level, physical risk

factors for cardiovascular diseases and prevalence of cardiovascular diseases at study entry). Also in the study of Rosengren et al. the association between marital status and all cause mortality remained significant after control for smoking and alcohol abuse (together with age and educational level).

In conclusion, psychosocial factors, material circumstances and health behaviours each appear to explain part of the differences in physical health between the marital status groups. Only one study has focused on all three intermediary factors, assessing the separate contributions of the factors in a population in the age of 55 years. Studies have generally been limited to either one sex or small age ranges.

1.3. Marital status and living arrangement

The presence or absence of a spouse plays an important role in both the social causation theory and selection theory. According to the social causation theory the spouse provides social support, which might buffer the negative health effects of stress. People sharing a household profit from economies of scale in purchase and use of housing and other goods and services. Health behaviours are also likely to be influenced by the presence of the spouse, through either social control or partner support in behaviour changes or because social support might decrease the need for palliative coping responses (smoking and drinking) in case of stress. In the selection theory the presence of a spouse means that the likelihood of being healthy or having favourable health behaviours is large, since these have been selected upon. It is likely that partners in non-marital cohabitation perform similar roles as spouses. Also, similar selection processes might be operative in the selection of a partner for cohabitation as in the selection of a spouse.

In the past marital status corresponded with a certain living arrangement: married persons lived with their spouse, young never married persons lived with their parents, and widowed, divorced and older never married persons lived on their own. Research of health differences between marital status groups then implicitly incorporated health differences by living arrangement. During the last two decades the link between marital status and living arrangement has been fading in many Western countries. While most married persons still live with their spouse, the proportion of people living with a partner without being married is growing. In The Netherlands, for instance, among persons aged 25 years or older, 20-25% of the never married men and women, 25% of the divorced men, 13% of the divorced women, 12% of the widowed men and 4% of the widowed women lived with a partner in 1989/1990 (124).[4]

Given the large proportion of unmarried people who live with a partner in contemporary Western societies and the relevance of the presence of a partner in

the explanations of health differences by marital status, it is preferable to take differences in living arrangement into account in studies of the association between marital status and health. In the last few years, the concept of marital status has indeed been extended with that of living arrangements in some studies of health differences (28,38,125-127). Anson studied the importance of a 'proximate adult' for the relationship between marital status and women's health in a population of working age (18-55 years) (28). Anson did not find an effect of living arrangement on health, separate from that of marital status (28). Results of studies of the effect of living arrangements on survival differences have been inconclusive. Davis et al. did not find "any evidence to suggest that living arrangements have an additional influence on mortality beyond marital status" when examining the association of living arrangement (living with a spouse, living with someone other than a spouse or living alone) and survival in a sample of US adults aged 45-74 during a 7- to 13-year period (125). Helsing et al. found that among a widowed population aged 18 years and over during a 12-year period "living alone was associated with significantly higher mortality rates than living with someone" (126). A disadvantage of all 3 studies is that there was no further information available on the 'someone other than the spouse': the 'someone other than the spouse' could be a partner, a relative or someone else. Prinz et al. studied mortality differences between married, cohabiting (i.e. living in a consensual union) and single (i.e. not living as a couple) persons aged 20 years or over in Sweden (127). Both among men and women the married had the lowest mortality risks. For men, cohabitation reduced the risk of dying when compared to persons living alone, while there were hardly differences between cohabiting and single women.

Thus, studies of the association between marital status and health should preferably take living arrangements into account. So far, only a few studies have included presence or absence of other adults in the households in their analyses. Evidence on the effect of inclusion of living arrangement on the association between marital status and health in these studies is contradictory and generally information on the nature of the relationship between the adults in the household was missing.

1.4. Scientific and societal relevance

The monocausal and subsequently the multicausal orientation directed at physical risk factors proved only partially successful in clarifying disease etiology. Since long characteristic mortality and morbidity patterns have been found for groups differentiated by social factors. The idea that these differences in health status must be attributable to specific group characteristics has led to the incorporation

of social factors in research of disease etiology (1,8,9). Marital status is one of the social factors (besides for instance gender, social class, ethnicity and area of residence) for which intriguing health differences have been found. Despite differences across countries and over time, the constant factor emerging from research of mortality differentials between marital status groups is that during the past 150 years and for the majority of countries married people have had lower mortality rates than unmarried people. During the past 150 years many changes have occurred in The Netherlands and the other Western countries, which conceivably would have had a major influence on the association between marital status and mortality. Life expectancies of both men and women have almost doubled, there have been huge changes in the marriage and marriage dissolution rates and societal values and attitudes regarding marital status have greatly altered. Despite all these changes, married people have retained more favourable mortality rates than unmarried people. Marital status and living arrangement directly affect us all and marital status and living arrangement offer opportunities for the study of most other social factors which have been associated with health, such as life events, social integration and social support. Since marital status and living arrangement are associated with most causes of death and many of these associations have been demonstrated to be independent of other known risk factors (for instance, the association between marital status and coronary health disease is independent of risk factors such as serum cholesterol, blood pressure and obesity) unravelling the mystery of health differences between marital status/living arrangement will highly contribute to our knowledge of disease etiology.

Explaining the health differences by marital status and living arrangement not only has scientific relevance, but also has societal relevance. Knowledge of the association between marital status, living arrangements and health will help target subpopulations who are especially in need of prevention or intervention strategies. Identification of persons with higher risks of diseases will enlarge cost effectiveness of public health programs. Additionally, if marital transitions (i.e., divorce and bereavement) prove to be associated with adverse health effects, thus when social causation mechanisms are involved, this offers opportunities for disease prevention. Clarification of the relevance of social causation in the association between marital status, living arrangement and health is required. Knowledge about the quantitative contribution of intermediary factors to the social causation effect of marital status on health provides necessary information for the development of prevention or intervention programmes, i.e., at which intermediary factors programmes should be directed.

Furthermore, current changes in marriage and marriage dissolution rates also urge for clarification of the relevance of the social causation theory in the explanation of health differences between marital status groups and living arrangements.

The increasing number of divorced persons and of one-person-households in recent decades and the expected further increase in the future in The Netherlands and other Western countries, would increase the total number of persons with ill-health in the population and increase the rates for health care utilization if social causation mechanisms are operative. This might require adjustments or changes of policy measures with regard to the training of medical and nursing staff, number of hospital beds. If on the other hand selection effects are operative, increasing divorce rates will change the distribution of healthy and unhealthy persons over the marital status groups; the total number of persons with ill-health in the population, however, will remain constant.

During the last 30 years social factors have become increasingly important in research of disease etiology. In The Netherlands and in most other Western countries research on social determinants of health and the attention of health policy makers has primarily been focused on social class. However, Mackenbach studied for The Netherlands which of six socio-demographic factors (age, gender, marital status, level of education, degree of urbanization and region) was associated with the largest degree of variation in the health measures perceived general health, prevalence of chronic conditions and mortality (128). He found that age was associated with the largest degree in variation, followed by gender, marital status and level of education, which appeared to be of equal importance (128). Therefore health inequalities by marital status and their causes deserve more attention from researchers and health policy makers.

1.5. Problem definition

Although The Netherlands was among the first countries to report mortality differentials between marital status groups (11), and although marital status is measured in most large scale population studies (e.g. the Netherlands Health Interview Surveys (30)), marital status has only infrequently been used as an independent variable in Dutch studies of health. This is regrettable, since Dutch studies could well make a positive contribution to the international discussion on health inequalities by marital status and living arrangement. Estimates of mortality differences by marital status from Dutch national statistics will be more reliable than estimates of many other countries: the Dutch system of municipal population registration is less prone to errors than systems based on censuses, and since the mortality data and population data are based on the same source the problem of numerator denominator bias does not occur.

As has been stated above, researchers consistently have found that married people have lower mortality and morbidity rates than never married, divorced and widowed people. In contrast to the many descriptive studies about the

relationship between marital status and health, research of the explanation has been more scarce, although there has been a growth of explanatory studies in the past two decades. There is general agreement that two processes could be responsible for the health differences between marital status groups, marital selection or social causation mechanisms. Evidence on the role of selection effects is scarce, partial and far from conclusive. The evidence that has been gathered, however, indicates that selection effects play a role in the explanation, albeit this role seems limited. Studies of the appropriateness of the social causation theory as an explanation of the association between marital status and health provide evidence that marital status is indeed causally related with health outcomes. However, only few studies have addressed marital status effects on morbidity and the effects of being never married and divorced on survival. Also, little is known of the relative contributions of the different intermediary factors (health behaviours, material circumstances, psychosocial factors) to the causal process. Finally, the question of the relative importance of marital selection and causal mechanisms remains unsolved.

The purpose of this thesis is to describe health differentials by marital status in The Netherlands and to contribute to the explanation of health differences between marital status groups. With regard to the health differentials studied, the emphasis will be on physical health status. Where the data and the size of the research population allow this, the concept of marital status will be extended with that of living arrangement.

This thesis is divided in a descriptive part and an explanatory part. In the former differences in morbidity, mortality and use of health services between marital status groups and, where possible, living arrangement, are described for The Netherlands. In the explanatory part evidence of marital selection and social causation is studied, and the relative contributions of different intermediary factors to the causation mechanism are estimated. This thesis aims at answering the following questions:

1. Are there differences in health and health care utilization by marital status and living arrangement in The Netherlands?
2. Are these health differences based on an effect of health on marital status and living arrangement, or on an effect of marital status and living arrangement on health?
3. To what extent is the effect of marital status and living arrangement on health mediated by specific risk factors (psychosocial factors, material circumstances and health behaviours)?

Contents of this thesis

In chapters 3-6 differences in self-reported health, health care utilization and mortality between marital status groups (and where possible living arrangements) are described. Selection effects are examined in chapter 7 and social causation effects in chapter 10. The relative contribution of intermediary factors to effects of marital status on health is addressed in chapters 8-10. In chapter 11 several methodological aspects of the studies in chapters 3-10 are discussed and the gained insights are evaluated.

Notes

1. The term 'unmarried' is used throughout this thesis to refer to the never-married, the widowed and the divorced.
2. In the literature on health differences between widowed and married people three theories about the explanation are generally distinguished: selection, social causation and homogamy (48,49). The selection theory is confined to health selection in case of remarriage: it is assumed that the "mortality rate of those who became widowed is no different than for those of the same age who remained married. However, it [the selection theory] hypothesizes that those who became widowed and were in good health tended to remarry and return themselves to the married population, while the ill who became widowed tended to remain widowed" (48, p.212). According to the homogamy theory "the conditions of widowhood do not themselves produce an increased risk of mortality, but the event of becoming widowed identifies a group which has an excessive risk for other reasons" (48, p.214). These other reasons might be 'mutual choice of poor-risk mates', the 'joint unfavourable environment' and mutual infections and accidents (see for a review Stroebe and Stroebe (49)). The 'mutual choice of poor-risk mates' hypothesis assumes that "individuals with a short survival potential tend knowingly or unknowingly to chose mates with a similar potential" (48, p.214). The hypothesis of 'joint unfavourable environment' assumes that mortality ratios of the widowed would be increased since widowed people had as a married couple shared conditions with mutual, detrimental health effects. The hypothesis of mutual infections and accidents assumes that mortality ratios of the widowed would be increased because both spouses might be infected or in an accident together and would therefore be more likely to die closer in time than those who were not. Thus, according to the theory of homogamy those who will become widowed differ from the those who will remain married with regard to health status or risk factors for ill health. In the former case health differences precede marital status (direct selection) and in the latter determinants of health precede marital status (indirect selection).
3. When the 'joint unfavourable environment' (e.g. health behaviours, material circumstances) already has caused illness in the surviving spouse at the moment of bereavement, this will be considered direct selection. When risks are increased but illness has not yet developed, this will be considered indirect selection.
4. In these figures persons of the same generation of the same or the opposite sex living in the same household are considered as partners. This means that brothers and/or sisters who live together are included in the figures.

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Chapter 2

Data sources

In this thesis two sources of data have been used. Data of a large prospective cohort study, the GLOBE-study, which investigates the explanation of socio-demographic inequalities in health in The Netherlands, and national mortality statistics. The data of the GLOBE-study have been used in the studies which are described in chapters 3, 4 and 7-10, while the national mortality statistics have been used in the studies of chapters 5 and 6.

2.1 The GLOBE-study

The GLOBE acronym refers to 'Gezondheid en LevensOmstandigheden Bevolking Eindhoven en omstreken' (Health and Living Conditions of the Population of Eindhoven and surroundings). Eindhoven is an industrial city in the South-East of The Netherlands of approximately 195000 inhabitants (the fifth largest city of The Netherlands). Because of the inclusion of smaller surrounding municipalities, the study area is mixed rural-urban.

The core of the GLOBE-study consisted of a baseline measurement in the form of a postal questionnaire. Two subsamples have been approached for more extensive oral interviews. Follow-up procedures include(d), among others, use of registration data (mortality, marital transitions), postal questionnaires and oral interviews. Since the follow-up procedures heavily rely on the availability of administrative data from public authorities, it was decided to perform the study in a geographically restricted area.

Baseline measurement
For the baseline measurement a random sample of approximately 27 000 people was drawn from the population registers of the city of Eindhoven and a number of surrounding municipalities. Eligible were persons with the Dutch nationality in the age range 15-74 years. In the sample persons older than 45 years and persons in the lowest and highest socioeconomic groups were over-represented. The baseline measurement took place in March 1991. All those selected were sent a postal questionnaire with questions concerning, among others, health status, health behaviours and socio-demographic characteristics. The overall response rate was 70.1% (18 973 people). The response rate was lower than average among younger people, those from urban areas and the never married and divorced, but the differences in response rates were small.

Subpopulation 1
Subpopulation 1 consisted of a random sample of 3529 respondents to the postal questionnaire. Persons of this subsample were approached in May 1991 for an oral interview, which permitted more complete measurement of several factors, such as

health status, social support, financial situation and psychological factors (e.g. neuroticism). The overall response rate was 79,4% (2802 persons). More detailed information on the design and objective of the GLOBE-study, the baseline measurement and subpopulation 1 has been described elsewhere (1).

Subpopulation 2

Subpopulation 2 is part of the Longitudinal Study on Socio-Economic Differences in the Utilization of Health Services (LS-SEDUHSE), which is a substudy of GLOBE. To enlarge the power of the LS-SEDUHSE for measuring differences in health care utilization those respondents were selected, who mentioned to suffer from one of the following 4 chronic conditions: (1) "diabetes mellitus", (2) "chronic bronchitis, asthma, emphysema or chronic non-specific lung disease" (CNSLD), (3) "serious heart disease or heart attack", (4) "chronic back complaints or slipped disc". This sample of 2637 respondents was extended with an random sample of 1333 persons of the remaining respondents on the postal questionnaire. Of these 1333 persons the majority had no chronic conditions and a few had another chronic condition than diabetes mellitus, CNSLD, heart condition or back complaints.

All 3970 were approached in October-December 1991 for an oral interview concerning their health care utilization. Additionally several questions on health status, social support, financial situation and psychological factors were asked which were similar to those in the interview of subpopulation 1. The overall response of the LS-SEDUHSE was 72.0% (2867 persons). The response was slightly higher among the 2637 persons with one of the selected chronic conditions (74%) than among the 1333 persons without any of the selected chronic conditions (69%). The prevalence of the chronic conditions, which was 66.4% in the sample of the LS-SEDUHSE, was 67.8 % among the respondents. More detailed information on the LS-SEDUHSE has been described elsewhere (2).

2.2 National mortality statistics

In chapters 5 and 6 the mortality and population statistics of Statistics Netherlands have been used. Both statistics consider the *de jure* resident population of The Netherlands: all persons who are registered in the population registers of the Dutch municipalities.

In The Netherlands the system of population registration is municipally organised. For each inhabitant of the municipality there is a Personal Card on which (among others) information concerning his/her date of birth, sex and marital status is registered. At Statistics Netherlands the information of the municipal population registers is brought together, resulting in annual statistics of

the population by sex, year of birth and marital status for The Netherlands as a whole (3).

With regard to the mortality statistics, for each death occurring in The Netherlands the underlying cause of death is recorded by a physician on a Death Certificate, which is sent in a closed envelope to the local Registrar of the municipality in which the death occurred. After receiving the Death Certificate, the Registrar removes the Personal Card of the deceased from the population files. The Personal Card is sent to Statistics Netherlands, together with the unopened envelope containing the Death Certificate. At Statistics Netherlands the demographic information on the Personal Card of the deceased person is combined with the information of the Death Certificate (4).

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Part I

Descriptive studies

Chapter 3

Differences in self-reported morbidity by marital status and by living arrangement

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Abstract

It has frequently been shown that the never married, divorced and widowed have higher rates of self-reported morbidity than married people. The purpose of this study was to assess to what extent morbidity differences by marital status can be explained by differences in living arrangement (i.e. living with a partner or not). If living arrangement plays a major role, one expects to find that: 1) people who live with a partner have lower morbidity rates than people who live alone; 2) morbidity differences by marital status decrease substantially after controlling for living arrangement. Data from the GLOBE-study, a large prospective cohort in the Netherlands, on 18 973 persons from Eindhoven and surroundings, aged 15-74, were used to test the hypotheses. The measures for morbidity were perceived general health, subjective health complaints, chronic conditions and work disability. Multiple logistic regression models were used to calculate odds ratios for morbidity by living arrangement (question 1) and for morbidity by marital status, firstly without control and subsequently with control for living arrangement (question 2). In all models we controlled for other socio-demographic variables (age, sex, educational level, degree of urbanization, religion and country of birth). Our analyses showed that people who live with a partner have lower morbidity rates than those who live alone. They further showed that the excess risks of the never married, widowed and divorced decreased by 40-70% for all health measures (except subjective health complaints) after controlling for living arrangement. After control for living arrangement, however, there were still statistically significant morbidity differences by marital status, in particular the divorced still had higher morbidity rates than married people.

3.1. Introduction

In many Western countries morbidity differences by marital status have been reported (1-7). These closely resemble mortality differences by marital status (1,2,6,8). Married people have the lowest morbidity rates, while the divorced show the highest rates. The fact that married people live with a partner and most unmarried people do not, has been mentioned as an explanation for these health differences (3,6). The purpose of this study is to assess to what extent morbidity differences by marital status can be explained by differences in living arrangement, and more specifically, by the differences between living with a partner or not.

In the past someone's marital status gave a good description of his or her living arrangement: the married lived with a partner, while never married, divorced and

widowed people were single (= did not live with a partner). Because of recent demographic developments this is not the case any more. Nowadays in The Netherlands and in some other Western countries, it is becoming common to live with a partner without being married.

Because marital status and living arrangement do not coincide any more, it is now possible to investigate how important differences in living arrangement are in the explanation of health differences by marital status. If living arrangement plays a major role in the explanation of differences in health by marital status, one expects that: 1) people who live with a partner have lower morbidity rates than people who live alone; 2) morbidity differences by marital status decrease substantially after controlling for living arrangement. This study tested these hypotheses using the baseline data of a large prospective cohort study which has recently been started in the Netherlands.

3.2. Materials and methods

Material

We used the baseline data of the GLOBE-study (9). The health measures used in the analyses were (table 1):

- perceived general health (dichotomized into "very good" or "good" *versus* "fair", "sometimes good and sometimes bad" or "bad")
- subjective health complaints (suffering from 3 or less of the 13 listed complaints *versus* suffering from more than 3 complaints)
- chronic conditions (suffering from none *versus* suffering from at least one of the 23 listed chronic conditions)
- long-term work disability (receiving *versus* not receiving a long-term work disability benefit) (males only).[1]

Further questions used from the questionnaire concerned marital status (married, never married, divorced, widowed) and living arrangement (cohabiting, having a lasting relationship but not cohabiting, single, living with one's parents). Married people skipped the question about living arrangement in the questionnaire. However, by combining the answers on questions about the number of people living in the house and the number of children living in the house, we could calculate that only 64 of the 12604 married people (0.5%) were not living with their partner.[2] For our analyses we have assumed that all married people are cohabiting. In table 2 our study population is shown by marital status and living arrangement.

Table 1. Questions in the questionnaire from which the health measures were constructed

Perceived general health

How is your health in general? (very good, good, fair, sometimes good and sometimes bad, bad)

Subjective health complaints

1. Do your bones or muscles ever ache? (Yes/No)
2. Do you often have pains in the chest or heart region?
3. Is your stomach regularly upset?
4. Are you often troubled by back-ache?
5. Do you often feel tired?
6. Do you often have headaches?
7. Do your arms and legs often go dead or get pins-and-needles?
8. Do you often feel dizzy?
9. Do you often feel listless?
10. Do you get tired sooner than you would consider normal?
11. Are you often short of breath?
12. Do you often have a squeezing or blown-up feeling in the stomach region?
13. Do you normally feel tired when you get up in the morning?

Chronic conditions

Will you check for each chronic condition separately whether you have this condition or whether you are under treatment/control for this condition?
(Yes/No)

1. Asthma/chronic bronchitis or chronic a-specific respiratory diseases
2. Serious heart disease or heart attack
3. Hypertension
4. Stroke or effects of stroke
5. Stomach ulcer/duodenal ulcer
6. Gall-stones or inflammation of the gall-bladder
7. Severe disorder of the bowels for longer than 3 months
8. Stones in the kidney
9. Serious disease of the kidney
10. Prostate problems
11. Diabetes mellitus
12. Chronic spinal affections, slipped disc
13. Arthrosis of knees, hips or hands
14. Arthritis of hands or feet
15. Other rheumatoid arthritis
16. Diseases of the nervous system, such as Parkinson's disease, multiple sclerosis, or epilepsy
17. Migraine or severe headache
18. Overstrained, depression, serious nervousness
19. Malignant neoplasm or cancer
20. Chronic skin disease or eczema
21. Prolapse
22. Varicose veins
23. Injury from an accident in or near the home, during sport, school or job, or a traffic accident

Long-term work disability

Did the respondent receive a long-term work disability benefit? (Yes/no)

Table 2. Number of persons in the study by marital status and living arrangement

Marital status	Living arrangement				
	cohabiting	relationship, not cohabiting	single	living with parents	total
married	12604	-[a]	-[a]	-[a]	12604
never married	739	446	1124	1498	3807
divorced	221	112	753	10	1096
widowed	78	43	806	1	928
total	13642	601	2683	1509	18435[b]

[a] We did not have information about the living arrangement of the married persons in our study. As described we have assumed in our analysis that all married persons are cohabiting.
[b] Marital status and/or living arrangement were unknown for 538 persons.

Table 3. The multiple logistic regression models used

Model 1:	health status =	*f*(living arrangement + confounders[a])
Model 2:	health status =	*f*(marital status + confounders[a])
Model 3:	health status =	*f*(marital status + living arrangement + confounders[a])

[a] Age + sex + education + degree of urbanization + religion + country of birth.

Methods

The hypotheses were tested by using multiple logistic regression models (table 3). Separate models were fitted for each of the health measures. The regression coefficients of the models were used to calculate odds ratios (OR). The married were the reference category for the variable marital status, and those cohabiting were the reference category for the variable living arrangement.

In our analyses we have controlled for the following potential confounders of the relationship between marital status/living arrangement and health status: age (coded as 12 5-year categories), sex (male, female), educational level (seven categories), degree of urbanization (five categories), religion (four categories) and country of birth (Netherlands, abroad). The analyses showed that the most important confounders of the relationship between marital status/living arrangement and the four health measures were age and educational level.

To test our first hypothesis, concerning the relationship between living arrangement and morbidity, a model was fitted containing living arrangement and the confounders (model 1). In order to test our second hypothesis, concerning the

effect of living arrangement on the health differences by marital status, we first fitted a model containing marital status and the confounders (model 2). Subsequently we fitted a model containing, besides the confounders, both marital status and living arrangement (model 3) and compared the ORs for marital status obtained in model 2 with those obtained in model 3.

3.3. Results

The ORs calculated from model 1, containing living arrangement and confounders, are shown in table 4. In general single people have the highest morbidity rates. They more often have 'less than good' perceived general health, they more often suffer from more than three subjective health complaints, and they more often receive a work disability benefit than those who cohabit. People who have a lasting relationship but do not cohabit, also mostly have ORs higher than 1.00. Of these the ORs for subjective health complaints and chronic conditions differ significantly from 1.00. People who live with their parents have ORs lower than 1.00, except for receiving a work disability benefit. The OR for subjective health complaints is significantly lower than 1.00. It can be concluded that there is an association between living arrangement and health status, in which people who cohabit or live with their parents have the lowest morbidity rates and those who are single or have a relationship but do not cohabit have the highest rates.

The ORs for marital status without control for living arrangement (model 2) are shown in table 5. The divorced have the highest rates for all health measures. The ORs for these people range from 1.32 for chronic conditions to 3.12 for work disability and all differ significantly from 1.00. This means that the divorced suffer significantly more from all four health problems than married people. The never married have ORs between those of the married and the divorced. Their ORs are also significantly higher than 1.00, except for chronic conditions. For the widowed the picture is less clear. They suffer significantly more often from work disability than married people, but less from chronic conditions. The widowed do not differ significantly from the married in their perceived general health and subjective health complaints.

If we look at the ORs for marital status after controlling for living arrangement (model 3, table 6), we see that almost all ORs have decreased in comparison with the ORs found without control for living arrangement (model 2, table 5). For the divorced the decline in ORs is large for perceived general health, chronic conditions and work disability (a 36-50% reduction of the excess risks) and small for subjective health complaints (7%). For the never married the decline is large for perceived general health and work disability (respectively 59 and 52%). Their OR for subjective health complaints increases a little while controlling for living

Table 4. Model 1: Differences in health status by living arrangement controlled for age, sex, education, degree of urbanization, religion and country of birth; odds ratios (95% confidence intervals)

	perceived general health	subjective health complaints	chronic conditions	work disability benefit
cohabiting	1.00	1.00	1.00	1.00
relationship, not cohabiting	1.12 (0.88-1.42)	1.38 (1.14-1.67)	1.22 (1.02-1.47)	0.94 (0.42-2.09)
single	1.55 (1.41-1.72)	1.35 (1.23-1.48)	1.08 (0.99-1.19)	2.93 (2.32-3.69)
living with parents	0.95 (0.74-1.22)	0.67 (0.55-0.82)	0.96 (0.80-1.16)	1.58 (0.79-3.16)

Table 5. Model 2: Differences in health status by marital status controlled for age, sex, education, degree of urbanization, religion and country of birth; odds ratios (95% confidence intervals)

	perceived general health	subjective health complaints	chronic conditions	work disability benefit
married	1.00	1.00	1.00	1.00
never married	1.37 (1.19-1.57)	1.22 (1.08-1.38)	1.06 (0.94-1.18)	2.15 (1.59-2.90)
divorced	1.95 (1.70-2.24)	1.81 (1.59-2.07)	1.32 (1.15-1.50)	3.12 (2.38-4.08)
widowed	1.04 (0.89-1.21)	1.06 (0.90-1.23)	0.81 (0.70-0.94)	1.76 (1.05-2.95)

arrangement. For the widowed we see a large decline of the OR for work disability (74%) and also for perceived general health. For this last health measure the odds ratio changes from 1.04 to 0.78. Again we hardly see any change in the odds ratio for subjective health complaints. The odds ratio of the widowed for chronic conditions, which was 0.81 without control for living arrangement, drops even further, while controlling for living arrangement, to 0.71. So after control for living arrangement we see a general decrease of the ORs of the non-married compared to the married, but there still are significant differences in health by marital status. Divorced people still have the highest ORs for all health measures. These ORs are all significantly higher than 1.00, except for chronic conditions. The never married still have ORs between those of the married and the divorced except for chronic conditions. But now only the odds ratio for subjective health complaints differs significantly from 1.00. Widowed people have ORs significantly lower then 1.00 for perceived general health and chronic conditions.

Table 6. Model 3: Differences in health status by marital status and living arrangement, controlled for each other and for the confounders; odds ratios (95% confidence intervals)

	perceived general health	subjective health complaints	chronic conditions	work disability benefit
married	1.00	1.00	1.00	1.00
never married	1.15 (0.94-1.40)	1.27 (1.07-1.50)	0.96 (0.81-1.12)	1.55 (0.97-2.48)
divorced	1.54 (1.26-1.90)	1.75 (1.46-2.10)	1.16 (0.97-1.39)	2.36 (1.55-3.58)
widowed	0.78 (0.62-0.99)	1.01 (0.82-1.25)	0.71 (0.58-0.87)	1.20 (0.64-2.25)
cohabiting	1.00	1.00	1.00	1.00
relationship, not cohabiting	0.97 (0.73-1.29)	1.08 (0.86-1.35)	1.26 (1.01-1.56)	0.50 (0.21-1.20)
single	1.41 (1.16-1.71)	1.05 (0.89-1.24)	1.16 (0.99-1.36)	1.70 (1.10-2.61)
living with parents	0.86 (0.65-1.15)	0.55 (0.44-0.70)	1.00 (0.81-1.24)	1.04 (0.47-2.28)

3.4. Discussion

Our analyses show that there is an association between living arrangement and health: people who live alone have higher morbidity rates than people who live with a partner. They further show that the excess risks of morbidity for all 3 groups of non-married people decrease after controlling for living arrangement. The declines in ORs are large for perceived general health, chronic conditions and work disability. The changes in the ORs for subjective health complaints are small. After control for living arrangement, however, there still are statistically significant health differences by marital status. So living arrangement appears to play an important role in the explanation of health differences by marital status, but does not appear to explain all health differences by marital status.

Our results suggest that both marital status and living arrangement have a separate effect on health status. Table 6 shows the ORs for marital status and living arrangement controlling for each other. Both marital status and living arrangement are associated with morbidity.

Looking at the results one should keep in mind that they are based on self-reported data. This could bias the results if there were systematic differences in the answering of questions by marital status and/or by living arrangement. But it is not very likely that bias can account for our results. In order to explain the health differences we found, one would have to assume, for instance, that on the

one hand both widowed people and people who live with their parents systematically report less chronic conditions and more work disability than married people, and that on the other hand people who have a relationship but do not cohabit systematically report more chronic conditions and less work disability.

As mentioned earlier we did not have information about the living arrangement of married people. From our data we calculated that probably 0.5% of the married people was not living with their spouse. Data of the Central Bureau of Statistics show that less than 1.3% of the married people is separated (10). So separation is rare in the Netherlands and our assumption that all married people were cohabiting will hardly bias the results.

With regard to the classification of living arrangements for the non-married groups it must be stated that the categories are not mutually exclusive. At this moment we only have information about one living arrangement for each respondent. Problems, if any, are most likely to occur for people who both 'have a lasting relationship but do not cohabit' and 'live with their parents'. In case of non-differential misclassification of the exposure variable living arrangement it will have occurred between these two categories. The emphasis of this paper, however, was on differences between people who cohabited and people who were single. Furthermore, non-differential misclassification will tend to deflate differences between ORs. So the differences we found can be seen as conservative estimates of the real differences.

Both for marital status and for living arrangement the largest differences in ORs are observed for long-term work disability. Our measure for long-term work disability was whether a person did or did not receive a long-term work disability benefit. In the Netherlands an employee is eligible for a work disability benefit if he/she is under 65 years of age and if his/her work disability has lasted for over a year. A medical examiner determines whether someone is disabled for his/her work or not. The fact that we find larger differences for long-term work disability than for the other three health measures, could indicate that non-married and single people not only suffer more frequently from health problems, but that their condition is also more severe and/or longer lasting.

For chronic conditions the differences were smaller than for the two more subjective health measures, perceived general health and subjective health complaints. Only the ORs of divorced people and people with a relationship but not cohabiting were significantly higher than 1.00. This came as a surprise to us: we expected the never married, widowed and single people to have higher morbidity rates too, given the fact that they have higher mortality rates. An explanation could be that although they suffer more often from lethal chronic conditions, they suffer less from non-lethal chronic conditions. The list of chronic conditions in the postal questionnaire contained both severe and less severe conditions. This last

point needs further research. Within the GLOBE-study it is possible to investigate the prevalence of separate chronic conditions.

To our knowledge, there is only one other study which reported on the effect of controlling for living arrangement on differences in morbidity by marital status before. Anson has studied the importance of a "proximate adult" for the relationship between marital status and women's health in a population of 25,542 American women of working age (18-55 years) (3). A proximate adult was a person of 18 or older living in the household, adult children excluded. There was no further information about the nature of the relationship. Two of her measures of health status can be compared to our perceived general health and chronic conditions. Anson did not find a separate effect of living arrangement on health in a model containing both marital status and living arrangement. She further found that, without control for the presence of a proximate adult, never married women had a better perceived general health than married women. So her relationship between marital status and perceived general health differed from the relationship we found. Confining our analyses to only women in the age group 15-54 did not alter the conclusions from the analyses of our whole population (data not shown). We have no explanation for this discrepancy. Maybe that cultural differences are involved. Replication of these analyses in other populations and/or other data-sets will probably give the answer.

There are two major explanations for the association between marital status and health. One states that marital status depends on health: health is a selection criterion for being chosen as a marriage partner (selection theory). The other states that health depends on marital status: one's marital status influences one's health (social causation theory) through the social support provided by the marriage partner or through social control and regulation. It is very likely that both theories are of importance for the explanation of health differences by marital status. Both theories are probably also of importance for the explanation of health differences by living arrangement. If health is a selection criterion for being chosen as a marriage partner, it will most probably also be a selection criterion for being chosen as a partner in a consensual union. If married people have a better health because the marriage partner provides social support and regulation, then it is very likely that people who live in a consensual union have a better health because their partner also provides some degree of social support and regulation. Living arrangement explains a part of the morbidity differences by marital status. Both the selection theory and the social causation theory could be operating here.

After control for living arrangement there still are morbidity differences by marital status, in which especially the divorced have higher rates. Explanations for these differences have to be searched in certain characteristics in which divorced people differ from other non-married people. For instance the loss of the partner, but one then has to assume that the loss of a partner due to divorce has more

negative health effects than the loss of a partner due to bereavement. Another explanation could be a negative societal attitude towards divorce and divorced people.

All these explanations need further research. In order to disentangle the effect of selection and the effect of social support, regulation and control on health, one needs longitudinal data. The GLOBE-study is a longitudinal study, so we hope that we can make a start with this in the future.

Notes

1. Long-term work disability is only used as a health measure for our male population. Because relatively few women work in The Netherlands, looking at long-term work disability benefits would not be a good measure for long-term work disability among women.
2. One expects that the number of people living in the house for married people equals the number of children living in the house plus two parents. In all 215 married people (1.7%) did not fill in the question concerning the number of people living in the house and/or the question concerning the number of children living in the house. Some 398 people (3.2%) were living with more people in the house than expected, but only 64 people (0.5%) were living with fewer people than expected.

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Chapter 4

Marital status and health care utilization

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Abstract

Background: Several studies have reported differences in health care utilization by marital status, but usually only controlling for age and sex. Our study aimed at answering the questions: 1) To what extent are differences in health care utilization by marital status due to confounding by socio-demographic variables other than age and sex?; 2) To what extent are these differences due to differences in health status by marital status?

Methods: For the analyses we used the baseline data of the Longitudinal Study on Socio-Economic Differences in the Utilization of Health Services. Our study population consisted of 2662 people from the Netherlands, aged 25-74 years. People with diabetes mellitus, chronic non-specific lung diseases, heart conditions and back complaints were overrepresented. Our measures for health care utilization were general practitioner consultation, specialist consultation, hospital admission and use of prescription medicines. Multiple logistic regression models were used to calculate odds ratios (OR) for health care utilization by marital status, controlling for the socio-demographic variables age, sex, educational level, degree of urbanization, religion and country of birth (question 1), respectively a number of health indicators (question 2).

Results: We found that educational level is an important confounder of the relationship between health care utilization and marital status. In addition differences in health status to a considerable extent explain the higher utilization of health services of widowed and divorced people, but not the lower utilization of the never married. After control for confounding and health status there still were unexplained differences in health care utilization by marital status: e.g. the divorced were more frequently hospitalized (OR 1.53, 95% c.i. 1.03-2.22) than married people.

Conclusions: There are differences in health care utilization by marital status which are not due to confounding by other socio-demographic variables or differences in health status. Further investigation of these differences is necessary, and is likely to benefit from inclusion of socio-psychological variables. Living arrangement should also be included in these future analyses.

4.1. Introduction

Several studies have shown that there are differences in the utilization of health services by marital status. In comparison to married people, the divorced and widowed appear to have a high, and the never married a low utilization of health services (1-5). For example, in The Netherlands differences in the utilization of health services by marital status have been described by the Central Bureau of Statistics (CBS). Results of the CBS Health Interview Survey 1981-1991 indicate that the widowed have the highest frequency of general practitioner (GP) consultations and the highest use of prescription medicines. Divorced people had the highest hospital admission rates and, together with those married, the highest frequency of specialist consultations. The never married had the lowest rates for health care utilization on all indicators (5).

Andersen has formulated a behavioral model, which relates individual characteristics to health care utilization (6). This model is often used as a starting point in research on health care utilization. The model assumes that utilization is dependent on the predisposition of the individual to use services, his/her ability to secure services and his/her illness level. The model correspondingly distinguishes predisposing, enabling and need variables. *Predisposing variables* are individual characteristics which exist prior to the onset of illness. The predisposing characteristics in Andersen's model are divided into 1) demographic variables (age, sex, marital status, etc.), 2) social structure variables (education, race, religion, etc.) and 3) attitudinal-belief variables (values concerning health and illness, etc.). Andersen distinguishes two categories of *enabling variables*: 1) family-related variables like income, health insurance and access to regular sources of care and 2) community-related variables like the amount of health facilities and personnel in a community. The *need variables* in the model are 1) individual's perceived illness (symptoms, disability) and 2) the evaluated illness (diagnosis by a physician). The predisposing and enabling variables are not considered to be a direct reason for using services, but do result in differences in probability of health care utilization. The illness level is the most immediate cause of health service use.

Andersen's model gives a useful framework for the study of variations in health care utilization between population subgroups. It does not, however, provide explanations about why certain groups, e.g. the non-married, make more or less use of health services than others. To understand how certain 'predisposing' characteristics work, a social-psychological approach may be needed. For instance, Rosenstock's 'Health Belief Model' could be employed (7). According to the Health Belief Model utilization of health services can be explained by three elements: 1) the individual's subjective readiness to take action, which is, among others, determined by the individual's perceived severity of the consequences of illness; 2) the extent to which a particular course of action is believed to be

beneficial; 3) a factor that serves as a cue or a trigger to trip off appropriate action, which can be internal (symptoms) or external (e.g. interpersonal interactions). On the basis of this model it can be hypothesized that married people are more inclined to use health services because the consequences of illness are more severe for them as they have the responsibility for a spouse and children. The spouse could also function as a trigger for use of health services when, in the case of complaints about health, the spouse encourages on GP consultation.

Before we can address the question about the explanation of differences in the health care utilization by marital status, however, we first have to make sure that the association between marital status and health care utilization is real, and not due to confounding by other socio-demographic characteristics and/or to differences in health status between marital status groups. In research which has focused on the relation between marital status and health care utilization, age and sex are usually the only variables controlled for (1,2,4). However, other socio-demographic variables, such as socioeconomic status, religion, ethnicity or degree of urbanization, could also confound the association between marital status and health care utilization. Further it is known that marital status is associated with health status (1-5,8-10). Married people generally have the lowest mortality and morbidity rates, while the divorced have the highest rates. Thus the differences in health care utilization will be partly due to differences in the prevalence of diseases and differences in severity of diseases between the marital status groups.

Our study aimed at answering the following questions: 1) To what extent are differences in health care utilization by marital status due to confounding by socio-demographic variables other than age and sex? and 2) To what extent are differences in health care utilization by marital status due to differences in health status between marital status groups?

4.2. Material and methods

Material

In order to answer our questions we used data from the Longitudinal Study on Socio-Economic Differences in the Utilisation of Health Services (LS-SEDUHSE) (11), which is part of the GLOBE-study (12). Because almost all respondents in the age group 15-24 were never married (155 of 161), we have excluded this age group from the analysis. The distribution of the remaining respondents by marital status, age and sex is shown in table 1.

In the LS-SEDUHSE many different health indicators have been measured: perceived general health, Nottingham Health Profile (NHP), chronic conditions, constraints in 'Activities of Daily Life' (ADL) and the OECD long-term disability indicator. This offers good opportunities for controlling for health status.

Table 1. The numbers of respondents by marital status, age and sex

	Marital status				Total
	married (n=2077)	never married (n=207)	divorced (n=206)	widowed (n=172)	(n=2662)[a]
Age					
25-34	145	79	6	1	231
35-44	236	27	38	1	302
45-54	629	33	78	22	762
55-64	666	39	50	61	816
65-74	401	29	34	87	551
Sex					
male	1123	105	96	40	1364
female	954	102	110	132	1298

[a] Marital status was unknown for 32 respondents.

Methods

In this study the following indicators for health care utilization have been used: whether the GP has been consulted during the past 2 months; whether a specialist has been consulted during the past 2 months; whether the respondent has been admitted to hospital in the past year; whether prescription medicines were used during the past 14 days.

To assess the association between marital status and health care utilization, separate multiple logistic regression models were fitted for each of the four health care utilization indicators with marital status as independent variable and married people as the reference category (table 2). The regression coefficients from these models and their standard errors have been used to calculate odds ratios (OR) with 95% confidence intervals (CI). In the results section we also show change in deviance due to including marital status in the model and its P-value, to give an indication of the overall significance level of the variable marital status in the models (13).

For research question 1 we first fitted models only containing the usual confounders age and sex (model 1). We compared these models to models which also contained educational level, degree of urbanization, country of birth and religion as possible confounders (model 2). Each of these four variables have been described to be associated with health and utilization of health services. It is possible that the distribution of each of these variables differs by marital status, which would lead to confounding of the association between marital status and health care utilization (1,3,8,14,15).

Table 2. The multiple logistic regression models used

Model 1:	medical consumption=	*f*(marital status + age + sex)
Model 2:	medical consumption=	*f*(model 1 + educational level + degree of urbanization + religion + country of birth)
Model 3:	medical consumption=	*f*(model 2 + chronic condition)
Model 4:	medical consumption=	*f*(model 3 + perceived general health + comorbidity + NHP[a] scales + ADL-constraints[b] + OECD-indicator[c])

[a] Nottingham Health Profile.
[b] Activities of Daily Life constraints.
[c] OECD long-term disability indicator.

