

The influence of social isolation & loneliness on the mortality risk of German older adults

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Abstract

The older aged group in Germany is growing rapidly. Previous work on this group has focused on their mortality risk by studying social isolation and loneliness, but less so with combined elements. This research analyses their use for studying mortality risk for the elderly in Germany, and looks at the role of the level of religiosity and the degree of urbanity of the elderly by using interaction effects. Survey data from 1996, 2002, and 2008 of the German Ageing Survey which was collected by the German Centre of Gerontology forms the base on which the logistic regression is used. Descriptive results show that very lonely and highly isolated have higher percentages of women, older aged, lower educated, and living in rural areas than those who are not lonely or are little isolated. Binary logistic regressions show that there is a negative association between social isolation and the mortality risk of older aged adults. Loneliness did not reveal such an consistent association with mortality risk after controlling for demographic variables. The interaction effects show that rural residence areas can be detrimental for older aged adults when compared to their more urban city counterparts. The analyses provide support for the use of social isolation instruments in mortality risk research if it is not possible to use both social isolation and loneliness instruments. Policy may be directing its attention mainly at rural isolated older adults.

Keywords: Social isolation, Loneliness, Mortality risk, Level of religiosity, Degree of urbanity, German Ageing Survey

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1 Introduction

The prevalence of loneliness and isolation is considered to be one of the main challenges in nowadays society (De Jong Gierveld, Van Tilburg, Dykstra, 2016). Social isolation is defined as the lack of social relations and participation in a network or society whilst loneliness is the subjective experience of a lack of social relations and social support.

Over the past couple decades medical and social sciences have dug into the subject. A number of factors play a role in this issue gaining attention: first, the negative effects of being lonely or socially isolated; second, a lack of support by social relations to the individual; third, the associated risk of mortality; fourth, the demographic trend amongst Western countries in general, and Germany in particular, of an increasing elderly population.

The relationship between mortality risk and social isolation and loneliness has been established in previous research as described in the meta-analysis of Holt-Lunstad et al. (2015). Studies which measure both the relationship of social isolation and loneliness with mortality risk are less common. This research will study mortality using a combination of social isolation and loneliness measures with the aim to give insight into which measure may prove more useful for future research.

The study of mortality risk and population ageing helps to determine the structure and the size of the current population, and how mortality trends may influence the future population. Adding to that, research on mortality risk may help to understand how to lower premature mortality. Understanding the mortality risk posed by social isolation and loneliness may help to evaluate the sustainability of modern societies lifestyles (Christensen et al., 2009).

The oldest-age group (aged over 85) is the most susceptible to morbidity and disease (Christensen et al., 2009). When older people are able to remain healthy over a long period in their life this enables them to maintain a high quality of life and to be able to stay in contact with other people. From a societal perspective, older people are able to contribute to society for a longer period of time, and it reduces the burden on health care and care providers. A couple of trends are important to recognise in this respect.

The older aged group has been expanding in developed countries, and future societies' populations are projected (figure 1.1) to have a large group of elderly people. The increasing elderly population will enlarge the dependency ratio (figure 1.2) in concerning countries. As a consequence government expenditure on health care will increase to balance the cost of an

older population. Additionally, the demand for care will increase based on these projections (Kluge et al., 2014).

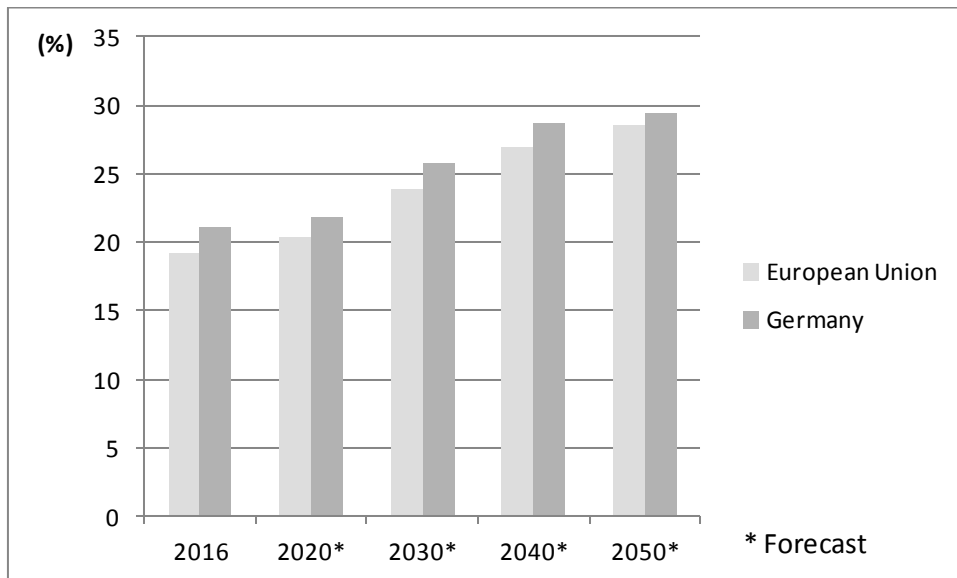


Figure 1.1 Percent of population aged 65 years and more of total population in Germany and the European Union. Adapted from Eurostat

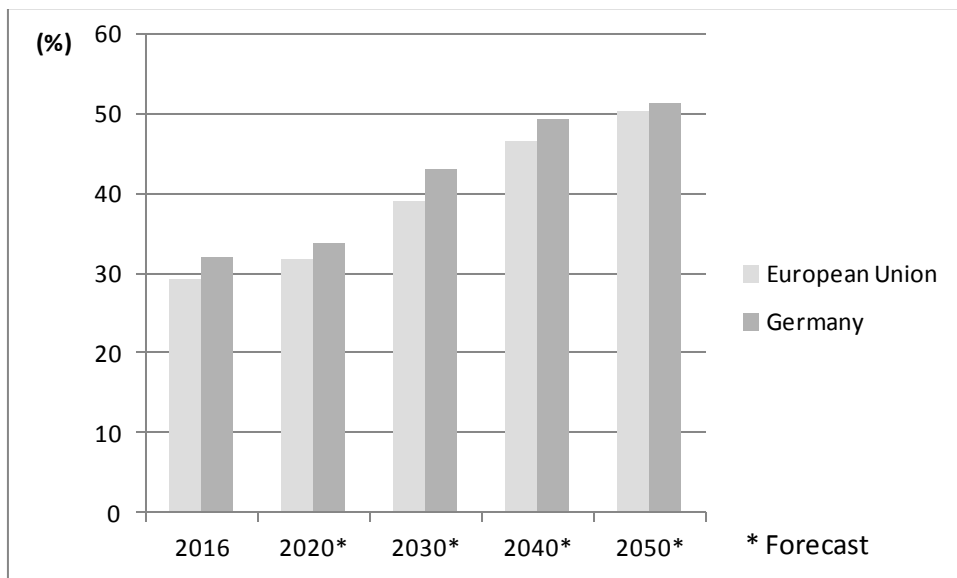


Figure 1.2 Old-age-dependency ratio. This figure illustrates the proportion of population aged 65 and over to population 15-65 years. Adapted from Eurostat

Currently, the ageing of society in Europe goes hand in hand with an increasingly individualization and a growing number of single person households. European societies also appear to be characterized by the lack of a sense of community: individuals seem to feel less belonging and experience increased loneliness (Schirmer & Michailakis, 2016).

Population decline is another phenomenon which is becoming more common in European countries. Especially rural areas in Germany are affected by shrinking

municipalities (Beets, 2009). When rural areas shrink the amenities in the area generally decrease because younger people are leaving the region. Older people may derive their support from the younger inhabitants in the region, and their departure makes it increasingly difficult to receive local support and find care providers.

This research will thus investigate the two conditions loneliness and social isolation, and their impact on the mortality risk of the elderly in Germany. More specifically, the main research question is: To what extent does loneliness and social isolation increase the risk of mortality of German older adults? In order to look at the influence of religion a distinction is made between Catholics and Protestants and those who are non-religious. In addition to that a distinction is made between rural areas and more urbanized areas namely urban-rural, urban cities and large cities in this research. Interaction effects are used to study the role of the level of religion and degree of urbanity.

The thesis structure to answer these questions is as follows: first, the theoretical framework is presented with the conceptual model, followed by the classification model, after that the methods and data are explained, then the results and the conclusion, and finally the discussion.

2 Theoretical framework

2.1 Literature review

Social relations consist of different layers of social exchanges. Typically relations are divided between strong ties such as intimate relations (e.g., marriage) and social networks (e.g., connections to relatives and friends), and weak ties which consist of involvement in community, voluntary, and religious organizations (Granovetter, 1973).