Table 3. Coding of the variables

Variable	No. of categories	Categories
Marital status	4	married; never married; divorced; widowed
Age	5	25-34; 35-44; 45-54; 55-64; 65-74
Sex	2	male; female
Educational level	7	primary school, lower vocational, lower general secondary, intermediate vocational, higher general secondary, higher vocational, university
Degree of urbanization	5	rural (≥20% farmers), urban-rural (<20% farmers), dormitory suburban, urban (<100,000 inhabitants), urban (≥100,000 inhabitants)
Religion	4	not religious; roman catholic; protestant; other
Country of birth	2	The Netherlands; abroad
Chronic condition	6	none; diabetes; CNSLD[a]; heart condition; back complaints; another chronic condition
Perceived general health	2	very good or good; moderate, sometimes good and sometimes bad, bad
Comorbidity	2	<2 chronic conditions; ≥2 chronic conditions
Nottingham Health Profile (each scale separate: mobility, pain, energy, sleep, social isolation, emotional reaction)	6 x 2	0 items answered confirmative; ≥1 items answered confirmative
ADL-constraints[b]	2	no constraints; ≥1 constraint
OECD-indicator[c]	2	no constraints; ≥1 constraint

[a] Chronic non-specific lung disease.
[b] Activities of Daily Life constraints.
[c] OECD long-term disability indicator.

To answer research question 2 we first fitted models which controlled for having diabetes mellitus, CNSLD, a heart condition, back complaints or at least one other chronic condition, in addition to controlling for the socio-demographic variables (model 3). To control additionally for the severity of the chronic condition, the presence of a second chronic condition (comorbidity) and other health differences, model 3 was extended with the variables perceived general health, comorbidity, the six scales of the Nottingham Health Profile, ADL-constraints and the OECD long-term disability indicator (model 4). The coding of the variables is shown in table 3.

4.3. Results

If we control for age and sex only, there are statistically significant differences by marital status in GP consultation, hospital admission and use of prescribed medicines (table 4, model 1). The never married exhibit ORs below 1.00 for all indicators of health care utilization, except for the use of prescription medicines. This indicates that the never married consult their GP less frequently than married people (the reference category) and that they are less frequently hospitalized. Those divorced and widowed have ORs above 1.00 for all indicators of health care utilization.

After additional control for educational level, degree of urbanization, country of birth and religion, we found a decline in the ORs of the divorced and especially for those widowed for all indicators of health care utilization as compared to model 1 (table 4, model 2). The decline in ORs was mainly caused by the addition of the variable education to model 1: widowed people are often less educated which in turn is associated with a high morbidity and a high health care utilization. The ORs of the never married people in model 2 hardly differ from those in model 1. After the additional control for socio-demographic variables there still are statistically significant differences by marital status in GP consultation and hospital admission. The differences in the use of prescribed medicines are now borderline significant.

If we subsequently control for diabetes mellitus, CNSLD, a heart condition, back complaints or at least one other chronic condition, the ORs of the never married, the divorced and the widowed all decline (table 5, model 3). The decrease in ORs is most remarkable among the divorced. The OR of the never married for specialist consultation becomes significantly lower than 1.00. However, the overall marital status variable only contributes significantly to the model describing differences in hospital admission.

Table 4. Differences in health care utilization by marital status: crude percentages, model 1 and model 2; odds ratios (95% confidence intervals)

	% that has used the health care facility	model 1: control for age + sex		model 2: control for the socio-demographic confounders[a]	
GP consultation:					
married	48.8	1.00		1.00	
never married	43.8	0.91	(0.66-1.26)	0.97	(0.70-1.34)
divorced	57.7	1.57	(1.14-2.14)	1.53	(1.11-2.11)
widowed	63.3	1.40	(0.98-2.01)	1.33	(0.93-1.91)
change in deviance			11.509		8.950
P-value			0.0093		0.0300
Specialist consultation:					
married	38.4	1.00		1.00	
never married	28.7	0.78	(0.54-1.11)	0.77	(0.54-1.11)
divorced	43.1	1.34	(0.97-1.84)	1.28	(0.93-1.77)
widowed	49.7	1.09	(0.77-1.55)	1.04	(0.73-1.48)
change in deviance			5.733		4.696
P-value			0.1254		0.1954
Hospital admission:					
married	16.5	1.00		1.00	
never married	11.4	0.68	(0.41-1.12)	0.68	(0.41-1.12)
divorced	25.6	1.87	(1.30-2.69)	1.80	(1.24-2.60)
widowed	21.7	1.27	(0.83-1.93)	1.18	(0.77-1.81)
change in deviance			14.615		12.721
P-value			0.0022		0.0053
Prescribed medicines:					
married	57.3	1.00		1.00	
never married	51.0	1.10	(0.78-1.54)	1.11	(0.79-1.56)
divorced	63.4	1.49	(1.07-2.08)	1.39	(1.00-1.95)
widowed	79.2	1.62	(1.07-2.46)	1.52	(1.00-2.31)
change in deviance			10.696		7.407
P-value			0.0135		0.0600

[a] Age + sex + educational level + degree of urbanization + religion + country of birth

If we finally add the variables for comorbidity, ADL-constraints, physical disabilities, and perceived general health to model 3, the ORs for GP and specialist consultations decrease slightly for all three unmarried groups (table 5, model 4). The ORs for hospital admissions and use of prescription medicines hardly change in comparison to model 3. The differences in hospital admissions by marital status are still statistically significant.

Table 5. Differences in health care utilization by marital status: model 3 and model 4; odds ratios (95% confidence intervals)

	model 3: control for the socio-demographic confounders[a] + having a chronic condition		model 4: control for the socio-demographic confounders[a] + health status	
GP consultation:				
married	1.00		1.00	
never married	0.85	(0.60-1.20)	0.79	(0.55-1.12)
divorced	1.27	(0.91-1.79)	1.11	(0.78-1.57)
widowed	1.25	(0.85-1.83)	1.17	(0.79-1.73)
change in deviance		4.273		2.943
P-value		0.2334		0.4019
Specialist consultation:				
married	1.00		1.00	
never married	0.66	(0.45-0.96)	0.64	(0.43-0.94)
divorced	1.04	(0.74-1.46)	0.97	(0.68-1.37)
widowed	0.92	(0.63-1.34)	0.89	(0.60-1.31)
change in deviance		5.021		5.496
P-value		0.1702		0.1389
Hospital admission:				
married	1.00		1.00	
never married	0.62	(0.37-1.03)	0.61	(0.37-1.03)
divorced	1.53	(1.05-2.24)	1.53	(1.03-2.26)
widowed	1.09	(0.70-1.68)	1.10	(0.70-1.72)
change in deviance		9.273		9.000
P-value		0.0259		0.0293
Prescribed medicines:				
married	1.00		1.00	
never married	0.95	(0.65-1.38)	0.94	(0.64-1.37)
divorced	1.08	(0.74-1.56)	0.91	(0.62-1.34)
widowed	1.36	(0.86-2.14)	1.35	(0.85-2.16)
change in deviance		1.986		2.122
P-value		0.5753		0.5475

[a] Age + sex + educational level + degree of urbanization + religion + country of birth

4.4. Discussion

In summary we found that confounding by socio-demographic factors other than age and sex (degree of urbanization, religion, country of birth and especially educational level) explains part of the higher utilization of health services of widowed and divorced people. After additional control for chronic conditions

there is a substantial decline in the OR's of the widowed and divorced. This indicates that widowed and divorced people have a higher utilization of health services because they suffer more often from chronic conditions than married people. Once we have controlled for chronic conditions, the addition of other health status measures to the model hardly reduces the ORs. Controlling for health status does not explain why the never married use health services less. On the contrary, control for health status increases the differences in health care utilization between the never married and those married. After controlling for both socio-demographic factors and health status, there still were unexplained differences in health care utilization by marital status: divorced people had significantly higher ORs for hospital admission and the never married still tended to use health services less frequently than married people.

Possible sources of bias, which could affect the interpretation of our results, are information bias and additional confounding bias. Firstly, our results are based upon self-reported data. This could bias the results if there are systematic differences in the answering of the questions by marital status (information bias). In order to be able to explain the differences in the utilization of health services we found, however, one has to assume that never married people systematically underreport health care utilization and that divorced and widowed people systematically overreport health care utilization. This does not seem very likely.

Secondly, it is possible that there are still additional factors, which confound the relation between marital status and health care utilization after controlling for the socio-demographic variables and health status measures in our study. We have controlled for the predisposing demographic and social structure variables mentioned in Andersen's model and for illness level, but not for the enabling variables in his model. Our study population comes from the same relatively small geographical area so it is unlikely that there are differences in community-related enabling variables between the marital status groups which are not covered by the control for degree of urbanization. With regard to the importance of the family-related enabling factors, income and health insurance, we assume that these do not play a major role in the relation between marital status and health care utilization in The Netherlands. For the United States it has been reported that more married people have health insurance than those unmarried (2). In The Netherlands, however, almost everybody has health insurance so we assume that the differences in health care utilization we found, are not due to confounding by differences in enabling variables between the marital status groups.

To explain the remaining differences further research of the determinants of health care utilization is needed. One possible approach could focus on the social-psychological variables mentioned in the introduction. It is possible that married,

divorced and widowed people value good health higher than never married people if they have responsibility for children. The inclination to use health services could also be influenced by the opinion of the spouse or adult children who could insist upon GP consultation in case of complaints about health. Divorced and widowed people could have even higher health care utilization than married people because they are more inclined to visit health services to discuss (health) problems which, in a marital relationship, are solved at home.

Another approach could focus on the fact that marital status is also related to differences in supply of informal care. Hospital admissions on social grounds will be less frequent among married people, because they have a carer at home. This could explain the lower hospital admission rates for married people in comparison to the divorced and widowed.

In these explanations the presence or absence of a spouse plays an important role. The role of a spouse in the use of health services could be further investigated by including the partner status of the non-married in the study. If the presence of a partner plays an important role it can be expected that the health care utilization by people living in a consensual union shows more resemblance to the utilization of married people than that of people who live without a partner. In our study population 25.6% (n=50) of the never married, 18.2% (n=36) of the divorced and 10.7% (n=17) of the widowed people lived with a partner[1]. In order to study the role of partner status in health care utilization, we fitted model 4 again with 2 additional marital status categories for the never married and divorced who lived with a partner (data not shown). We found that never married people with a partner had higher OR's for GP and specialist consultation and use of prescribed medicines than the never married without a partner. Divorced people with a partner had lower OR for GP consultations and use of prescribed medicines than divorced person without a partner. For hospital admissions living with or without a partner did not seem to be important. So the health care utilization of people with a partner seemed to be more similar to the health care utilization of married people than that of those without a partner for three of the four indicators for health care utilization. These results suggest that further research on the determinants of variation in health care utilization by marital status is indeed likely to benefit from the inclusion of partner status.

Finally, an important question is raised by the fact that control for health status increases the differences in health care utilization between never married and married people. Health status is an important determinant of health care utilization and, in general, control for health status will diminish differences in utilization of health services between groups. The fact that never married people have a lower utilization of health services after control for confounding and health status could indicate that they neglect their health. This raises the question whether the higher mortality and morbidity of the never married is caused by

their lower health care utilization. To answer this question more research on the effect of health care utilization on morbidity and mortality is needed. Preferably longitudinal data should be used to answer these questions.

Notes

1. Living arrangement was unknown for 36 of the 2662 respondents mentioned in table 1. The percentages of unmarried people living with a partner are based on the respondents for whom both marital status and living arrangement were known and therefore cannot be calculated from table 1. People under the age of 45 and divorced and widowed men were more likely to live with a partner than people or 45 year of age or older and divorced and widowed women.

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Chapter 5

The contribution of specific causes of death to mortality differences by marital status in The Netherlands

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Abstract

The purpose of this study was to describe the differences in mortality by marital status in The Netherlands in the period 1986-1990 for specific causes of death and to estimate the contribution of each specific cause to the differences in total mortality. We have used mortality and population data from Statistics Netherlands. Poisson regression was used to calculate relative risks of dying from the specific causes of death. The relative risks and the overall mortality rates were used to estimate the contribution of the specific causes of death to the differences in total mortality by marital status. For men the general pattern was that the divorced had the highest risks, followed by the never-married and that the widowed had risks closest to married men. For women the general pattern was that the divorced had the highest risks, while widowed and never-married women alternately had risks closest to married women. Important exceptions to these risk patterns were found for, among others, infectious and parasitic diseases among men and breast cancer among women. External causes of death in particular, contributed more to the excess mortality of the 3 unmarried groups of men and women than expected, while the contributions of malignant neoplasms and diseases of the circulatory system were lower than expected on the basis of the percentages of these causes of death in mortality in the married population. Since the causes of death that contributed disproportionately to the excess mortality of the unmarried almost all have unhealthy life styles as important risk factors, we argue that the majority of the mortality differences by marital status can be explained by social causation (marital status affects health through life style differences). However, longitudinal data are necessary to rule out selection effects (effect of health on marital status), preferably controlling for socio-demographic confounders such as socioeconomic status and taking into account living arrangements.

5.1. Introduction

Mortality differences between marital status groups have already been described in the previous century (1,2). Since then many researchers have looked into this subject and have reported very consistently that married persons have the most favourable death rates, that the never-married and widowed have intermediate rates and that the divorced have the most unfavourable rates (3-8).

Some studies have focused on the differences in mortality from specific causes of death by marital status (6,9-14). Knowledge about the causes of death that are responsible for the mortality differences by marital status can give an indication as

to the explanations for these differences. Gove (9), for instance, described large mortality differences by marital status from causes which are due to 'overt social acts' (e.g. suicide and homicide), causes which are associated with the use of socially approved 'narcotics' (e.g. cirrhosis of the liver and cancer of the lung) and from causes which require prolonged and methodical care (e.g. diabetes and tuberculosis), but only small mortality differences from causes which are largely unaffected by these 'social factors' (e.g. leukaemia and aleukemia). From these results Gove (9) concluded that mortality differences by marital status can largely be attributed to the psychological states and life styles associated with the different marital roles (emotional stability, willingness to take risks) and not to selective processes. Koskenvuo et al. (10) found the greatest variation in mortality rates by marital status in the main categories of mental disorders, disorders of the nervous system, respiratory diseases, infectious diseases and external causes of death.

The purpose of this study was to describe the differences in mortality by marital status in The Netherlands in the period 1986-1990 for a number of specific causes of death and to estimate the contribution of each specific cause to the differences in total mortality by marital status.

5.2. Material and methods

Material

In this study we have used mortality statistics and population statistics of Statistics Netherlands (formerly the Central Bureau of Statistics, CBS) (15,16). The mortality data consisted of information about the underlying cause of death, marital status, age and sex of all deceased persons in The Netherlands in the period 1986-1990. The underlying causes of death are divided into 29 categories and a category containing all other causes of death (information on the ICD codes of the causes of death and number of deaths by marital status and sex, is available on request). In the analyses we have aggregated the numbers of deaths for the several years. The analyses have been confined to the Dutch population of 25 years and older and men and women have been analyzed separately.

Methods

In order to describe the mortality differences by marital status we have used Poisson regression models (17). Separate models have been fitted for total mortality and specific causes of death. In the models we have controlled for age, coded as 13 5 year categories and a 'rest' category for the oldest age group (25-29, 30-34, .., 90+ years of age). The regression coefficients of marital status and their stan-

dard errors have been used to calculate relative risks (RR) with 95% confidence intervals. The married group was the reference category. The statistical package used was EGRET (18,19).

In order to estimate the contribution of each specific cause of death to the differences in total mortality by marital status, we have used the RR of the unmarried groups to calculate risk differences (RD) for dying from the specific causes of death between each of the unmarried groups and the married. Dividing the RD for each cause of death by the RD for total mortality results in the relative contribution of the causes of death to the differences in total mortality (C_{ix}). Details of these calculations are given in the Appendix. Contrary to the RR_{ix}s the C_{ix}s also take into account the importance of a specific cause for overall mortality.

5.3. Results

Relative mortality risks

The RRs for total mortality and for mortality from the specific causes of death of the unmarried groups, controlled for age, are shown in table 1. The figures represent the mortality risks of the unmarried relative to married persons.

For both men and women, all unmarried groups have higher total mortality risks than the married. Divorced people have the highest risks (RR=1.62 for men; RR=1.49 for women). Never-married men have higher risks than widowed men, while never-married and widowed women have equal risks for total mortality.

The pattern for differences in total mortality *among men* is not followed by each specific cause. We found no differences in the risks of mortality from colon cancer or pancreas cancer between the marital status groups. The RRs for mortality from cirrhosis of the liver (with and without mention of alcoholism), suicide, homicide and injury purposely inflicted by other persons and other external causes of injury and poisoning are twice those for total mortality for all 3 unmarried groups. Furthermore, the very high RR of never-married men for mortality from infective and parasitic diseases (RR with 95% confidence interval: 6.08, 5.50-8.71) and the fact that never-married men have a lower risk for mortality from cancer of the trachea, bronchus and lung (0.92, 0.88-0.97) than married men is striking.

Likewise, *among women* the pattern for differences in total mortality is not followed by each specific cause. We found no differences in the risks of mortality from pancreas cancer. Again the RRs for mortality from cirrhosis of the liver with mention of alcoholism, suicide, homicide and injury purposely inflicted by other persons and other external causes of injury and poisoning were twice those for total mortality. Never-married women were found to have highest RRs of all marital status groups for mortality from breast cancer (1.28, 1.21-1.35), cancer of the body of the uterus (1.57, 1.35-1.83) and ovary cancer (1.48, 1.34-1.62), and the

lowest RRs for mortality from diabetes mellitus (0.83, 0.77-0.90) and complications of pregnancy, childbirth and the puerperium (0.22, 0.08-0.61). Widowed women had a higher RR for mortality from ischaemic heart disease than divorced women (1.32 versus 1.18). The very high RR for cervical cancer mortality among divorced women (3.76; 3.25-4.37) was striking.

Finally it is noteworthy that the mortality differences between the marital status groups are larger for men than for women for all specific causes of death, except for cancer of the trachea, bronchus and lung and chronic obstructive lung diseases (COLD).

Contributions of specific causes of death to differences in total morality

The contributions of each specific cause of death to the excess total mortality by marital status are shown in table 2. If the total mortality risks of the never-married, widowed or divorced *men* had applied to the married male population, 517, 356 and 720 more men per 100,000 person years would have died respectively (the mortality rate of married men is 1,207 per 100,000 person years). If we compare the contributions of larger categories of causes of death to the excess total mortality with the contributions of these categories to overall mortality in the married population, it appears that, in particular, external causes contribute disproportionately to the excess mortality of unmarried men (external causes constitute 3.0% of the total mortality of married men against more than 13% of the excess mortality of the separate groups of unmarried men) (figure 1). Malignant neoplasms and diseases of the circulatory system, which constitute 35.0 and 40.3% respectively of the total mortality of married men, contribute far less to the excess mortality of the unmarried groups (figure 1). If we finally look at the contributions of the specific causes of death, diabetes mellitus, other heart diseases, pneumonia, cirrhosis of the liver with mention of alcoholism and 'all other causes' prove to contribute more than expected to the excess mortality of all 3 groups of unmarried men (table 2). Infective and parasitic diseases are over-represented as an underlying cause of death among never-married men and COLD are over-represented among widowed and divorced men.

If the mortality risks of the never-married, widowed or divorced *women* had applied to the married female population, 122, 124 and 225 more women per 100,000 person years would have died respectively (the mortality rate of married women is 486 per 100,000 person years) (table 2). In addition, among women we find that, in particular, external causes contribute more than expected to the excess mortality (external causes constitute 3.5% of the total mortality of married women against 13-20% of the excess mortality of unmarried women) (figure 2). The overall excess mortality from malignant neoplasms is lower than expected (38.5% of the total mortality of married women versus <= 27% of the excess mortality for unmarried women). This also applies for the mortality from diseases of the

Table 1. Relative mortality risks (RR_{ix}) by marital status (95% confidence intervals), controlled for age, with the married as reference category, 1986-1990.[a]

	Men			Women		
	Never married	Widowed	Divorced	Never married	Widowed	Divorced
Total mortality	1.47 (1.45-1.49)	1.28 (1.27-1.30)	1.62 (1.60-1.65)	1.24 (1.22-1.25)	1.23 (1.21-1.24)	1.49 (1.46-1.52)
Infective and parasitic diseases	6.08 (5.50-8.71)	1.75 (1.52-2.01)	2.20 (1.84-2.63)	1.82 (1.55-2.14)	1.36 (1.19-1.55)	2.08 (1.69-2.56)
Malignant neoplasms	1.05 (1.02-1.07)	1.13 (1.11-1.15)	1.23 (1.19-1.27)	1.16 (1.13-1.19)	1.12 (1.10-1.14)	1.26 (1.22-1.30)
Stomach	1.15 (1.04-1.26)	1.08 (1.01-1.16)	1.06 (0.94-1.20)	0.90 (0.80-1.01)	1.10 (1.02-1.19)	1.01 (0.86-1.18)
Colon	1.03 (0.93-1.13)	1.07 (1.00-1.14)	1.02 (0.90-1.16)	1.17 (1.08-1.26)	1.08 (1.02-1.14)	1.01 (0.90-1.13)
Pancreas[c]	1.07 (0.94-1.21)	1.06 (0.97-1.17)	1.10 (0.95-1.28)	0.94 (0.84-1.06)	1.05 (0.97-1.14)	1.12 (0.96-1.31)
Trachea, bronchus and lung	0.92 (0.88-0.97)	1.19 (1.16-1.23)	1.28 (1.22-1.34)	1.09 (0.99-1.21)	1.34 (1.25-1.43)	2.09 (1.91-2.29)
Breast[b]	2.34 (1.29-4.47)	2.18 (1.27-3.74)	1.67 (0.67-4.18)	1.28 (1.21-1.35)	1.01 (0.96-1.05)	1.02 (0.95-1.05)
Prostate	0.92 (0.84-1.01)	1.09 (1.04-1.15)	1.13 (1.01-1.26)	-	-	-
Cervix	-	-	-	0.95 (0.77-1.18)	1.52 (1.33-1.74)	3.76 (3.25-4.37)
Corpus uteri	-	-	-	1.57 (1.35-1.83)	1.22 (1.08-1.36)	1.17 (0.93-1.47)
Ovary	-	-	-	1.48 (1.34-1.62)	1.09 (1.02-1.18)	1.10 (0.96-1.25)
Other malignant neoplasms	1.18 (1.13-1.23)	1.11 (1.08-1.15)	1.29 (1.22-1.35)	1.11 (1.06-1.16)	1.13 (1.09-1.16)	1.27 (1.20-1.34)
Diabetes mellitus	1.92 (1.77-2.08)	1.51 (1.42-1.62)	2.17 (1.96-2.39)	0.83 (0.77-0.90)	1.35 (1.29-1.42)	1.40 (1.28-1.54)
Diseases of the circulatory system	1.33 (1.31-1.36)	1.26 (1.24-1.28)	1.47 (1.44-1.51)	1.09 (1.06-1.11)	1.17 (1.16-1.19)	1.36 (1.32-1.40)
Ischaemic heart disease	1.23 (1.19-1.26)	1.25 (1.22-1.27)	1.38 (1.34-1.43)	1.02 (0.98-1.05)	1.32 (1.27-1.38)	1.18 (1.15-1.20)
Other heart diseases	1.90 (1.81-1.99)	1.45 (1.40-1.51)	1.89 (1.77-2.01)	1.26 (1.20-1.32)	1.27 (1.22-1.32)	1.52 (1.42-1.63)
Arteriosclerosis	0.95 (0.87-1.05)	1.16 (1.10-1.23)	1.38 (1.24-1.54)	1.10 (0.99-1.22)	1.19 (1.10-1.29)	1.15 (0.98-1.36)
Cerebrovascular accident	1.39 (1.32-1.45)	1.20 (1.16-1.23)	1.52 (1.43-1.62)	1.09 (1.04-1.13)	1.12 (1.08-1.15)	1.34 (1.26-1.41)

Diseases of the respiratory system	1.54 (1.47-1.61)	1.38 (1.34-1.42)	1.77 (1.68-1.88)	1.44 (1.36-1.52)	1.38 (1.32-1.44)	2.09 (1.95-2.25)
Chronic obstructive lung diseases	1.38 (1.31-1.46)	1.39 (1.34-1.44)	1.73 (1.62-1.85)	1.33 (1.22-1.46)	1.46 (1.38-1.56)	2.41 (2.18-2.65)
Pneumonia[bc]	1.92 (1.76-2.09)	1.41 (1.33-1.49)	2.02 (1.78-2.29)	1.47 (1.34-1.60)	1.32 (1.23-1.42)	1.75 (1.55-1.98)
Other diseases of the respiratory system	1.80 (1.57-2.08)	1.29 (1.16-1.43)	1.60 (1.30-1.97)	1.43 (1.21-1.68)	1.15 (1.01-1.31)	1.90 (1.53-2.36)
Cirrhosis of the liver with mention of alcohol	4.80 (4.15-5.56)	4.59 (3.81-5.54)	9.14 (3.81-5.54)	2.32 (1.73-3.12)	3.05 (2.38-3.91)	6.02 (4.89-7.41)
Cirrhosis of the liver without mention of alcohol	2.65 (2.20-3.18)	1.59 (1.29-1.95)	3.19 (2.60-3.91)	1.20 (0.94-1.54)	1.42 (1.20-1.68)	2.31 (1.82-2.94)
Nephritis and nephrosis[bc]	1.67 (1.43-1.94)	1.29 (1.17-1.43)	1.51 (1.19-1.91)	1.32 (1.15-1.52)	1.35 (1.22-1.51)	1.62 (1.33-1.96)
Complications of pregnancy, childbirth and the puerperium[d]	-	-	-	0.22 (0.08-0.61)	-	1.08 (0.39-3.00)
External causes of injury and poisoning	2.92 (2.78-3.07)	2.09 (1.96-2.22)	3.82 (3.61-4.05)	2.32 (2.17-2.48)	1.90 (1.79-2.01)	2.99 (2.77-3.22)
Traffic/transport accidents	1.78 (1.62-1.95)	1.58 (1.38-1.81)	2.24 (1.98-2.53)	1.67 (1.43-1.96)	1.28 (1.11-1.49)	1.69 (1.40-2.05)
Accidental falls[bc]	2.02 (1.76-2.32)	1.64 (1.49-1.80)	2.77 (2.33-3.28)	1.42 (1.26-1.60)	1.37 (1.25-1.51)	1.87 (1.59-2.20)
Suicide	4.25 (3.94-4.60)	3.70 (3.27-4.18)	5.00 (4.57-5.47)	3.42 (3.08-3.81)	2.63 (2.33-2.97)	3.94 (3.52-4.41)
Homicide and injury purposely inflicted by other persons[e]	3.89 (2.96-5.12)	3.50 (1.78-6.88)	10.6 (8.11-13.79)	2.44 (1.49-3.97)	2.47 (1.01-6.00)	8.69 (5.86-12.87)
Other external causes	3.96 (3.50-4.47)	2.08 (1.74-2.47)	5.26 (4.58-6.03)	3.39 (2.78-4.11)	2.27 (1.88-2.73)	4.22 (3.40-5.24)
All other causes	2.21 (2.14-2.28)	1.45 (1.41-1.49)	2.21 (2.11-2.30)	1.65 (1.59-1.70)	1.38 (1.34-1.41)	1.78 (1.70-1.86)

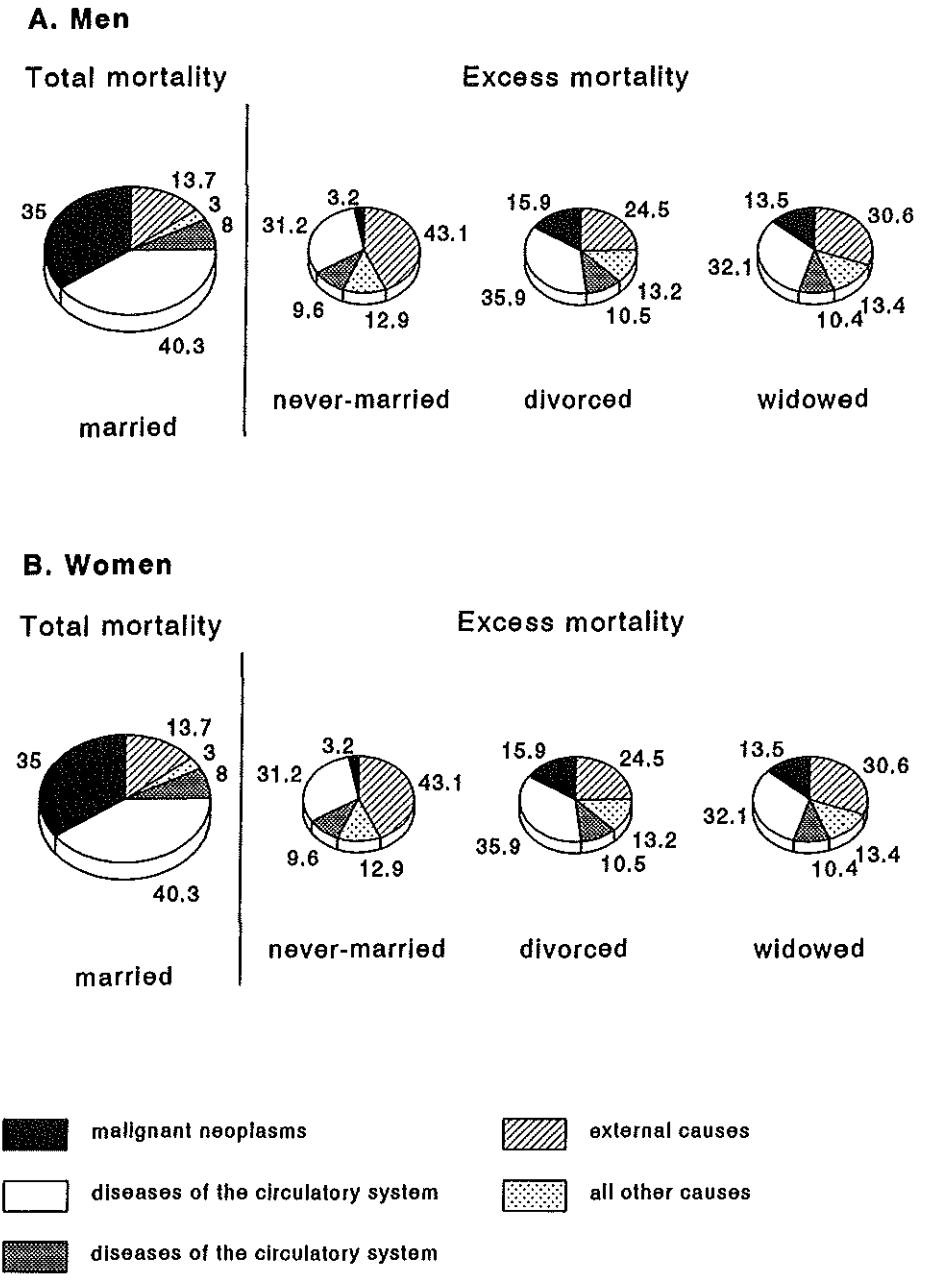
[a] Separate models have been fitted for men and women.
[b] model for men could only be fitted for age ≥45 years
[c] model for women could only be fitted for age ≥45 years
[d] model for women could only be fitted for age 25-44 years
[e] model could only be fitted for age 25-89 years for men and age 25-64 years for women

Table 2. Risk difference in mortality (RD_{ix}) per 100,000 person years (contribution to excess mortality in percentage, C_{ix}) by marital status and sex, 1986-1990

	Men						Women					
	Never married		Widowed		Divorced		Never married		Widowed		Divorced	
Total mortality	516.8	(100.0)	355.7	(100.0)	720.3	(100.0)	121.7	(100.0)	123.7	(100.0)	225.2	(100.0)
Infective and parasitic diseases	30.2	(5.9)	4.5	(1.3)	7.1	(1.0)	2.3	(1.9)	1.0	(0.8)	3.0	(1.3)
Malignant neoplasms	16.3	(3.2)	56.4	(15.9)	97.1	(13.5)	32.6	(26.8)	21.3	(17.2)	50.2	(22.3)
Stomach	4.4	(0.8)	2.3	(0.7)	1.7	(0.2)	-0.9	(-0.7)	0.9	(0.7)	0.1	(0.0)
Colon	0.9	(0.2)	2.0	(0.6)	0.6	(0.1)	3.0	(2.5)	1.4	(1.2)	0.2	(0.1)
Pancreas	1.3	(0.2)	1.1	(0.3)	1.8	(0.3)	-0.6	(-0.5)	0.5	(0.4)	1.2	(0.5)
Trachea, bronchus and lung	-13.2	(-2.6)	31.4	(8.8)	46.3	(6.4)	1.5	(1.2)	5.6	(4.5)	17.9	(7.9)
Breast	0.5	(0.1)	0.4	(0.1)	0.2	(0.0)	13.7	(11.2)	0.5	(0.4)	1.0	(0.4)
Prostate	-3.1	(-0.6)	3.5	(1.0)	5.0	(0.7)	-		-		-	
Cervix	-		-		-		-0.2	(-0.2)	2.0	(1.6)	10.7	(4.7)
Corpus uteri	-		-		-		2.3	(1.9)	0.9	(0.7)	0.7	(0.3)
Ovary	-		-		-		6.8	(5.6)	1.3	(1.0)	1.4	(0.6)
Other malignant neoplasms	25.7	(5.0)	15.7	(4.4)	41.4	(5.7)	7.0	(5.7)	8.2	(6.6)	17.1	(7.6)
Diabetes mellitus	21.0	(4.1)	11.6	(3.3)	26.7	(3.7)	-3.2	(-2.6)	6.6	(5.3)	7.5	(3.3)
Diseases of the circulatory system	161.0	(31.2)	127.8	(35.9)	231.2	(32.1)	14.5	(12.0)	43.2	(34.9)	48.9	(21.7)
Ischaemic heart disease	69.3	(13.4)	75.3	(21.2)	114.5	(15.9)	1.8	(1.4)	28.1	(22.7)	15.8	(7.0)
Other heart diseases	59.2	(11.4)	29.6	(8.3)	58.5	(8.1)	7.8	(6.4)	8.1	(6.6)	15.6	(6.9)
Arteriosclerosis	-1.7	(-0.3)	5.3	(1.5)	12.6	(1.7)	0.6	(0.5)	1.2	(0.9)	0.9	(0.4)
Cerebrovascular accident	34.3	(6.6)	17.6	(4.9)	45.7	(6.3)	4.4	(3.6)	5.8	(4.7)	16.5	(7.3)

Diseases of the respiratory system	49.6	(9.6)	37.2	(10.5)	74.6	(10.4)	7.8	(6.4)	7.6	(6.1)	22.7	(10.1)
Chronic obstructive lung diseases	26.9	(5.2)	27.6	(7.8)	51.7	(7.2)	3.6	(3.0)	5.1	(4.1)	15.5	(6.9)
Pneumonia	16.5	(3.2)	7.4	(2.1)	18.3	(2.5)	3.1	(2.6)	2.1	(1.7)	5.0	(2.2)
Other respiratory diseases	6.2	(1.2)	2.2	(0.6)	4.6	(0.6)	1.0	(0.9)	0.4	(0.3)	2.2	(1.0)
Cirrhosis of the liver with mention of alcohol	12.7	(2.5)	12.0	(3.4)	27.3	(3.8)	1.9	(1.6)	2.9	(2.4)	7.2	(3.2)
Cirrhosis of the liver without mention of alcohol	5.7	(1.1)	2.1	(0.6)	7.6	(1.1)	0.4	(0.4)	0.9	(0.7)	2.9	(1.3)
Nephritis and nephrosis	4.5	(0.9)	1.9	(0.5)	3.4	(0.5)	1.0	(0.8)	1.1	(0.9)	1.9	(0.9)
Complications of pregnancy, childbirth and the puerperium	-		-		-		-0.2	(-0.2)	-		-0.3	(-0.1)
External causes of injury and poisoning	66.8	(12.9)	46.9	(13.2)	96.4	(13.4)	25.0	(20.6)	16.0	(13.0)	33.8	(15.0)
Traffic/transport accidents	9.3	(1.8)	6.9	(1.9)	14.7	(2.0)	3.0	(2.5)	1.3	(1.0)	3.1	(1.4)
Accidental falls	7.4	(1.4)	4.6	(1.3)	12.9	(1.8)	1.6	(1.3)	1.4	(1.1)	3.2	(1.4)
Suicide	34.4	(6.6)	28.5	(8.0)	42.3	(5.9)	16.1	(13.2)	10.8	(8.8)	19.6	(8.7)
Homicide and injury purposely inflicted by others	2.1	(0.4)	1.8	(0.5)	6.9	(1.0)	0.5	(0.4)	0.5	(0.4)	2.7	(1.2)
Other external causes	13.7	(2.6)	5.0	(1.4)	19.7	(2.7)	3.8	(3.1)	2.0	(1.6)	5.2	(2.3)
All other causes	148.8	(28.8)	55.4	(15.6)	148.8	(20.7)	39.5	(32.5)	23.1	(18.7)	47.4	(21.1)

Figure 1. Contributions of broad causes of death (in percentages) to mortality by marital status



circulatory system among never-married and divorced women (35.6% of the total mortality of married women versus 12 and 22% among never-married and divorced women respectively) (figure 2). Specific causes of death which contribute more than expected to the excess mortality of all 3 groups of unmarried women are pneumonia, cirrhosis of the liver with mention of alcoholism and 'all other causes'. Among never-married women the contribution of breast cancer and ovary cancer is also higher than expected. Cancer of the trachea, bronchus and lung, diabetes mellitus, ischaemic heart disease and COLD contribute disproportionately to the excess mortality of widowed women. Cancer of the trachea, bronchus and lung, cervical cancer and COLD contribute disproportionately to the excess mortality of divorced women.

5.4. Discussion

We found that unmarried persons, among both men and women, had higher mortality risks than married persons for almost all specific causes of death investigated in this study. For men the general pattern was that the divorced had the highest risks, followed by the never-married and that the widowed had risks closest to married men. For women the general pattern was that the divorced had the highest risks, while widowed and never-married women alternately had risks closest to married women. Important exceptions to these risk patterns were found for, among others, infectious and parasitic diseases among men and for breast cancer among women. External causes of death in particular, contributed more to the excess mortality of the 3 unmarried groups of men and women than expected, while the contributions of malignant neoplasms and diseases of the circulatory system were lower than expected on the basis of the percentages of these causes of death in mortality in the married population.

Since the mortality statistics and the population statistics both have the same municipal population registration system as a basis, numerator denominator bias will hardly be a problem in our analyses of mortality differences, unlike many analyses based on population size estimates from census data.

Misclassification of the causes of death could be a problem if there is differential misclassification by marital status. Given the fact that the coding of the cause of death precedes the linkage of mortality data with demographic data, we assume that it is unlikely that differential misclassification occurs during the coding procedure. Differential misclassification could occur, however, if the cause of death is more often unknown among the unmarried than married or vice versa. Never-married persons have lower health care utilization and divorced and widowed persons have higher utilization of health services than married persons

(4,20,21). However, the fact that never-married persons use health services less, does not necessarily imply that their diseases are not diagnosed, but could also mean that given a certain disease, never-married persons consult physicians less often. This might especially be the case for The Netherlands, where financial constraints do not explain the lower use of health services among never-married persons, since ±99.5% of the population has health insurance (22). Thus, it is unlikely that differential misclassification can account for our results.

In this study we did not have information about possible confounders of the relationship between marital status and mortality, such as socioeconomic status, degree of urbanization of residence or religious affiliation. Each of these variables is associated with mortality. The distribution of these variables probably also differs among the marital status groups. The higher mortality risks of unmarried persons compared to married persons could partly be due to these variables and not to marital status itself. Thus, not controlling for these variables might lead to an overestimation of mortality differences by marital status. However, other studies concerning health differences by marital status, in which information about such factors was available, showed that health differences still existed after controlling for 1 or more of these factors (4,6,20,23).

In addition, we did not have information about the living arrangements of the deceased. One of the explanations mentioned in the literature for the health differences by marital status is that marital status affects health through social support or control (20,24-27). Since social support and control can also be provided by a partner in a consensual union, analyses by a combination of marital status and living arrangements are preferable. However, it has been shown that, besides having a common effect, marital status and living arrangements both have a separate effect on health (23). Thus, marital status is still important as an independent determinant of health. Furthermore, only a relatively small percentage of unmarried persons are cohabiting in the older age groups (where most deaths occur) and the importance of cohabitation in our analysis should therefore not be overestimated.

For both men and women, we found that the category 'all other causes' contributed disproportionately to the excess mortality of the widowed and divorced and in particular, to the excess mortality of the never-married (29 and 33% for respectively never-married men and women versus 10 and 13% respectively of the total mortality among married men and women). This category consists of, among others, mental disorders and disorders of the nervous system, for which Koskenvuo et al (10) reported very large mortality differences by marital status. Unfortunately we do not have information about the specific causes of death within the category 'all other causes' by marital status.

Our results are, in general, similar to those reported for other countries (6,9-14). Some results differed, however. For example, never-married men in our study had an extremely high RR for mortality from infective and parasitic diseases (RR=6.08). The RR of never-married men showed a clear interaction with age: the RR declines from 32.9 for the 25-44 year olds, via 11.7 for the 45-64 year olds, to 1.4 for the never-married men of 65 years and older. Tuberculosis, which has been mentioned as an explanation for the mortality differences for infective diseases found in other decades (10), hardly plays a role in the differences found in our study. Possibly mortality from AIDS, which in our data set could not be distinguished from the other infective and parasitic diseases, could explain some of the differences among men younger than 65 years. Of all men between 25 and 64 years of age in The Netherlands between 1986 and 1990, 972 died from infective and parasitic diseases; 705 of them died from AIDS (28).

In our study never-married men had lower risks for mortality from cancer of the trachea, bronchus and lung than married men. This is contrary to the results which have been reported for the United States and the United Kingdom, where never-married men had higher RRs than married men (9,11,29). From studies of smoking behaviour in The Netherlands it appears that there have been higher percentages of never smokers among never-married men than among the married men, although these differences have been declining (30-34). This could explain some of the differences in mortality from cancer of the trachea, bronchus and lung among never-married and married men in our study.

The specific causes of death which we found contributed disproportionately to the excess mortality of the unmarried almost all have unhealthy life styles as important risk factors. Alcohol is an important cause of cirrhosis of the liver, traffic/transport accidents and poisoning. Smoking is an important cause of cancer of the trachea, bronchus and lung and COLD. Obesity is an important risk factor for diabetes mellitus. Unprotected sexual activity, having several partners or a partner with several other partners is associated with cervical cancer, cirrhosis of the liver without mention of alcoholism and certain infectious diseases. This seems to point to an effect of marital status on health (social causation), either through marriage promoting healthy life styles, marriage buffering the effects of stress by providing social support and so reducing the 'need' for smoking and alcohol (palliative coping responses) or the stressful event of divorce or bereavement itself increasing the 'need' for these drugs (20,24-27).

However, it cannot be ruled out that selection effects cause the different distributions of life styles among the marital status groups. Drinking, obesity and emotional (in)stability could influence one's chances of becoming married (or divorced) as well as one's chances of contracting chronic diseases. It is also possible and likely that some of the mortality differences by marital status are caused by health selection: unhealthy persons are probably less attractive marriage

candidates and disease of 1 of the partners could increase the likelihood of divorce (8,12,35,36).

Thus, although our results point more to an effect of marital status on health as the explanation for health differences by marital status, longitudinal data are necessary to disentangle the selection effects from the social causation effects (37), preferably controlling for socio-demographic confounders such as socioeconomic status and taking into account differences in living arrangements.

Intervention strategies to decrease the mortality differences between the marital status groups should first of all be aimed at lowering the mortality from those causes of death that contribute disproportionately to the excess mortality of the unmarried, such as diabetes mellitus, cancer of the trachea, bronchus and lung, COLD, cirrhosis of the liver with mention of alcoholism and external causes of death. However, although the contribution of diseases of the circulatory system to the excess mortality of the unmarried was lower than expected, they still contributed 30-35% of the excess mortality of widowed women and all groups of unmarried men. Thus, intervention strategies could also be directed at lowering the excess mortality from diseases of the circulatory system. The diseases mentioned in both strategies have several risk factors in common such as smoking, obesity and alcohol consumption. Thus, strategies directed at these risk factors could prove to be very fruitful.

Appendix

Let RR_{ix} be the relative risk of dying from cause x for the unmarried index population i, and let R_{mx} be the mortality rate for dying from cause x in the married population. Then the risk difference for dying from cause of death x between the unmarried index population i and the married population is estimated by

$$RD_{ix} = (RR_{ix} \times R_{mx}) - R_{mx} = (RR_{ix} - 1) \times R_{mx}$$

The outcome of this formula represents the number of extra deaths per 100,000 person years that would have occurred in the married population if the married population had had the death rates of the unmarried index populations. Dividing the RD for cause of death x (RD_{ix}) by the RD for total mortality (RD_i) results in the relative contribution of this cause of death to the difference in total mortality between the unmarried index population i and the married population:

$$C_{ix} = RD_{ix} / RD_i$$

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Chapter 6

Trends in total and cause-specific mortality by marital status in The Netherlands, 1950-1990

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Abstract

We investigated (1) which changes there have been in total mortality differentials by marital status in The Netherlands in the period 1950-1990, (2) which changes there have been in the differentials of specific causes of death by marital status in this period and (3) the contributions of specific causes of death to the differentials in total mortality between marital status groups. Since 1965 several important societal changes have occurred, which, according to the social causation theory should have diminished the mortality excess of never married and divorced people. It was indeed found that the mortality differences between the divorced and married decreased during the 1970s, but the mortality differences between the never married and the married increased over the same period. Decomposing the changes in total mortality among the never married into changes in cause-specific mortality showed that, while most specific causes of death followed the trend in total mortality (i.e. mortality differences between the never married and married increased), the differences in mortality from external causes decreased. This can be explained by assuming the existence of a time lag between the societal changes and the changes in mortality rates, which differs by cause of death and by marital status. Mortality from external causes is likely to be a rather direct reflection of the changes in perceived stress, social support and social integration among the marital status groups. Effects of changes in these psychosocial factors on mortality from other causes are likely to take much longer, especially among the never married who are a relatively young group. Thus, the trends in mortality differences between the divorced and married are in agreement with the predictions of the social causation theory, while the increases in mortality differentials between the never married and married might only be seemingly in contradiction with these predictions.

6.1. Introduction

Purpose of this study

The existence of mortality differences between marital status groups has been reported for over a century and for many different countries (1-8). Results from these studies very consistently have found that married people have lower mortality rates than unmarried people. The sizes of the mortality differences between the married and the unmarried groups have changed over time. Hu and Goldman (9) found, for instance, in a study of mortality differences between marital status groups in 16 industrialized countries, that the excess mortality of the

unmarried groups had increased in the majority of countries during the period 1950-1980.

In the study described here we investigated the changes in the differences in total mortality by marital status in The Netherlands in the period 1950-1990, and the changes in the contribution of specific causes of death to differences in total mortality by marital status in this period. By decomposing the changes in the mortality differential by marital status into changes in specific causes of death, and by relating the changes in mortality differentials to the huge changes which occurred in the marriage and marriage dissolution rates, in the link between marital status and living arrangement, and in the societal values and regulations concerning marriage and divorce, we tried to increase our understanding of the causes of health differences by marital status.

There are two major theories about the explanation of health differences by marital status: the selection theory and the social causation theory. The selection theory states that marital status depends upon health: healthier persons may be more likely to (re)marry than unhealthy persons. According to the social causation theory health depends upon marital status: marriage may promote health or may have a health protective effect, while being unmarried would have adverse health effects. The selection and social causation theory are not mutually exclusive and most researchers maintain that a combination of selective and causal factors are responsible for the observed patterns of health between marital status groups (6,10-14). The question of the relative contributions of the selection and social causation mechanism to the explanation of health differences between marital status groups remains to be answered and requires longitudinal data (15,16). In this study we investigated whether the changes in total and cause-specific mortality by marital status in The Netherlands between 1950-1990 were in agreement with predictions of the social causation theory.

The social causation theory

According to the social causation theory, marital status causes health differences through differences in intermediate factors such as psychosocial stress, social integration, social support, health behaviours and material resources (14,17-20). *Psychosocial stress* is assumed to vary between the marital status groups. Bereavement and divorce are stressful events themselves (21). Societal stigmatizing of never married and divorced persons is a source of stress. The amount of psychosocial stress experienced is also assumed to vary with the level of a person's status integration in the population (19). Gibbs (19) argues that persons with low status integration, with which he means persons in infrequently occupied configurations of, for instance, marital, parental or employment statuses, are less able to maintain stable social relationships and to conform to societal expectations, and thus are more likely to experience role conflict. So, the status integration theory predicts

that declining proportions of a certain unmarried group are associated with increasing levels of stress and vice versa. *Social integration*, which refers to the existence and quantity of social relationships, also differs between marital status groups. Social integration improves health because it meets important human needs for security, social contact, belonging and affection (22). Married persons are more socially integrated for several reasons. They at least have one social tie in their spouse; their children constitute additional social ties which most never married persons lack; and their social network is expanded with the social ties of their spouse. *Social support* can buffer the negative health effects of stress. Partner relationships are found to be more supportive than other types of relationships (23). Married persons are also found to engage more often in positive *health behaviours* than unmarried persons (20,24-27). Several mechanisms could be operating here. Social control: married persons try to influence their partners health behaviours (20,24). Social support is important in health behaviour changes: partner support is beneficial to smoking cessation maintenance (28-31). Finally psychosocial stress, which is more frequent among unmarried persons, could increase negative health behaviours: smoking and drinking as palliative coping responses (20,32). A final intermediary of the relationship between marital status and health are *material resources*. Changes in marital status are often associated with large changes in material resources (decline in or loss of income, poor housing; double incomes, economies of scale in consumption) which could affect health. One should keep in mind, however, that marital relationships can also have negative health effects. For instance, marital problems are a source of stress and social control in an environment in which hazardous health behaviours are valued, could have unfavourable consequences. In general, however, marriage has been found to be favourably associated with the intermediaries.

Demographic and other changes concerning marital status in The Netherlands during the period 1900-1990

Since changes in the mortality differentials between marital status groups in the period 1950-1990 could originate from societal changes which took place before this period, we will review the societal changes which have occurred in The Netherlands since approximately 1900. The changes in family formation and living arrangement which have occurred in The Netherlands have been similar to those in other Western countries, although there have been differences in the time of occurrence and the extent of the changes. At least four types of changes occurred: changes in the marriage and marriage dissolution rates, in the link between marital status and living arrangement, in the societal values concerning marriage and divorce and in the material conditions of unmarried persons[1].

Firstly, there have been changes in *marriage rates and marriage dissolution rates.* The period between 1965 and 1970 is a breaking point in the trends of marriage and divorce rates. The rate of first marriage, which had been increasing gradually since 1900, sharply decreased between 1971 and 1983. Since 1983 the rates of first marriage have been constant. The divorce rate, which had been increasing gradually since the previous century, showed, after a small decline between 1950 and 1965, an exponential increase between 1965 and 1985. Marriage dissolution by death of the husband or wife shows ongoing trends: marriage dissolution by death of the wife has continuously been decreasing since 1900, marriage dissolution by death of the husband has been increasing since 1945. The changes in marriage and marriage dissolution rates have resulted in substantial changes in the composition of the Dutch population by marital status in the period 1899-1990 (table 1).[2]

Table 1. Composition of the population (≥ 25 years of age) by marital status, sex and year in crude percentages with directly age-standardized percentages[a] in brackets

Sex	Year	Marital status				
		% never married	% married	% widowed	% divorced	total
Men	1899[b]	22.1 (20.9)	70.1 (69.7)	7.7 (9.3)	0.2 (0.2)	100.0
	1909[b]	21.3 (20.0)	71.3 (70.6)	7.1 (8.8)	0.3 (0.3)	100.0
	1930[b]	18.7 (17.6)	74.7 (74.2)	6.0 (7.7)	0.6 (0.6)	100.0
	1950[b]	16.2 (16.0)	77.6 (76.9)	5.1 (5.9)	1.1 (1.1)	100.0
	1969[b]	10.9 (11.1)	83.7 (83.6)	4.2 (4.0)	1.2 (1.2)	100.0
	1990[c]	19.0	72.2	3.2	5.7	100.0
Women	1899[b]	21.2 (19.6)	64.1 (60.1)	14.5 (20.0)	0.3 (0.3)	100.0
	1909[b]	21.1 (19.4)	65.5 (61.2)	13.0 (18.9)	0.4 (0.4)	100.0
	1930[b]	19.7 (18.5)	68.9 (64.3)	10.4 (16.3)	0.9 (0.9)	100.0
	1950[b]	16.3 (16.0)	71.6 (67.6)	10.5 (14.8)	1.6 (1.5)	100.0
	1969[b]	10.2 (10.3)	75.0 (73.7)	12.9 (14.2)	1.9 (1.8)	100.0
	1990[c]	13.1	66.2	13.9	6.8	100.0

[a] The population of 1990 has been used as standard population

[b] CBS. Bevolking van Nederland naar geslacht, leeftijd en burgerlijke staat, 1830-1969 (Population of the Netherlands by sex, age and marital status 1830-1969). 's-Gravenhage: Staatsuitgeverij, 1970.

[c] CBS. Bevolking van Nederland naar burgerlijke staat, geslacht leeftijd en land van nationaliteit, 1 januari 1990 (Population of the Netherlands by marital status, sex and country of nationality, January 1st 1990). Mndstat bevolk (CBS) 1991;38(9):31-36.

A second change was the fading of the *link between marital status and living arrangement*. Until the 1960s marital status used to correspond with a specific living arrangement: married persons lived with their spouse, young never married persons lived with their parents, and widowed, divorced and older never married persons lived on their own or with family. Since the beginning of the 1970s a growing percentage of unmarried persons has been living with a partner. Of persons of 25 years of age and older, 20-25% of the never married men and women, 25% of the divorced men, 13% of the divorced women, 12% of the widowed men and 4% of the widowed women lived with a partner in 1989/1990 (33).[3] Another phenomenon in this period was the growing percentage of persons living single.[4] It has become common for young never married persons to have a household of their own, and less divorced and widowed persons move in with family after the loss of their spouse.

The demographic changes have been accompanied by *changes in societal values and attitudes* regarding marriage and divorce. Idealization of marriage has declined, especially in the past decades: marriage has gradually been disconnected from feelings, needs and strivings associated with human happiness, such as security, safety, intimacy, sexuality, communication, reproduction and status. While, for instance in 1965 60% of interviewees believed that, in general, married persons were happier than others, in 1975 only 35% of interviewees held this belief, and in 1991 a meagre 14% was left (34). Marriage itself has also changed. During the first half of the twentieth century the ideal of the companionship marriage, which was based on the harmony model, spread over all layers of society. In order to maintain the harmony in the marriage, sacrifices had to be made. Since it was in practice the wife, who had to make sacrifices by making her needs and desires subordinate to those of her husband, the companionship marriage had in fact a patriarchal character. Since the 1960s the ideal of the companionship marriage had to compete with the ideal of self-development, based upon the equality of the wife and husband in the marital relationship. Through the emergence of marriages based upon the ideal of self-development, the traditional roles of wife and husband in the marriage started to loose their significance and married persons started to show more resemblance to unmarried persons. Housework and child care have been viewed more and more as the mutual responsibility of wife and husband (34). The number of married women in paid employment grew from 7% in 1960 to 47% in 1990, approaching the employment rates of unmarried women (56% in 1960 and 64% in 1990) (35). Together with the decrease in idealization of marriage and the change in division of roles within marriage, the prejudices against, and stereotyped images of never married persons gradually decreased (36) and other living arrangements were accepted as attractive alternatives to marriage (34,37). Views on the indissoluble tie of matrimony also became more liberal. While in 1947 48% of interviewees was in support of making

the legal act of divorce more difficult, this percentage was 39 in 1960 and 11 in 1970 (38). Whereas in 1965 48% of interviewees held the view that a divorce was not acceptable if there were still children living at home, only 13% of interviewees held this view in 1970 and 4% in 1991 (34).

Besides these changes in societal values and standards concerning marriage and divorce, there have also been *material changes* which have made the lives of unmarried persons easier. In 1959 the Widows and Orphans Act (Algemene Weduwen- en Wezenwet) and in 1965 the General Welfare Act (Algemene Bijstandswet) have become operative, which provide a minimum income to widows and orphans respectively all other persons who are temporary or permanent unable to earn an income. Through these Acts widows and, for instance, divorced women are no longer dependent on charity, but have guaranteed minimum incomes. Discrimination against unmarried people in tax and social security legislation has decreased. And finally, the building of smaller apartments for single-persons or non-family households and changes in the housing allocation have improved the accommodation of never married and no longer married persons.

Expected changes in the mortality differences between marital status groups according to the social causation theory

How could the demographic and societal changes have affected the intermediate factors between marital status and mortality and, consequently, the mortality differences between marital status groups according to the social causation theory? *Demographic changes:* The decrease in proportions of never married men and women until 1970 and the ongoing decrease in the proportion of widowers in the population will, according to the status integration theory, have increased the psychosocial stress experienced by these groups in the periods concerned. Likewise, the increasing proportions of divorced men and women and widows in this century and the increase in the proportion of never married since 1970 will have been associated with a decrease in psychosocial stress. *Changes in living arrangement:* The status integration theory is also applicable to the growth of persons living in a consensual union. In the beginning of the seventies this will have been rather stressful, but the amount of stress will have decreased with the increasing proportion of unmarried persons living with a partner. Persons living in a consensual union are also likely to benefit from the social support and control provided by their partner, and their social network will be extended with family and friends of their partner. The increase in one person households, however, might enlarge the health differences between the married and unmarried, at least among men. Kobrin (12) described that unmarried men living in one person households had higher mortality rates than unmarried men living in a household as a family member (while not being the family head), whereas the opposite was

found for unmarried women. The more liberal *societal values* and the changes in *material regulations* concerning marital status will have had favourable health effects for unmarried persons.

In summary, after 1965 large changes have occurred in The Netherlands with regard to marriage and divorce. The sudden decrease in first marriage rates and the huge increase in divorce rates, the increasing numbers of unmarried couples sharing a household, the decrease in societal stigmatizing of never married and divorced persons and the favourable changes in material conditions of unmarried persons would, according to the social causation theory, all have had favourable health effects for unmarried persons and consequently would have caused a reduction of mortality differences between unmarried and married persons. However, as mentioned in the introduction, Hu and Goldman (9) found that in several industrialized countries the excess mortality of the unmarried groups increased during the two to three decades preceding 1980. Thus, the trends in mortality differences between marital status groups seem in contradiction with predictions of the social causation theory.

In this study we investigated (1) whether the trend of marital status differences in total mortality in The Netherlands during the period 1950-1990 was in contradiction with predictions from the social causation theory, (2) whether this was also true for the trends of differences in mortality from specific causes of death and (3) which specific causes of death contributed most to the differences in total mortality between marital status groups.

6.2 Materials and methods

Materials

In this study we have used the mortality statistics and the population statistics of Statistics Netherlands (39,40). The mortality data used in this study consisted of information about the underlying cause of death, marital status, age and sex of all deceased persons in The Netherlands for the years 1950-1990. During the period 1950-1990 four successive ICD's have been used in The Netherlands: the 6th revision during the period 1950-1957, the 7th revision during the period 1958-1968, the 8th revision during the period 1969-1978, the 9th revision during the period 1979-1990. The ICD-revisions reflect the progress in medical sciences and generally the previous version is refined. In this study all ICD-codes have been recoded according to the 6th revision. We present data on mortality from infectious and parasitic diseases, malignant neoplasms, diseases of the cardiovascular system, diseases of the respiratory system, external causes and all other causes. In the analyses the data of each successive period of 5 years have been aggregated, only

the first period consisted of 6 successive years (1950-1955). The analyses have been confined to the Dutch population of 25 years and older and men and women have been analyzed separately.

Methods

In order to describe the trends in mortality differences by marital status we have used Poisson regression (41). Separate models have been fitted for total mortality and mortality from the specific causes of death. In the models we have controlled for age coded as 13 five-year categories and a rest category for the oldest age group (25-29, 30-34,.., 90+ years of age). The trends in mortality are estimated by using an interaction term for marital status and period:

$$\ln(Y_{ijx}) = \ln(P_{ijx}) + \alpha + \sum_{i=1}^{3}(\beta_i . ms_i) + \sum_{j=1}^{7}(\gamma_j . per_j) + \sum_{x=1}^{13}(\delta_x . age_x) + \sum_{i=1}^{3}\sum_{j=1}^{7}(\lambda_{ij} . ms_i . per_j)$$

in which

Y_{ijx} = the number of deaths (total mortality or due to a specific cause of death) in marital status group i of age group x during period j,

P_{ijx} = the population size of marital status group i of age group x during period j,

α = the intercept,

β_i = regression coefficient of marital status group i,

ms_i = dummy variable of marital status group i (there are 3 dummy variables for marital status, respectively for the never married, the divorced and the widowed; the married are the reference category),

γ_j = regression coefficient of period j,

per_j = dummy variable of period j (there are 7 dummy variables for period; period 1950-1955 is the reference category),

δ_x = regression coefficient for age group x,

age_x = dummy variable of age group x (there are 13 dummy variables for age group; age group 25-29 years of age is the reference category),

λ_{ij} = regression coefficient of the interaction term of marital status group i and period j.

The regression coefficients and standard errors of marital status (β_i) and the interaction term for marital status and period (λ_{ij}) have been used to calculate relative risks (RR) with 95% confidence intervals for the marital status groups. Models have been fitted using the statistical package EGRET (42,43).

In order to estimate the contribution of each specific cause of death to the differences in total mortality by marital status, we have used the RR of the unmar-

ried groups to calculate risk differences (RD) for dying from the specific causes of death between each of the unmarried groups and the married:

$$RD_{ic} = (RR_{ic} * R_{mc}) - R_{mc} = (RR_{ic} - 1) * R_{mc}$$

in which

RD_{ic}= risk difference for dying from cause of death 'c' between the unmarried index population 'i' (respectively the never married, the divorced and the widowed) and the married population,

RR_{ic}= relative risk of dying from cause 'c' for the unmarried index population 'i',

R_{mc} = death rate for dying from cause 'c' in the married population.

The outcome of this formula represents the number of extra deaths per 100 000 person years that would have occurred in the married population if the married population had had the death rates of the unmarried index populations.

Dividing the RD of each cause of death by the RD of total mortality results in the relative contribution of the cause of death to the differences in total mortality:

$$C_{ic} = RD_{ic} / RD_i$$

in which

C_{ic} = relative contribution of cause of death 'c' to the difference in total mortality between unmarried population 'i' and the married population

RD_i = risk difference for total mortality between unmarried population 'i' and the married population

Contrary to the RR_{ic}s the RD_{ic} and C_{ic}s also take into account the importance of a specific cause for overall mortality.

6.3. Results

The changes in total mortality differentials by marital status

Figure 1a shows the trends in total mortality by marital status for men, controlled for age. Married men in period 1950-1955 were the reference category. During the whole study period married men had the lowest mortality risks, followed by respectively widowed and never married men, while divorced men had the highest risks. The RRs for total mortality of all marital status groups increased between periods 1950-1955 and 1971-1975, then decreased. This trend was most distinct among divorced men, and was less pronounced among never married and

widowed men than among married men. The effects of the trends in total mortality on the relative mortality differences by marital status are shown in figure 1b. Married men were the reference category, which means that their RR is set to 1.00 for each period. Compared to married men the RR of divorced men decreased between 1971-1975 and 1981-1985. The RR of never married and widowed men, however, increased after 1966-1970.

Figure 1. Trends in total mortality by marital status among men, 1950-1990

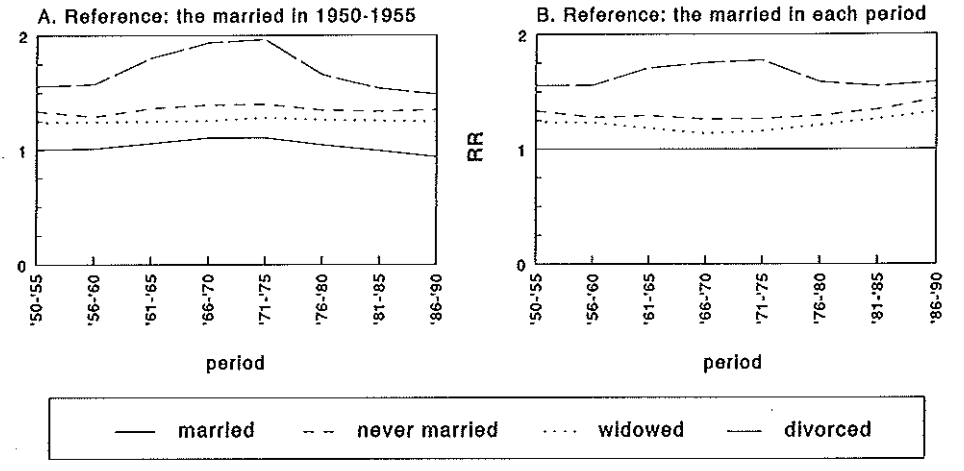


Figure 2. Trends in total mortality by marital status among women, 1950-1990

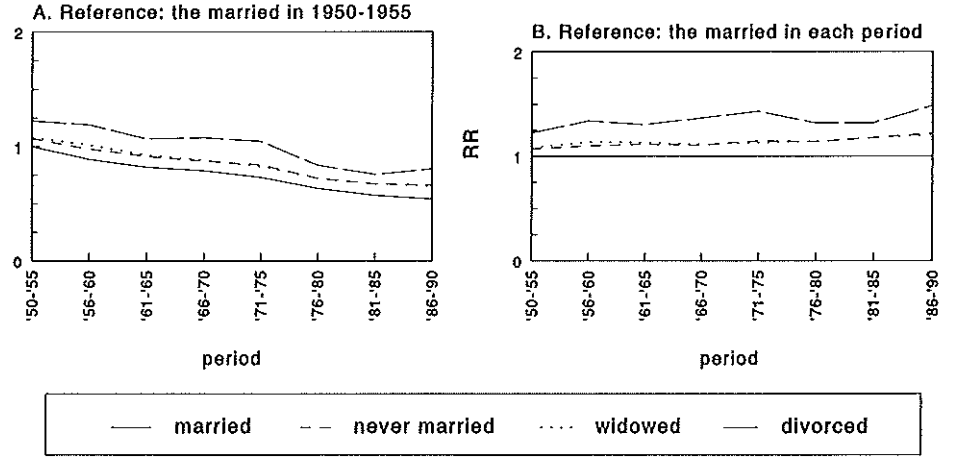


Figure 2a shows the trends in total mortality by marital status for women, controlled for age. Married women in period 1950-1955 are the reference category. The mortality differences between marital status groups are much smaller among women than among men. During the whole study period married women have the lowest mortality risks and divorced women the highest. The risks of never married and widowed women largely overlap. Contrary to the trends among men, we see among women a steady decline of the RRs of all marital status groups. The effects of the trends in total mortality on the relative mortality differences by marital status are shown in figure 2b. As among the men, we see that compared to the married women, the RR of divorced women decreased between 1971-1975 and 1981-1985, while the RR of never married and widowed women increased.

Changes in the differentials of specific causes of death by marital status

First describe the trends in cause-specific mortality among men are described. Figure 3 shows the trends in mortality from respectively infectious and parasitic diseases, malignant neoplasms, diseases of the cardiovascular system, diseases of the respiratory system, external causes and all other causes. Married men during the first period 1950-1955 were the reference category. In general, the same trend in mortality is found for all marital status groups: mortality from infectious and parasitic diseases and mortality from all other causes decreased, and mortality from malignant neoplasms decreased between 1950-1990. Both for diseases of the cardio-vascular system and for the external causes, mortality increased until 1971-1975, then decreased. There were, however, differences in the amount of increase or decrease between the marital status groups. For instance, the increase in mortality from external causes between 1950-1955 and 1971-1975 was much larger for unmarried (and especially divorced) men than married men. There were also several deviations from the general trends. Mortality from infectious and parasitic diseases of never married men increased sharply in the period 1986-1990.[5] Among divorced men mortality from malignant neoplasms decreased from 1976-1980 onward and their mortality from the other causes increased until 1976-1980. Finally, the trends in mortality from diseases of the respiratory system were different for the different marital status groups.

Figure 4 shows the trends in mortality from the specific causes for women. Married women during period 1950-1955 were the reference category. Again we found largely similar trends in cause-specific mortality by marital status. Mortality from external causes increased until 1971-1975 and decreased thereafter. Mortality from all other causes of death declined. The largest differences in the amount of increase and decrease between the marital status groups were found for mortality from external causes. The increase in mortality from external causes between 1950-1955 and 1971-1975 was much larger among the unmarried than married women and the increase among divorced women lasted until 1976-1980.

Figure 3. Trends in specific causes of death among men, 1950-1990

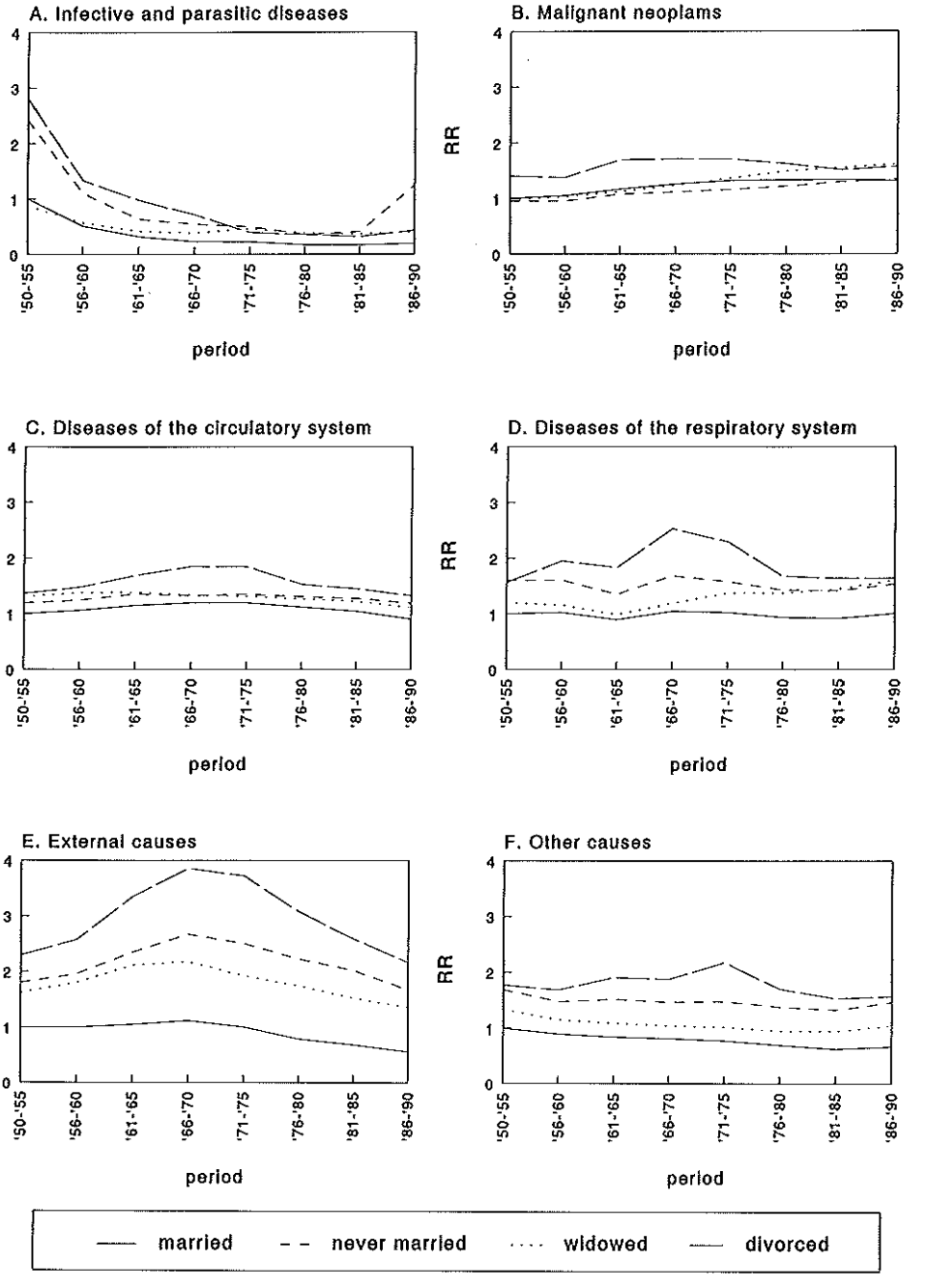
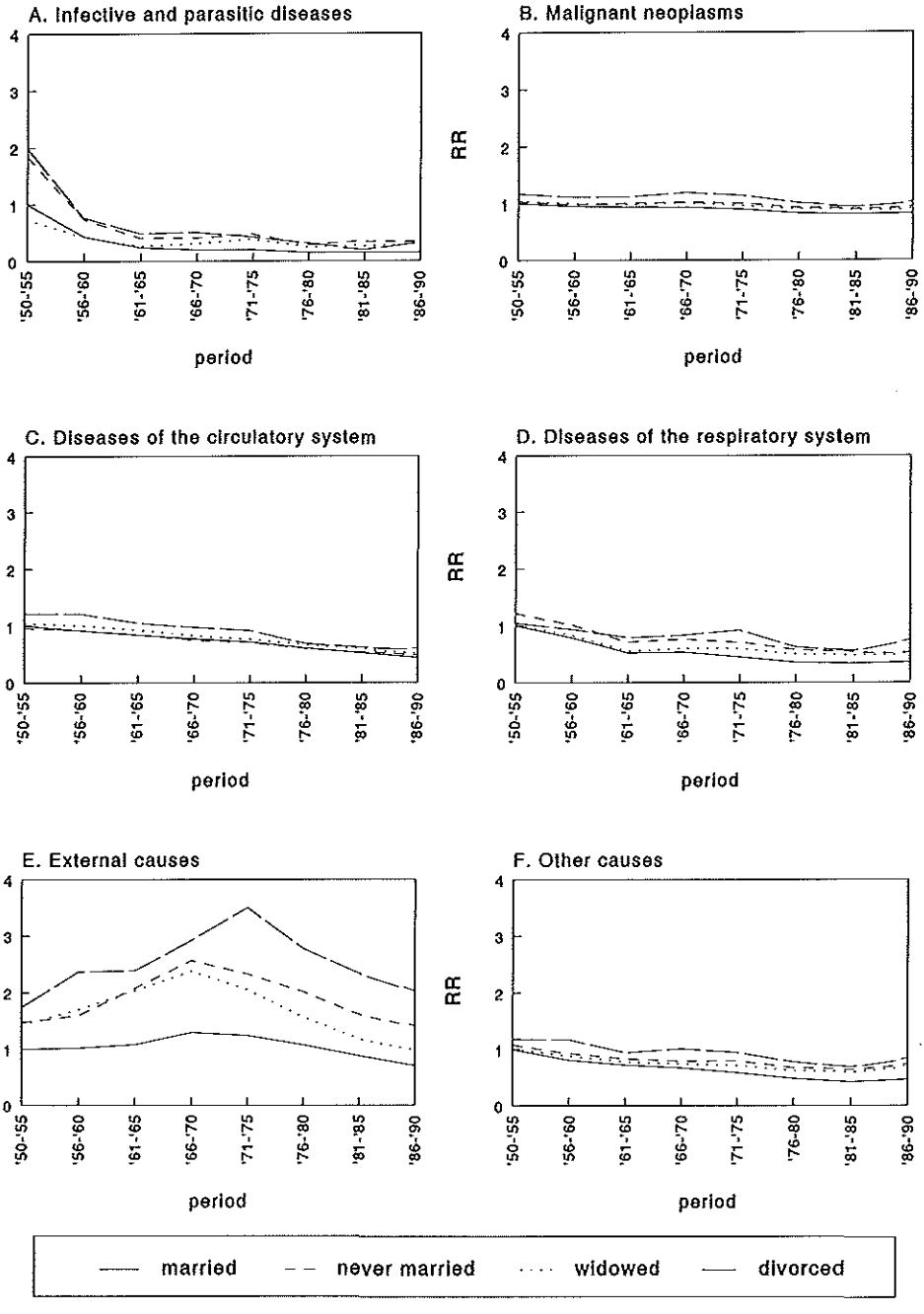


Figure 4. Trends in specific causes of death among women, 1950-1990



Changes in the contributions of specific causes to total mortality differentials by marital status

In table 2 the RDs and Cs of the causes of death to the excess mortality of unmarried men are shown. The RDs and Cs give an impression of the importance of the specific causes of death for *excess mortality*, which can not be obtained from the RRs. For instance, despite the extreme high RR for mortality from external causes, they contributed less to the excess mortality of unmarried men than cardiovascular diseases. Also shown in table 2 are the absolute and relative contributions of these causes of death to *total mortality of married men*. The contributions of the causes of death to total mortality of married men constitute a frame of reference against which the Cs of the unmarried can be evaluated. Table 2 shows that, while total mortality of all 3 unmarried groups first increased and then decreased, only the (total) risk difference of divorced men showed this pattern. The (total) risk differences of never married and widowed men first decreased and then increased. Especially mortality from cardiovascular diseases, and to a lesser extent mortality from respiratory diseases, external causes and the 'other' causes of death, contributed to the large increase in the RDs among divorced men between 1950-1955 and 1966-1970. The increase in RDs among never married men between 1971-1975 and 1986-1990 was mainly caused by increases in mortality from cardiovascular diseases, but also by mortality from infectious and parasitic diseases, malignant neoplasms and the 'other' causes of death. The increase in RDs among widowed men between 1971-1975 and 1986-1990 was caused by increases in mortality from malignant neoplasms, and to a lesser extent mortality from cardiovascular diseases, respiratory diseases and the 'other' causes of death. Comparing the Cs of the causes of death to the excess mortality of unmarried men to the contribution of these causes to total mortality of married men showed that cardiovascular diseases and malignant neoplasms contributed relatively less to the excess mortality of unmarried than to the total mortality of married men, and that external causes and the 'other' causes of death contributed relatively more. However, despite the fact that cardiovascular diseases contributed less to the excess mortality of unmarried men than could be expected by their significance for total mortality, mortality from cardiovascular diseases proved to be the single most important cause of death in explaining the trends in mortality differences between unmarried and married men.

The consequences of trends in specific causes of death for the RDs and Cs of *unmarried women* are shown in table 3. Also shown are the absolute and relative contributions of these causes of death to *total mortality of married women*. While total mortality of all 3 unmarried groups steadily decreased, the RDs of divorced women first increased and then decreased, and the RDs of the never married and widowed women even showed a steady increase. Mortality from malignant neoplasms, external causes and the 'other' causes were responsible for the trend in

Table 2. Risk differences (RDs) and contributions (Cs) of the specific causes of death to the excess mortality of unmarried men and to total mortality of married men

	RD between unmarried and married (deaths/100.000)			C to excess mortality of the unmarried		
	1950-1955	1966-1970	1986-1990	1950-1955	1966-1970	1986-1990
Never married						
infectious + parasitic diseases	36,80	8,23	27,32	11,89	3,08	7,12
malignant neoplasms	-10,23	-35,20	7,85	-3,30	-13,15	2,04
cardiovascular diseases	77,43	50,58	112,68	25,01	18,91	29,35
respiratory diseases	39,56	42,12	34,96	12,78	15,74	9,11
external causes	44,39	86,46	61,41	14,34	32,31	15,99
other causes of death	121,58	115,35	139,70	39,28	43,11	36,39
total excess mortality	309,54	267,55	383,93	100,00	100,00	100,00
(total mortality)	(1276,98)	(1335,56)	(1291,55)			
Divorced						
infectious+parasitic diseases	46,88	12,65	6,21	8,70	1,54	1,18
malignant neoplasms	101,79	115,97	65,58	18,88	14,14	12,46
cardiovascular diseases	144,36	253,30	164,82	26,78	30,88	31,31
respiratory diseases	37,26	97,52	41,80	6,91	11,89	7,94
external causes	71,92	152,05	88,88	13,34	18,54	16,88
other causes of death	136,89	188,69	159,11	25,39	23,01	30,23
total excess mortality	539,10	820,19	526,40	100,00	100,00	100,00
(total mortality)	(1506,54)	(1888,20)	(1434,01)			
Widowed						
infectious+parasitic diseases	-3,23	4,09	5,48	-1,45	2,57	1,75
malignant neoplasms	-3,62	-6,08	76,47	-1,62	-3,81	24,41
cardiovascular diseases	122,57	52,53	80,78	54,94	32,93	25,78
respiratory diseases	13,34	9,59	39,50	5,98	6,02	12,61
external causes	34,41	58,77	44,21	15,42	36,85	14,11
other causes of death	59,63	40,59	66,90	26,73	25,45	21,35
total excess mortality	223,10	159,49	313,32	100,00	100,00	100,00
(total mortality)	(1190,54)	(1227,50)	(1220,93)			
	mortality rate (deaths/100.000)			contribution to total mortality		
Married, total mortality						
infectious+parasitic diseases	25,91	5,91	5,04	2,68	0,55	0,56
malignant neoplasms	253,21	318,54	333,48	26,17	29,83	36,74
cardiovascular diseases	389,10	467,70	352,68	40,22	43,79	38,86
respiratory diseases	65,72	68,74	65,91	6,79	6,44	7,26
external causes	55,49	62,04	31,38	5,74	5,81	3,46
other causes of death	178,01	145,08	119,13	18,40	13,58	13,13
total mortality	967,45	1068,01	907,61	100,00	100,00	100,00

Table 3. Risk differences (RDs) and contributions (Cs) of the specific causes of death to the excess mortality of unmarried women and to total mortality of married women

	RD between unmarried and married (deaths/100.000)			C to excess mortality of the unmarried		
	1950-1955	1966-1970	1986-1990	1950-1955	1966-1970	1986-1990
Never married						
infectious+parasitic diseases	13,23	3,29	3,23	34,66	5,02	3,37
malignant neoplasms	7,22	17,47	22,77	18,93	26,64	23,73
cardiovascular diseases	-10,24	-5,45	12,26	-26,83	-8,31	12,78
respiratory diseases	8,24	8,79	6,67	21,58	13,40	6,95
external causes	9,56	25,83	14,49	25,06	39,39	15,11
other causes of death	10,15	15,66	36,52	26,59	23,87	38,06
total excess mortality	38,16	65,58	95,94	100,00	100,00	100,00
(total mortality)	(689,70)	(579,50)	(454,53)			
Divorced						
infectious+parasitic diseases	15,45	4,85	2,92	10,76	2,49	1,65
malignant neoplasms	32,50	49,59	39,23	22,64	25,46	22,19
cardiovascular diseases	54,51	51,44	42,41	37,96	26,41	23,98
respiratory diseases	1,85	11,19	15,15	1,29	5,74	8,57
external causes	15,03	33,08	26,90	10,46	16,98	15,21
other causes of death	24,25	44,65	50,20	16,89	22,92	28,39
total excess mortality	143,60	194,80	176,81	100,00	100,00	100,00
(total mortality)	(795,14)	(708,72)	(535,40)			
Widowed						
infectious+parasitic diseases	-4,10	1,77	2,65	-14,66	2,65	3,06
malignant neoplasms	9,12	15,76	16,21	32,61	23,67	18,74
cardiovascular diseases	12,03	14,20	22,96	43,00	21,33	26,54
respiratory diseases	0,68	2,56	6,15	2,43	3,84	7,11
external causes	8,79	22,05	5,93	31,43	33,12	6,85
other causes of death	1,45	10,24	32,61	5,18	15,38	37,69
total excess mortality	27,97	66,58	86,51	100,00	100,00	100,00
(total mortality)	(679,52)	(580,50)	(445,10)			
	mortality rate (deaths/100.000)			contribution to total mortality		
Married, total mortality						
infectious+parasitic diseases	15,66	3,09	2,29	2,40	0,60	0,64
malignant neoplasms	190,08	177,37	155,03	29,17	34,51	43,23
cardiovascular diseases	255,93	198,32	112,86	39,28	38,59	31,47
respiratory diseases	37,78	20,24	13,36	5,80	3,94	3,73
external causes	20,31	26,32	14,32	3,12	5,12	3,99
other causes of death	131,79	88,59	60,72	20,23	17,24	16,93
total mortality	651,54	513,92	358,59	100,00	100,00	100,00

excess mortality among divorced women. Among never married and widowed women the increase in excess mortality was caused by the combination of increases in mortality from malignant neoplasms, cardiovascular diseases and other causes of death. Comparison of the Cs of the causes of death to the excess mortality of unmarried women to their contributions to total mortality of married women, gave similar results as among men. In general, cardiovascular diseases and malignant neoplasms contributed less to the excess mortality of the unmarried women than to the total mortality of married women, and external causes and the 'other' causes of death contributed more.

6.4. Discussion

According to the social causation theory the societal changes which took place after 1965 should have caused reductions in the mortality differences between the married and the unmarried. The mortality differences between the divorced and married decreased indeed during the 1970s, but the mortality differences between the never married and married increased. Thus, the changes in mortality differences between the divorced and the married seemed at least partly to correspond with the predictions of the social causation theory, and the changes in mortality between the never married and the married seemed not to correspond with the predictions at all. Decomposing the changes in total mortality among the never married into changes in cause-specific mortality showed that, while most specific causes of death followed the trend in total mortality (i.e. mortality differences between the never married and married increased), the differences in mortality from external causes decreased. Among the divorced most specific causes, including the external causes, followed the trend in total mortality (i.e. mortality differences between the divorced and married decreased). Additionally, it was found that, despite the fact that cardiovascular diseases contributed less to the excess mortality of unmarried men than could be expected by their significance for total mortality, mortality from cardiovascular diseases proved to be the single most important cause of death in explaining the trends in mortality differences between unmarried and married men. Among women malignant neoplasms, cardiovascular diseases and the 'other' causes cooperated in bringing about the increase in RDs.

There are several methodological issues which should be kept in mind when interpreting our results. Since the mortality statistics and the population statistics both have the same municipal population registration system as basis, numerator denominator bias will hardly be a problem in our analyses of mortality differences, unlike many analyses based on population size estimates from census data.

Misclassification of the causes of death is only a problem if there is differential misclassification by marital status, which seems unlikely. Problems could arise, however, with regard to the recoding of the ICD-revisions. In revisions new diseases are sometimes added or diseases are classified elsewhere which complicates the process of recoding. Changes in medical views or diagnostic techniques can affect the recording of causes of death on the Death Certificate. Since only broad categories of causes of death were distinguished in our study, we do not believe that this might have affected our results.

Another issue is that we did not have information about possible confounders of the relationship between marital status and mortality, such as socioeconomic status, degree of urbanization of residence, or religious affiliation. Each of these variables is associated with mortality. The distribution of these variables probably also differs among the marital status groups. The higher mortality risks of unmarried persons compared to married persons partly could be due to differences in these confounders and not to marital status itself. So not controlling for these variables might lead to an overestimation of mortality differences by marital status. However, other studies concerning health differences by marital status, in which information about such factors was available, showed that health differences still existed after controlling for one or more of these factors (5,7,17,44). More problematic, however, is that there could have been changes in these variables over time and that these changes might have differed between the marital status groups. It seems unlikely, however that changes in these variables over time could account for the decrease of the excess mortality among the divorced of the unexpected increase of the excess mortality of the never married.

The trends in family formation and living arrangement, and the changes in the societal values and material regulations which have occurred since 1965, would, according to the social causation theory predict decreases in the mortality differences between the married and the never married and divorced. The changes in RDs and Cs of *total mortality* of divorced men and women seemed only partly in agreement with these predictions, but those of the never married seemed not at all. The RDs and Cs of mortality from *cardiovascular and malignant neoplasms* decreased for divorced men and women, but increased for the never married men and women between 1971-1975 and 1986-1990. However, the changes in RDs and Cs of the *external causes* were in agreement with the predictions of the social causation theory among all unmarried groups.

How can this be explained? Our first hypothesis is that time lags should be assumed between the occurrence of societal changes and the consequent change in mortality rates, the size of which might differ by the specific societal changes, the specific causes of death and between the marital status groups. Therefore, a direct comparison of the predictions deduced from the social causation theory and the

observed differences in total mortality is not justified. Mortality from external causes of death and especially suicide is likely to be a rather direct reflection of the changes in perceived stress, social support and social integration among the marital status groups. The effects of these intermediaries on mortality from cardiovascular diseases and malignant neoplasms are likely to have a longer time lag. In addition, the size of the lag time for these degenerative diseases might be larger for changes concerning never married people than for changes concerning divorced or widowed persons: as never married people are on average younger than divorced and widowed people, their mean survival time is larger at the time of occurrence of relevant societal changes than the survival time of divorced and widowed people.

Our second hypothesis is that the declines in mortality differences from degenerative diseases will be smaller than for the never married than for the divorced. A larger proportion of never married people who cohabit will eventually marry than of divorced people. Long-term beneficial effects of living in a consensual union will therefore to a lesser extent be represented in the mortality rates of never married than among divorced persons. Additionally, it is probable that the societal changes such as the decline in stigmatizing and the improvement in material living conditions will have larger beneficial effect for the divorced than for the never married.

In this paper we have focused on social causation as an explanation for mortality differences between marital status groups. As was mentioned in the introduction, an alternative explanation for marital status differences in mortality is the selection theory. In order to determine the relative contributions of social causation and selective processes to mortality differences by marital status longitudinal data are required (15,16). Given the cross-sectional nature of our data, this study is unfit to solve this still unresolved problem.

It should be considered here, however, whether the trends in mortality differences between the marital status groups could also result from selection effects. Studies in which the selection theory was tested often have been based on hypotheses concerning the correlations between the proportion of unmarried people in the population and their mortality rates (9,11,45). In these studies it was assumed that when health selection was the (main) explanation for the mortality differences between marital status groups, it might be expected that the greater the proportion of married people in the population and consequently the smaller the proportion of unmarried people, the stronger health selection would be, and thus the larger the health differences between the married and unmarried persons and vice-versa. In the Netherlands first marriage rates sharply decreased between 1971 and 1983 and divorces rates largely increased between 1965 and 1985. According to the above mentioned hypothesis of the selection theory these changes in marriage and divorce rates should be associated with a decrease in the

mortality differences between the married and unmarried. A decrease in the mortality differences was indeed found between the divorced and married, but not between the never married and married.

Goldman (15), however, testing the validity of the hypothesis in a simulation model, found that under the assumption of health selection, increasing proportions of married persons could be associated with both larger and smaller health differences between marital groups. The underlying assumption of the negative relationship between the proportion never married persons and the magnitude of the relative mortality risks, is that differences in the proportion of never married persons result entirely from differing marriage rates among the healthy: only healthy persons enter marriage and when the proportion of never married persons is relatively large more healthy persons have chosen not to marry. However, when differences in the proportion of never married persons would result predominantly from varying degrees of discrimination against unhealthy persons (e.g. a decrease in the proportion of never married persons might result from an increased entrance of unhealthy persons into marriage), increasing marriage rates might be associated with decreasing mortality differences between the never married and married. Thus, when the proportion of unmarried people in the population increases, marital selection might explain both increasing and decreasing mortality differences between marital status groups.

In order to explain the trends in mortality differences between the marital status groups in The Netherlands from the selection theory, one has to assume that the increase of the proportion of never married people resulted from a decreased entrance of unhealthy persons into marriage, while the increase of the proportion of divorced people between 1971-1975 and 1981-1985 resulted from an elevation of divorce rates among predominantly healthy persons. Too little is known of health selection in marital transitions to determine the plausibility of these assumptions. Further (longitudinal) research is required on this issue.

In conclusion, the differences in total mortality by marital status do not or only partly decrease, despite the occurrence of beneficial societal changes for the unmarried. Decomposing the changes in the mortality differences by marital status into changes in specific causes of death shows, however, that the marital status differences in mortality from external causes, for whom little or no time lag is expected between occurrence of the societal changes and the occurrence of changes in mortality, decrease. Declines of the differences in mortality from malignant neoplasms and diseases of the cardiovascular system and consequently a decrease in the differences of total mortality are, particularly for never married persons, expected to occur only in the coming decades. Additionally, declines of the differences in mortality from malignant neoplasms and diseases of the cardiovascular system among never married people are likely to be smaller than

those for divorced persons. Thus, increases in differences in total mortality between the unmarried and married are not necessarily in contradiction with the social causation theory.

Notes

1. With the term unmarried persons we refer to all persons who are not married, so never married, divorced and widowed persons.
2. Changes in mortality rates by marital status and changes in emigration and immigration patterns by marital status have also contributed to the change in the composition of the Dutch population by marital status, but to a lesser extent.
3. In these figures persons of the same generation of the same or the opposite sex living in the same household are considered as partners. This means that brothers and/or sisters who live together are included in the figures (33).
4. Persons who do not share a household with other adults are considered as single, irrespective of the presence of children in the household.
5. The increase in mortality from infectious and parasitic diseases among never married men in the period 1986-1990 is probably due to AIDS.

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Part II

Explanatory studies

Chapter 7

A longitudinal study of health selection in marital transitions

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Abstract

We examined whether differences in health were associated with different probabilities of marital transitions in a longitudinal study. Data on approximately 10 000 Dutch persons of the GLOBE-study, aged 25-74 years, were used for this purpose. The study started in 1991 and study subjects have been followed for 4,5 years. Of the four marital transitions studied (marriage among never married and divorced persons, and divorce and bereavement among married persons), only divorce among married persons was associated with health status: married persons who reported four or more subjective health complaint or two or more chronic conditions were 1.5 respectively 2 times more likely to become divorced during follow-up than persons without these health problems. Since hardly any other studies have examined the role of health selection in marital transition with longitudinal data, more research is required before firm conclusions can be drawn. It can be concluded, however, that the frequently made assumption that health selection contributes only little to the explanation of health differences between marital status groups, seems, at least for the divorced, not justified.

7.1. Introduction

In contrast to the many descriptive studies, research of the explanation of the relationship between marital status and health has been more scarce, although there has been a growth of explanatory studies in the past two decades (1-9). There is general agreement that two processes could be responsible for the health differences between marital status groups, marital selection and social causation mechanisms. According to the marital selection theory the relatively good health status of married persons is the result of the selection of 'healthy' persons into, and 'unhealthy' persons out of the married state, thus increasing the relative amount of unhealthy persons in the unmarried states (3,6,7,9-11). According to the social causation theory marriage has a health promoting or a health protective effect, while being unmarried would have adverse health effects (5,8,12,13). In the social causation theory the effect of marital status on health is generally assumed to be intermediated by psychosocial factors, material circumstances and health behaviours (4,13-21). The marital selection theory and social causation theory are not mutually exclusive and most researchers maintain that a combination of selection and causal factors can account for the health differences between marital status groups (4,7,8,13,22,23). Several longitudinal studies have provided evidence that social causation mechanisms are operative in the association between marital status and health (2,4,24-26). Studies testing the selection hypothesis mainly have

used indirect argumentation and the evidence resulting from these studies in favour of selection effects is far from conclusive.

Approaches to test the validity of the selection theory have mainly used aggregate patterns of mortality by marital status, derived from cross-sectional data (6,7,9, 27,28). The hypotheses tested in these approaches were based on the age patterns of mortality differentials. It was hypothesized that if marriage selection was operative, the mortality differentials between never married and married people would increase throughout the marriageable ages (from age 20 to age 35-40), and decrease thereafter (from age 40 onwards as first marriage become rare) (9). Observations consistent with this age pattern, which can be found in many countries (see for example (6)), have been taken as support for the selection theory (6,9,27,28). Additionally, hypotheses were based on the correlation between the relative size of the unmarried population and the magnitude of the mortality differentials between the unmarried and married (6,7,9). It was hypothesized that, if health selection was the main explanation for the mortality differences between marital status groups, populations in which only a small proportion of the population remained never married should be characterized by larger mortality differences between the married and never married than populations in which larger proportions remain never married. This correlation between the relative size of never married and divorced populations and magnitude of mortality differentials has indeed been demonstrated across countries and within countries over time and has been taken as evidence of the importance of the marital selection theory (6,7,9).

There are, however, two problems with the legitimacy of these approaches. Firstly, the hypotheses derived from the marital selection theory can be criticized (3,29,30). Goldman (3,29) developed a simulation model of the marriage selection process, with which she showed that, under the assumption of health selection, mortality differentials between never married and married persons could show many contrasting age patterns. The simulation model (3) also demonstrated that, under the assumption of health selection, increasing proportions of married persons in the population could be associated with both larger and smaller health differences between marital groups.

Besides the problem with the justifiability of the hypotheses, there is a second problem with the legitimacy of the approaches. Even if the hypotheses derived from the marital selection theory were correct, they would only be supportive of the selection theory at the expense of the importance of the social causation theory, if hypotheses deducted from the social causation theory would predict contrasting, or at least other, age patterns of the mortality differentials, or another (non-negative) correlation between the relative size of the never married population and the magnitude of the mortality differentials. However, several theories which try to explain how marital status could affect health (social causation)

predict similar associations. For instance, social integration theories also predict decreasing mortality differentials of marital status groups after ages 35-40 (5,31). Social integration has been found to be positively associated with health (32,33) and social integration of married persons is likely to be largest under age 40, when children are present in the household (5,31). Additionally, the status integration theory, which assumes that the amount of psychosocial stress varies with the level of a person's status integration in the population (34,35), predicts both increasing mortality differentials between ages 20 and 40 and a negative correlation between the size of the never married population and magnitude of the mortality differentials. Persons with low status integration, i.e. persons in infrequently occupied configurations of marital, parental or employment statuses, would be less able to maintain stable social relationships and to conform to societal expectations, and thus would be more likely to experience role conflict. Reasoning from the status integration hypothesis being never married at a young age is not stressful, but when one is middle aged or even older and still never married, this (rare) situation would cause stress and subsequently illness. The status integration theory also predicts that declining proportions of a certain unmarried group are associated with higher levels of stress. Thus, the results of previous studies using aggregate patterns in cross-sectional mortality data can not be used as evidence for the selection theory. Longitudinal data are required to unambiguously establish the time order of events: do health differences precede marital status or does marital status precede health differences.

In this longitudinal study we examined whether differences in health at baseline were associated with different probabilities of marital transitions during a follow-up period of approximately 4,5 years. Four transitions were studied: marriage among never married and divorced persons, and divorce and bereavement[1] among married persons. If health differences between marital status groups are at least in part the result of selection on health, health at one point in time is expected to predict the probability of changes in marital status later in time. We expected that never married and divorced person in good health would be more likely to marry than those in ill health, and that married persons in ill health would be more likely to divorce or become widowed than those in good health.

7.2. Material and methods

Material

We have used data of a subpopulation of the GLOBE-study, consisting of all respondents living in Eindhoven at the time of the baseline measurement (n=10811). From the municipality of Eindhoven we received information on marital transitions, deaths and migrations from Eindhoven of the respondents for

the period between March 1991 and August 1995 including the corresponding dates of occurrence. From the other municipalities in the study area (and other Dutch municipalities if respondents moved from the study area) we also gathered information on marital transitions. However, information on dates at which the marital transitions took place outside Eindhoven was not complete and was therefore not used in the analyses.

For each of the marital transitions the analysis have been restricted to the age ranges in which the marital transition under study was common. The analyses of marriage among never married persons have been restricted to persons in the 20-39 age range at baseline, the analyses of divorce among married persons and marriage among divorced persons to the 20-64 age range and the analyses on bereavement among married persons to the 45-74 age range. Marriage among widowed persons has not been studied because of the rare occurrence of this event in our study population (only 6 of the 699 widowed persons at baseline married during the follow-up).

Several health measures have been used to test wether health differences at one point in time were associated with differences in the likelihood of marital transitions later on: perceived general health, subjective health complaints and chronic conditions. The question regarding perceived general health was "how is your health in general?". For the analyses the answer categories were dichotomized in good ('very good', 'good') and less-than-good ('fair', 'sometimes good and sometimes bad', 'bad'). The subjective health complaints consisted of 13 complaints, such as regularly upset stomach and often feeling tired. Respondents were divided in those with none, one to three and four or more complaints. With regard to the chronic conditions the respondent was asked to check for each of 23 listed chronic conditions whether they had this condition or whether they had been under treatment or control for this condition during the previous year (e.g. chronic obstructive lung diseases, serious heart disease or heart attack). Distinguished were persons with none, one, and two or more chronic conditions.

In the analyses we have controlled for several socio-demographic variables for which associations with both marital status transitions and health status have been shown: age (coded as 5-year age groups), sex, educational level (primary school, low vocational and lower general secondary; intermediate vocational and higher general secondary; higher vocational and university), religious affiliation (roman catholic; other; not religious) and employment status (gainfully employed; unemployed; student or in military service). All variables have been coded as dummy variables.

Methods

Cox proportional hazard models (36) have been fitted using the COXREG procedure in SPSS (37) in order to estimate health related differences in the probabil-

ity of marital transitions while controlling for the effects of other covariates. Separate models have been fitted for each of the four marital transitions and three health measures. In each of the models the 'healthy' category was the reference category. The regression coefficients and standard errors have been used to calculate relative risks (RR) and 95% confidence intervals (CI). In all models we have controlled for age, sex, educational level, religious affiliation and employment status. Since 'unhealthy' never married and divorced persons were hypothesized to have lower marriage probabilities, their RRs were expected to be smaller than 1.00. Since 'unhealthy' married persons were hypothesized to have higher divorce and bereavement probabilities, their RRs were expected to be larger than 1.00.

Marital transitions indicate the legal change in marital status. Since the social causation processes which are assumed to be associated with marital status are not likely to occur from one day to the next simultaneous with the change in legal marital status, social causation processes might already have influenced health before the actual marital transition. If, with regard to the transition from the married to divorced state, the marital problems that caused the divorce already were present at the time of the baseline health measurement and already had resulted in a deterioration of health, we would find that ill health was associated with increased divorce probabilities. This could be interpreted as support for the marital selection theory, while, instead, causal processes were involved. Similarly, with regard to the transition from the married to the widowed state, severe illness of one of the spouses might be a source of physical and emotional strain in the other spouse. In order to diminish these problems supplementary analyses have been carried out in which the time between the health measurement and the start of the observation period is gradually increased. In the first model of divorce and bereavement among married persons all events which occurred during the follow-up have been included. In the second model the events which occurred in the first year following baseline measurement and in the third model those occurring in the first two years following baseline measurement have been excluded from the analyses. As the time between health measurement and start of the observation period increases, social causation effects on the measurement of baseline health are assumed to decrease.

With regard to marriage probabilities, never married and divorced persons who have a relationship with a partner at the time of the baseline measurement already might have experienced positive health effects from this relationship and might also be more likely to become married than unmarried persons without a partner. Relating the baseline measurement of health to marriage probabilities would show an increased likelihood of marriage among persons in good health. In order to diminish these problems, models of marriage among never married and divorced

persons have been fitted without and with control for partner status at baseline (cohabiting; partner, but not cohabiting; no partner).

The adequacy of the proportional hazard assumption was examined by using a standard graphical method (36,37): for each marital transition the log-minus-log survival functions of the separate health categories were plotted against time. For all four marital transition the differences between the plots of the health categories were nearly constant. Additionally, the proportional hazard assumption was tested by modelling health status as a time dependent variable: the effects of health status on marital transition were allowed to vary with the log of time since baseline measurement (36,38). The models in which the effect of health status was allowed to vary over time were not significantly better than models in which proportional hazards were assumed. Thus, both methods indicated that the assumption of proportional hazards was reasonable.

Persons have been followed until the occurrence of the event under study or censored at either the end of follow-up, date of death or date of migration from Eindhoven. In the analysis of divorce among married persons, respondents who became widowed during the follow-up period have been censored at the date of bereavement. Similarly, in the analyses of the bereavement among married people, respondents who became divorced have been censored at the date of divorce. Table 1 shows for each of the marital transitions the number of the population at risk and the number of events and persons censored by cause of censoring.

Table 1. Study subjects by marital status at baseline, number of events and the number of persons censored by cause of censoring

	Transition:			
	never married ↓ married	divorced ↓ married	married ↓ divorced	married ↓ widowed
(age-range)	(20-39)	(25-64)	(25-64)	(≥45)
total population at risk	1601	701	5349	5047
events	296	84	144	272
censured cases:				
- end of follow-up	846	539	4704	4323
- other marital transition	-	-	145	63
- death	1	22	111	247
- emigration	29	4	31	18
- migration	429	52	214	124
(number of events among the migrated)	(15)	(4)	(1)	-

7.3. Results

Transition from never married to married

Table 2 shows for 'healthy' and 'less healthy' never married persons their RRs on marriage. None of the health measures showed a statistically significant association with marriage probability. Also, no support whatsoever was found for the selection hypothesis in the pattern of the RRs. The addition of partner status to the model hardly changed the RRs of 'healthy' and 'unhealthy' never married persons. The RRs for the control variables in the model containing partner status and chronic conditions are shown in the Appendix. Most control variables were significantly related to marriage probability. Particularly employment status and partner status were important predictors of subsequent marriage among never married persons. Gainfully employed persons were most likely and students and persons in military service were least likely to marry. Persons who already lived with a partner were most likely and persons without a partner were least likely to marry.

Table 2. Health related differences in the probability of marriage among never married persons during 4 years of follow-up[a]; relative risks (95% confidence intervals)

	without control for partner status		with control for partner status	
Perceived general health				
good	1.00		1.00	
less	0.97	(0.67 -1.38)	1.13	(0.79 -1.63)
Subjective health complaints				
0	1.00		1.00	
1-3	1.09	(0.82 -1.45)	1.13	(0.85 -1.51)
>4	0.94	(0.68 -1.30)	0.90	(0.64 -1.24)
Chronic conditions				
0	1.00		1.00	
1	1.12	(0.85 -1.48)	1.17	(0.88 -1.56)
>2	1.22	(0.82 -1.80)	1.21	(0.82 -1.79)

[a] in both models there has been controlled for age, sex, educational level, religion and employment status

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Transition from divorced to married

None of the health measures showed a statistically significant association with marriage probability among divorced persons (table 3). Also, no support whatsoever was found for the selection hypothesis in the pattern of the RRs. For instance the RRs of chronic conditions rather seemed to point to larger marriage probabilities of 'unhealthy' than of 'healthy' divorced persons. Addition of partner status to the model did not cause any major changes in the estimates of the RRs. The RRs for the control variables in the model containing partner status and chronic conditions are shown in the Appendix. Marriage among divorced persons decreased with age, was larger among men than women and was largest among persons who lived with a partner.

Table 3. Health related differences in the probability of marriage among divorced persons during 4 years of follow-up[a]; relative risks (95% confidence intervals)

	without control for partner status		with control for partner status	
Perceived general health				
good	1.00		1.00	
less	0.99	(0.61 -1.61)	1.07	(0.65 -1.74)
Subjective health complaints				
0	1.00		1.00	
1-3	1.10	(0.54 -2.23)	0.99	(0.49 -2.01)
>4	1.11	(0.55 -2.21)	1.10	(0.55 -2.18)
Chronic conditions				
0	1.00		1.00	
1	1.20	(0.69 -2.10)	1.27	(0.73 -2.21)
>2	1.41	(0.80 -2.49)	1.53	(0.87 -2.70)

[a] in both models there has been controlled for age, sex, educational level, religion and employment status

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Transition from married to divorced

Differences in subjective health complaints and chronic conditions were significantly related to divorce probability (table 4): the larger the number of subjective health complaints and chronic conditions the larger the likelihood of divorce. These associations remained largely unchanged after exclusion of divorces which occurred in the first and first two years following baseline measurement. Married

persons with four or more subjective health complaints were 1.5 times more likely to become divorced than persons with less complaints. Married persons with two or more chronic conditions were two times more likely to become divorced than persons with less chronic conditions. Of the control variables only age was significantly related to divorce probability, while the association between employment status and divorce probability was borderline significant (see Appendix).

Table 4. Health related differences in the probability of divorce among married persons[a]; relative risks (95% confidence intervals)

	divorces in years 0-4		divorces in years 1-4		divorces in years 2-4	
Perceived general health						
good	1.00		1.00		1.00	
less	1.39	(0.95 -2.05)	1.06	(0.67 -1.69)	1.24	(0.71 -2.14)
Subjective health complaints	*					
0	1.00		1.00		1.00	
1-3	0.92	(0.58 -1.47)	0.92	(0.55 -1.54)	1.10	(0.57 -2.15)
>4	1.52	(0.96 -2.41)	1.26	(0.75 -2.12)	1.59	(0.81 -3.11)
Chronic conditions	**		*		**	
0	1.00		1.00		1.00	
1	1.17	(0.77 -1.76)	0.95	(0.59 -1.55)	0.98	(0.52 -1.81)
>2	2.04	(1.35 -3.08)	1.94	(1.22 -3.09)	2.35	(1.34 -4.12)

a in all models there has been controlled for age, sex, educational level, religion and employment status

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Transition from married to widowed

None of the health measures showed a statistically significant association with bereavement probability (table 5). Of the control variables age, sex and religious affiliation were significantly related to probability of widowhood (see Appendix). Not surprisingly bereavement was higher among women than men and increased with age.

Table 5. Health related differences in the probability of widowhood among married persons[a]; relative risks (95% confidence intervals)

	bereavement in years 0-4		bereavement in years 1-4		bereavement in years 2-4	
Perceived general health						
good	1.00		1.00		1.00	
less	0.82	(0.49 -1.38)	1.19	(0.88 -1.61)	1.22	(0.86 -1.75)
Subjective health complaints						
0	1.00		1.00		1.00	
1-3	1.20	(0.83 -1.73)	1.27	(0.83 -1.95)	1.28	(0.78 -2.12)
>4	1.08	(0.74 -1.57)	1.17	(0.76 -1.82)	1.21	(0.72 -2.04)
Chronic conditions						
0	1.00		1.00		1.00	
1	1.06	(0.78 -1.44)	1.08	(0.76 -1.54)	1.29	(0.86 -1.93)
>2	0.95	(0.69 -1.30)	0.96	(0.67 -1.37)	0.98	(0.64 -1.51)

[a] in all models there has been controlled for age, sex, educational level, religion and employment status

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

7.4. Discussion

We examined whether differences in health were associated with different probabilities of marital transition during a period of approximately 4,5 years after baseline health measurement. Of the four marital transitions studied, only divorce among married persons was associated with health status at baseline: married persons who reported 4 or more subjective health complaints or two or more chronic conditions were 1.5 respectively 2 times more likely to become divorced during follow-up than persons without these health problems. Additional control for possible social causation processes by excluding divorces which occurred in the first respectively first two years after the baseline health measurement from the analyses, did not alter these results.

In the interpretation of the results several issues regarding our data-collection and data-analysis need to be considered. First of all, our study population is constituted from a sample of the non-institutionalized population. Obviously, inclusion of the institutionalized population would have increased the probability that the hypothesized health related differences in marital transitions would have been

found. However, the institutionalized population only constitutes a small proportion of the total population (approximately 1.7% of the total population and 0.8% of the population aged 20-74 in The Netherlands in 1992 (39)). Additionally, not all inhabitants of institutions remain there for health reasons (39). Furthermore, while mortality studies often have considered the total population (5,6,40-42), most studies addressing morbidity differences between marital status groups have been restricted to data of the non-institutionalized population and many of them have found substantial differences in morbidity (13,43-45). Thus, health selection effects should also be detectable within the non-institutionalized population if health selection indeed plays a role of importance in the explanation of health differences between marital status groups.

Secondly, the data on health status and the control variables are self-reported. This could have biased the results if there would have been systematic differences in the answering of the questions by marital status. With regard to this issue it is important to make a distinction between 'illness' (subjective interpretation of the person involved) and 'disease' (clinically diagnosed) (46). Since our data on health status are self-reported they should primarily be considered measures of subjective health ('illness'). It probably would have been preferable to examine both subjective and objective health measures. In decisions concerning marital transitions generally a second person is involved. If health status of the respondent is an issue in marital transitions, this second person will make his/her own evaluation of the respondent's health status. Probably this second person considers both information about the respondent's objective and subjective health status. However, little (or nothing) is known on this subject. It is possible that (more) effects of health selection could have been demonstrated if objective health measures had been used. This needs further research.

With regard to the data-analysis, a source of bias could have been introduced in our study by the censoring of persons at the time they migrated from the city of Eindhoven. These persons were censored at the date of migration, because, although marital transitions itself were generally known, most dates of marital transition were unknown.[2] To examine the potential effects of censoring persons at the point they migrated from Eindhoven, the analyses were repeated, including the migrants who did not experience a marital transition until the end of follow-up. In the analyses the missing dates of persons who did experience a marital transition, were replaced by estimations of the dates of marital transition (marital transitions were assumed to have occurred in the middle of the period between migration from Eindhoven and the date we received information on the marital transition). The results of these analyses were virtually identical to those reported above (results not shown). Finally, men and women have been analyzed simultaneously, while controlling for sex. This would have obscured selection effects if the association between health differences and subsequent marital transition

would have been opposite for men and women. In order to examine this possibility, we tested whether there was statistically significant interaction between sex and health status (results not shown). This proved not to be the case.

We are only aware of one other study which has reported on the effects of health differences on subsequent probabilities of marital transition, and in this study only the transition from the never married to the married state was investigated (47). Mastekaasa studied whether never married persons in Norway (aged 20-39 years) with differences in psychological well-being were differentially selected into marriage, while adjusting for physical health (47). Two health measures were used in the analyses: respondents who reported any disease which restricted daily activities in some way were distinguished from those who did not, and respondents with 'poor' and 'not quite good' self-assessed health were distinguished from others. Mastekaasa found that having a restricting disease reduced the probability of marriage of never married men (n=6431), but not of never married women (n=3252). Limiting our analyses to never married men and distinguishing only two health categories, those without and those with at least one chronic conditions, we did not find statistically significant differences in marriage likelihood nor did the size of the RRs point to lower marriage probabilities of the 'unhealthy' (data not shown). Cultural differences between Norway and The Netherlands might be involved. However, since the study of Mastekaasa and our study seem to be the first to examine the role of health selection in the transition from the never married to the married state in a longitudinal design, no firm conclusions regarding the contradictory findings can be drawn. More research with other data sets is required to reproduce either of these findings and to determine the role of cultural differences. Since we are not aware of any previous longitudinal studies examining the role of health selection in the other marital transitions, the need for other studies to reproduce our findings before firm conclusions can be drawn, applies even more so with regard to marriage among divorced persons and the divorce and bereavement among married persons.

In order to diminish potential social causation effects in the analyses of divorce among married persons, supplementary analyses were carried out in which the time between the health measurement and the start of the observation period was gradually increased up to two years. Is this period sufficient to exclude potential social causation effects? Divorce is a legal condition which has to be brought before the court of law. The procedure at the court takes on average 1-2 months when there is mutual consent among the spouses and 0.5-1 year in more complicated cases. Thus, the period of two years seems reasonable with regard to the duration of the legal procedure. However, decisions concerning divorce are probably not taken from one day to the next and the duration of the decision process might show large variations between individuals. However, the fact that

RRs of divorce did hardly decrease if time between health measurement and the start of the observation period was increased, supports the assumption that the differences in RRs are due to health selection. In order to further control for potential social causation effects, the analyses were repeated with simultaneous control for all three health measures. We assume that marital problems will affect perceived general health and subjective health complaints to a larger extent than the chronic conditions. If differences in chronic conditions still are related to divorce probabilities after adjustment for perceived general health and subjective health complaints, this strongly suggests that health selection is operative. The RRs of divorce among married persons with 2 or more chronic conditions after adjustment for perceived general health and subjective health complaints were 1.97 (divorces in years 0-4), 2.13 (divorces in years 1-4) and 2.39 (divorces in years 2-4).[3] We feel that our study demonstrates convincingly that health selection is operative in the transition from the married to the divorced state.

Our findings suggested that selection on health did not occur with regard to marriage among never married and divorced persons and bereavement among married persons. On the one hand this seems implausible, since one would expect that if health selection indeed occurs in one marital transition, health selection also plays a part in other marital transitions. On the other hand, it is conceivable that processes involved in the different marital transitions are not quite the same. Firstly, with regard to partner selection it has been described that persons generally tend to marry partners with resembling traits such as physical attractiveness (48). This so-called assortive mating (49) probably also includes health status (50). A tendency to select partners with resembling traits, however, might differentially affect the transitions from the unmarried to the married state and from the married to the divorced state. With regard to the first transition assortive mating would not as much influence *whether* one marries as well *whom* one marries. Thus, 'healthy' and 'unhealthy' unmarried persons might have comparable marriage probabilities, but the 'healthy' might be more likely to marry 'healthy' others, while the 'unhealthy' might be more likely to marry 'unhealthy' others. Subsequent changes in health status, however, might be relevant for marital dissolution. Discrepancies in health status which arise in an initially healthy couple, might cause, or contribute to, marriage dissolution. These hypotheses need further research. In any case, the finding that health selection only plays a role in the transition from the married to the divorced state is not as implausible as it might seem at first sight. Additionally, this finding might partially explain why generally higher excess morbidity is found among divorced people than among never married and widowed people.

In this study only selection on health was examined. In the literature a distinction is made between direct (selection on health) and indirect selection (3). In the case of indirect selection, determinants of health (factors associated with health

and illness) are assumed to be the selection criteria, such as socioeconomic status, physical appearance (e.g. body height, obesity), health-related habits (e.g. alcohol consumption) and emotional stability (3). Evidence from a number of studies suggests that marital transition probabilities indeed differ by some of these health-related characteristics (50-53). Especially in young age groups where the prevalence of health problems is rather small, it is conceivable that indirect selection is more important than direct selection. Some support for this assumption can be found in the fact that among the never married many statistically significant associations were found between the control variables and the probability of marriage but not for the health measures (see Appendix). The fact that no direct selection could be demonstrated for most of the marital transitions studied should therefore not be interpreted as evidence of absence of selection in these transitions. Indirect selection processes might be present and need further research.

The detection of differences in divorce probabilities between 'healthy' and 'unhealthy' married persons, raises the question to what extent health selection can account for health differences between married and divorced persons. Unfortunately, no data on health status at the end of the follow-up period were available. In order to obtain some idea of the contribution of selection to the explanation of health differences between marital status groups, two logistic regression models were fitted. In the first model, health differences (as measured at baseline) were estimated between those who would remain married (reference category) and those who would become divorced during the follow-up period, while controlling for age, sex, educational level, religious affiliation and employment status. The health measures were dichotomized in 'good' versus 'less-than-good' perceived general health, less than 4 versus 4 or more subjective health complaints and less than 2 versus 2 or more chronic conditions. In the second model, health differences were estimated between those married at baseline (reference category) and those divorced at baseline, while controlling for the same variables. Results are shown in table 6. Under the assumption that health status will remain equal during the follow-up period, health selection is able to account for substantial parts of differences between the divorced and married in perceived general health (36%), subjective health complaints (78%) and chronic conditions (over 100%) (table 6).[4] Of course the population of persons who will become divorced during the follow-up period is not quite comparable with the population of divorced persons at baseline, for instance because the latter also consists of persons who have been divorced for longer than 4,5 years and divorced persons with the worst health status might already have died. Furthermore, the finding that health selection might explain all health differences between married and divorced people is in conflict with the evidence that social causation processes substantially contribute to the explanation of health and mortality differences between marital status groups (2,4,24-26). Thus, more longitudinal research of

health selection in marital status transitions is required, before firm conclusions on the relative contribution of selection and social causation processed to health differences between marital status groups can be drawn.

In summary, large and highly significant differences in divorce probabilities were demonstrated between 'healthy' and 'unhealthy' married persons. The differences in chronic conditions still existed after additional control for possible social causation effects, i.e. exclusion of divorces which occurred in the first respectively the first two years after baseline measurement and after adjustment for perceived general health and subjective health complaints. We conclude that our study demonstrated convincingly that health selection is operative in the transition from the married to the divorced state. Additionally, our findings further suggest that the frequently made assumption that health selection contributes only little to the explanation of health differences between marital status groups, seems, at least for the divorced, not justified. More research is required before firm conclusions regarding the presence of health selection in the other marital transitions can be drawn and the relative contribution of selection and social causation processes to health differences between marital status groups can be assessed. The issue of indirect selection in marital transitions also needs further research.

Table 6. Health differences between married and divorced persons, solely due to health selection and due to both health selection and social causation, logistic regression models[a]; odds ratios (95% confidence intervals)

	Perceived general health (less-than-good)	Subjective health complaints (≥ 4)	Chronic conditions (≥ 2)
Effect of health selection[b] (persons married at baseline)			
- married until end-of-follow-up	1.00	1.00	1.00
- divorced at end-of-follow-up	1.39 (0.94 - 2.06)	1.58 (1.11 - 2.24)	1.92 (1.29 - 2.84)
Combined effects of health selection and social causation			
- persons married at baseline	1.00	1.00	1.00
- persons divorced at baseline	2.08 (1.73 - 2.48)	1.73 (1.45 - 1.75)	1.45 (1.19 - 1.75)

[a] adjusted for age, sex, educational level, religious affiliation and employment status
[b] it is assumed that health status as measured at baseline will remain unchanged during follow-up

Appendix. Differences in the probability of marital transition by the control variables for the marital transition

	marriage among never married persons (with control for partner status)	marriage among divorced persons (with control for partner status)	divorce among married persons (divorce in years 0-4)	widowhood among married persons (bereavement in years 0-4)
Age	*	*	**	**
20-24	1.00			
25-29	0.97	1.00	1.00	
30-34	0.82	1.48	0.95	
35-39	0.39	0.74	0.72	
40-44		0.57	0.46	
45-49		0.34	0.23	1.00
50-54		0.47	0.24	1.62
55-59		0.43	0.17	1.64
60-64		0.25	0.09	4.72
65-69				6.66
70-74				9.00
Sex		**		**
male	1.00	1.00	1.00	1.00
female	1.14	0.51	0.73	2.65
Educational level	*			
high	1.00	1.00	1.00	1.00
medium	1.29	0.85	1.31	1.39
low	0.88	0.97	1.19	1.55
Religion	*			*
roman catholic	1.00	1.00	1.00	1.00
other	1.40	1.78	1.25	0.98
non	0.85	1.20	0.99	1.64
Employment status	**		†	
gainfully employed	1.00	1.00	1.00	1.00
unemployed	0.62	1.15	1.50	0.98
student/military service	0.23	-	-	-
Partner status	**	**		
cohabiting	1.00	1.00		
partner, not cohabiting	0.46	0.37		
no partner	0.19	0.39		
Chronic conditions			**	
0	1.00	1.00	1.00	1.00
1	1.17	1.27	1.17	1.06
>2	1.21	1.53	2.04	0.95

[a] in all models there has been controlled for age, sex, educational level, religion and employment status

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Notes

1. The concept of health selection in the transition from the married to the widowed state might seem less obvious and different from that in the other marital transitions. In the other marital transitions health selection might be seen as part of the process of partner choice: 'unhealthy' persons might be less attractive marriage partners and thus might either not be chosen or might be discarded as a marriage partner. The purpose of this study, however, was to examine health selection as a concept opposed to social causation. Health selection refers to the process through which health differences precede marital status and social causation to the process through which marital status affects health. Thus, we test whether prior health differences are associated with different probabilities of subsequent marital transitions. Health selection in partner choice is one of the mechanisms through which health selection might cause health differences between marital status groups. With regard to the transition from the married to the widowed state, becoming widowed might identify a group which has excessive health risks for other reasons such as joint unfavourable environment (i.e., material circumstances or health behaviours). Thus, health differences between the married and widowed might not caused by the conditions of widowhood itself (social causation), but might be based in already existing health differences between those who will become widowed and those who will remain married (selection).
2. The number of events among the persons who migrated from Eindhoven might raise some questions. Especially the number of marriages among never married persons who migrated from Eindhoven seems small relative to the total number of never married persons who migrated. Examination of the data, however, revealed large differences in employment status between the never married persons (at baseline) who did and did not migrate from Eindhoven: while approximately 20% of those who did not migrate was student or in military service (the category least likely to become married), this percentage was 40 among those did migrate. The expected number of marriages among never married persons who migrated taking employment status into account was no more than 30.
3. The overall statistical significance of adding chronic conditions to the model was <0.05 in all three models.
4. The percentages are calculated by the formula:

$$100 * \frac{OR_a - OR_b}{OR_a - 1}$$

in which, OR_a is the OR of divorced persons resulting from both health selection and social causation effects, and OR_b is the OR of divorced persons resulting only from health selection effects.

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Chapter 8

Health behaviours explain part of the differences in self-reported health by partner/marital status

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Abstract

Study objective: To describe the differences in health behaviours in disparate marital status groups and to estimate the extent to which these can explained differences in health associated with marital status.
Design: Baseline data of a prospective cohort study were used. Directly age standardized percentages of each marital group that engaged in each of the following behaviours - smoking, alcohol consumption, coffee consumption, breakfast, leisure exercise and body mass index - were computed. Multiple logistic regression models were fitted to estimate the health differences associated with marital status with and without control for differences in health behaviours.
Setting: The population of the city of Eindhoven and surrounding municipalities (mixed urban-rural area) in The Netherlands in March 1991.
Participants: There were 16311 men and women, aged 25-74 years, and of Dutch nationality.
Main results: There were differences in relation to marital status for each health behaviour. Married people were more likely to practise positive health behaviours (such as exercise and eating breakfast) and less likely to engage in negative ones (such as smoking or drinking heavily) than the other groups. Control for all six health behaviours could explain an average of 20-36% of the differences in perceived general health and subjective health complaints.
Conclusions: Differences in health behaviours explained a considerable amount, but not all, of the health differences related to marital status. Longitudinal data are necessary to confirm these findings; to determine whether the differences in health behaviours related to marital status are caused by selection effects or social causation effects; and to learn how social control, social support and stress interrelate to reinforce negative or maintain positive health behaviours.

8.1. Introduction

In many Western countries mortality and morbidity differences related to marital status have been reported (1-10). Married people generally have the lowest mortality and morbidity rates, while divorced people have the highest ones. In addition to differences in psychosocial factors and material circumstances, differences in health behaviours have been mentioned as possible explanations for the relationship between marital status and health, or, more general, the association between social relationships and health (9,11-14).

The fact that there is a relationship between common health practices like smoking, drinking, regularity of meals and physical activity on the one hand and physical health status on the other hand, has been known for many years (15).

The association between marital status and health behaviours has also been described. In most studies it is found that marriage has a deterrent effect on negative health behaviours, such as smoking, excessive alcohol consumption and other risk taking behaviour (13,14,16-20). Only for studies concerning the relationship between marital status and obesity the results have been inconsistent (21).

We know of only four studies that have looked at the inter-relationship between marital status, health behaviours and health - and then only limited age ranges and/or only one sex were considered (6,9,22,23). The extent to which health behaviours explained health differences related to marital status varied in the four studies from almost not at all to considerably. In all four the association between marital status and health remained significant after controlling for the health behaviours.

We have assessed the effect of several health behaviours on the health differences related to marital status and partner status for both men and women. We considered a larger age range (25-74 years of age) than the four studies mentioned above. In addition, we decided not to focus on health differences in relation to marital status alone. In the past marital status corresponded with a type of living arrangement - married people lived with their spouses; young people who had not married lived with their parents; and widowed, divorced and older people who had not married lived on their own. During the past two decades this has changed in many Western countries. While most married people still live with their spouse, the proportion of people living with a partner without being married is growing and the proportion of young never married people with their own household has also increased. In a previous study we found that both partner status and marital status have a separate effect on health status (10). As a result we decided not to concentrate on health differences in relation to either marital status or partner status alone in this study but instead constructed a variable taking both marital status and partner status into account.

The study aimed to answer the following questions:

1) What are the differences in health behaviours between partner/marital status groups?
2) To what extent can differences in health related to partner/marital status be explained by differences in health behaviours?

8.2. Material and Methods

Material

We have used the baseline data of the GLOBE-study (24). The analyses in this study were restricted to people of 25 and older (n=16311), because most of the younger people had never married. Analyses were performed separately for men and women.

The health measures used in the analyses were as follows: perceived general health, subjective health complaints and chronic conditions (10). The health behaviours used were: smoking, alcohol consumption, coffee consumption, breakfast, leisure exercise and body mass index (BMI). The coding of these variables is shown in table 1.

Table 1. Coding of the variables for health status and health behaviours

Variable	Categories
Health status:	
Perceived general health ("How is your health in general?")	"very good" or "good" *versus* "fair", "sometimes good and sometimes bad" or "bad"
Subjective health complaints (13 listed complaints such as headache, tiredness)	suffering from 3 or less complaints *versus* suffering from more than 3 complaints
Chronic conditions (23 listed chronic conditions such as heart diseases, diabetes mellitus, rheumatoid arthritis)	suffering from none *versus* suffering from at least one of the chronic conditions in the past year
Health behaviours:	
Smoking	never, former, only pipes or cigars, <=20 cigarettes/day, >20 cigarettes/day
Alcohol consumption	non, low, moderate, excessive, very excessive
Coffee consumption	non, 1-4 cups/day, >4 cups/day
Breakfast	>=5 times/week, <5 times/week
Leisure exercise (hours spent on sports + gardening/cycling/walking[a])	none, <1 hour/week, 1-2 hours/week, >=2 hours/week
Body mass index (weight in kilogram divided by height in metres squared)	<20 ; 20-27; 27-30; >30

[a] Hours spent on gardening, cycling, or walking counted half, hours spent on sports counted full.

The independent variable in our analysis, based on both partner status and marital status (referred to as partner/marital status), was classified as: 1) married, living with a partner; 2) never married, living with a partner; 3) divorced, living with a partner; 4) widowed, living with a partner; 5) never married, single; 6) divorced, single; 7) widowed, single; and 8) other.

People were classified irrespective of whether they had children or not, because in a previous analysis having children was not associated with health. Thus divorced persons living with children but not with a partner are classified in group 6 and not in group 8. Group 8 mainly consists of never married persons living with their parents. The variable partner/marital status was constructed by using a question concerning marital status and a question concerning living arrangement. Married persons skipped the question about living arrangement in the questionnaire. However, by combining the answers on questions about the number of people living in the house and the number of children living in the house we estimated that only 64 of 12568 married people (0.5%) were not living with their spouse. Data from The Netherlands Central Bureau of Statistics show that fewer than 1.3% of the married population is separated (25). So separation is rare in The Netherlands and we can assume that the vast majority of the married persons in our study is living with their spouse. In table 2 the study population is shown in relation to by our variable partner/marital status and sex.

Table 2. Study subjects (column percentages) in relation to partner/marital status and sex

Partner/ marital status	Men		Women		Total	
	no.	(%)	no.	(%)	no.	(%)
Partner						
- married	6225	(78.9)	6220	(73.9)	12445	(76.3)
- never married	281	(3.6)	224	(2.7)	505	(3.1)
- divorced	126	(1.6)	93	(1.1(	219	(1.3)
- widowed	31	(0.4)	47	(0.6)	78	(0.5)
No partner						
- never married	521	(6.6)	458	(5.4)	979	(6.0)
- divorced	329	(4.2)	522	(6.2)	851	(5.2)
- widowed	157	(2.0)	688	(8.2)	845	(5.2)
Other	222	(2.8)	167	(2.0)	389	(2.4)
Total	7892	(100.0)	8419	(100.0)	16311	(100.0)

Methods

To find out whether there are differences in health behaviour between the partner/ marital status groups, we computed directly age standardized percentages indicating the percentage of each partner/marital status group that engaged in each health behaviour.

To determine the extent to which health differences associated with partner/ marital status groups could be explained by differences in health behaviour, we used multiple logistic regression models (26). Separate models were fitted for each health measure using SPSS. All variables have been coded as dummy variables. The regression coefficients of the variables and their standard errors were used to calculate odds ratios (ORs) with 95% confidence intervals. In the results section we also show the change in deviance and its P-value that resulted from including the health behaviours in model 1 and partner/marital status in models 2 and 3, in order to give an indication of the overall significance level of the variable in the model. The models used are shown in table 3.

To determine whether the known relationships between the health behaviours and health could be reproduced with our data, we fitted models containing age (five year categories), sex and all six health behaviours (model 1).

Next, we determined what the relationship was between the partner/marital status variable and the health measures by fitting logistic regression models (model 2) containing partner/marital status as the independent variable and variables for the following confounders: age, educational level (seven categories), degree of urbanisation (five categories), religion (four categories) and country of birth (Netherlands, abroad).

Finally we fitted models containing partner/marital status, the confounders and all health behaviour variables (model 3). The change in ORs of partner/marital status was examined (change in ORs between model 2 and model 3). We tested whether the change in ORs, caused by adding all health behaviours to the model, was statistically significant using the Wald type collapsibility test (27).

Table 3. The multiple logistic regression models used

Model 1:	health measure =	*f* (age + sex + health behaviours)
Model 2:	health measure =	*f* (partner/marital status + confounders[a])
Model 3:	health measure =	*f* (partner/marital status + confounders[a] + health behaviours)

[a] age + educational level + degree of urbanisation + religion + country of birth

8.3. Results

Table 4 shows the standardized percentages of the partner/marital status groups that engaged in the different health behaviours. In the table we show only one category for each health behaviour as an example (data for the other categories are available on request). Differences associated with partner/marital status were found for each health behaviour. Married people were more likely to practise positive health behaviours and less likely to engage in negative health behaviours than the other groups. Differences in health behaviour were also found between the other partner/ marital status groups but there was no group that consistently engaged in more positive health behaviours than the others.

Table 4. Differences in health behaviour by partner/marital status and sex (directly standardized percentages)

	Smoking	Alcohol	Coffee	Breakfast	Leisure exercise	Body mass index
	>20 cigarettes/day	very excessive	>4 cups/day	<5 times a week	none	>30 kg/m²
Men						
Partner						
married	6.9	5.0	62.5	14.1	5.1	4.5
never married	10.6	8.6	63.9	31.9	3.0	8.9
divorced	15.5	10.8	68.7	25.5	10.9	4.8
widowed[a]	-	-	-	-	-	-
No partner						
never married	9.6	6.6	50.9	23.9	4.8	5.8
divorced	17.9	9.2	57.3	23.4	6.1	6.3
widowed	12.6	8.5	48.4	11.1	7.0	6.2
Other	22.9	14.2	54.4	26.4	4.8	9.8
Women						
Partner						
married	4.7	0.7	44.3	10.7	5.1	8.2
never married	2.9	0.0	34.5	17.1	5.8	4.2
divorced	9.6	1.9	55.0	19.0	6.2	6.6
widowed[a]	-	-	-	-	-	-
No partner						
never married	7.0	0.2	39.9	17.5	4.7	9.3
divorced	13.9	1.2	39.4	21.9	5.8	11.7
widowed	9.4	1.7	48.9	15.4	7.0	12.3
Other	5.5	0.0	43.2	11.4	5.3	8.6

[a] Since there were only a small numbers of widowed men and women living with a partner in our study we did not calculate the directly standardized percentages for them.

Smoking: In both among men and women, married people were least likely and divorced people most likely to be current smokers. Married men and never married men living with a partner comprised the greatest number of former smokers (43%), as did married and divorced women living with a partner (30%). The percentages of never smokers were highest in the never married without a partner and 'other' category for men and in the married and 'other' category for women.

Alcohol: There were fewer teetotallers among those living with a partner than among those not living with a partner. Married people and never married people without a partner were least likely to drink (very) heavily.

Coffee: Never married men without a partner, and the two categories of never married women were the most likely never to drink coffee.

Breakfast: Married men and widowed men without a partner and married women and women in the category 'other' ate breakfast most regularly.

Leisure exercise: Among the men, those living with a partner took more exercise in their leisure time than the other groups. With regard to women, the group of the never married living with a partner had the highest percentage of subjects who took more than two hours' leisure exercise, followed by the married women.

Body mass index: Married men showed the highest percentage of people with a normal weight. The percentage of married women who were overweight (BMI> 27: 21%) was intermediate, and widowed women without a partner showed the highest percentage overweight (28%). Only 8% of the never married women living with a partner were overweight, but 27% of this group were underweight (compared with only 8-11% of the other female groups).

Table 5 shows the relationships between the health behaviours and health measures in our study. The results of the separate analyses for men and women were similar to those presented in table 5. For all 6 health behaviours we found a statistically significant association with the health measures, except for breakfast and chronic conditions. In general, the relationships in our data between the specific health behaviours and health were consistent with those described in other studies. For the association between alcohol consumption and health, however, we did not find the frequently described U-shaped relationship (more health problems among teetotallers and excessive drinkers). We found instead that only teetotallers had most health problems, which has also been reported for the 1992 *General Household Survey* of the OPCS (28).

Table 5. **The association between the health behaviours and health (model 1: health measure = *f* (age + sex + smoking + alcohol consumption + coffee consumption + breakfast + leisure exercise + BMI)**

	Perceived general health		Subjective health complaints		Chronic conditions	
Smoking						
never	1.00		1.00		1.00	
former	1.35	(1.21-1.50)	1.32	(1.20-1.46)	1.49	(1.36-1.64)
pipe/cigars	1.39	(1.10-1.76)	1.34	(1.07-1.68)	1.17	(0.96-1.44)
1-20 cig./day	1.75	(1.56-1.96)	1.71	(1.54-1.89)	1.29	(1.17-1.43)
>20 cig./day	2.01	(1.69-2.38)	2.37	(2.01-2.78)	1.43	(1.23-1.67)
Δ deviance[a]		113.558		155.214		78.995
P-value[b]		0.0000		0.0000		0.0000
Alcohol consumption						
non	1.00		1.00		1.00	
low	0.51	(0.46-0.57)	0.67	(0.61-0.74)	0.76	(0.69-0.83)
moderate	0.40	(0.35-0.45)	0.54	(0.48-0.60)	0.66	(0.59-0.74)
excessive	0.49	(0.41-0.60)	0.32	(0.27-0.39)	0.73	(0.62-0.87)
very excessive	0.48	(0.38-0.60)	0.64	(0.51-0.80)	0.67	(0.54-0.83)
Δ deviance[a]		253.455		123.381		59.600
P-value[b]		0.0000		0.0000		0.0000
Coffee consumption						
non	1.00		1.00		1.00	
1-4 cups/day	0.63	(0.53-0.75)	0.70	(0.59-0.81)	0.84	(0.72-0.98)
>4 cups/day	0.54	(0.45-0.64)	0.59	(0.51-0.70)	0.74	(0.64-0.87)
Δ deviance[a]		51.943		45.684		19.576
P-value[b]		0.0000		0.0000		0.0001
Breakfast						
>=5 times/week	1.00		1.00		1.00	
<5 times/week	1.15	(1.02-1.29)	1.18	(1.06-1.31)	1.02	(0.92-1.13)
Δ deviance[a]		5.195		8.829		0.134
P-value[b]		0.0226		0.0030		0.7142
Leisure exercise						
>2 hours/week	1.00		1.00		1.00	
1-2 hours/week	1.66	(1.38-2.00)	1.43	(1.20-1.71)	1.15	(0.96-1.36)
<1 hour/week	2.18	(1.90-2.49)	1.94	(1.71-2.20)	1.28	(1.13-1.44)
none	3.63	(3.29-3.99)	2.47	(2.27-2.69)	1.56	(1.44-1.69)
Δ deviance[a]		261.373		171.674		35.124
P-value[b]		0.0000		0.0000		0.0000
Body mass index						
<20	1.19	(1.01-1.41)	1.07	(0.92-1.25)	1.08	(0.94-1.25)
20-27	1.00		1.00		1.00	
27-30	1.43	(1.28-1.59)	1.34	(1.20-1.48)	1.30	(1.17-1.44)
>30	1.93	(1.66-2.25)	1.78	(1.53-2.06)	1.51	(1.30-1.75)
Δ deviance[a]		98.929		78.164		49.667
P-value[b]		0.0000		0.0000		0.0000

[a] change in deviance of the model due to adding the specific health behaviour variable to the model

[b] the overall significance of the specific health behaviour variable in the model

Table 6a and 6b show the influences of the health behaviours on the relationship between partner/marital status and perceived general health, subjective health complaints and chronic conditions for men and women respectively. The ORs (95% confidence intervals) for the partner/marital status groups for models 2 and 3 are shown together with the changes in deviance in models 2 and 3 that resulted from adding the variable partner/marital status to a model without this variable and the overall significance of the variable partner/ marital status in the models.

With regard to the relationship between partner/marital status and health, there were significant differences associated with partner/marital status for all health measures except chronic conditions for men (models 2 in table 6). There were large differences in perceived general health associated with partner/marital status. Unmarried men who live with a partner had ORs of ± 1.50 and never married and divorced men not living with a partner had ORs of more than 2.00. Divorced women living with a partner and those not living with a partner had ORs of 1.77 and 2.03 respectively. The differences in subjective health complaints by partner/marital status were also large. The differences in chronic conditions among women were relatively small, only the ORs of never married and divorced women who live without a partner were higher than 1.00. For all three health measures divorced persons (both men and women) who did not live with a partner had the highest ORs.

Adding only one health behaviour to model 2 generally resulted in a significant improvement of the model, but did not usually result in large changes in the ORs of partner/marital status (data not shown). The variables for smoking, alcohol consumption and leisure exercise caused the largest changes in ORs.

When the ORs of model 3, containing variables for all health behaviours (results of models 3 in table 6), were compared with those of model 2, there was a decrease in the ORs of perceived general health and subjective health complaints for almost all male partner/marital status groups. The decreases in ORs were statistically significant at the 0.05 level for most male groups for the subjective health complaints, but only for never married and divorced men living without a partner with regard to perceived general health. Among women a different pattern was seen. Control for health behaviours had hardly affected the ORs of never married women living with a partner or widowed women. The ORs of never married and divorced women living without a partner, however, showed a significant decrease, both for perceived general health and subjective health complaints. Adding all health behaviours to the model for chronic conditions for women caused hardly any changes in the ORs of partner/marital status. A significant decline in the ORs was seen only for divorced women not living with a partner.

Table 6a. **Differences in health in relation to partner/marital status among men; OR with 95% confidence intervals for models 2 and 3**

	Perceived general health		Subjective health complaints		Chronic conditions	
	model 2: confounders	model 3: confounders+ health behaviours	model 2: confounders	model 3: confounders+ health behaviours	model 2: confounders	model 3: confounders+ health behaviours
Men						
Partner:						
married	1.00	1.00	1.00	1.00	1.00	1.00
never married	1.41(0.95-2.08)	1.33(0.89-1.98)	1.69(1.24-2.31)	1.57*(1.14-2.17)	0.99 (0.73-1.33)	0.96 (0.70-1.30)
divorced	1.45(0.95-2.22)	1.32(0.85-2.05)	1.96(1.33-2.90)	1.76*(1.17-2.63)	1.03 (0.70-1.51)	1.02 (0.69-1.51)
widowed	1.50(0.67-3.36)	1.34(0.58-3.09)	0.99(0.44-2.26)	0.85 (0.37-1.98)	0.91 (0.43-1.93)	0.83 (0.39-1.78)
No partner:						
never married	2.15(1.69-2.75)	1.94(1.51-2.49)	1.42(1.13-1.78)	1.25*(0.99-1.58)	1.09 (0.88-1.36)	1.06 (0.85-1.33)
divorced	2.43(1.88-3.14)	2.18(1.67-2.84)	2.22(1.73-2.85)	1.97*(1.52-2.54)	1.33 (1.04-1.70)	1.31 (1.02-1.68)
widowed	1.47(1.00-2.14)	1.37(0.93-2.03)	1.33(0.91-1.93)	1.21*(0.82-1.78)	0.90 (0.62-1.30)	0.88 (0.61-1.26)
Other	2.13(1.48-3.06)	1.97(1.36-2.86)	1.17(0.83-1.64)	1.03*(0.73-1.47)	1.07 (0.77-1.47)	1.06 (0.76-1.46)
Δ deviance[a]	89.180	62.402	61.370	39.914	6.197	5.619
p-value[b]	<0.0001	<0.0001	<0.0001	<0.0001	0.5170	0.5849

[a] change in deviance of the model due to adding the variable partner/marital status to a model without this variable

[b] the overall significance of the variable partner/marital status in the model, based on a comparison of Δ deviance with a chi-square distribution with 7 degrees of freedom

* according to the Wald type collapsibility test the change in OR between model 2 and model 3 is statistically significant ($p<0.05$)

Table 6b. **Differences in health in relation to partner/marital status among women; OR with 95% confidence intervals for models 2 and 3**

	Perceived general health		Subjective health complaints		Chronic conditions	
	model 2: confounders	model 3: confounders+ health behaviours	model 2: confounders	model 3: confounders+ health behaviours	model 2: confounders	model 3: confounders+ health behaviours
Women						
Partner:						
married	1.00	1.00	1.00	1.00	1.00	1.00
never married	1.12(0.75-1.69)	1.12(0.74-1.70)	1.32(0.96-1.82)	1.32 (0.95-1.83)	0.81 (0.59-1.11)	0.81 (0.59-1.12)
divorced	1.77(1.09-2.88)	1.65(1.00-2.74)	1.32(0.83-2.09)	1.20 (0.75-1.93)	0.97 (0.62-1.52)	0.94 (0.60-1.48)
widowed	1.00(0.51-1.97)	1.03(0.51-2.07)	1.15(0.61-2.17)	1.17 (0.61-2.24)	0.74 (0.39-1.39)	0.74 (0.39-1.40)
No partner:						
never married	1.36(1.05-1.76)	1.23(0.95-1.60)	1.34(1.07-1.68)	1.24*(0.98-1.56)	1.30 (1.04-1.62)	1.30 (1.04-1.63)
divorced	2.03(1.63-2.52)	1.74(1.39-2.19)	1.73(1.41-2.13)	1.50*(1.21-1.85)	1.44 (1.17-1.77)	1.37* (1.11-1.70)
widowed	0.88(0.72-1.09)	0.84(0.67-1.04)	1.02(0.84-1.25)	0.97 (0.79-1.19)	0.81 (0.67-0.99)	0.81 (0.66-0.99)
Other	1.17(0.80-1.71)	1.04(0.70-1.52)	0.97(0.68-1.38)	0.87 (0.61-1.25)	1.00 (0.71-1.41)	0.96 (0.68-1.36)
Δ deviance[a]	50.102	30.915	34.219	19.545	26.285	22.729
p-value[b]	<0.0001	0.0001	<0.0001	0.0066	0.0004	0.0019

[a] change in deviance of the model due to adding the variable partner/marital status to a model without this variable

[b] the overall significance of the variable partner/marital status in the model, based on a comparison of Δ deviance with a chi-square distribution with 7 degrees of freedom

* according to the Wald type collapsibility test the change in OR between model 2 and model 3 is statistically significant ($p<0.05$)

On average, the *increased* ORs of the unmarried partner/marital status groups decrease by 22% for men and 31% for women for general perceived health, and by 36% and 20% respectively for subjective health complaints. It is remarkable that controlling for the health behaviours decreased the ORs, but did not change the overall pattern of health differences between the partner/marital status groups. For instance divorced people (both men and women) who did not live with a partner still had the highest OR for all health measures after controlling for the health behaviours.

8.4. Discussion

We found differences associated with partner/marital status for each health behaviour. Married people were more likely to engage in positive health behaviours (such as exercise and eating breakfast) and less likely to engage in negative health behaviours (such as smoking or drinking heavily) than the other groups. Differences in health behaviour were also found between the other partner/marital status groups, but none of these consistently engaged in more positive health behaviours than the others. Control for only one health behaviour did not result in any large reductions of the health differences. Control for all six health behaviours explained, on average, 20-36% of the health differences in perceived general health and subjective health complaints, but not the differences in chronic conditions among women (the differences in chronic conditions in relation to partner/marital status in men were not statistically significant). Our results suggest therefore that health behaviours explain a considerable proportion of the health differences associated with partner/marital status - but certainly not all differences.

Our results are based on self-reported data. The accuracy of information on health behaviours obtained from questionnaires is known to vary (21,29-31). However, this could only bias the result if there were systematic differences related to partner/marital status in the response to questions concerning health behaviours or health. This does not seem likely.

In our study we controlled for the cumulative effects of six health behaviours on the relationship between partner/marital status and physical health. We have also fitted models in which interaction terms for the health behaviours were added to the full model, in order to determine whether more of the health differences could be explained by the health behaviours in our study (results not shown). This did not prove not to be the case. It is likely, however, that extra control for other health behaviours such as hours' sleep (not available in our study) and food habits (only available for a subsample of the study population) would increase the proportion of the health differences explained by health behaviours.

Of the studies describing the relationship between marital status, health behaviours and health status, mentioned in the introduction, those of Davis et al., Rosengren et al., and Ben-Shlomo et al. are longitudinal studies, with mortality as health measure, and are therefore difficult to compare with our study (6,22,23). The study of Wyke and Ford lends itself best to comparison with our study (9), despite important differences in study population, variable definitions, etc., which complicate the comparison. The study of Wyke and Ford is a cross-sectional study of 1042 people of 55 years of age. In that study smoking and drinking respectively could explain 25% and 10% of the differences in self rated health among women, 20% and 0% of the differences in self-rated health among men, and 1% and 1% of the differences in number of chronic conditions among women (for men there were no statistically significant differences in number of chronic conditions). It is striking that both Wyke and Ford's results and ours showed that health behaviours had some effect on the relationship between marital status and self rated general health, but hardly any effect on the relationship between marital status and chronic conditions.

Since both this and Wyke and Ford's studies used cross-sectional data, it is possible that health influenced health behaviours. Health problems could have forced people to adjust their health behaviours. For example, those who had had a heart attack could have quit smoking and started a diet or regular exercise on their doctor's advice. It is more likely that this has occurred in those suffering from severe health problems, which could explain why the health behaviours explain so little of the differences in chronic conditions. This hypothesis is supported by the fact that we found that former smokers had ORs between those of the never smokers and current smokers for perceived general health and subjective health complaints, but had the highest ORs for chronic conditions, and by the fact that teetotallers had more health problems than drinkers (table 4). That health might have influenced health behaviours is a disadvantage of working with cross-sectional data. Longitudinal data are necessary to estimate the extent to which differences in chronic conditions related to partner/marital status can be explained by health behaviours and to adjust our estimates for perceived general health and subjective health complaints to take into account the influence of health on health behaviours.

Another disadvantage of cross-sectional data is that we cannot locate the place of health behaviours in the relationship between partner/marital status and health. There are several possibilities for the causal pathways between marital status, health behaviours and physical health. Firstly, partner/marital status could depend on health behaviours (selection), which is especially possible for alcohol consumption. Heavy drinkers probably have less chance of marrying, and heavy drinking while married could cause or contribute to divorce. However, Miller-Tutzauer et al., in a three year follow-up study of 18-25 year olds, found that

people two years before marriage did not differ in drinking behaviour from those who remained single. They therefore concluded that the findings did not suggest pre-existing differences in alcohol consumption between those who marry and those who do not (17).

Secondly, health behaviours could be an intermediate in the causal pathway between marital status and health. In this view health depends on partner/marital status. This is the so called social causation theory or protection theory (5,9,11,13, 14,20). Partner/marital status could affect health behaviours through social control (telling or reminding someone to engage in certain health behaviours), social support (support when changing health behaviours) and/or stress. Umberson found strong suggestions that married women especially attempt to affect the health behaviour of their spouses and that "over time, social control may have some beneficial consequences for health behaviour among those individuals who remain married" (14). Partner support has been found to be beneficial to smoking cessation maintenance (32-35), which is also consistent with the larger proportions former smokers in our study among the married and those with a partner. Finally, stress from the loss of a partner due to divorce or bereavement, or stress from the negative attitude of society to divorced/single people could increase negative health behaviours (smoking and drinking as palliative coping responses) (14,36). If all three mechanisms operate, they are likely to reinforce each other.

Both possibilities could be present in our study. Further research is necessary to estimate the relative importance of selection and social causation effects in differences in health behaviours in relation to partner/marital status, and to learn how social control, social support and stress interrelate to reinforce negative or maintain positive health behaviours. For this, longitudinal data are required. If it is found that social causation effects are responsible for the differences in health behaviours by partner/marital status, there may be opportunities for preventive actions. For instance health education programs especially directed at newly separated (both divorced people and those whose consensual union has been dissolved) or widowed persons, and aimed at preventing them from changing their health behaviours for the worse, could be organised. These groups might also be approached to participate in training courses in stress management run by of local public health services.

We conclude that health behaviours may explain a considerable proportion - but certainly not all - of the health differences associated with partner/marital status, Further research using longitudinal data is required to confirm these findings and to learn how to reduce the health differences caused by differences in health behaviours. The explanation of the remaining health differences related to partner/marital status also requires further research which could be directed at differences in psychosocial factors and material circumstances.

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Chapter 9

Contribution of psychosocial factors, material circumstances and health behaviours to marital status differences in self-reported health

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Abstract

The aim of this study was to estimate the relative contribution of psychosocial factors, material circumstances and health behaviours to health differences between marital status groups. Data on 3510 Dutch persons of the GLOBE-study, aged 25-74 years were used for this purpose. Most of the explanatory factors were very unevenly distributed over the marital status groups. Multiple logistic regression models showed that psychosocial conditions were the most important factor in explaining marital status differences in self-reported morbidity among men. Of the psychosocial factors emotional support was particularly relevant for never married men and marital dissolution in the previous year for divorced men. Material circumstances accounted for the majority of morbidity differences among women.

9.1. Introduction

Researchers have since long been intrigued by the existence of health differences between marital status groups. Nevertheless, the explanation of health differences between marital status groups is still unresolved. There is general agreement that two (not mutually exclusive) processes could be responsible for the health differences between marital status groups: marital selection and social causation mechanisms (1-6). According to the marital selection theory the relative good health of married persons is the result of the selection of 'healthy' persons into and 'unhealthy' persons out of the married state (2,7-11). According to the social causation theory marriage has a health promoting or a health protective effect, while being unmarried would have adverse health effects (3,6,12,13). In the social causation theory the effect of marital status on health is generally assumed to be intermediated by factors, such as psychosocial conditions, material circumstances and health behaviours (1,6,14-21). The aim of this study was to estimate the relative contribution of these intermediary factors to the health differences between marital status groups.

With regard to the *psychosocial conditions*, marital status groups are assumed to differ in both their exposure and vulnerability to psychosocial stress (22). Bereavement and divorce itself are the most obvious sources of differences in psychosocial stress. On the social readjustment rating scale of Holmes and Rahe, a scale of 43 life events ordered on basis of the assumed intensity and length of time necessary to accommodate to a life event, bereavement and divorce rank first and second respectively (23). Results from longitudinal studies of mortality after bereavement and morbidity following divorce suggest that a crisis model is appropriate to

describe the health effects of bereavement and divorce (14). Bereavement and divorce are also often accompanied by other stressful life-events, such as changes in parental responsibilities and forced move to other housing, which add to the experienced psychosocial stress (7,24). With regard to the differential vulnerability to psychosocial stress, social support is assumed to buffer the negative health effects of stress and to differ between the marital status groups (25-28). As put by Stroebe and Stroebe "... marital couples typically far exceed other social groups in the extent of mutual social support. ... they are likely to fulfil a wider range of functions for each other than is characteristic for normal social groups" (29, p.91).

Differences in marital status are also associated with differences in *material circumstances* (1,6,15-17). People who share a household are able to profit from economies of scale in purchase and use of housing and other goods and services (18). Additionally, among women, bereavement and divorce often imply loss of the (greater part of the) household income and consequently a deterioration of other structural living circumstances such as housing (15,17,30-35).

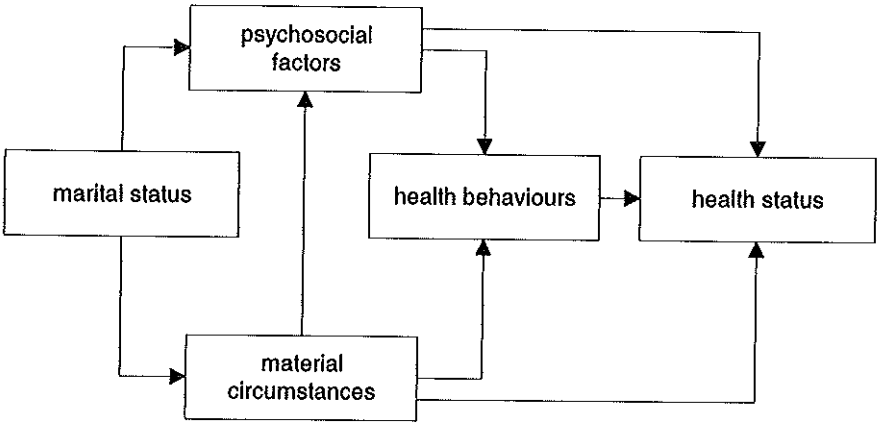
Finally, differences in *health behaviours* between marital status groups are mentioned as an intermediary of the association between marital status and health. Married persons are generally found to engage less in unfavourable health behaviours such as smoking and excessive drinking than unmarried persons (20,21,36-39).

The three groups of intermediary factors can not be viewed as three independent pathways of the effects of marriage on health. Several interrelationships could exist. Figure 1 shows our conceptual model of the effect of marital status on health. Marital status is not assumed to have a direct effect on health behaviour but only indirect through psychosocial conditions and material conditions. The psychosocial factors might either have direct health effects or might operate through effects on health behaviours (28). The increased levels of psychosocial stress experienced by unmarried persons might, for instance, increase their smoking rates and alcohol consumption, as these are palliative coping responses to psychosocial stress (21,40). Additionally, the increased levels of social support of married persons might have favourable effects on their smoking rates and alcohol consumption, as partner support is beneficial for behavioral changes, for instance, smoking cessation maintenance (41-44). The material circumstances might either have direct health effects, increase psychosocial stress or operate through changes in health behaviours. For instance, unhealthy eating habits and a lack of recreation possibilities might in part be determined by financial position (45).

The presence or absence of a spouse plays an important role in the social causation theory: the spouse is an important provider of social support, contributes to the household income and generally encourages healthy behaviours. It is likely that partners in a consensual union will perform similar roles as spouses. In combination with the large proportions of unmarried people living with a partner

in The Netherlands (i.c., 20-25% of never married men and women and divorced men of 25 years of age and older lived with a partner in 1989/1990 (46)), we decided to treat unmarried persons who live with a partner as a separate category in our analyses.

Figure 1. **A graphical representation of the pathways through which marital status is assumed to affect health status**



9.2. Material and methods

Material

We used the baseline data of subpopulations 1 and 2 of the GLOBE study (see chapter 2). Since persons with chronic conditions were oversampled in the subpopulation 2, only data of a weighted random sample of respondents of this subpopulation have been used (n=1136). Because of the small variation in marital status among the youngest age groups, the analyses have been restricted to persons of 25 years of age and older. This limited the number of study subjects to 3510.

Five categories of *marital status/living arrangement* are distinguished: married, unmarried and living with a partner (these persons could either be never married, divorced or widowed), never married, divorced and widowed. Of the persons in the last three groups, who do not live with a partner, most live in a one-person-household or with children and a few still live with their parents or in another living arrangement.

We used several *health measures*: perceived general health, subjective health complaints, chronic conditions and the Nottingham Health Profile (NHP). The question regarding perceived general health was "how is your health in general?". For the analyses the answer categories were dichotomized in good ('very good', 'good') and less-than-good ('fair', 'sometimes good and sometimes bad', 'bad'). The subjective health complaints consisted of 13 complaints, such as regularly upset stomach and often feeling tired. Respondents were divided in those with less than 4 subjective health complaints and those with 4 or more complaints. With regard to the chronic conditions the respondent was asked to check for each of 23 listed chronic conditions whether they had this condition or whether they were under treatment or control for this condition (e.g. chronic obstructive lung diseases, serious heart disease or heart attack). Persons who had none of these conditions were distinguished from those who had at least one of these conditions. The NHP consists of 6 scales each measuring different aspects of health: mobility, pain, energy, sleep, social isolation and emotional reaction (47). Separate models have been fitted for each of the scales. Persons who answered none of the items of a separate scale confirmative were distinguished from persons who answered at least 1 of the items of the scale confirmative.

Four indicators of *psychosocial condition* were employed: emotional support, instrumental support, partner loss in the previous year and other life-events. With regard to the support variables respondents were asked to mention 3 persons with whom they had a close personal bond (confidants). Spouses and partners could be mentioned as a confidant. For each of the confidants the respondent was asked 5 items on emotional support (e.g. whether the respondent could notice that the confidant cared for him/her) and 4 items on instrumental support (e.g. whether the respondent was helped by the confidant with little things such as shopping). The scores were summed over the items and confidants and respondents were divided in 4 categories with increasing amounts of emotional and instrumental support respectively. With regard to partner loss the respondents were asked whether their spouse or partner had died or whether they had divorced or separated in the previous year. Respondents were also asked whether they had experienced 7 other life-events in the previous year (e.g. had moved; become unemployed). Respondents were divided in those who had experienced none, one and two or more of these other life-events.

Four indicators of *material circumstances* were used: household income, financial problems, crowding and housing conditions. Household income was divided by an equivalence factor to adjust for the number of persons inside and outside the household who had to live from the household income. The equivalence factor (F) was calculated by the formula $F = (NA + c.NC)^b$, in which NA is the number of adults in the household who have to live from the household income, NC is the number of children in the household, c is a parameter which indicates to what

extent children count less than adults (0<c<1), and b is the parameter which adjusts for economies of scale (0<b<1) (48). Schiepers recommended the values 0.7 for c and 0.5 for b (48). In our study all persons inside and outside the household who were supported from the household income, except the respondent and his/her spouse or partner, were counted as children. Other persons inside the household who are supported from the household income will mainly be children. Persons outside the household who are supported from the household income will generally also have other income sources. Household income has been divided in 5 categories, each containing approximately 20% of the respondents. With regard to financial problems the respondents were asked whether they had experienced none, some or great difficulties in the previous year with the payment of food, rent, electricity, etc. Crowding has been calculated as the number of persons living in the household divided by the number of rooms in the house. Four categories of crowding are distinguished, each containing approximately 25% of the respondents. The questionnaire contained 7 problems with housing conditions (e.g. serious noise pollution, cold or draught in the house). Respondents were divided in those who had experienced none, one and two or more of the housing conditions.

Health behaviours taken into account were smoking status (never smoker, ex-smoker, only pipe or cigars, 1-20 cigarettes per day, more than 20 cigarettes per day), alcohol consumption (non, low, moderate, excessive, very excessive), leisure physical activity (none, less than 1 hour/week, 1-2 hours/week, 2 or more hours/week) and body mass index (BMI: weight in kilogram divided by height in metres squared: <20; 20-27; 27-30; >30).

Analyses have been performed separately for men and women. In each of the models we have controlled for age (5-year age categories), educational level (6 categories)[1], degree of urbanization (4 categories) and religion (4 categories). These variables are further referred to as *confounders.*

Methods

Directly age-standardized percentages have been calculated to examine the distribution of the intermediary factors over the marital status groups.

Multiple logistic regression models have been used to estimate the health differences between marital status groups and the relative contribution of the intermediary factors (49). The models have been fitted with the statistical package SPSS (50). All variables have been coded as dummy variables in the models. In the analysis the missings on the intermediary variables and confounders have been treated as separate categories. The regression coefficients of marital status and their standard errors have been used to calculate odds ratios (ORs) with 95% confidence intervals (CI). The married have been the reference category in all

models (OR=1). ORs of the unmarried groups larger than 1.00 indicate that they on average have more health problems in comparison to the married.

Separate models have been fitted for each of the health indicators. First a model was fitted containing only marital status and the confounders as explanatory variables. With this model the health differences between the marital status groups are determined. Next three models were fitted in which the variables for the psychosocial conditions, material circumstances and health behaviours respectively, were added. Finally a model was fitted containing marital status, the confounders and the variables of all 3 intermediary factors. The changes in ORs of the marital status groups between the first model and the subsequent models were examined in order to estimate the separate and mutual contributions of the intermediary factors to the health differences. We tested whether the change in ORs, caused by adding the intermediary factors to the model, was statistically significant using the Wald type collapsibility test (51).

9.3. Results

Distribution of the intermediary factors over the marital status groups

Tables 1a and 1b show the distributions of the intermediary factors by marital status for men and women respectively. In the table only one category for each intermediary factor is shown as an example (data on the other categories are available on request). Many intermediary factors appeared to be very unevenly distributed over the marital status groups. Among both men and women, never married persons had the lowest levels of social support. However, the percentages never married men in the categories with lowest emotional and instrumental support were twice those of never married women. Relatively large percentages of widowed and divorced persons had lost their spouse or partner in the previous year. With regard to the material circumstances some differences between the marital status groups were found among men, but they were small compared to the differences among women. Among men, only household income of divorced men compared unfavourably to that of married men. Among women, 40 and 55% of widowed and divorced women respectively were found in the lowest category of equivalent household income, while this percentage was only 18% among married women. Divorced women also compared unfavourably to other women with regard to financial difficulties and problems with housing conditions. Finally, married persons, on average, engaged more often in healthy behaviours than the other marital status groups.

Table 1. Distribution of the intermediary factors by marital status groups and sex[a]; directly age-standardized percentages

	Married	Cohabiting	Never married	Divorced	Widowed
MEN					
Number of respondents	1385	113	137	56	37
Psychosocial conditions					
Emotional support (low)	9.4	12.7	40.9	16.8	9.9
Instrumental support (low)	8.5	7.5	32.2	10.5	9.7
Partner lost in the previous year	0.4	4.9	4.0	23.3	22.4
Life-events in the previous year (≥2)	14.6	14.7	16.0	18.4	27.4
Material circumstances					
Household income (low)	13.3	10.0	17.5	19.1	12.9
Financial difficulties (large)	3.3	5.0	4.7	4.4	5.2
Crowding (high)	21.8	8.5	12.4	7.9	1.1
Unfavourable housing conditions (≥2)	21.6	27.7	28.8	27.2	18.4
Health behaviours					
Smoking (>20 cigarettes/day)	6.6	8.8	14.3	5.7	7.4
Alcohol consumption ((very) excessive)	12.2	13.4	21.0	15.8	12.6
Physical activity ((almost) none)	5.0	4.9	10.9	4.5	9.7
Body mass Index (>30 kg/m^2)	4.3	12.8	6.3	4.5	0.0
WOMEN					
Number of respondents	1351	71	106	104	127
Psychosocial conditions					
Emotional support (low)	5.4	3.5	19.2	12.5	7.2
Instrumental support (low)	5.5	3.5	17.3	13.4	6.4
Partner lost in the previous year	0.7	4.8	6.1	22.0	34.3
No. life-events in the previous year (≥2)	16.9	13.0	22.9	15.6	21.2
Material circumstances					
Household income (low)	17.8	4.2	27.1	55.0	43.3
Financial difficulties (large)	2.6	0.0	1.3	19.4	6.8
Crowding (high)	20.6	18.2	9.7	5.9	3.1
No. unfavourable housing conditions (≥2)	19.5	14.7	31.9	34.0	16.0
Health behaviours					
Smoking (>20 cigarettes/day)	5.3	11.5	2.7	12.4	10.1
Alcohol consumption ((very) excessive)	2.2	1.8	1.5	22.9	1.4
Physical activity ((almost) none)	4.1	0.0	5.0	3.9	6.1
Body mass Index (>30 kg/m^2)	7.9	5.6	9.0	8.9	22.9

[a] only one category of each intermediary factor is shown as an example

Differences in self-reported morbidity by marital status

Among *men* statistically significant differences in self-reported morbidity by marital status were found for perceived general health and the NHP scales for energy, sleep, social isolation and emotional reaction (table 2). There were hardly any differences in self-reported health between married and cohabiting men. Never married, divorced and widowed men had for most health measures ORs which were larger than 1.00. Among *women* statistically significant differences in self-reported morbidity by marital status were found for subjective health complaints and the NHP scales for mobility, energy, sleep, social isolation and emotional reaction (table 2). In comparison with married women, hardly any excess morbidity was found among cohabiting, never married or widowed women. Thus, the statistically significant differences in self-reported morbidity by marital status among the women were almost solely due to excess morbidity among divorced women.

Relative contribution of the intermediary factors to the health differences

The contribution of the intermediary factors to the health differences are only shown for those health measures for which statistical significant marital status differences were found and for those marital status groups for whom sizeable increased ORs (larger than 1.50) were found.

Of the intermediary factors, the psychosocial factors accounted for the largest part of the excess morbidity of unmarried men (table 3). Of the psychosocial factors emotional support was particularly relevant for never married men and partner loss for divorced men. Material circumstances and health behaviours also seemed to account for some of the excess morbidity of divorced men, but less than the psychosocial factors. On the other hand, control for material circumstances increased the ORs of cohabiting, never married and widowed men, indicating that their more favourable material circumstances in comparison with married men had a protective effect on their health status. Control for all intermediary factors only caused considerable decreases in the ORs of divorced men. In model 5 the morbidity differences among men were still statistically significant for perceived general health and the NHP scales for sleep and social isolation. If the variables for material circumstances were omitted from model 5, statistically significant differences among men were only found for NHP-social isolation.

Among women, the material circumstances were the most important intermediary factor (table 4). The majority of the excess morbidity of divorced women was explained by material circumstances, of which financial problems were the most relevant. Psychosocial conditions (partner loss in particular) and health behaviours (smoking in particular) also accounted for some of the excess morbidity of divorced women. In model 5 statistically significant excess morbidity among women was only found for the NHP-scale social isolation.

Table 2. Self-reported morbidity of the unmarried compared to the married, adjusted for age, educational level, degree of urbanisation and religion; odds ratios (95% confidence intervals)

	Cohabiting		Never- married		Divorced		Widowed		P-value[a]
Men									
perceived general health	1,24	(0,72 -2,14)	2,35	(1,47 -3,76)	1,75	(0,96 -3,21)	2,11	(1,03 -4,32)	0.0010
subjective health complaints	1,30	(0,82 -2,07)	1,63	(1,07 -2,49)	1,37	(0,76 -2,47)	1,47	(0,73 -2,94)	0.1312
chronic conditions	1,16	(0,75 -1,81)	1,38	(0,92 -2,07)	1,38	(0,78 -2,45)	0,78	(0,40 -1,53)	0.3773
NHP-mobility[b]	0,94	(0,52 -1,69)	1,36	(0,82 -2,25)	1,45	(0,77 -2,74)	1,39	(0,69 -2,81)	0.4958
NHP-pain	0,82	(0,44 -1,53)	1,93	(1,18 -3,18)	0,82	(0,39 -1,72)	0,84	(0,38 -1,82)	0.0875
NHP-energy	1,74	(0,95 -3,17)	1,43	(0,81 -2,55)	2,28	(1,17 -4,45)	1,90	(0,90 -4,01)	0.0306
NHP-sleep	1,68	(1,04 -2,72)	1,82	(1,18 -2,82)	1,50	(0,82 -2,73)	0,70	(0,33 -1,47)	0.0168
NHP-social isolation	0,88	(0,30 -2,55)	6,32	(3,51 -11,37)	5,57	(2,65 -11,69)	8,14	(3,73 -17,77)	0.0000
NHP-emotional reaction	1,15	(0,68 -1,93)	1,70	(1,09 -2,67)	2,20	(1,20 -4,03)	2,23	(1,08 -4,59)	0.0060
Women									
perceived general health	0,97	(0,52 -1,81)	0,99	(0,61 -1,62)	1,98	(1,27 -3,10)	1,05	(0,68 -1,60)	0.0669
subjective health complaints	0,60	(0,33 -1,08)	0,74	(0,47 -1,17)	1,64	(1,08 -2,51)	0,83	(0,55 -1,26)	0.0246
chronic conditions	0,97	(0,57 -1,65)	1,06	(0,69 -1,63)	1,21	(0,79 -1,84)	0,73	(0,49 -1,10)	0.4999
NHP-mobility	0,33	(0,14 -0,80)	1,23	(0,75 -2,00)	1,67	(1,06 -2,62)	0,80	(0,52 -1,24)	0.0044
NHP-pain	0,64	(0,31 -1,31)	1,24	(0,76 -2,03)	1,79	(1,14 -2,82)	0,91	(0,60 -1,40)	0.0579
NHP-energy	0,37	(0,16 -0,90)	0,57	(0,31 -1,05)	2,34	(1,49 -3,69)	0,60	(0,36 -1,02)	0.0000
NHP-sleep	0,80	(0,41 -1,56)	1,23	(0,77 -1,98)	2,35	(1,52 -3,64)	1,05	(0,70 -1,59)	0.0033
NHP-social isolation	0,69	(0,24 -2,01)	1,47	(0,75 -2,87)	4,27	(2,53 -7,21)	3,10	(1,88 -5,10)	0.0000
NHP-emotional reaction	1,03	(0,55 -1,93)	1,21	(0,75 -1,95)	2,55	(1,65 -3,95)	1,34	(0,87 -2,07)	0.0011

[a] Overall significance marital status
[b] Nottingham Health Profile

Table 3: Contribution of the intermediary factors to the differences in self reported morbidity among men; odds ratios[a] (contribution in percentages)

	Model 1: marital status + confounders	Model 2: model 1 + psy-cho-social factors		Model 3: model 1 + mate-rial circumstances		Model 4: model 1 + health behaviours		Model 5: model 1 + all in-termediary factors	
Cohabiting									
NHP-energy	1.74	1.64	(13)	1.95	-	1.73	(1)	1.87	-
NHP-sleep	1.68	1.59**	(13)	1.83	-	1.73	-	1.82	-
Never-married									
perceived general	2.35	2.04***	(23)	2.41	-	2.35	-	2.18	(13)
health	1.82	1.63***	(24)	2.12	-	1.69	(16)	1.83	-
NHP-sleep	6.32	6.16	(3)	6.64	-	6.06	(5)	6.43	-
NHP-social isolation	1.70	1.47***	(33)	1.70	-	1.53**	(24)	1.38**	(46)
NHP-emotional reaction									
Divorced									
perceived general	1.75	1.33***	(56)	1.58	(23)	1.58	(23)	1.08***	(90)
health	2.28	1.85	(33)	2.29	-	2.02	(20)	1.65*	(50)
NHP-energy	5.57	4.88	(15)	4.98	(13)	6.50	-	5.12	(10)
NHP-social isolation	2.20	1.75*	(37)	1.96	(20)	2.11	(7)	1.53**	(56)
NHP-emotional reaction									
Widowed									
perceived general	2.11	1.80	(28)	2.50	-	1.97	(13)	1.97	(13)
health	8.14	6.78	(19)	10.25	-	8.45	-	8.41	-
NHP-social isolation	2.23	1.78*	(36)	2.48	-	2.37	-	2.07	(13)
NHP-emotional reaction									

[a] The asterisks indicate the statistical significance of the change in OR's of models 2-5 compared to model 1, according to the Wald type collapsibility test [Maldonado]: *** ($P < 0.05$), ** ($0.05 < P < 0.10$), * ($0.10 < P < 0.20$)

Table 4: Contribution of the intermediary factors to the differences in self reported morbidity among women; odds ratios[a] (contribution in percentages)

	Model 1: marital status + confounders	Model 2: model 1 + psy-cho-social factors		Model 3: model 1 + mate-rial circumstances		Model 4: model 1 + health behaviours		Model 5: model 1 + all in-termediary factors	
Divorced									
subj. health complaints	1.64	1.58	(11)	0.88***	+[b]	1.36***	(45)	0.76***	+[b]
NHP-mobility	1.67	1.71	-	1.19***	(71)	1.53	(20)	1.24	(65)
NHP-energy	2.34	2.26	(6)	1.46***	(66)	2.00***	(26)	1.32**	(76)
NHP-sleep	2.35	2.04**	(23)	1.45***	(67)	2.13*	(17)	1.26***	(81)
NHP-social isolation	4.27	3.32***	(29)	2.72***	(47)	4.15	(4)	2.13***	(65)
NHP-emotional reaction	2.55	1.98***	(37)	1.41***	(74)	2.21***	(22)	1.02***	(99)
Widowed									
NHP-social isolation	3.10	2.60*	(24)	2.95	(7)	2.90	(10)	2.33*	(37)

[a] The asterisks indicate the statistical significance of the change in OR's of models 2-5 compared to model 1, according to the Wald type collapsibility test [Maldonado]: *** ($P < 0.05$), ** ($0.05 < P < 0.10$), * ($0.10 < P < 0.20$)

[b] All excess morbidity has been explained

9.4. Discussion

Many intermediary factors appeared to be very unevenly distributed over the marital status groups. Most notable were the low levels of social support among never married men and the very unfavourable material circumstances of divorced women. Significant differences in self-reported health between marital status groups were found for perceived general health, subjective health complaints and most NHP-scales, but not for chronic conditions. Compared to married men, never-married, divorced and widowed men had higher rates for most health measures. Among women, the significant differences in self-reported morbidity by marital status were almost solely due to excess morbidity among divorced women. The contributions of intermediary factors to the explanation of health differences reflected the differences in distributions of psychosocial factors, material circumstances and health behaviours over the marital status groups. Psychosocial factors were the most important intermediary factor in the explanation of the morbidity differences among men. The more favourable material circumstances of never married and widowed men had a health protective effect. However, material circumstances were the most important intermediary factor of the health differences between divorced and married women and accounted for the majority of their health differences.

In the interpretation of the results several issues need to be considered. Firstly, it should be kept in mind that all data were self-reported. This could bias the results if there are systematic differences in the answering of the questions by marital status. For most variables, except NHP-social isolation, this seems unlikely. In a validation study of the NHP, Hunt et al. tested whether marital status and living alone were associated with different scores on the NHP scales within groups of elderly persons with a favourable and an unfavourable objective health status (52). Systematic differences in the answering of the NHP by marital status were only found with regard to NHP-social isolation within the group with an unfavourable objective health status: unhealthy married persons were less likely than unhealthy divorced or widowed persons to score on the social isolation scale (52). This indicates that the social isolation scale might not only measure adverse (social) consequences of ill-health, as was the intention of the NHP (53), but also with marital status associated differences in social support. This means that there might be operational confounding (54) between the independent variable marital status and the dependent variable NHP-social isolation. Operational confounding inflates the relationship between two variables (54), which could explain why much higher ORs were found for NHP-social isolation than for the other outcome variables. In order to err on the safe side, the results concerning NHP-social isolation are ignored in the overall interpretation of our results.

Two other issues regarding our outcome measures also need discussion. Firstly, we found no statistically significant differences in chronic conditions between marital status groups. Unmarried men and divorced women had ORs for the chronic conditions which were larger than 1.00, but smaller than those of the other health measures. In previous studies in which health differences by marital status were examined in the total population of the GLOBE-study (n=18973) the magnitudes of the differences in chronic conditions were similar, while statistical significance was reached (55,56). Since statistically significant differences in chronic conditions also have been reported from other studies (4,6,7,13,57), lack of statistical significance in this study should not be taken as evidence of absence of differences in chronic conditions by marital status. Apparently, the size of the study population is insufficient to reach statistical significance if ORs are smaller than 1.50.

Secondly, health is a rather complex concept and to assess health differences several health measures were employed. To examine which health aspects were measured a factor analysis with varimax rotation was employed with the combined data of perceived general health, the 6 NHP-scales, the subjective health complaints and chronic conditions. The factor analysis yielded 2 factors with eigenvalues > 1.0, indicating that a model with 2 factors may be adequate to represent the data. The first and second factor explained 33.0 and 19.6% of common variance respectively. Of the health measures NHP-physical mobility, NHP-pain, NHP-energy, perceived general health, the subjective health complaints and chronic conditions loaded high on the first factor, while NHP-emotional reaction and NHP-social isolation loaded high on the second factor. NHP-sleep loaded almost equally on both factors. The factors were interpreted as a physical and mental health dimension respectively. The factor analyses outcomes with regard to the NHP were largely similar to those reported by Essink-Bot et al. (58) a study of renal patients. In that study data on additional instruments of physical and mental health with proved validity were available, which justified the interpretation of the factors as physical and mental health dimensions.

Several issues concerning the relationship between the intermediate factors and health status also need attention. Firstly, partner loss is a stressful life event, which is assumed to act as a crisis (14). In a cross-sectional data set, the divorced and widowed population will exist of persons who have lost their partners only recently and who according to the crisis theory have elevated stress levels and persons who have lost their partner for a longer period and who might have returned to the pre-loss stress levels ((14); see also (19)). We did find some support for the crisis theory. Separate control for partner loss in the previous year lowered the ORs of the divorced and widowed, however, more so among men than among women. Among men, partner loss in the previous year was associated with most of the health measures: men who had lost their partner in the previous year had

twice the OR's of men who had not lost their partner for most health measures (data not shown). Consequently, addition of the variable partner loss in the previous year to the model caused decreases in the differences between divorced and widowed men and married men for most health measures. On the other hand, women who had lost their partner in the previous year only had increased ORs for the health measures NHP-sleep and NHP-emotional reaction (data not shown). When partner loss in the previous year was added to the model, decreases in the ORs of divorced women only were seen for these health measures. Our results could be interpreted as that men experience immediate health disadvantages upon marital disruption, while for women the health disadvantages only occur with duration of marital dissolution. After control for partner loss, there were still unexplained health differences by marital status, indicating that the crisis theory is not the sole explanation.

Secondly, it should be kept in mind that the changes in the ORs due to the control for intermediary factors are the product of two factors: the magnitude of the differences in the distribution of the intermediary factors over the marital status groups and the effect of the intermediary factors on health status which might differ between the health measures. For instance, among women the psychosocial factors only seem related to the more psychological health measures, while the effects of health behaviours seem larger on the physical health measures.

We found that among men psychosocial conditions were the most important intermediary factor in the explanation of the morbidity differences, while differences in material circumstances had a health protective effect for never married and widowed men. Among women, however, material circumstances were the most important intermediary factor in the explanation of the health differences. With regard to these sex differences it is important to note that not the effect of material circumstances on health differs, but the distribution of material circumstances over the male and female marital status groups (table 1) (see also Ross (19)). Among women, it is somewhat surprising that no excess morbidity was found among widowed women, of whom almost equally large proportions were found in the lowest income group as of divorced women. Lillard and Waite (17) reported similar findings in a longitudinal study of marital changes and mortality and hypothesized that "widowed women with the same level of household income as divorced women are actually better of financially, since ... [d]ivorced women often loose their house and generally must divide assets with their ex-husband, but widowed women more often retain the family home and other financial assets intact" (p.1154). Some evidence in support of this hypothesis can be found in our data. While almost equally large percentages of divorced and widowed women were found in the lowest income group, a substantially larger proportion of divorced than of widowed women reported financial difficulties with payment of

rent and electricity and problems with housing conditions (table 1). This issue certainly needs more attention.

Two other studies have performed (partly) similar analyses. Gerstel, Riesmann and Rosenfield studied the role of material conditions and social networks in explaining mental health differences between divorced and married persons in Northern California and found that for women "while dimensions of social networks are clearly important in any explanation of divorced women's symptoms, they are not as important as the material resources", whereas the reverse was found for men (15) (p.95). Wyke and Ford studied the separate contributions of stress, social support, car ownership, smoking and alcohol consumption to differences in self-reported health between marital status groups among persons aged fifty-five years and living in the West of Scotland (6). They found that among men material resources (measured as car ownership), felt distress/eustress and quality/intimacy of support could individually account for the differences in self-rated health between married and no longer married persons, while among women only the first two intermediary factors could. The proportion of the differences in self-reported health explained by the material resources among women was larger than among men (6). Despite differences in the study populations, choice of intermediary factors and variable definitions which complicate comparisons, the findings of these studies seem to correspond with those of our study in that material circumstances seem more important in the explanation of health differences among women, while psychosocial factors seem more important for men. However, both in the studies of Gerstel et al. and Wyke and Ford health differences among men were no longer statistically significant after inclusion of the psychosocial factors (6,15). This indicates that we might underestimate the contribution of psychosocial conditions in our study and that the estimated contribution might increase by more extensive measurement of quality of support and/or by adding indicators of social isolation.

This last issue also complicates the evaluation of the accuracy of our conceptual model. Among women no statistically significant health differences were found after control for all three intermediary factors. The contribution of health behaviours after previous control for psychosocial conditions and material circumstances was only small but not negligible (data not shown). This could either mean that our assumption that marital status only affects health behaviour indirectly through changes in the psychosocial conditions and material conditions is correct, but that the measurement of the psychosocial conditions and material conditions was inadequate, or that the assumption was inaccurate and should be that marital status has also direct effects on health behaviour. This needs further research.

Our conceptual model only describes the social causation theory and in estimating the contribution of intermediary factors to the health differences between marital status groups and living arrangement, we have implicitly assumed that the

health differences were the result of social causation processes. However, because of the cross-sectional nature of our data, the direction of the causal pathways between marital status, the 'intermediary' factors and health can not be ascertained. Selection processes might have caused (part of) the health differences between marital status groups and living arrangements. Differences in, for instance, material circumstances and health behaviours might have affected marital status or might have affected health and through health marital status. Of the material resources and health behaviours income and alcohol consumption are most likely to be criteria in partner selection. In order to diminish selection of material resources, level of education was used as a confounder in the models. Education determines (to some extent) the potential material resources to be gained in later life and is unlikely to be influenced by marital status. With regard to alcohol consumption, Miller-Tutzauer et al. in a 3-year follow-up study of persons of 18-25 years of age found no preexisting differences in alcohol consumption between those who married and those who did not (38). Maguro and Shapiro, in a macro-level study examining U.S. data for 1933-1984 found that divorce was highly significant as a cause of problem drinking but that problem drinking was not significant as a cause of divorce and concluded that the link from divorce to alcohol seemed 'stronger' than the link from alcohol to divorce (59).

We conclude that psychosocial conditions are the most important intermediary factor in the explanation of marital status differences in self-reported morbidity among men, while material circumstances are the most important intermediary factor among women. Men seem to experience immediate health disadvantages upon marital disruption, while for women the health disadvantages only seem to occur with duration of marital dissolution and with marital dissolution associated material deprivation. Even in a country as the Netherlands, where a relatively generous welfare system is present (60), large differences in material circumstances are found among women, which seem the primary cause of the unfavourable health status of divorced women in particular. This should provoke contemplation among policy makers before policy measures which lead to even further deteriorations in the material position of divorced women are introduced.

Notes

1. The educational levels ' higher vocational' and 'university' have been combined in the analyses.

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Chapter 10

Survival differences by marital status: the role of health behaviours and material circumstances

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Abstract

The purpose of this study was to assess the relative contributions of health behaviours and material circumstances to survival differences between marital status groups. Data of a large prospective cohort study which started in 1991 in the Netherlands were used. Respondents, aged 40-74 years at baseline (n=12849), have been followed for over 4 years. In order to diminish effects of marital selection on the estimation of survival differences we controlled for initial health status, educational level and body height. Large survival differences between marital status groups were found among men. Together health behaviours and material circumstances accounted for approximately 50% of excess mortality among divorced men but only small parts of the excess mortality of never married and widowed men. Among divorced men health behaviours contributed more to the explanation of excess mortality than material circumstances. No statistically significant survival differences could be demonstrated among women. The results indicated, however, that divorced women had higher mortality risks than married women. Among divorced women it also seemed that health behaviours contributed more to the explanation of excess mortality than material circumstances. The contributions of intermediary factors to the explanation of mortality differences largely reflected the differences in distributions of the intermediary factors over the marital status groups.

10.1. Introduction

Hypotheses about the explanation can be grouped in two main theories: the marital selection theory and the social causation theory. Proponents of the social causation theory believe that marital status affects health status (1-4). The effect of marital status on health is assumed to be intermediated by factors such as health behaviours (e.g. smoking, alcohol consumption), material circumstances (e.g. financial situation, housing conditions) and psychosocial factors (e.g. stress and social support) (4-13). The intermediary factors can not be viewed as three independent pathways of the effects of marriage on health. Several interrelationships could exist. The material circumstances might either have direct health effects, increase psychosocial stress or operate through changes in health behaviours. For instance, unhealthy eating habits and a lack of recreation possibilities might in part be determined by financial position (14). The health behaviours might also be affected by the psychosocial factors. The increased levels of psychosocial stress caused by divorce or bereavement might, for instance, increase smoking rates and alcohol consumption among the groups, as these are palliative

coping responses to psychosocial stress (13,15). Increased levels of social support of married persons might have favourable effects on their smoking rates and alcohol consumption, as partner support is beneficial for behavioral changes, for instance, smoking cessation maintenance (16-19).

According to the selection theory health (direct selection) or health related factors (indirect selection) affect marital status (20). Educational level is an example of a determinant of health which might be operative in indirect selection. Educational level is positively related with health status and persons with a high educational level are more likely to marry than persons with a lower educational level. The selection theory and social causation theory are not mutually exclusive and it is probable that both selection and social causation can to some extent account for the health differences between marital status groups (2,4,7,21-23).

From the public health point of view primarily social causation effects are of interest. If selection effects are operative, increasing divorce rates will change the distribution of healthy and unhealthy persons over the marital status groups; the total number of persons will ill-health in the population, however, will remain constant. If, on the other hand, social causation mechanisms are operative, a rise in divorce rates will result in an increase of the total number of persons with ill-health in the population. Knowledge of the relative contribution of intermediary factors to the effect of marital status on health is of additional concern for public health. Assessment of the relative contributions of intermediary factors provides essential information for the development of strategies for the prevention or decrease of health differences between marital status groups.

The purpose of this study was to assess the relative contributions of health behaviours and material circumstances to survival differences between marital status groups. We used data of a large prospective cohort study which started in 1991 in the Netherlands. Respondents have been followed for 4 years. Since initial health differences might partly be due to marital selection, evaluation of social causation effects necessitates control for health status at the start of the observation period.

10.2. Material and methods

Material

We have used data of the GLOBE-study (24). The population registers of the municipalities involved in the study (and other municipalities if cohort members moved from the study area) have been used to track the study population with respect to vital status. Respondents have been followed until July 1995.

Analyses in this study have been restricted to persons aged 40 to 74 years at baseline (n=12849), because of the very small number of deaths in younger age

groups. Of the study subjects 12194 (94.9 %) were alive in July 1995, 555 (4.3 %) had died and 100 (0.8 %) were lost-to-follow-up.[1]

Marital status at baseline, classified as married, never married, divorced and widowed, was used in the analyses. Data on marital status were derived from the population registers from the municipalities of the study area. Table 1 shows the number of study subjects and deaths by to marital status at baseline and sex.

Socio-demographic confounders included in the study were age (coded as 5-year age groups) and degree of urbanisation (4 categories). The variables used to control for selection processes were perceived general health (answers to the question "How is your health in general?": very good, good, fair, sometimes good and sometimes bad, bad), number of chronic conditions (whether a respondent suffered from none, one, two, or three or more chronic conditions during the past year)[2], educational level (7 categories ranging from 'primary school only' to 'university') and body height (5 categories). We controlled for educational level and body height in order to account to some extent for indirect selection effects in our estimations of survival differences. Both factors are associated with health (25,26), are presumably factors in partner selection (26-29) and generally precede marital status transitions.

Health behaviours taken into account were smoking status (never smoker, ex-smoker, only pipe or cigars[3], 1-20 cigarettes/day, more than 20 cigarettes/day), alcohol consumption (non, low, moderate, excessive, very excessive)[4], leisure exercise (hours spent on sports and/or gardening/cycling/walking, in which hours spent on gardening, cycling, or walking counted half and hours spent on sports counted full: none, less than 1 hour/week, 1-2 hours/week, 2 or more hours/week) and body mass index (weight in kilogram divided by height in metres squared: <20, 20-27, 27-30, >30).

The material circumstances included were financial difficulties, level of household income, housing conditions and crowding. With regard to financial difficulties respondents were asked whether they had experienced difficulties in the past year with paying food, rent, electricity bills and the like. Answer categories were none, some or great difficulties. Household income was only available for a subsample of the GLOBE population. Therefore level of household income for the total study population was estimated by using proxies for income level, namely health insurance, housing tenure and car ownership. Respondents were classified into five groups, which corresponded with decreasing levels of household income: privately insured, house owner; privately insured, rented house; publicly insured, house owner; publicly insured, rented house, car; publicly insured rented house, no car. With regard to housing conditions, respondents were classified as experiencing none, one, two, or three or more of 7 listed unfavourable housing conditions (e.g. cold or draught in the house; noise from traffic, airplanes, and the like). Crowding was calculated as the number of persons living in the household

divided by the number of rooms in the house. Four crowding categories, each containing approximately 25% of the respondents, were distinguished.

Table 1. Number of study subjects and deaths according to marital status at baseline and sex

	Men		Women	
	sample	no. of deaths	sample	no. of deaths
married	5217	277	5050	125
never married	350	23	374	13
divorced	360	27	541	21
widowed	186	26	771	43
total	6113	353	6736	202

Methods

Directly age-standardized percentages have been calculated to examine the distribution of the intermediary factors over the marital status groups. In order to see whether known relationships between the intermediary factors and survival could be reproduced with our data, Cox proportional hazard models were used (30). For each intermediary factor associations with survival were assessed adjusting for age. Additionally, two models were fitted, the first model contained age and the health behaviours and the second age and the material circumstances. Thus, it could be determined whether the associations between the indicators of the intermediary factors and survival were independent of other indicators of the same intermediary factor.

The survival differences between the marital status groups were also estimated with Cox proportional hazard models (30). For the estimations of Cox proportional hazard models the COXREG procedure in SPSS was used (31). Analysis have been performed separately for men and women. All variables have been coded as dummy variables. Missing responses comprised a separate category in the multivariate analyses[5]. In each of the models married persons were the reference category. The regression coefficients and standard errors have been used to calculate relative risks (RR) and 95% confidence intervals (CI). The models used in the analyses are shown in table 2. In model 1 the mortality differences between marital status groups are adjusted for age. The mortality differences in model 1 could be due to confounding by other socio-demographic variables or selection mechanisms. Therefore, in model 2 we additionally controlled for degree of urbanisation, religion, educational level, body height, perceived general health and

number of chronic conditions, as measured at baseline. In models 3 and 4 there health behaviours and material circumstances respectively were added to model 2. The contribution of health behaviours and material conditions to the explanation of the mortality differences by marital status can be assessed by the comparing the RR's from model 3 and 4 with the RR's from model 2. In model 5 the joint contribution of health behaviours and material circumstances to the survival differences between marital status groups is estimated.

The adequacy of the proportional hazard assumption was examined by using a standard graphical method (30,31): the log-minus-log survival functions of the marital status groups were plotted against time. The differences between the plots of the marital status groups were nearly constant. Additionally, the proportional hazard assumption was tested by modelling marital status as a time dependent variable: the association between marital status and survival was allowed to vary with the log of time since baseline measurement (30,32). The models in which the effect of marital status was allowed to vary over time were not significantly better than models in which proportional hazards were assumed. Thus, both methods indicated that the assumption of proportional hazards was plausible.

Table 2. Cox proportional hazard models

model 1: survival=	*f*(age + marital status)
model 2: survival=	*f*(confounders (age + degree of urbanisation + religious affiliation) + selection variables (perceived general health + serious chronic condition + length) + marital status)
model 3: survival=	*f*(confounders + selection variables + health behaviours (smoking + alcohol consumption + physical activity + B.M.I.) + marital status)
model 4: survival=	*f*(confounders + selection variables + material conditions (financial difficulties + level of household income + housing problems + crowding) + marital status)
model 5: survival=	*f*(confounders + selection variables + health behaviours + material conditions + marital status)

10.3. Results

Distribution of the intermediary factors over the marital status groups

Table 3 shows the distribution of the intermediary factors by marital status and sex. In the table only one category for each intermediary factor is shown as an

example (data on the other categories are available on request). The intermediary factors were unevenly distributed over the marital status groups. Both among men and women, married persons had the highest percentages of persons without financial problems, with high levels of household income, former smokers and persons with neither underweight nor overweight. Among men, the never married had the highest percentage of persons in the lowest level of household income and of never smokers and teetotallers. Divorced men had the highest rates of current smokers and (very) excessive drinkers. Among women, divorced women and to a lesser degree widowed women were over-represented in the categories with financial problems, low levels of household income and among the current smokers.

Table 3. Distribution of the intermediary factors[a] by marital status groups and sex; directly age-standardized percentages

	Married	Never married	Divorced	Widowed
MEN				
Material circumstances				
Financial difficulties (large)	3.0	6.1	9.8	5.5
Level of household income (low)	6.3	27.8	19.9	10.0
Crowding (high)	25.9	12.2	9.1	4.3
Unfavourable housing conditions (≥2)	20.8	25.0	27.7	19.6
Health behaviours				
Smoking (>20 cigarettes/day)	6.9	9.8	18.0	12.8
Alcohol consumption ((very) excessive)	13.5	14.9	18.9	11.7
Physical activity ((almost) none)	5.0	4.1	8.0	8.8
Body mass Index (>30 kg/m^2)	4.7	8.2	8.1	5.6
WOMEN				
Material circumstances				
Financial difficulties (large)	2.7	3.2	20.4	7.8
Level of household income (low)	7.7	18.2	39.4	26.3
Crowding (high)	21.7	6.8	8.5	6.4
Unfavourable housing conditions (≥2)	19.2	28.2	29.7	20.6
Health behaviours				
Smoking (>20 cigarettes/day)	4.2	4.8	10.8	10.3
Alcohol consumption ((very) excessive)	2.8	1.9	4.1	4.0
Physical activity ((almost) none)	5.9	4.9	6.6	6.4
Body mass Index (>30 kg/m^2)	9.4	10.0	13.7	12.0

[a] only one category of each intermediary factor is shown as an example

Associations between the intermediary factors and survival

Among men, statistically significant associations with survival were found for all intermediary factors except crowding and housing problems, when adjusting for age. Among women, statistically significant associations with survival were found for all health behaviours. Of the material conditions statistically significant differences in survival only were found for financial problems. Table 4 and 5 show whether the associations between the health behaviours and material circumstances were independent from other the indicators of the same intermediary factor. Known relationships between health behaviours and survival were reproduced with our data: mortality risks increased with number of cigarettes smoked and decreased with amount of physical activity, both for alcohol consumption and BMI a U-shaped relationship with mortality was found (teetotallers and excessive drinkers and under- and overweighed persons had increased mortality risks). Between the material circumstances and survival, the expected associations were found for financial problems and level of household income: mortality risks increased with financial problems and decreased with level of household income. No clear patterns were found for the relationships between crowding and housing problems.

Table 4. Mortality differences by material circumstances (model: survival=*f*(age + financial problems + level of household income + housing problems + crowding)); relative risks (95% confidence intervals)

	Men		Women	
Financial difficulties				
none	1.00		1.00	
some	1.29	(0.97 -1.72)	0.90	(0.61 -1.32)
large	2.40	(1.52 -3.79)	1.74	(0.98 -3.09)
Level of household income				
1 (high)	1.00		1.00	
2	1.19	(0.84 -1.69)	1.25	(0.73 -2.14)
3	0.94	(0.65 -1.38)	1.35	(0.83 -2.20)
4	1.18	(0.85 -1.63)	1.54	(0.95 -2.47)
5 (low)	1.61	(1.11 -2.34)	1.51	(0.91 -2.49)
Housing problems				
none	1.00		1.00	
1	0.80	(0.60 -1.06)	1.16	(0.82 -1.64)
2	1.01	(0.73 -1.41)	0.88	(0.53 -1.44)
3 or more	1.20	(0.83 -1.73)	0.73	(0.38 -1.41)
Crowding				
1 (low)	1.00		1.00	
2	0.92	(0.71 -1.20)	1.08	(0.77 -1.52)
3	1.07	(0.78 -1.49)	0.77	(0.46 -1.30)
4 (high)	0.78	(0.52 -1.16)	0.95	(0.56 -1.60)

Table 5. Mortality differences by health behaviour (model: survival=*f*(age + smoking + alcohol consumption + physical activity + body mass index)); relative risks (95% confidence intervals)

	Men		Women	
Smoking				
never	1.00		1.00	
former	1.12	(0.72 -1.74)	1.39	(0.97 -2.00)
pipe/cigars	1.24	(0.70 -2.20)	[a]	
1-20 cig./day	1.41	(0.89 -2.24)	1.28	(0.85 -1.92)
>20 cig./day	1.96	(1.14 -3.39)	2.47	(1.38 -4.43)
Alcohol consumption				
none	1.00		1.00	
low	0.79	(0.59 -1.07)	0.79	(0.55 -1.13)
moderate	0.94	(0.68 -1.29)	0.91	(0.56 -1.48)
excessive	1.06	(0.68 -1.67)	1.20	(0.43 -3.34)
very excessive	1.07	(0.66 -1.76)	2.01	(0.73 -5.55)
Physical activity				
>2 hours/week	1.00		1.00	
1-2 hours/week	1.39	(1.00 -1.93)	1.43	(0.89 -2.28)
<1 hours/week	2.24	(1.51 -3.31)	2.11	(1.22 -3.66)
none	2.97	(1.90 -4.64)	5.16	(3.01 -8.85)
Body mass index				
<20	2.09	(1.29 -3.38)	2.20	(1.34 -3.61)
20-27	1.00		1.00	
27-30	1.30	(0.98 -1.72)	1.02	(0.68 -1.55)
>30	1.45	(0.92 -2.27)	1.10	(0.69 -1.73)

[a] Women who only smoked pipe or cigar (n=19) were classified as missing responses.

Survival differences between the marital status groups and the contributions of the intermediary factors

The survival differences between the marital status groups are shown in table 6. Adjusting for age, large mortality differences were found among men. Divorced men had the highest mortality risks followed by never married men. After additional control for socio-demographic confounders and selection effects statistically significant differences still were found. However, the mortality risks of divorced men were slightly lower than those of never married men. The material circumstances slightly contributed to the explanation of excess mortality among never married and divorced men, but not of widowed men. Differences in health behaviours accounted for almost half of the excess mortality of divorced men and some of the excess mortality of widowed men, but not of never married men. Control for both material circumstances and health behaviours accounted for a substantial part of the excess mortality of divorced men (51%), but for only small parts of the excess mortality of never married (8%) and widowed (20%).[6]

Table 6. Relative mortality risks (95% confidence intervals) of the unmarried compared to the married by sex, successively adjusted for socio-demographic confounders and selection factors, health behaviours and material circumstances

		Never married		Divorced		Widowed		P-value[a]
Men								
model 1:	adjustment for age and degree of urbanization	1,79	(1,17 -2,75)	1,89	(1,27 -2,81)	1,50	(1,00 -2,25)	0.0011
model 2:	model 1 + adjustment for selection factors	1,61	(1,04 -2,49)	1,57	(1,05 -2,36)	1,41	(0,93 -2,13)	0.0229
model 3:	model 2 + adjustment for health behaviours	1,61	(1,03 -2,50)	1,32	(0,87 -1,99)	1,34	(0,89 -2,04)	0.0916
model 4:	model 2 + adjustment for material circumstances	1,58	(1,01 -2,47)	1,50	(0,99 -2,28)	1,42	(0,93 -2,17)	0.0494
model 5:	model 2 + adjustment for health behaviours and material circumstances	1,56	(0,99 -2,45)	1,28	(0,84 -1,96)	1,33	(0,87 -2,05)	0.1569
Women								
model 1:	adjustment for age and degree of urbanization	1,00	(0,56 -1,78)	1,73	(1,07 -2,81)	1,15	(0,80 -1,66)	0.2035
model 2:	model 1 + adjustment for selection factors	1,05	(0,58 -1,89)	1,52	(0,93 -2,50)	1,12	(0,77 -1,63)	0.4456
model 3:	model 2 + adjustment for health behaviours	1,09	(0,60 -1,98)	1,35	(0,82 -2,24)	1,17	(0,80 -1,70)	0.6403
model 4:	model 2 + adjustment for material circumstances	1,05	(0,57 -1,92)	1,50	(0,87 -2,58)	1,07	(0,71 -1,61)	0.5752
model 5:	model 2 + adjustment for health behaviours and material circumstances	1,08	(0,58 -1,99)	1,30	(0,74 -2,27)	1,10	(0,73 -1,66)	0.8362

[a] Overall significance marital status

No statistically significant survival differences were found among women. However, the size and changes in RR in the consecutive models suggest that excess mortality is largest among divorced women and that health behaviours contribute more to the explanation of their excess mortality than differences in material conditions.

10.4. Discussion

Survival data of a large prospective cohort study with a follow-up of 4 years were used to assess the contributions of health behaviours and material circumstances to survival differences between marital status groups. In order to diminish effects of marital selection on the estimation of survival differences we controlled for initial health status, educational level and body height. Large survival differences between marital status groups were found among men. Together health behaviours and material circumstances accounted for approximately 50% of excess mortality among divorced men but only small parts of the excess mortality of never married and widowed men. Among divorced men health behaviours contributed more to the explanation of excess mortality than material circumstances. No statistically significant survival differences could be demonstrated among women. The results indicated, however, that divorced women had higher mortality risks than married women. Among divorced women it also seemed that health behaviours contributed more to the explanation of excess mortality than material circumstances. The contributions of intermediary factors to the explanation of mortality differences largely reflected the differences in distributions of the intermediary factors over the marital status groups.

In the interpretation of the results several issues need to be considered. At the end-of-follow-up vital status was unknown for 100 study subjects (0.8% of the total study population). Given the small number of persons lost-to-follow-up and the fact that the majority of them was known to be alive after 3 years of follow-up, it seems unlikely that censoring of these study subjects has had a major influence on our results. Additionally, marital status at baseline was used in the analyses. Respondents may have become widowed or divorced during follow-up or may have (re)married. This potential misclassification, however, will reduce the likelihood of finding true differences between the marital status groups, thereby making the significant findings even more important. Most other data used in the analyses were self-reported. Consequently, only self-reported health could be used to control for potential selection effects. Self-reported health should primarily be considered as subjective health measures ('illness': subjective interpretation of the persons involved) and not as objective health measures ('disease': clinically diagnosed) (33). Several studies have shown that subjective health is a strong

predictor of mortality, independent of objective health status (34,35). However, it is likely that additional control for objective health status would have further decreased mortality differences between marital status groups. Thus, selection effects might be underestimated in our analyses. On the other hand, however, selection effects probably also are overestimated. Control for health status at baseline is necessary to rule out possible effects of health selection on survival. However, differences in health status at baseline also partly result from previous social causation effects.

Finally, it theoretically would have been preferable, if unmarried persons living with a partner had been distinguished from those without a partner in the analyses. The presence or absence of a spouse plays an important role in the social causation theory. The spouse provides social support, which might buffer the negative health effects of stress (36). People sharing a household profit from economies of scale (10). Health behaviours are also likely to be influenced by the presence of a spouse, through either social control, support in behaviour changes or because social support decreases the need for palliative coping responses such as smoking and drinking in case of stress (13,15-17). Partners in cohabitations are likely to fulfil (to some extent) similar roles as spouses. Unfortunately, because of the small numbers of unmarried living with a partner in the age range studied and the small number of deaths among them in particular, no reliable estimations could be obtained with our data if unmarried people living with a partner were distinguished from those without. On the other hand, results of studies of the effect of living arrangements on survival differences have been inconclusive. Davis et al. did not find "any evidence to suggest that living arrangements have an additional influence on mortality beyond marital status", when he examined the association of living arrangement (living with a spouse, living with someone other than a spouse or living alone) and survival in a sample of US adults aged 45-74 during a 7- to 13-year period (37). Helsing et al. found that among a widowed population aged 18 years and over during a 12-year period "living alone was associated with significantly higher mortality rates than living with someone" (38). In these studies there was no further information whether the 'someone other than the spouse' was a partner, relative or someone else. Thus, in theory inclusion of living arrangement would have been preferable, but further research on the association between living arrangement and survival is required, in which the category 'living with someone other than the spouse' should be divided in those living a partner and those living with someone other that spouse or partner.

No statistically significant survival differences between marital status groups were found among women. However, a longer follow-up period may be needed to detect statistically significant survival differences between marital status groups among women. Mortality rates of women are lower than those of men and consequently the number of deaths occurring during the follow-up period in our

study was much smaller for women than for men. Additionally, previous studies have shown that mortality differences between marital status groups are smaller for women than for men (1,39,40). Thus, the number of events which is required to detect statistically significant mortality differences among women is larger.

Our goal was to assess the contribution of health behaviours and material circumstances (as intermediary factors of the effect of marital status on health) to the survival differences between marital status groups. In order to diminish the influence of selection processes on the survival differences we adjusted our estimates for health status at baseline. An additional problem is the possibility that indirect selection processes (selection on determinants of health) could have been operative and that these indirect selection processes might have involved some of the variables used as intermediary factors. Differences in material circumstances and health behaviours might have affected marital status or might have affected health and, through health, marital status. Because the material circumstances and health behaviours were only measured at baseline, the direction of the causal pathways between marital status and the 'intermediary' factors could not be ascertained. Among the intermediary factors income and alcohol consumption seem most likely to have been involved in partner selection. Control for educational level was used to diminish possible effects of indirect selection on material circumstances. Education determines (to some extent) the potential material resources to be gained later in life and is unlikely to be influenced by marital status. With regard to alcohol consumption, several studies have provided support for the assumption that alcohol consumption is more likely to be an intermediary factor of the relationship between marital status and health than a determinant in indirect selection. Miller-Tutzauer et al. in a 3-year follow-up study of persons of 18-25 years of age found that individuals 2 years prior to marriage did not differ in drinking behaviour from those who remained single (41). She therefore concluded that the findings did not suggest preexisting differences in alcohol consumption between those who marry and those who do not (41). Maguro and Shapiro, in a macro-level study of U.S. data for 1933-1984 found that divorce was highly significant as a cause of problem drinking but that problem drinking was not significant as a cause of divorce and concluded that the link from divorce to alcohol seemed 'stronger' than the link from alcohol to divorce (42).

We found that control for health behaviours and material circumstances explained a substantial part of the excess mortality of divorced men, but only small parts of excess mortality among never married and widowed men. The more unfavourable material circumstances and health behaviours of divorced men in comparison with never married and widowed men seem to explain why divorced men generally have higher mortality rates than never married and widowed men. Health behaviours contributed much more to the explanation of excess mortality among divorced men than material circumstances. Also among women, health

behaviours seemed to contribute more to the explanation of excess morfality than material circumstances. Besides health behaviours and material circumstances, psychosocial factors such as stress and social support, are often mentioned as a potential intermediary factor of the association between marital status and health. Unfortunately we only had information on psychosocial factors for a subsample of our study population. In a cross-sectional analyses of differences in self-reported health between marital status groups, we indeed found that psychosocial conditions were the most important factor in the explanation of health differences among men. Thus, research of the intermediary factors through which marital status affects survival might further benefit from inclusion of psychosocial factors.

Our results indicate that survival differences between marital status groups might be decreased by favourable changes in the health behaviours of divorced persons. As stated in the introduction, however, health behaviours can not be seen as an independent pathway through which marital status affects health. The unfavourable health behaviours of divorced people might for instance have been started as a coping response to increased levels of psychosocial stress experienced during the divorce. Further research of the interrelationships between the intermediary factors is needed to determine whether prevention and intervention programmes could best be directed at changes in health behaviours or, for instance, stress management.

Notes

1. Persons who were lost-to-follow-up were censored in the analyses at the last date they were known to be alive (mainly the date of migration from their last known residence). Of the 100 persons who were lost-to-follow-up 39 had emigrated from the Netherlands. The other 61 persons were lost during migration within The Netherlands. The majority of these 61 persons were still known to be alive after 3 years of follow-up.
2. Respondent were asked to check for each of 23 listed chronic conditions whether they had this condition or whether they had been under treatment or control for this condition during the previous year. Answers on ten of these chronic conditions (asthma, chronic bronchitis or chronic obstructive pulmonary diseases; serious heard disease or heart attack; stroke or effects of stroke; stomach ulcer or duodenal ulcer; serious disease of the kidney; diabetes mellitus; arthritis of hands or feet; other rheumatoid arthritis; diseases of the nervous system, such as Parkinson's disease, multiple sclerosis, or epilepsy; malignant neoplasm or cancer) have been used to construct the variable chronic conditions.
3. Because of the small number (n=19), smoking only pipe or cigar could not be distinguished as a separate category in the analyses of women. Women who only smoked pipe or cigar were classified as missing responses.
4. Alcohol consumption was categorized using questions on frequency and quantity. Persons who daily drank less than two consumptions or who drank 3 days per week 3 or less consumptions, were considered low drinkers. Excessive drinking was defined as 3 days per week 6 or more consumptions or 6 or 7 days per week 5 consumptions. Very excessive drinking was defined as 6 or 7 days per week 6 or more consumptions.
5. When respondents with missing responses were excluded from the analyses, relatively more

married than never married and widowed deceased persons were excluded from the analyses. Since exclusion of respondents with missing responses artificially increased the mortality differences between these groups, we decided to treat the missing responses as a separate category in the analyses.

6. The percentages are calculated by the formula:

$$100 * \frac{RR_a - RR_b}{RR_a - 1}$$

in which, RR_a is the RR of the marital status group resulting from model 2 (in which selection effects are assumed to be ruled out), and RR_b is the RR of the marital status groups resulting from model 5 (in which both health behaviours and material circumstances are controlled for).

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Chapter 11

General discussion

The goal of this study was to describe health differentials by marital status in The Netherlands and to contribute to the explanation of these health differences. In chapters 3-6 differences in self-reported health, health care utilization and mortality between marital status groups have been described. In chapters 7 and 10 it was examined whether effects of health on marital transitions (selection) respectively effects of marital status on health (social causation) could be demonstrated. In chapters 8-10 quantitative assessments were made of the contributions of several intermediary factors to the social causation mechanism. Because of the large proportion of unmarried people who live with a partner in contemporary Dutch society and the relevance of the presence of a partner in the explanations of health differences by marital status, the concept of marital status has been extended with that of living arrangement (where permitted by the data and the size of the research population). This chapter provides a general discussion and summary of these studies.

11.1. Differences in health status, health care utilization, and mortality

Our first aim concerned the description of health differentials in The Netherlands: are marital status and living arrangement related to health status, health care utilization and mortality in The Netherlands? This question was answered in part I of this thesis.

11.1.1. Outcomes

Differences in self-reported health
Differences in perceived general health, subjective health complaints, chronic conditions and work disability were studied (chapter 3). With regard to marital status it was found that divorced persons had the highest morbidity rates, married people had the lowest rates and never married and widowed people had rates in between. With regard to living arrangement it was found that single people had higher morbidity rates than people living with a partner (either married or unmarried). Given the relevance of the presence of a partner in the explanations of health differences by marital status, it was tested whether morbidity differences by marital status were due to differences in living arrangement. It was found that differences in living arrangement between married and unmarried people accounted for a substantial part of the morbidity differences by marital status (40-70%). However, after marital status had been controlled for living arrangement,

there were still statistically significant health differences by marital status and vice versa. The results suggest that both marital status and living arrangement have a separate effect on health status. In studies of health differences preferably both marital status and living arrangement should be taken into account.

Differences in health care utilization

Differences in health care utilization by marital status were also found (chapter 4). Compared to married people never married people used less and divorced and widowed people used more health services after extensive control for socio-demographic confounders. These differences in health care utilization were only partly due to differences in health status between the marital status groups. The fact that never married people had a lower utilization of health services after control for confounding and health status could indicate that they neglect their health, which in turn might explain some of the higher mortality and morbidity of the never married.

If unmarried persons who lived with a partner were distinguished from those without a partner in the analyses, it was found that the health care utilization of unmarried people with a partner was more similar to the health care utilization of married people than that of those without a partner.

Mortality differences

Two studies were performed using national mortality statistics. In the first study the contribution of specific causes of death to contemporary differences in total mortality between marital status groups was examined (chapter 5). External causes of death (e.g. suicide, accidents) contributed more to the contemporary (1986-1990) excess mortality of unmarried people, while cardiovascular diseases and malignant neoplasms contributed less than could be expected from their contribution to overall mortality among married people. The specific causes of death which had a relatively large contribution to the excess mortality of unmarried people (e.g. external causes of death, cirrhosis of the liver, COLD, diabetes mellitus, cervical cancer) almost all have unhealthy life styles as important risk factors.

In the second study differences in total and cause-specific mortality between the marital status groups were examined for the period 1950-1990 and related to important societal changes concerning marital status (chapter 6). Since 1965 several societal changes have occurred, which, according to the social causation theory, should have reduced mortality excess of never married and divorced people: a large decrease in first marriage rates, a huge increase in divorce rates, increasing numbers of unmarried couples sharing a household, a decrease in societal stigmatizing of never married and divorced persons and favourable changes in material conditions of unmarried persons. It was indeed found that the mortality differences between the divorced and married decreased during the 1970s, but the

mortality differences between the never married and the married increased over the same period. Decomposing the changes in total mortality among the never married into changes in cause-specific mortality showed that, while most specific causes of death followed the trend in total mortality (i.e. mortality differences between the never married and married increased), the differences in mortality from external causes decreased. This could be explained by assuming a time lag between the societal changes and the changes in mortality rates, the length of which differs between the specific causes of death and the specific societal changes. Mortality from external causes can be considered as a rather direct reflection of the changes in perceived stress, social support and social integration among the marital status groups. A longer time lag could be expected for mortality from cardiovascular diseases and malignant neoplasms. The size of the time lag for these degenerative diseases could be especially large for never married people, since the mean survival time of never married persons (because of the younger average age) is larger at the time of occurrence of relevant societal changes than the survival time of divorced and widowed persons. Thus, the increase of total mortality differences between the never married and the married is not necessarily in contradiction with the social causation hypothesis.

11.1.2. Discussion

Successively, the limitations of the studies with regard to internal and external validity, the interpretation of the health measures, the relationship between marital status and living arrangement and the clues which the descriptive studied provided for the explanation of the health differences, will be discussed.

Internal validity of the studies

Several issues concerning the internal validity of the descriptive studies need to be considered. Internal validity of a study refers to the extent to which the results are valid for the study subjects themselves, more specifically, the extent to which the results might be distorted by systematic errors (1,2). Three possible sources of systematic errors are generally distinguished: selection bias, information bias and confounding (2,3). The most likely sources of systematic errors are selection and information bias in the studies of differences in self-reported health and health care utilization and information bias and confounding in the mortality studies.

The studies concerning differences in self-reported health and health care utilization have used data of the GLOBE-study. Differential non-response by marital status could have resulted in selection bias if the non-response was associated with the outcome variable. There were some differences in response to the postal questionnaire by marital status. The response rates of married, never

married, divorced and widowed persons were 72.3, 65.8, 61.5 and 70.6% respectively. In order to evaluate whether non-response was differential by health status, a small subsample of the non-responders to the postal questionnaire was approached for a brief interview. It appeared that non-responders did not differ from the respondents with regard to health status (4).

Additionally, the data of the GLOBE-study are self-reported. This could have biased the results if there would have been systematic differences in the answering of the questions by marital status (information bias). With regard to this issue it is important to make a distinction between 'illness' (subjective interpretation of the person involved) and 'disease' (clinically diagnosed) (5). Since our data on health status are self-reported they should primarily be considered measures of subjective health ('illness'). There is no one to one relationship between the subjective interpretation of the individual and clinically diagnosed organic conditions (6). This can for instance be demonstrated by taking neuroticism into account. Neuroticism is a personality trait referring to the tendency to experience negative, distressing emotions and to possess associated behavioral and cognitive traits such as fearfulness, irritability, low self-esteem, social anxiety, poor inhibition of impulses, and helplessness (6). Neuroticism is highly associated with self-reported health, but seems not to be associated with mortality (6). Therefore, it is assumed that "given identical objective health statuses, individuals high and low in neuroticism might have very different perception of health" (6, p.312). Neuroticism was only available for a subpopulation of the GLOBE population. Data of the 3510 respondents of the study described in chapter 9, who constituted a random sample of the total GLOBE-population, were used in the analyses. There were differences in neuroticism between the marital status groups. Married persons had the smallest percentages of persons with high levels of neuroticism: of married, never married, divorced and widowed persons, 4.2, 8.7, 13.3 and 5.0% respectively were found in the category with the highest level of neuroticism. Control for neuroticism decreased the excess morbidity of divorced men and women and to a lesser extent of never married men, while the excess morbidity of widowed men increased (table 1). However, health measures for which statistically significant differences by marital status were found without control for neuroticism, generally still showed statistically significant health differences by marital status after control for neuroticism. These results clearly suggest that not all differences in self-reported health are due to differences in objective health status and that the differences in self-reported health are also partly based on differences in the perception of health status. The sizes of these parts are differential by marital status. Thus, in the interpretation of the outcomes it is important to keep in mind that they pertain to 'illness' and not to 'disease'. The analyses regarding neuroticism showed that reliance on self-reported health as an indicator of objective health status would be inappropriate, since systematic differences seem

to exist between marital status groups in the translation of objective health status to subjective health status.

Table 1: Effects of control for neuroticism on health differences between marital status groups; odds ratios (95% confidence intervals)

	Men		Women	
	Model 1: confounders[a]	Model 2: confounders + neuroticism	Model 1: confounders[a]	Model 2: confounders + neuroticism
Perceived general health				
married	1,00	1,00	1,00	1,00
never married	2,14 (1,37 -3,33)	1,78 (1,11 -2,85)	1,00 (0,64 -1,56)	0,94 (0,60 -1,49)
divorced	1,49 (0,93 -2,40)	1,27 (0,77 -2,09)	1,79 (1,16 -2,75)	1,47 (0,94 -2,30)
widowed	1,91 (0,99 -3,68)	2,05 (1,01 -4,15)	1,05 (0,70 -1,58)	0,95 (0,61 -1,46)
P-value	0,0011	0,0203	0,0689	0,3751
Subjective health complaints				
married	1,00	1,00	1,00	1,00
never married	1,64 (1,11 -2,44)	1,32 (0,86 -2,01)	0,72 (0,48 -1,08)	0,61 (0,39 -0,94)
divorced	1,24 (0,78 -1,97)	1,04 (0,64 -1,70)	1,45 (0,97 -2,17)	1,14 (0,74 -1,77)
widowed	1,39 (0,74 -2,62)	1,51 (0,75 -3,05)	0,81 (0,54 -1,21)	0,68 (0,44 -1,05)
P-value	0,0594	0,4127	0,0618	0,0425
Chronic conditions				
married	1,00	1,00	1,00	1,00
never married	1,42 (0,98 -2,07)	1,28 (0,87 -1,88)	0,98 (0,67 -1,44)	0,94 (0,64 -1,38)
divorced	1,20 (0,77 -1,86)	1,09 (0,70 -1,71)	1,24 (0,83 -1,85)	1,11 (0,74 -1,67)
widowed	0,78 (0,42 -1,44)	0,76 (0,40 -1,42)	0,75 (0,51 -1,11)	0,71 (0,48 -1,06)
P-value	0,2050	0,4742	0,3384	0,3513

[a] Socio-demographic confounders are age, educational level, degree of urbanization, religious affiliation.

With regard to the mortality studies, a variety of errors in the data could have distorted the estimation of mortality differentials by marital status (information bias). For mortality studies in which national mortality and population statistics are used, generally mentioned data errors are differential undercount of the population by marital status and misreporting of marital status on death certificates (7,8). The Dutch system of municipal population registration is, however, less prone to errors in the estimation of the population at risk than systems based on censuses, in which self reports of marital status are used. Moreover, since the municipal population registration is the basis for both the population and mortal-

ity statistics in The Netherlands, estimations of mortality differentials by marital status will not be distorted by numerator denominator bias, contrary to estimations of mortality differentials in countries in which the marital status information of the deceased and the population at risk is derived from different sources (e.g. death certificates and censuses).

Finally, in the mortality studies we only had information on the confounders age and sex. No information was available on possible additional confounders of the association between marital status and mortality, such as socioeconomic status (SES), degree of urbanization of the place of residence, or religious affiliation. Each of these variables is associated with mortality. The distribution of these variables also differs among the marital status groups (9-12). The excess mortality of unmarried persons compared to married persons could partly be due to these variables and not to marital status itself. Thus, not controlling for these variables might have biased the estimation of mortality differences by marital status. However, other studies of mortality differences between marital status groups in which information on such factors was available, showed that mortality differences still existed after controlling for one or more of these factors (13-15). Furthermore, using mortality data of the GLOBE-study (see chapter 10) it could be demonstrated that additional control for SES, degree of urbanization and religious affiliation only caused minor reductions of the mortality differences between marital status groups. The relative mortality risks of never married, divorced and widowed men in a model in which only age was controlled for, decreased from 1.79 to 1.74, 1.89 to 1.80 and 1.50 to 1.49 respectively after the addition of SES, degree of urbanization and religious affiliation to the model.

External validity of the studies

The external validity of a study refers to the generalizability of the study outcomes to people outside the study population, i.e., the Dutch population. The data used in the mortality studies of chapters 5 and 6 concerned the total Dutch population. The studies of chapters 3 and 4, however, used data of the GLOBE-study, which was confined to the non-institutionalized population in a geographically restricted area.

The institutionalized population constituted only 1.7% of the total Dutch population in 1992 (16). With regard to our studies it is important to note that institution rates increase with age and that not all inhabitants of institutions remain there for health reasons. Firstly, in the age range 15-74, which was relevant for our studies, the proportion of persons in institutions was much lower than in the overall population (approximately 0.8%). Secondly, the populations of nursing homes, institutions for the mentally disabled and psychiatric hospitals constituted only 30% of the total institutionalized population. Homes for the aged provided

accommodation for the largest part of the institutionalized population (approximately 52%) (16). On the other hand, the proportions of institutionalized persons differ by marital status. Of married, never married, divorced and widowed men 0.1, 1.9, 1.0 and 1.6% respectively remained in an institution in 1992. These proportions were 0.1, 2.1, 0.8 and 1.4% for women. These figures suggest that, if the institutionalized population would have been included in the GLOBE-study, this might have increased the health differences between the marital status groups. However, since the institutionalized population only constitutes a small proportion of the total population, we believe that, although institutionalization is differential by marital status, inclusion of the institutionalized population would hardly have caused changes in our estimates of differences in self-reported health by marital status.

The average health status of the population of Eindhoven and surroundings appears to differ from that of the Dutch population as a whole. Although Eindhoven and surroundings seemed healthier than The Netherlands as a whole with regard to perceived general health, subjective health complaints and chronic conditions (17), mortality was higher than in the rest of the country (18). Mackenbach et al. (18) found that the excess mortality was related to the high percentage Roman-Catholics in this part of the country. Since the distribution of religious affiliations of the population of Eindhoven and surroundings differs from that in the rest of the country and religious affiliation is associated with marital status, it is important that estimations of health differences between marital status groups are controlled for religious affiliation. This has been done in all studies in which GLOBE data were used. Consequently, we believe that the outcomes of our studies in which GLOBE data were used, will roughly pertain to the Dutch population as a whole.

How do our results compare to other Dutch and international findings? Our results of differences in self-reported health are largely comparable with those of the Netherlands Health Interview Survey (HIS) (19). In the HIS differences in perceived general health, number of subjective health complaints and number of chronic conditions were studied by means of interviewing a representative sample of the non-institutionalized Dutch population. The analyses concerning health differences between marital status groups were restricted to the population of 16 years and older. As in our study, divorced people showed the highest morbidity rates in the HIS. However, health differences between marital status groups seemed smaller than in our study. An explanation for the differences between the GLOBE-study and the HIS might be that in the HIS persons above the age of 74 were included. Health differences between marital status groups decrease with age (20,21).

Differences in morbidity, health care utilization and mortality by marital status and living arrangement, as have been reported in other studies concerning

Western countries (21-24), largely have been reproduced in this study. An inconsistency was that never-married men were found to have lower risks for mortality from cancer of the trachea, bronchus and lung than married men in The Netherlands (chapter 5), while studies from the United States and the United Kingdom reported that never-married men had higher risks of mortality from cancer of the trachea, bronchus and lung than married men (25-27). From studies of smoking behaviour in The Netherlands it appears that there have been higher percentages of never smokers among never-married men than among married men, although these differences have been declining (28-32). This could explain some of the inconsistency in mortality differences from cancer of the trachea, bronchus and lung by marital status between our study and studies of other Western countries.

The interpretation of the health measures used in the descriptive studies

The aim of this thesis was to study differences in health by marital status and living arrangements, with an emphasis on physical health aspects. Several health indicators have been used for this purpose: perceived general health, subjective health complaints, chronic conditions and mortality. What do these health indicators measure and what is their interrelationship?

As stressed above, the measures of self-reported morbidity should be considered as indicators of 'illness' (subjective interpretation of the person involved) and not of 'disease' (clinically diagnosed) (5). The World Health Organization defines health as "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity" (5). While most objective health measures primarily address the latter part of this definition, our subjective health measures also incorporate aspects of the former part of the definition. As put by McDowell and Newell subjective health measures "amplify the data obtainable from morbidity and mortality statistics by describing the quality rather than merely the quantity of survival. They give insights into matters of human concern such as pain, suffering or depression that could never be inferred solely from physical measurements or laboratory tests. They give information about individuals whether they seek care or not, they can reflect the positive aspects of good health, and they do not require invasive procedures or expansive laboratory analyses" (33, p.15). Additionally, perceived health status (besides objective health status) is also important as a predictor of need for, and utilization of, health services (34). The individual's subjective interpretation of his/her health status must be seen as an essential complement to traditional indicators in the assessment of health status (34).

The importance of subjective measures as a supplement to objective measures of health status can also be seen from the association of subjective health measures with mortality. Research has demonstrated that, for instance, perceived general health, in its own right, is an important predictor of mortality (35). Despite

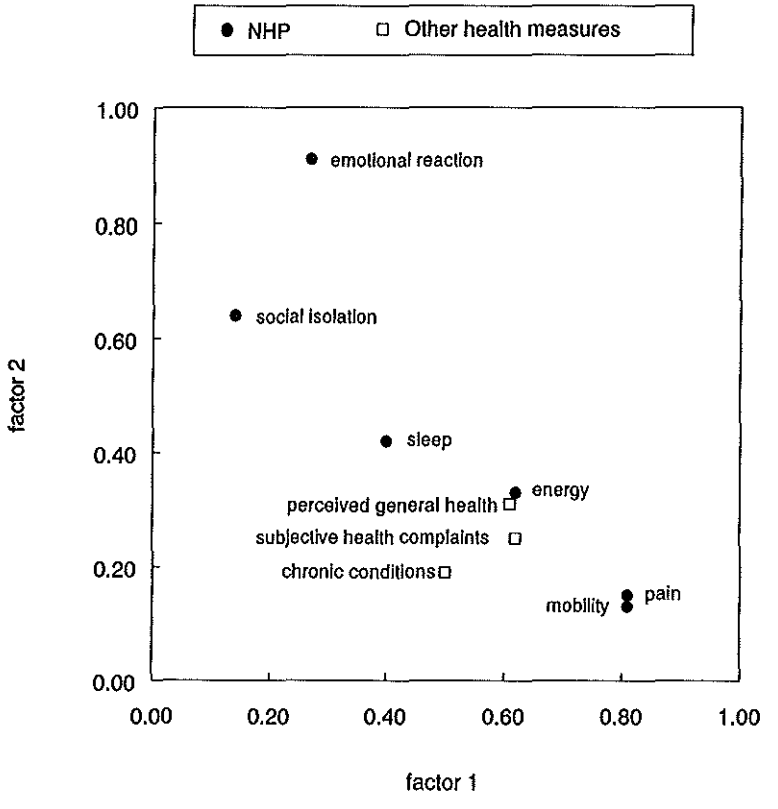
extensive control for objective health status and socio-demographic variables, perceived general health appeared a strong predictor of mortality. This does not mean, however, that objective ('disease') and subjective health status ('illness') are totally independent. Mossey and Shapiro found for instance in a sample of elderly persons that measures of perceived general health and objective health status agreed for 65% of the study population (35). The proportion of agreement with objective health status is likely to differ by the measure of self-reported morbidity used. In the analyses described above, in which the differences in self-reported health between marital status groups were controlled for neuroticism, the association between neuroticism and self-reported health proved to be much stronger for perceived general health and subjective health complaints than for chronic conditions. While the OR of the highest compared to the lowest category of neuroticism was 12.85 for perceived general health and 19.54 for subjective health complaints, the OR for chronic conditions was 3.44. If neuroticism is considered a measure of the extent to which differences in perception of objective health status influence self-reports of health status, these findings indicate that the proportion of agreement between chronic conditions and objective health status is much larger than the agreement between perceived general health or subjective health complaints and objective health status.

Health is a multidimensional concept (5). The WHO definition distinguishes three dimensions: physical, mental and social (5). We used three different measures of self-reported health to assess morbidity differences. Perceived general health is considered a general health measure, indicating that in answering this question people are assumed to evaluate their physical well-being as well as more psychological aspects of their well-being (5). Krause and Jay, however, refer to a validation study of perceived general health, in which it was found that perceived general health principally reflected physical health problems and to a lesser extent mental health problems (36). The literature on subjective health complaints (VOEG) is ambiguous. Joosten and Drop (37) state that the VOEG only addresses physical well-being, while König-Zahn et al. (5) classify the VOEG among the mental health measures. Finally, chronic conditions are assumed to refer to physical health aspects (5).

To examine more precisely which health aspects were measured by these three health indicators in our studies, a factor analysis with varimax rotation was employed in which data of perceived general health, the subjective health complaints and chronic conditions were combined with data of the NHP (see also chapter 9). The NHP was only available for a subpopulation of the GLOBE population. Data of the 3510 respondents of the study described in chapter 9, who constituted a random sample of the total GLOBE-population, were used in the analyses. The factor analysis yielded 2 factors with eigenvalues > 1.0. The first and second factor explained 33.0 and 19.6% of common variance respectively, and

were interpreted as a physical and mental health dimension. The results of the factor analysis are shown in figure 1. Our results with regard to the NHP are highly similar to those reported by Essink-Bot et al. in a study of renal patients (38) . In the study of Essink-Bot data on additional instruments of physical and mental health with proved validity were available, which justified the interpretation of the factors as physical and mental health dimensions. In our study NHP-physical mobility, NHP-pain, NHP-energy, perceived general health, the subjective health complaints and chronic conditions loaded high on the physical factor, while NHP-emotional reaction and NHP-social isolation loaded high on the mental factor. NHP-sleep loaded almost equally on both factors. Thus, it is likely that perceived general health, the subjective health complaints and chronic conditions mainly reflect differences in physical health aspects.

Figure 1. **Factor analysis with varimax rotation of the Nottingham Health Profile (NHP), perceived general health, subjective health complaints and chronic conditions**



In summary, perceived general health, the questionnaire of subjective health complaints and the checklist of chronic condition predominantly measure (subjective aspects of) physical health. Of the NHP, which was used as a health indicator in chapter 9, the scales of mobility, pain and energy also address physical health aspects, while the scales for emotional reaction and social isolation measure psychological health aspects.

Relationship between marital status and living arrangement

Given the relevance of the presence of a partner in the explanations of health differences by marital status, marital status was extended with the concept of living arrangement, where possible. With regard to differences in self-reported morbidity it was shown that, although differences in self-reported health decreased after adjustment for living arrangement, marital status and living arrangement each had a separate effect on health status. This implies that the health differences between marital status groups are partly due to differences in living arrangements: people who live with a partner are healthier than those living without a partner; the vast majority of married people lives with their spouse, while the proportion of unmarried persons living with a partner is substantially less. However, within specific living arrangements there still are health differences between marital status groups: among persons who live with a partner, divorced persons exhibit higher morbidity rates when compared to married persons, while never married persons seem to have intermediate morbidity rates (chapter 3).

This might be due to confounding by socio-demographic factors. For instance if religious people are more inclined to choose for marriage in stead of cohabitation and religiosity is associated with good health, the lower morbidity rates of married people could be explained by differences in being religious between married and cohabiting persons. However, in the analysis we controlled for several socio-demographic factors known to be associated with the choice for marriage or cohabitation: age, educational level, degree of urbanization and religious affiliation (12,39).

Another explanation might be that marriage differs from cohobation in social attachment as was hypothesized by Ross (40). Ross hypothesized that not having a partner, having a partner but not living together, living with a partner while unmarried and being married could be viewed as an increasing scale of social attachment, with married people being most committed to the relationship and most supportive. Married people were therefore expected to experience the lowest level of psychological distress. This hypothesis, however, was not confirmed by the results of Ross's study: no statistically significant differences in well-being were found between the married and the unmarried who lived with a partner. On the other hand, Schoen reported differences in partner choice in marriages and cohabitations which might indicate that there are differences in social attachment

(41). Schoen assumed that when cohabitations would be "informal marriages", partner choice in cohabitations would resemble that in marriage, in which great weight is given to homogamy of ascribed characteristics (such as age, race and religion) and women are likely to "marry up" with regard to education (that is, women marry men with more education than their own to a greater extent than men marry women with more education than their own). However, when cohabitations would be "looser bonds", partner choice in cohabitations was assumed to give less weight to ascribed characteristics that reflect long-term considerations of union permanency and more weight to homogamy in achieved characteristics (such as education) which can reflect a short-term ability to contribute to the relationship. Schoen found that, compared to married couples, cohabiting couples were more homogamous with respect to education, less homogamous with respect to age and religion and showed less educational hypergamy (tendency for women to "marry up"). Schoen argued that this was consistent with the hypothesis that cohabitation is a distinct relationship and should be viewed more as a "looser bond" than as an "informal marriage" (41). Additional support for this assumption is found in a study of Manting (12). Manting found that the likelihood of union disruption varied with the legal status of the union. Cohabiting women had a much higher likelihood of experiencing a union disruption than married women. Manting interpreted this as support for the assumption that legal status was an indicator for commitment to a union (12).

The hypothesis that marriage and unmarried cohabitation differ in social attachment could also explain the health differences in self-perceived health between the married on the one hand and the cohabiting on the other hand, but not the health differences between cohabiting never married persons and cohabiting divorced persons. In comparison with never married people, divorced people who cohabit might experience more stress as a consequence of the divorce and the concurrent life changes, the relationship with the ex-spouse, parental obligations or the more negative attitudes towards divorce (p.8-9).

Similar results as with regard to self-reported health, appeared to exist for the effects of marital status and living arrangement on health care utilization. However, analyses with larger study populations are required to demonstrate whether this result is genuine or spurious. Because the national mortality statistics lack information on living arrangement, we were unable to take the effects of living arrangement into account in the investigations of mortality differences between marital status groups. Circumstantial evidence (the fact that growing percentages of unmarried people who live with a partner coincide with decreases in the excess mortality of unmarried people from external causes of death and suicide in particular) seems to confirm the importance of the presence of a partner in the explanation of mortality differences between marital status groups. However, together with the growth of consensual unions several other societal changes

occurred which could explain the decrease in excess mortality of unmarried people. Thus, in order to demonstrate the mutual and separate effects of marital status and living arrangement on mortality both information on marital status and living arrangement in mortality and population data is required.

Clues for the explanation of the health differences

The results of this descriptive part of health differences by marital status in The Netherlands provide some clues with regard to the explanation of the health differences. Firstly, living arrangements explained a considerable part, although not all, of the morbidity differences between marital status groups. This finding, however, does not shed light on the selection and social causation debate, since health differences between living arrangements can just as well be founded on either selection or social causation. On the one hand, health or determinants of health might be a selection criterion in the choice of a partner for cohabitation. On the other hand, partners in a consensual union presumably also provide social support, increase social integration, contribute to the household income, enable economies of scale and create conditions for engagement in positive health behaviours.

The large contribution of causes of death in which health behaviours are important risk factors to the excess mortality of unmarried groups, points to a larger role for social causation as the explanation of mortality differences by marital status than selection processes. As described in the introduction (p.16-17), the existing evidence indicates that differences in health behaviours between marital status groups are a result of social causation processes (marital status precedes health behaviours) rather than selection effects (health behaviours precede marital status). However, since the mortality analysis are based on cross-sectional data and no information regarding health behaviours was available, the conclusion that social causation might be more important than selection is only tentatively made.

The never married seemed to constitute a rather distinct group with regard to health care utilization. Despite the fact that they experienced more health problems than married people, the never married had lower rates for health care utilization. This might indicate that never married people neglect their health, which might in turn explain a part of the higher morbidity and mortality rates of never married people.

Finally, our results regarding the trends in mortality differences between the marital status groups indicate that the coincidence of societal changes, which are assumed to be favourable for the unmarried, and a widening of mortality differences between the never married and the married in the past decades, should not be considered as necessarily in contradiction with the social causation hypothesis. Examination of the mortality trends by cause of death showed that differences in

mortality from external causes, which can be viewed as a more direct reflection of the changes in perceived stress and social integration among the marital status groups than other causes of death, do indeed decrease from the 1965s onwards.

11.2. Evidence for marital selection and social causation

The second research question of this study concerned the explanatory theories of the health differentials by marital status and living arrangement: do the health differences between marital status groups and living arrangements result from an effect of health status on marital status and living arrangement (selection) or from an effect of marital status and living arrangement on health status (social causation)? A longitudinal study design is required to disentangle marital selection effects from social causation effects in the explanation of health differences between marital status groups.

We are only aware of one previous study which has used longitudinal data to examine health selection in marital transitions, and in this study only the transition from the never married to the married state was investigated (42). Of the longitudinal studies in which social causation effects of marital status on health were examined, the majority addressed the mortality effects of conjugal bereavement (43-45). Only two studies have examined mortality effects of all marital status groups simultaneously in a longitudinal design (13,20). Of these, the study of Ben-Shlomo et al. only focused on the male population and the study of Goldman et al. concentrated on an elderly population (70 years and over) (13,20). The study of Goldman et al. is also the only longitudinal study we know of which addressed morbidity differences by marital status (20).

Research question 2 was addressed in chapters 7 and 10 of this thesis.

11.2.1. Outcomes

Evidence for the marital selection theory

It was tested whether differences in health were associated with different probabilities of marital transitions in a longitudinal study. Of the four marital transitions studied (marriage among never married and divorced persons, and divorce and bereavement among married persons), only divorce among married persons was associated with health status: married persons who reported 4 or more subjective health complaints or two or more chronic conditions were 1.5 respectively 2 times more likely to become divorced during the follow-up period than persons without these health problems. Our findings suggest that the frequently made assumption that health selection contributes only little to the explanation of health differences between marital status groups, is, at least for the divorced, not justified.

Evidence for the social causation theory

It was tested whether survival differences by marital status could be demonstrated after control for health status at baseline (chapter 10). Since initial health differences might (partly) be due to marital selection, evaluation of social causation effects necessitates control for health status at the baseline of the observation period. After a follow-up period of four years statistically significant survival differences were found among men. Compared to married men, never married and widowed men were 1.5 times as likely to die, while the RR of divorced men was 1.8. No statistically significant survival differences were found among women. A longer follow-up period may be needed to detect statistically significant survival differences by marital status among women. Mortality rates of women are lower than those of men and consequently the number of deaths occurring during the follow-up period in our study was much smaller for women than for men. Additionally, previous studies have shown that mortality differences between marital status groups are smaller for women than for men. Thus, the number of events which is required to detect statistically significant mortality differences among women is larger.

We also performed a longitudinal study of social causation effects on morbidity differences (not described in the previous chapters). It was tested whether in an initially healthy population, health differences had developed between marital status groups after a period of 2-2.5 years. Data of the 3510 respondents of the study described in chapter 9, who constituted a random sample of the total GLOBE-population, were used. Health status of these persons was assessed for a second time in the autumn of 1993 by means of a postal questionnaire. Only persons without health problems in 1991 were included in the analyses (approximately 2000 persons).[1] Men and women were analyzed separately. Logistic regression models were fitted with health status as outcome variable (either perceived general health, chronic conditions or the NHP scales), marital status (married, never married, divorced, widowed) as independent variable and age, level of education, religious affiliation and degree of urbanisation as control variables.[2] Among men statistically significant differences had developed in the NHP-scales energy, sleep and emotional reaction after 2.5 years.[3] Among women statistically significant differences had developed in the NHP-mobility (table 2).[4] Both among men and women it was found that in particular divorced persons had a higher incidence of health problems compared to married persons. Since it was demonstrated that health differences developed in an initially healthy population, it seems probable that social causation mechanisms are involved.

Table 2: Development of differences in self-reported health in an initially healthy population after 2-2,5 years; logistic regression models[a] adjusted for age, educational level, degree of urbanisation and religion; odds ratios (95% confidence intervals)

	Never married	Divorced	Widowed	P-value[b]
Men (n[c])	(115)	(50)	(15)	
perceived general health	2,05 (0,80 -5,22)	1,89 (0,66 -5,42)		0,2061
chronic conditions	0,93 (0,51 -1,72)	1,02 (0,47 -2,18)		0,9743
NHP[d]-mobility	1,17 (0,45 -3,02)	2,86 (1,19 -6,85)		0,0891
NHP-pain	0,50 (0,15 -1,70)	1,18 (0,43 -3,24)		0,4449
NHP-energy	1,84 (0,82 -4,12)	3,65 (1,60 -8,35)		0,0098
NHP-sleep	1,64 (0,62 -4,38)	5,41 (2,29 -12,81)		0,0015
NHP-social isolation	4,00 (1,93 -8,30)	6,81 (3,04 -15,26)		0,0000
NHP-emotional reaction	1,42 (0,71 -2,81)	2,66 (1,25 -5,66)		0,0410
Women (n[c])	(85)	(55)	(65)	
perceived general health	1,44 (0,65 -3,21)	1,98 (0,86 -4,57)	0,70 (0,28 -1,74)	0,2912
chronic conditions	1,08 (0,59 -1,98)	1,63 (0,80 -3,31)	1,02 (0,53 -1,97)	0,6060
NHP-mobility	0,46 (0,13 -1,59)	2,53 (1,20 -5,34)	0,74 (0,32 -1,69)	0,0431
NHP-pain	0,27 (0,06 -1,23)	1,05 (0,43 -2,51)	0,44 (0,16 -1,20)	0,0855
NHP-energy	0,94 (0,46 -1,91)	1,84 (0,86 -3,92)	0,46 (0,17 -1,26)	0,1546
NHP-sleep	1,08 (0,35 -3,28)	1,57 (0,57 -4,27)	0,65 (0,21 -2,00)	0,7011
NHP-social isolation	2,05 (0,89 -4,68)	2,83 (1,15 -6,93)	2,26 (0,97 -5,27)	0,0370
NHP-emotional reaction	1,13 (0,58 -2,19)	1,95 (0,97 -3,95)	0,58 (0,22 -1,56)	0,1903

[a] Married persons were the reference category.
[b] Overall significance marital status
[c] Average number of initially healthy persons included in the analyses; 865 married men and 755 married women were included in the analyses; because of the small number of widowed men without health problems at base-line, this category has been excluded from the analyses
[d] Nottingham Health Profile

11.2.2. Discussion

Successively the limitations of the studies will be discussed and the evidence for selection effects and social causation mechanisms will be evaluated. Finally the relative contribution of selection and social causation in the explanation of health differences between marital status groups will be addressed.

Limitations of the studies

Since data of the GLOBE-study were used in the studies addressing our second research question, the issues concerning non-response, self-reported data and

generalizability which were mentioned in the discussion of part 1 are also relevant here. It should be noted, however, that although the baseline population was derived from the non-institutionalized population, mortality of all study subjects, including those who subsequently moved to institutions, is registered in the GLOBE-study. Two additional limitations of the studies need to be considered here: absence of objective health measures and the possibility of indirect selection.

No measures of objective morbidity were available in the GLOBE-study. With regard to the study of health selection in marital transitions, it would have been preferable to examine both subjective and objective health measures. In decisions concerning marital transitions generally a second person is involved. If health status of the respondent is an issue in marital transitions, this second person will make his/her own evaluation of the respondent's health status. Probably this second person considers both information about the respondent's objective and subjective health status. However, little (or nothing) is known on this subject. For instance, it is unknown wether objective or subjective health status is considered more relevant if indeed this distinction is made, and how discrepancies between objective and subjective health status are evaluated. Thus, it is possible that (more) effects of health selection could have been demonstrated if objective health measures had been used. This needs further research.

Additional information on objective health measures would also have been preferable in the study of chapter 10. Since health selection could have been directed at aspects of objective health which were not totally captured by the measures of self-reported health employed, additional control for objective health indicators might have decreased the survival differences between the marital status groups.

In the studies addressing social causation mechanisms, we tried to rule out possible effects of selection mechanisms by controlling for baseline health status. However, health differences detected after control for baseline health status might also (partly) be due to indirect selection (selection on determinants of health). The outcomes of the studies have to some extent been adjusted for possible effects of indirect selection: the estimates were adjusted for educational level and body height[5]. Both factors are associated with health (46-48), are presumably factors in partner selection (49) and generally precede marital status transitions. Other determinant of health also might have been involved in indirect selection processes (49). A problem is, however, that these other determinants might also function as intermediary factors of the effect of marital status on health. Results from most studies addressing this issue generally support the assumption that these other determinants are more relevant as intermediary factors than as factors in indirect selection processes (p.16-17).

All the limitation necessitate further research with more complete data sets and affect the firmness with which conclusions can be drawn. However, we do not

believe that indirect selection and differences in objective health status are an explanation for our overall results.

Evaluation of the evidence for selection effects

Our findings suggested that selection on health only occurs in the transition from the married to the divorced state. At fist sight this seems implausible, since one would expect that if health selection indeed occurs in one marital transition, health selection also plays a part in other marital transitions. However, as was described in chapter 7, it is conceivable that the processes involved in the separate marital transitions are not quite comparable, and that health selection would have greater weight in the transition from the married to the divorced state than in the other transitions.

Only direct selection was examined. To our knowledge the relative contribution of direct and indirect selection mechanisms to health differences between marital status groups has not been studied. The fact that no direct selection could be demonstrated for most of the marital transitions studied should therefore not be interpreted as evidence of absence of selection in these transitions. Indirect selection processes might be present. Especially in young age groups where the prevalence of health problems is rather small, it is conceivable that indirect selection is more important than direct selection.

In conclusion, large and highly significant differences in probabilities of divorce were demonstrated between 'healthy' and 'unhealthy' married persons. Additional control for possible social causation effects (i.e., exclusion of divorced which occurred in the first two years after baseline measurement) did not change the outcomes. We feel that our study convincingly demonstrated that health selection is operative in the transition from the married to the divorced state. However, further research is required before firm conclusions regarding the presence of health selection in the other marital transitions can be drawn. The issue of indirect selection in marital transitions also needs further research.

Evaluation of the evidence for social causation

Large differences in survival were found between the male marital status groups, which decreased 20-25% after control for health status at baseline, SES and body height. Control for health status at baseline is necessary to rule out possible effects of health selection on survival. However, differences in health status at baseline also partly result from previous social causation effects. Thus, the social causation effects of marital status on survival might be underestimated in our analyses.

In both studies of social causation mechanisms, a cross-section of the population was the starting point for the longitudinal data collection. This also might have caused an underestimation of real social causation effects. The population at baseline consists of persons who just recently acquired the specific marital status

and persons who have been in that marital state for a longer period. The last group, however, is a selected group. It contains only the survivors of persons who originally attained that specific marital status. This might particularly have affected the estimations of morbidity and survival rates of the widowed. Studies of conjugal bereavement mostly have reported that excess mortality among widowed persons is highest at short durations of bereavement (43-45,50). Additionally, remarriage rates for widowed persons are relatively low. Thus depletion of the widowed pool by mortality of the 'unhealthy' is not compensated by depletion of the widowed pool by selection of the 'healthy' for marriage.

Despite the limitations of the studies, we believe that our studies provide conclusive evidence that social causation mechanisms are operative in the association between marital status and health status.

Relative contribution of selection and social causation processes to health differences by marital status

The studies of chapters 7 and 10 and the longitudinal study regarding the development of morbidity differences provide conclusive evidence that health differences between marital status groups result from both selection and social causation effects. This raises the question of the relative importance of the separate mechanisms in the explanation of health differences.

To estimate the relative importance of selection and social causation mechanisms, information on health status at different points in time is required between which part of the population has experienced a marital transition. In this way the size of health differences between marital status groups caused by health selection can be determined and related to the size of the health differences as observed at one point in time, which result from both selection and social causation mechanisms. Several measurements of health status are preferred to capture health dynamics prior to and following the marital transition, but at least two measurements at different points in time are required to make reliable estimations. Health status measurements at several points in time are available for a subpopulation of the GLOBE-study. Unfortunately, the number of marital transitions in this subpopulation is, as yet, too small for the estimation of the relative contributions of selection and social causation processes.

In order to still obtain some idea of the possible contribution of selection effects to health differences, estimations were made using only health status at baseline. Estimations of health differences resulting from selection in the transition from the married to the divorced state were related to the existing health differences between the married and divorced at baseline (see chapter 7). Estimation were restricted to the transition from the married to the divorced state, since it was only for this transition that statistically significant differences by health status were demonstrated. First a model was fitted, in which health differences (as measured

at baseline) were estimated between those who would remain married and those who would become divorced during the follow-up period. Secondly a model was fitted, in which health differences were estimated between those married at baseline and those divorced at baseline. Results are shown in table 3. Under the assumption that health status will remain equal during the follow-up period, health selection (first model) is able to account for substantial parts of the differences between the divorced and married (second model) in perceived general health (36%), subjective health complaints (78%) and chronic conditions (over 100%).[6] Of course, the comparison is improper. The population of divorced persons at baseline consists partly of persons who have been divorced for longer than 4,5 years and divorced persons with the worst health status might already have died. Furthermore, the finding that health selection might explain all health differences between married and divorced people is in conflict with the rather convincing evidence that social causation processes contribute substantially to the explanation of health and mortality differences between the divorced and married (p.18-21; chapter 10). The findings do indicate, however, although conclusions must remain tentative, that health selection might account for a more than negligible part of the health differences between the married and divorced. Further research on this issue is demanded.

Table 3: Health differences between married and divorced persons, solely due to health selection and due to both health selection and social causation, logistic regression models[a]; odds ratios (95% confidence intervals)

	Perceived general health (less-than-good)		Subjective health complaints (≥ 4)		Chronic conditions (≥ 2)	
Effect of health selection[b] (persons married at base-line)						
- married until end-of-follow-up	1.00		1.00		1.00	
- divorced at end-of-follow-up	1.39	(0.94 - 2.06)	1.58	(1.11 - 2.24)	1.92	(1.29 - 2.84)
Combined effects of health selection and social causation						
- persons married at base-line	1.00		1.00		1.00	
- persons divorced at base-line	2.08	(1.73 - 2.48)	1.73	(1.45 - 1.75)	1.45	(1.19 - 1.75)

[a] Adjusted for age, sex, educational level, religious affiliation and employment status

[b] It is assumed that health status as measured at base-line will remain unchanged during follow-up

11.3. Contributions of risk factors to the effect of marital status on health

The third research question of this study concerned the quantitative assessment of the contribution of several intermediary factors to the social causation effect: to what extent do specific risk factors (psychosocial conditions, material circumstances and health behaviours) mediate the effect of marital status and living arrangement on health status?

Previous research has shown that psychosocial factors, material circumstances and health behaviours are able to explain larger of lesser proportions of differences in physical health status between marital status groups. However, we are only aware of one study which has focused on all three intermediary factors simultaneously and this study was restricted to persons of only 55 years of age (51).

11.3.1. Outcomes

In the GLOBE-study information on all three intermediary factors was available. Unfortunately, the data of the GLOBE-study did not (as yet) permit answering this question simultaneously for all three groups of intermediary factors in a longitudinal study design, distinguishing the study population by living arrangement for each separate marital status group. Therefore several studies have been employed (chapter 8, 9 and 10).

In chapter 8 the contribution of health behaviours to morbidity differences was studied using cross-sectional data. The size of the study population (n=16311) permitted differentiation of the study population by both marital status and living arrangement. Control for all health behaviours explained, on average, 20-36% of the health differences in perceived general health and the subjective health complaints, but not the differences in chronic conditions. The fact that nothing of the differences in chronic conditions was explained, might be attributable to the cross-sectional study design. Health problems might have forced persons to adjust their health behaviours, especially in case of severe health problems such as chronic conditions.

Since information on psychosocial conditions was only available for a relatively small subsample of the GLOBE population (n=3510), which did not allow distinction of the study population by living arrangement for each separate marital status group, nor permitted longitudinal analyses for the time being, the contribution of all three intermediary factors (psychosocial conditions, material circumstances and health behaviours) to morbidity differences was studied in a cross-sectional study

design in which the unmarried groups who lived with a partner were pooled (chapter 9). The aim of this study was to estimate the relative contribution of psychosocial factors, material circumstances and health behaviours to health differences by marital status. Psychosocial conditions were the most important intermediary factor in the explanation of the morbidity differences among men (25-40% of the morbidity differences was explained), while the more favourable material circumstances of never married and widowed men had a health protective effect. Among women, material circumstances were the most important intermediary factor of the health differences and accounted for approximately 70% of the health differences.

The contributions of material circumstances and health behaviours to survival differences between marital status groups and living arrangements were studied in a longitudinal study design (chapter 10). Four years after the baseline measurement mortality differences were only statistically significant for men. Material circumstances accounted for approximately 10% of the excess mortality of divorced men, but increased the mortality differences between married men and widowed men. Health behaviours accounted for approximately 20% and 40% of the excess mortality of widowed and divorced men respectively. Together material circumstances and health behaviours explained approximately 45% of the survival differences between married and divorced men, but only for moderate parts of the excess mortality of never married and widowed men.

11.3.2. Discussion

As on the previous two occasions, first the limitations of the studies will be discussed. Then, the results of the different studies will be compared, the relative contributions of the intermediary factors will be assessed and the outcomes will be related to the conceptual model of the introduction.

Limitations of the studies

Since data of the GLOBE-study were used in the studies addressing our last research question, the issues concerning non-response, self-reported data and generalizability which were mentioned in the discussion of part 1 are also relevant here. It should be noted, however, that although the baseline population was derived from the non-institutionalized population, mortality of all study subjects, including those who subsequently moved to institutions, is registered in the GLOBE-study.

An additional limitation is the cross-sectional nature of the data used in chapters 8 and 9. Our aim was to assess the contribution of intermediary factors to health differences which are caused by differences in marital status. As was demonstrated, however, in chapter 7, the health differences determined with cross-

sectional data are also partly caused by health selection. An additional problem is the possibility that indirect selection processes could have been operative and that these indirect selection processes might have involved some of the variables used as intermediary factors. Differences in material circumstances and health behaviours might have affected marital status or might have affected health and, through health, marital status. Because of the cross-sectional nature of our data, the direction of the causal pathways between marital status, the 'intermediary' factors and health cannot be ascertained. Among the intermediary factors income and alcohol consumption seem to be most likely to have been involved in partner selection. As was already mentioned in chapter 9, control for educational level was used to diminish possible effects of indirect selection on material circumstances. Educational level determines (to some extent) the potential material resources to be gained later in life and is unlikely to be influenced by marital status. With regard to alcohol consumption, several studies have provided support for the assumption that alcohol consumption is more likely to be an intermediary factor of the relationship between marital status and health than a determinant in indirect selection (see also p.16-17) (52,53).

Another problem of the cross-sectional nature of the data used in chapter 8 and 9, is that this might have obscured associations between the intermediary factors and health status. Health problems might have put a burden on social relationships, resulted in deteriorations of material circumstances and caused adjustments in health behaviours. The likelihood that this has occurred increases with the severity of health problems. Some evidence to support this assumption was found in chapter 8. We found that former smokers had ORs between those of the never smokers and current smokers for perceived general health and subjective health complaints, but the highest for chronic conditions. The limitations of the studies should be kept in mind when interpreting the outcomes and require replication of the studies with longitudinal data.

Assessment of the relative contributions of the intermediary factors

In the comparison of the results of chapters 8, 9 and 10 the differences in study design (cross-sectional versus longitudinal), the study population and the variables included in the analyses should be taken into consideration. While the study population in chapters 8 and 9 comprised persons aged 25 years and over, the study population of chapter 10 was restricted to persons of 40 years and older at baseline. Also, the variables included as intermediary factors differed between the three studies.

In addition, several other issues complicate the assessment of the relative contributions of the intermediary factors to differences in health status. Firstly, several indicators of health status have been used. The effect of the intermediary factors on health status is likely to differ between the health measures. For

instance, it can be assumed that health behaviours are more relevant as risk factors for mortality and chronic conditions than for poor perceived general health. Thus, the relative contribution of the intermediary factors is likely to differ between the health measures. Additionally, the time between exposure to the intermediary factor and emergence of health consequences is likely to differ by the specific intermediary factor. For instance, health effects of psychosocial stress caused by partner loss are assumed to be largest shortly after marital dissolution (54,55). On the other hand health effects of smoking are only assumed to occur after several decades. Finally, one intermediary factor might affect different health measures differentially in time. For instance, excessive alcohol consumption might have rather direct adverse consequences for perceived general health and subjective health complaints, but is only likely to be the cause of chronic conditions after several decades. These complication make it impossible to capture the relative contribution of intermediary factors to differences in health status between marital status groups in a single figure.

Table 4: Relative contribution of the intermediary factors (percentages)

	Differences in self-reported health[a]				Mortality differences[b]		
	psycho-social factors	material conditions	health behaviours	total	material conditions	health behaviours	total
Men							
never married	25	0	15	30	5	0	10
divorced	40	15	15	65	10	45	50
widowed	30	0	5	15	0	20	20
Women							
divorced	15	75	25	85	5	35	40

[a] Average of the contributions of the intermediary factors to differences in self-reported health (except NHP-social isolation) as reported in chapter 8 (see tables 3 and 4)

[b] Contribution of the intermediary factors to mortality differences as reported in chapter 9 (see table 6)

The estimations of the relative contributions of the intermediary factors to the associations between marital status and morbidity and mortality are shown in table 4. The contribution of psychosocial factors could only be estimated in one study. Loss of the partner and other life-events experienced in the previous year

were used as indicators of psychosocial stress, while emotional and instrumental support were used as indicators of social support. Partner loss is the most obvious source of differences in psychosocial stress in the association between marital status and health. Our analyses showed that recently divorced and widowed persons had higher morbidity rates than those who had been divorced and widowed for a longer period. The adverse health effects of partner loss was larger among men than among women. However, recently divorced and widowed persons did not account for all excess morbidity among the divorced and widowed. With regard to social support, it was found that never married and divorced persons compared unfavourably with married persons. Especially never married men reported strikingly low amounts of emotional and instrumental support. Together, the psychosocial factors accounted for 25-40% of the differences in self-reported health among men and 15% among women.

The contribution of material circumstances to differences in self-reported health showed opposite patterns among men and women. Among women extremely large proportions of divorced and widowed women were found in the lowest category of equivalent household income, while a large proportion of divorced women also reported financial problems. Among men, only household income and financial problems of divorced men compared unfavourably to those of married men. Among women material circumstances accounted for approximately 75% of the differences in self-reported health. Among men the material circumstances accounted for 15% of the excess morbidity of divorced men. Among never married and widowed men their relatively favourable material circumstances appeared to have a health protective effect. It is important to note that it is not the effect of the material circumstances on health status which differs between men an women, but the distribution of favourable and unfavourable material circumstances over the marital status groups. Additionally, although almost equally large proportion of divorced and widowed women were found in the lowest income groups, no excess morbidity was found among widowed women. Probably widowed women with the same level of household income are financially better off than divorced women, since widowed women more often retain the family house and other financial assets intact after the death of their husband. With regard to mortality differences, material circumstances accounted for approximately 5-10% of the excess mortality of never married and divorced men and 5% of the excess mortality among divorced women. It seems that material conditions contribute more to differences in self-reported health than to mortality differences among divorced women. However, no firm conclusions can be drawn with regard to excess mortality of divorced women, since no statistical significance was reached.

With regard to health behaviours it was generally found that married persons were more likely to practice positive health behaviours and less likely to engage in negative health behaviours. Among the other (partner/) marital status groups

there was no group that consistently engaged in more positive health behaviours than the others. When, in chapter 8, the contribution of the intermediary factors to the health differences is only assessed for those health measures for which statistical significant marital status differences were found and for those marital status groups for whom sizeably increased ORs (larger than 1.50) were found, as was done in chapter 9, health behaviours accounted for 15-20% of the morbidity differences among men and 20-30% among women. In chapter 9, health behaviours accounted for 5-15% of the morbidity differences among men, and for 25% among women. Finally, health behaviours explained 0, 45 and 20% respectively of the excess mortality of never married, divorced and widowed men and for 35% of excess mortality of divorced women.

Together all three intermediary factors accounted for approximately 30% of the excess morbidity among never married men, 65% among divorced men, 15% among widowed men and 85% among divorced women. Of the survival differences, material circumstances and health behaviours together explained 50% of the excess mortality of divorced men, but smaller percentages of the excess mortality of never married and widowed men (10 and 20% respectively). Together material circumstances and health behaviours seemed to explain 40% of the excess mortality of divorced women. On the assumption that additional control for psychosocial factors would also contribute to the explanation survival differences, the agreement between the morbidity and mortality studies seems rather large for men. The three intermediary factors are able to explain most or all health differences between the divorced and married, but seem insufficient to account for excess morbidity and mortality of never married and widowed men. Further research of intermediary factors of the excess morbidity and mortality of never married and widowed men is necessary. Further research might especially benefit from more extensive control for psychosocial factors, i.e. social isolation, and from inclusion of direct measures of psychosocial stress (chapter 9).

As mentioned in the introduction the effects of marriage on health through psychosocial conditions, material circumstances and health behaviours should not be viewed as three independent pathways. In our conceptual model (chapter 1) we supposed that the psychosocial conditions would have either a direct effect on health or indirect effects through changes in the health behaviours. Unfavourable material circumstances mainly were assumed to have indirect effects on health through the increase of psychosocial stress or through changes in the health behaviours. Marital status was not assumed to have a direct effect on health behaviour but only indirect through changes in the psychosocial conditions and material conditions. We are unable to ascertain the accuracy of the proposed conceptual model from the studies presented in this thesis. In only one study we had information on all three intermediary factors (chapter 9). For most combinations of marital status and health measure it was found that addition of health

behaviours to a model which already contained the psychosocial factors and material circumstances, caused further decline of the health differences (results not shown). This could either mean that our assumption that marital status only affects health behaviour indirectly through changes in the psychosocial conditions and material conditions is correct, but that the measurement of the psychosocial conditions and material conditions was inadequate, or that the assumption was inaccurate and should be that marital status also has direct effects on health behaviour.

11.4. Importance for public health

The overall findings are important from a public health perspective. In the descriptive part of this thesis it has been demonstrated that substantial differences in self-reported health exist between marital status groups and living arrangements in The Netherlands. It was also shown that considerable mortality differences between marital status groups existed. As was already mentioned in the introduction, health differences between marital status groups constitute important public health differences in comparison with other socio-demographic variables. Mackenbach studied which of six socio-demographic factors (age, gender, marital status, level of education, degree of urbanization and region) was associated with the largest degree of variation in the health measures perceived general health, prevalence of chronic conditions and mortality in The Netherlands (56). He found that age was associated with the largest degree in variation, followed by gender, marital status and level of education, the three of which appeared of equal importance (56). Thus, marital status is associated with similar degrees of health variation in the Dutch population as gender and SES, which are considered important social determinants of health.

The findings in this thesis offer several openings for public health interventions. The differences in morbidity and mortality rates between the marital status groups enable the identification of subpopulations who are at increased risk. Especially divorced people appear to have increased morbidity and mortality rates in comparison with married people. Divorced people have almost twice the ORs of married people with regard to perceived general health and health complaints (chapter 3), while their mortality rates are 1.5 times those of married people (chapter 4). Divorced people who do not live with a partner (the majority) especially are at increased risk for health problems (chapter 8).

In addition, the evidence that social causation processes are operative (chapter 10), indicates that changing marriage and divorce rates will lead to alterations in the amounts of ill health in the population. If health selection would have been the sole cause of health differences between marital status groups, changing marriage and divorce rates would only have caused alteration in the distribution of healthy

and unhealthy persons over the marital status groups, while the total number of persons with ill-health in the population would remain constant. The presence of social causation processes, however, creates possibilities to decrease health differences between marital status groups and living arrangements. In particular the transitions from the married to the divorced and widowed state constitute occasions at which preventive strategies might be employed successfully.

The assessment of the relative contributions of the intermediary factors has provided information regarding which intermediary factors intervention programmes should be directed to achieve (most) health gain. Intrinsic to social causation processes is that being in a particular marital status or changing from one marital status to another affects health. Therefore, theoretically, marital status itself might be the best target of policy: if the married state is the healthiest state, the transition to and remaining in that state might be encouraged and departures from this state might be discouraged by policy measures. However, irrespective of the feasibility of such policy measures, it is unlikely that the desired goal, decrease of health differences between marital status groups, will be obtained by targeting marital status itself. Other studies have shown that, while on average divorced people had more health problems than married people, most health problems were found among people in unhappy marriages (40,57-59). Thus, in order to decrease health differences between marital status groups, the most promising approach seems not targeting marital status itself, but the intermediary factors of the association between marital status and health.

One of the most striking findings of this thesis was that, even in a country like the Netherlands, where a relatively generous welfare system is present (60), large differences in material circumstances are found among women, which seemed the primary cause of the unfavourable health status of divorced women in particular (chapter 9). Large health gains might be attained by improvement of the material circumstances of divorced women. Whether the improvement of material circumstances should be achieved by raising levels of social security benefits or by stimulating labour force participation falls outside the scope of this thesis. The findings from this thesis should, in any case provoke contemplation among policy makers before policy measures are introduced which lead to even further deteriorations in the material circumstances of divorced women. Another noticeable finding was the large proportion of never married men who reported low levels of social support (chapter 9). Experimental programmes might be started, directed at expanding social networks and social support among never married men.

The transition from the married state to the divorced and widowed state provides opportunities for the provision of preventive programmes. Recently divorced and widowed people might be approached to participate in training courses in stress management. Or health education programmes could be started aimed at preventing harmful changes in health behaviours after divorce or

conjugal bereavement. Such preventive programmes might be provided by several health agencies like local public health services, regional institutes for mental welfare and health centres. Additionally, programmes might be offered in which newly widowed persons are supported with adjustment of daily activities to the new situation and encouraged to enter into new, or strengthen neglected social relationships.[7] Finally, by paying extra attention to patients who have recently been widowed or divorced, general practitioners might be able to detect deteriorations of health status in an early stage.

Finally, the outcomes of chapter 4 are of additional importance for public health. Not only did the differences in self-reported health result in a higher utilization of health care facilities among the divorced and widowed, being divorced was also associated with higher health care utilization independent of self-reported health. Clarification of the reasons behind the higher health care utilization of divorced persons, in excess of their increased morbidity, might offer opportunities for decreasing costs of health care. Furthermore, the finding that never married people had a lower health care utilization than married people despite higher morbidity might indicate that part of their higher morbidity and mortality is amenable to medical intervention.

11.5 Scientific relevance and future research

This thesis started with a sketch of the development of social epidemiology. Insufficiency of prior concepts of disease etiology in completely pinpointing the causes of diseases, together with the finding that groups differentiated by social factors exhibited characteristic mortality and morbidity patterns, led to the incorporation of social factors in research of disease etiology. In this thesis differences in self-reported health and mortality between marital status groups and living arrangements have been shown. It was ascertained that part of the health differences between marital status groups were due to health selection, but it was also demonstrated that they were in part attributable to marital status itself. Finally, it was shown that the effects of marital status on health were mediated by psychosocial factors, material circumstances and health behaviours.

The studies in this thesis have contributed much to our knowledge of the association between marital status and health. On the other hand, however, many questions have remained unanswered and others have been raised. After it was concluded that marital status and living arrangement each had a separate effect on health and that preferably both should be taken into account, lack of data on living arrangement and/or lack of statistical power precluded us from doing so ourselves in most studies. Future research might benefit from inclusion of living arrangement (besides marital status) in national statistics and other large scale

studies. With regard to the relative contribution of selection and social causation processes this thesis represents only the beginning of a necessarily much larger effort at unravelling these processes. Finally, with regard to the clarification of the pathways through which marital status affects health, much remains to be done.

Notes

1. The numbers of initially healthy widowed men were too small (n=15) to be included in the models.
2. The control variables were categorized and coded as in the study described in chapter 9.
3. Statistically significant differences were also found for NHP-social isolation. However, as described in chapter 9 there might be operational confounding between marital status and NHP-social isolation. The results concerning NHP-social isolation are therefore ignored in the interpretation of our results.
4. Idem.
5. In the study on social causation of morbidity differences we only controlled for educational level.
6. The percentages are calculated by the formula:

$$100 * \frac{OR_a - OR_b}{OR_a - 1}$$

   in which, OR_a is the OR of divorced persons resulting from both health selection and social causation effects, and OR_b is the OR of divorced persons resulting only from health selection effects.
7. ZAO Zorgverzekeringen in Amsterdam recently started a study of the effects of such a program on health care utilization.

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Summary

The purpose of this thesis was to describe health differentials by marital status and (where possible) living arrangement in The Netherlands, and to contribute to the explanation of these health differences. More specifically the studies presented in this thesis were aimed at answering the following questions:

1. Are there differences in health and health care utilization by marital status and living arrangement in The Netherlands?
2. Are the health differences based on an effect of health on marital status and living arrangement, or on an effect of marital status and living arrangement on health?
3. To what extent is the effect of marital status and living arrangement on health mediated by specific risk factors (psychosocial factors, material circumstances and health behaviours)?

Chapter 1 presents a general introduction regarding the association between marital status and health. During the last 30 years social factors have become increasingly important in the evolution of concepts of disease etiology. One of the social factors which might play a role in the etiology of diseases is marital status. It is generally found that married people have lower morbidity and mortality rates than unmarried[1] people. The possible explanations for this association between marital status and health are discussed. These explanations can be grouped into two main theories: the marital selection theory and the social causation theory. According to the marital selection theory the relatively good health of married persons is the result of the selection of 'healthy' persons into, and 'unhealthy' persons out of the married state. According to the social causation theory marriage has a health promoting or a health protective effect, while the unmarried state would have adverse health effects. Thus, in the marital selection theory health precedes marital status and in the social causation theory marital status precedes health. In addition, the evidence found to date on the appropriateness of the marital selection theory and the social causation theory was summarized and evaluated in chapter 1. Similar hypotheses on the cross-sectional association between marital status and health can be derived from the selection theory and the social causation theory. Therefore longitudinal data are required to unambiguously determine the sequence of marital status and health in time. However, most studies on marital selection have used cross-sectional data. The findings of the scarce longitudinal research on selection effects suggest that selection effects might be operative in marital transitions, though they seem to play only a minor role in the explanation of health differences. Longitudinal data have more often been

[1] The term 'unmarried' refers to the never married, the divorced and the widowed.

used in studies on social causation. The results of these studies provide evidence that marital status is causally related to health outcomes.

In *chapter 2* the data sources are described. In most studies of this thesis data of the GLOBE-study, a large prospective study on the 'Health and Living Conditions of the Population of Eindhoven and surroundings', have been used. In chapters 5 and 6 data of national mortality statistics of Statistics Netherlands have been used.

In *part I* differences in health and health care utilization by marital status and living arrangement were described.

In *chapter 3* we investigated (1) the differences in self-reported health by marital status and living arrangement and (2) to what extent health differences between marital status groups were based upon differences in living arrangement. Married people experienced less health problems than never married, divorced and widowed persons. People who lived with a partner (either married or unmarried) had less health problems than people who were single. Differences in living arrangement between married and unmarried people accounted for a substantial part of the morbidity differences by marital status (40-70%). However, after marital status had been controlled for living arrangement, there were still statistically significant health differences between marital status groups and vice versa. The results suggest that both marital status and living arrangement have a separate effect on health status.

In *chapter 4* we examined (1) to what extent differences in health care utilization by marital status were due to confounding by socio-demographic variables other than age and sex and (2) to what extent these differences were due to differences in health status. Compared to married people never married people used less and divorced and widowed people used more health services after extensive control for socio-demographic confounders. These differences in health care utilization were only partly due to differences in health status between the marital status groups. The fact that never married people had a lower utilization of health services after control for confounders and health status could indicate that they neglect their health. If unmarried persons who lived with a partner were distinguished from those without a partner in the analyses, it was found that the health care utilization of unmarried people with a partner was more similar to the health care utilization of married people than that of those without a partner.

In *chapter 5* the contribution of specific causes of death to differences in total mortality between marital status groups in the period 1986-1990 was examined. External causes of death (e.g. suicide, accidents) contributed more to the excess mortality of unmarried people, while cardiovascular diseases and malignant neoplasms contributed less than could be expected from their contribution to overall mortality among married people. The specific causes of death which had a relatively large contribution to the excess mortality of unmarried people (e.g.

external causes of death, cirrhosis of the liver, COLD, diabetes mellitus, cervical cancer) almost all have unhealthy life styles as important risk factors.

In *chapter 6* we investigated (1) which changes there have been in total mortality differentials by marital status in The Netherlands in the period 1950-1990, (2) which changes there have been in the differentials of specific causes of death by marital status in this period and (3) which specific causes of death contributed most to the differentials in total mortality between marital status groups. Since 1965 several important societal changes (e.g. increase of unmarried cohabitation) have occurred, which, according to the social causation theory should have diminished the mortality excess of never married and divorced people. It was indeed found that the mortality differences between the divorced and married decreased during the 1970s. Thus, the trends in mortality differences between the divorced and married are in agreement with the predictions of the social causation theory. The mortality differences between the never married and the married, however, increased over the same period. Decomposing the changes in total mortality among the never married into changes in cause-specific mortality showed that, while most specific causes of death followed the trend in total mortality (i.e. the differences between the never married and married increased), the differences in mortality from external causes decreased. Mortality from external causes can be considered as a more direct reflection of the changes in perceived stress, social support and social integration among the marital status groups than for instance mortality from malignant neoplasms. Effects of changes in these psychosocial factors on malignant neoplasms and other degenerative diseases are only expected in the long term. We therefore conclude that the increases in mortality differentials between the never married and married might only be seemingly in contradiction with predictions of the social causation theory.

In *part II* longitudinal data were used to examine whether selection effects and social causation effects could be demonstrated (chapters 7 and 10). In addition, the relative contributions of intermediary factors to the effect of marital status on health were estimated (chapters 8-10). In chapters 8 and 9 cross-sectional data were used and in chapter 10 longitudinal data.

In *chapter 7* it was tested whether differences in health were associated with different probabilities of marital transitions. Of the four marital transitions studied (marriage among never married and divorced persons, and divorce and bereavement among married persons), only divorce among married persons was associated with health status: 'unhealthy' married people had larger divorce probabilities than 'healthy' married people. Our results demonstrate convincingly that health selection is operative in the transition from the married to divorced state.

In *chapter 10* it was examined whether differences in marital status were related to differences in survival after a follow-up of four years (1991-1995). In order to

eliminate possible selection effects, we controlled for baseline health differences by marital status in the analyses. Among men statistically significant survival differences by marital status were found. Compared to married men, never married and widowed men were 1.5 times as likely and divorced men 1.8 times as likely to die. Among women no statistically significant survival differences were found. A longer follow-up period may be needed to detect statistically significant survival differences by marital status among women. Mortality rates of women are lower than those of men. Consequently the number of deaths which occurred during the follow-up period in our study was much smaller for women than for men. Additionally, previous studies have shown that mortality differences by marital status are smaller for women than for men. Thus, the number of events which is required to detect statistically significant mortality differences among women is larger.

In *chapter 8* the contribution of health behaviours to differences in self-reported health was estimated. Health behaviours (e.g. smoking, alcohol consumption, physical activity) explained, on average, 20-35% of the differences in perceived general health and the subjective health complaints, but not the differences in chronic conditions by marital status and living arrangement. The fact that nothing of the differences in chronic conditions was explained, might be attributable to the cross-sectional study design. Health problems might have forced persons to adjust their health behaviours, especially in the case of severe health problems such as chronic conditions.

In *chapter 9* the relative contributions of psychosocial conditions (e.g. partner loss in the previous year, social support), material circumstances (e.g. income, financial difficulties) and health behaviours (e.g. smoking, alcohol consumption) to differences in self-reported health were studied. Psychosocial conditions were the most important intermediary factor in the explanation of the morbidity differences among men: 25-40% of the morbidity differences was explained. Among women, material circumstances were the most important intermediary factor of the health differences and accounted for approximately 70% of the excess morbidity among unmarried women.

In *chapter 10* the contributions of material circumstances and health behaviours to survival differences between marital status groups were examined. Statistically significant differences in survival could only be demonstrated among men. Material circumstances accounted for approximately 10% of the excess mortality of divorced men. Health behaviours accounted for approximately 20% and 40% of the excess mortality of widowed and divorced men respectively.

In *chapter 11* the findings of the thesis are discussed and evaluated. The studies of this thesis have contributed substantially to the knowledge of the association between marital status and health. This is the first time that health selection in marital transitions has been studied systematically. The findings of this thesis

suggest that, besides social causation effects, also selection effects are relevant in the explanation of health differences by marital status. However, many questions remain unanswered. Further research is required to determine the relative contributions of selection effects and social causation effects in the explanation of health differences by marital status and to further clarify the mechanisms through which marital status affects health.

Samenvatting

Het doel van dit proefschrift was het beschrijven van gezondheidsverschillen tussen personen met een verschillende burgerlijke staat en (waar mogelijk) samenlevingsvorm in Nederland, en het leveren van een bijdrage aan de verklaring van deze gezondheidsverschillen. Meer in het bijzonder waren de studies van het proefschrift gericht op het beantwoorden van de volgende vragen:

1. Zijn er verschillen in gezondheid en het gebruik van gezondheidszorgvoorzieningen naar burgerlijke staat en samenlevingsvorm in Nederland?
2. Berusten de gezondheidsverschillen op een effect van gezondheid op burgerlijke staat en samenlevingsvorm, of op een effect van burgerlijke staat en samenlevingsvorm op gezondheid?
3. In hoeverre verloopt het effect van burgerlijke staat en samenlevingsvorm op gezondheid via specifieke risicofactoren (psychosociale factoren, materiële omstandigheden en leefwijzen)?

Hoofdstuk 1 geeft een algemene inleiding over de relatie tussen burgerlijke staat en gezondheid. In de afgelopen 30 jaar is de belangstelling voor de rol van sociale factoren in de etiologie van ziekten sterk toegenomen. Een van de sociale factoren die mogelijk een rol zou kunnen spelen bij het ontstaan van ziekten is burgerlijke staat. Gehuwden hebben over het algemeen lagere mortaliteits- en morbiditeitscijfers dan ongehuwden[1]. De mogelijke verklaringen voor deze relatie tussen burgerlijke staat en gezondheid worden beschreven. Deze verklaringen zijn terug te voeren op een tweetal theorieën: de selectie-theorie en de sociale causatietheorie. Volgens de selectie-theorie zouden de gezondheidsverschillen tussen burgerlijke staat groepen het gevolg zijn van selectie van 'gezonde' personen in, en 'ongezonde' personen uit de huwelijkse staat. Volgens de sociale causatietheorie zou er een gezondheidsbevorderend of gezondheidsbeschermend effect uitgaan van het huwelijk, terwijl het 'ongehuwd zijn' nadelige gezondheidseffecten zou hebben. Dus, in de selectie-theorie beïnvloedt gezondheid de burgerlijke staat, terwijl in de sociale causatie-theorie burgerlijke staat de gezondheid beïnvloedt. In hoofdstuk 1 wordt verder een overzicht gegeven van de aanwijzingen die in eerdere studies zijn gevonden voor respectievelijk de selectie-theorie en de sociale causatie-theorie. Overeenkomstige hypothesen over de cross-sectionele verbanden tussen burgerlijke staat en gezondheid kunnen worden afgeleid van de selectietheorie en de sociale causatie-theorie. Daarom zijn longitudinale gegevens vereist om de tijdsvolgorde tussen burgerlijke staat en gezondheid ondubbelzinnig te kunnen vaststellen. Echter, in de meeste studies naar selectie-effecten is gebruik gemaakt van cross-sectionele gegevens. De resultaten van studies waarin longitu-

[1] Met de term niet ongehuwd worden zowel de nooit-gehuwden als de gescheidenen en verweduwden aangeduid.

dinale gegevens zijn gebruikt suggereren dat er selectie-effecten optreden bij overgangen van burgerlijke staat, maar dat deze slechts een kleine rol spelen bij de verklaring van gezondheidsverschillen tussen burgerlijke staat groepen. In studies naar sociale causatie-effecten zijn vaker longitudinale gegevens gebruikt. De resultaten van deze studies maken het aannemelijk dat burgerlijke staat de gezondheid beïnvloedt.

In *hoofdstuk 2* worden de gebruikte gegevensbestanden beschreven. In de meeste studies zijn gegevens van het GLOBE-onderzoek gebruikt. Dit is een grootschalig prospectief onderzoek naar de 'Gezondheid en Levensomstandigheden van de Bevolking van Eindhoven en omstreken'. In hoofdstukken 5 en 6 is gebruik gemaakt van nationale sterftegegevens van het Centraal Bureau voor de Statistiek.

In *deel I* worden verschillen in gezondheid en het gebruik van gezondheidszorgvoorzieningen naar burgerlijke staat en samenlevingsvorm in Nederland beschreven. In *hoofdstuk 3* is nagegaan (1) welke verschillen er zijn in zelf-gerapporteerde gezondheid tussen burgerlijke staat groepen en samenlevingsvormen, en (2) in hoeverre gezondheidsverschillen tussen burgerlijke staat groepen berusten op verschillen in samenlevingsvorm. Gehuwden hadden minder gezondheidsproblemen dan nooit-gehuwde, gescheiden en verweduwde personen. Personen die alleen woonden rapporteerden meer gezondheidsproblemen dan personen die met een partner samenwoonden (gehuwd of ongehuwd). De verschillen in samenlevingsvorm tussen de gehuwden en ongehuwden verklaarden een aanzienlijk deel (40-70%) van de gezondheidsverschillen naar burgerlijke staat. Er waren echter nog steeds statistisch significante gezondheidsverschillen naar burgerlijke staat na controle voor samenlevingsvorm en vice versa. Dit suggereert dat burgerlijke staat en samenlevingsvorm elk een onafhankelijk effect hebben op gezondheid.

In *hoofdstuk 4* is onderzocht (1) of er verschillen zijn in het gebruik van gezondheidszorgvoorzieningen naar burgerlijke staat als naast leeftijd en geslacht gecontroleerd wordt voor meer sociaal-demografische variabelen (opleiding, urbanisatiegraad, geloof en geboorteland), en (2) in hoeverre verschillen in het gebruik van gezondheidszorgvoorzieningen berusten op met burgerlijke staat geassocieerde verschillen in gezondheidstoestand. Na uitgebreide controle voor sociaal-demografische factoren bleken nooit-gehuwden een lagere, en gescheidenen en verweduwden een hogere medische consumptie te hebben dan gehuwde personen. De hogere medische consumptie van gescheiden personen berustte slechts voor een deel op verschillen in gezondheidstoestand tussen gescheiden en gehuwde personen. Het feit dat nooit-gehuwde personen ondanks een slechtere gezondheidstoestand minder gebruik maakten van gezondheidszorgvoorzieningen dan gehuwde personen, zou erop kunnen wijzen dat nooit-gehuwden hun gezondheid verwaarlozen. Indien ook samenlevingsvorm in ogenschouw werd

genomen, bleek de medische consumptie van personen die ongehuwd samenwoonden tussen die van gehuwden en die van ongehuwde personen die niet met een partner samenwoonden te liggen.

In *hoofdstuk 5* is voor de periode 1986-1990 nagegaan welke doodsoorzaken hebben bijgedragen aan sterfteverschillen naar burgerlijke staat. Externe doodsoorzaken (onder andere suïcide en ongevallen) droegen relatief meer bij aan de oversterfte van ongehuwden, terwijl cardiovasculaire aandoeningen en maligne nieuwvormingen minder bijdroegen dan verwacht werd op grond van de bijdragen van deze doodsoorzaken aan de sterfte van gehuwde personen. Vrijwel alle doodsoorzaken die een relatief groot aandeel hadden in de oversterfte van ongehuwde personen (bijvoorbeeld suïcide, ongevallen, levercirrhose, CARA, diabetes mellitus, cervixkanker) hebben ongezonde leefwijzen als belangrijke risicofactoren.

In *hoofdstuk 6* is onderzocht (1) welke veranderingen er zijn opgetreden in de verschillen in totale sterfte naar burgerlijke staat in Nederland in de periode 1950-1990, (2) welke veranderingen er zijn opgetreden in de verschillen in specifieke doodsoorzaken tussen de burgerlijke staat groepen in deze periode, en (3) welke specifieke doodsoorzaken het meest hebben bijgedragen aan de verschillen in totale sterfte naar burgerlijke staat. Sinds 1965 hebben zich een aantal belangrijke maatschappelijke veranderingen voorgedaan (o.a. opkomst van het ongehuwd samenwonen) waardoor, volgens de sociale causatie-theorie, de sterfteverschillen tussen de niet-gehuwden en gehuwden zouden hebben moeten afnemen. Uit de trends in sterfte naar burgerlijke staat blijkt dat de verschillen in totale sterfte tussen de gescheidenen en gehuwden inderdaad zijn afgenomen in de zeventiger jaren. Dit betekent dat de trends in sterfteverschillen tussen de gescheidenen en gehuwden in overeenstemming zijn met de voorspellingen van de sociale causatie theorie. De verschillen in totale sterfte tussen de nooit-gehuwden en gehuwden zijn echter toegenomen in deze periode. Uitsplitsing van de trends in totale sterfte naar groepen van doodsoorzaken liet zien dat, terwijl de meeste doodsoorzaken de trend in totale sterfte volgden (i.c. de sterfteverschillen tussen de nooit-gehuwden en gehuwden namen toe), de verschillen in sterfte ten gevolge van externe doodsoorzaken tussen de nooit-gehuwden en gehuwden afnamen. Sterfte ten gevolge van externe doodsoorzaken kan beschouwd worden als een meer directe weerspiegeling van veranderingen in psychosociale stress, sociale steun en sociale integratie dan bijvoorbeeld sterfte ten gevolge van maligne nieuwvormingen. Effecten van veranderingen in deze psychosociale factoren op maligne nieuwvormingen en andere degeneratieve ziekten worden pas op de langere termijn verwacht. Daarom kan geconcludeerd worden dat de bevinding dat de verschillen in totale sterfte tussen de nooit-gehuwden en gehuwden zijn toegenomen niet noodzakelijkerwijs in tegenspraak is met voorspellingen van de sociale causatie-theorie.

In *deel II* zijn longitudinale gegevens gebruikt om na te gaan of selectie-effecten en sociale causatie-effecten konden worden aangetoond (hoofdstukken 7 en 10). Ook zijn de relatieve bijdragen van intermediaire factoren aan het effect van burgerlijke staat op gezondheid geschat (hoofdstukken 8-10). In hoofdstukken 8 en 9 zijn cross-sectionele gegevens gebruikt en in hoofdstuk 10 longitudinale gegevens.

In *hoofdstuk 7* is onderzocht of verschillen in gezondheid gerelateerd zijn aan verschillen in overgangen van burgerlijke staat. Van de vier onderzochte overgangen (huwelijk van nooit-gehuwde en gescheiden personen, en echtscheiding en verweduwing van gehuwde personen) werden alleen voor de overgang van de gehuwde naar gescheiden staat statistisch significante verschillen gevonden: de kans van 'ongezonde' gehuwden op een echtscheiding was groter dan die van 'gezonde' gehuwden. Onze resultaten tonen overtuigend aan dat selectie op gezondheid een rol speelt bij echtscheidingen.

In *hoofdstuk 10* is nagegaan of verschillen in burgerlijke staat geassocieerd waren met verschillen in overleving na een observatieperiode van vier jaar (1991-1995). Om eventuele selectie-effecten uit te sluiten, is in de analyses gecontroleerd voor gezondheidsverschillen die al aan het begin van de observatieperiode aanwezig waren. Er werden statistisch significante sterfteverschillen gevonden onder mannen. In vergelijking met gehuwde mannen, was het risico van nooit-gehuwde en verweduwde mannen om tijdens de observatieperiode te overlijden 1,5 keer en van gescheiden mannen 1,8 keer zo groot. Onder vrouwen werden er geen statistisch significante sterfteverschillen gevonden. Waarschijnlijk is voor vrouwen een langere observatieperiode nodig om sterfteverschillen aan te kunnen tonen. De sterftecijfers van vrouwen zijn lager dan die van mannen. Bovendien blijkt uit andere studies (zie onder andere hoofdstukken 5 en 6) dat de sterfteverschillen naar burgerlijke staat onder vrouwen kleiner zijn dan onder mannen.

Uit *hoofdstuk 8* kwam naar voren dat verschillen in leefwijzen (o.a. roken, alcoholconsumptie, lichaamsbeweging) 20-35% van de verschillen in het oordeel over de eigen gezondheid en subjectieve gezondheidsklachten tussen burgerlijke staat groepen en samenlevingsvorm konden verklaren, maar niet de verschillen in chronische aandoeningen. Het feit dat niets van de verschillen in chronische aandoeningen verklaard kon worden, zou aan het gebruik van cross-sectionele gegevens kunnen liggen. Personen met gezondheidsproblemen zouden hun leefwijzen kunnen hebben aangepast, vooral als het ernstigere gezondheidsproblemen zoals chronische aandoeningen betreft.

In *hoofdstuk 9* is de bijdrage van psychosociale factoren (o.a. verlies van de partner in het afgelopen jaar, sociale steun), materiële omstandigheden (o.a. inkomen, financiële moeilijkheden) en leefwijzen (o.a. roken, alcoholconsumptie) aan verschillen in zelf-gerapporteerde gezondheid naar burgerlijke staat onderzocht. Van de risicofactoren verklaarden psychosociale factoren het meeste van de gezondheidsverschillen onder mannen: 25-40% van de hogere morbiditeit van

ongehuwden werd verklaard. Bij vrouwen waren verschillen in materiële omstandigheden het belangrijkste in de verklaring van gezondheidsverschillen: 70% van de hogere morbiditeit van ongehuwden werd verklaard.

In *hoofdstuk 10* zijn de bijdragen van materiële omstandigheden en leefwijzen aan sterfteverschillen naar burgerlijke staat onderzocht. Alleen onder mannen werden statistische significante sterfteverschillen gevonden. Verschillen in materiële omstandigheden verklaarden 10% van de sterfteverschillen tussen gescheiden en gehuwde mannen. De oversterfte van gescheiden en verweduwde mannen berustte voor respectievelijk 40 en 20% op verschillen in leefwijzen.

In *hoofdstuk 11* werden de bevindingen van dit proefschrift bediscussieerd. De studies in dit proefschrift hebben veel bijgedragen aan de kennis van de relatie tussen burgerlijke staat en gezondheid. Voor het eerst is er systematisch onderzoek verricht naar selectie op gezondheid in overgangen van burgerlijke staat. De resultaten suggereren dat naast sociale causatie-effecten ook selectie-effecten een rol spelen bij het ontstaan van gezondheidsverschillen naar burgerlijke staat. Veel vragen blijven echter nog onbeantwoord. Verder onderzoek is nodig om de relatieve bijdragen van selectie-effecten en sociale causatie-effecten aan de verklaring van gezondheidsverschillen naar burgerlijke staat vast te stellen en om de mechanismen waarlangs burgerlijke staat de gezondheid beïnvloedt verder op te helderen.

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Curriculum Vitae

Inez Joung werd geboren op 11 juli 1965 te Oss. Daar behaalde zij in 1983 aan het Titus Brandsma Lyceum het eindexamen Gymnasium ß. Aansluitend begon zij de studie Geneeskunde aan de Katholieke Universiteit Nijmegen; het doctoraal examen volgde in 1987 (Cum Laude). In 1988 werd gestart met de studie Beleids- en Bestuurswetenschappen aan de Katholieke Universiteit in Nijmegen. In het kader van deze studie liep zij van maart tot juli 1991 stage op de afdeling Beleidsepidemiologie van het Rijksinstituut voor Volksgezondheid en Milieuhygiëne. In augustus 1991 behaalde zij het doctoraal examen van de studie Beleids- en Bestuurswetenschappen (Cum Laude).

Hierna verrichte zij het onderzoek beschreven in dit proefschrift naar de achtergronden van de relatie tussen burgerlijke staat, samenlevingsvorm en gezondheid op het Instituut voor Maatschappelijke Gezondheidszorg (iMGZ) van de Erasmus Universiteit Rotterdam (promotor Prof. dr. J.P. Mackenbach). Een gedeelte van het onderzoek werd uitgevoerd op het Nederlands Disciplinair Demografisch Instituut (NIDI) onder begeleiding van dr. F.W.A van Poppel.

In 1993 werd zij geregistreerd als epidemioloog. Vanaf augustus 1995 doet zij onderzoek naar de te verwachten gevolgen van sociaal-demografische veranderingen op de gezondheid en het gebruik van gezondheidszorgvoorzieningen in Nederland. Dit onderzoek wordt uitgevoerd aan het iMGZ en is een samenwerkingsproject met het NIDI. Het onderzoek maakt, evenals het promotie-onderzoek, deel uit van het Prioriteitsprogramma Bevolkingsvraagstukken van de Nederlandse Organisatie voor Wetenschappelijk Onderzoek.

Inez Joung is gehuwd met Harry Janssen.