The social ties of an individual serve as a potential source of various types of support. Social support theorists who focus on health outcomes through network ties describe several pathways how network ties affect health (Berkman et al., 2000; Thoits, 2011). Firstly, social control and social influence is a mechanism through which social ties can affect health behaviour (Berkman et al., 2000; Umberson and Montez, 2010). Social control refers to the attempts of a social network to encourage, convince, or pressure a person to conform to positive health behaviour. When network members notice a behaviour change such as abnormal eat and sleep regimes, or excessive smoking and drinking behaviour they can talk about the behaviour or intervene. These risky health behaviours are linked to morbidity and

mortality (Thoits, 2011). Another way people can obtain behavioural guidance is by comparing themselves to fellow network members. In this way individuals assess their health attitudes and behaviours against that of group members. When this comparing goes without explicit discussion it is referred to as social influence. Conforming to the standards of the group allows an individual to appropriate these norms.

Secondly, social relations can affect health by providing social support to the person. This can be described as support available by strong or in other cases weak ties which can range from emotional support, economical or informational support, and instrumental assistance (House and Kahn, 1985; Thoits, 2011; Lin, Simeone, Ensel, & Kuo, 1979). Emotional support involves showing encouragement, sympathy, showing love and care to the individual. Informational assistance refers to advice given to help. Economical support or instrumental assistance is provision of economical goods or material assistance or the behavioural assistance with practical tasks. Access to one or more types of support can provide the receiver or giver a purpose or sense of belonging, a feeling of security, and recognition of self-worth. These psychological states may benefit mental health by causing an increased motivation for self-care and protect against stress. Less intensive contact such as basic interactions has also been associated with improved emotional and social well-being by giving persons a sense of belonging (Sandstrom and Dunn, 2014).

Lastly, social relations may influence an individual to engage in social participation. Activities such as meeting friends and family, group recreating, attending social functions, participating in occupational or social roles, and church attendance are all instances of social participation. Social participation is associated with higher life satisfaction and high self-esteem, and also to lower mortality. The social participation might in turn lead to new social relations formed and access to social support (Takagi, Kondo, Kawachi, 2013).

Social isolation is usually characterised by a lack of social relations with others and indicated by situational factors, such as a small social network, infrequent interaction, and a lack of participation in social activities and groups. Individuals who are socially isolated lack the social structure and social support of social relationships and their benefits. Some studies find associations of social isolation with health-risk behaviours such as physical inactivity and smoking (Shankar, McMunn, Banks, & Steptoe, 2011). Other studies link social isolation with higher blood pressure levels (Hawkey, Thisted, Masi, & Cacioppo, 2010; Shankar et al., 2011), and increased risk of mortality (Holt-Lunstad et al., 2015; Pantell et al., 2013; Shankar

et al., 2011; Tanskanen & Anttila, 2016; Valtorta, Kanaan, Gilbody & Hanratty 2016). The aforementioned reasons result in the expectation that *social isolation leads to a higher mortality risk* (H1). The mentioned links found by in these studies are indirect effects as they look at how mortality risk changes when social isolation makes persons their health change. However, in the model in this research the direct effect is studied. The same holds for the studied relationship between mortality risk and loneliness.

Loneliness is characterised by the subjective experience of a shortcoming in social relations and a perceived lack of social support. Some studies distinct between social loneliness and emotional loneliness, as suggested by Weiss (1973). Social loneliness is the discrepancy between the amount of social contacts and or the quality of the contacts and what the individual wants to have. Or in other words, the subjective experience of missing meaningful relations with a group of people. Emotional loneliness is a perception of loneliness caused by a lack of closeness or intimacy with a partner or friend. Luo, Hawkey, Waite & Cacioppo (2012) use emotional, physical, and functional health as mechanisms how loneliness can be explained to increase mortality risk. Loneliness is predicted to increase depressive symptoms over time, decrease self-rated health over time, and make individuals engage in less activity over time (Luo et al., 2009). These physical outcomes predict mortality for individuals (Holwerda et al., 2012; Luo et al., 2012; Valtorta, Kanaan, Gilbody & Hanratty, Holt-Lunstad et al., 2015). The aforementioned reasons result in the expectation that *loneliness leads to a higher mortality risk* (H2).

Research which takes both social isolation and loneliness into account does not always come to same conclusion. Steptoe et al. (2012) and Tanskanen et al. (2016) find an association between social isolation and mortality risk, but the association of loneliness with mortality risk disappeared after covariates have been taken into account. Loneliness was also more related to poor health than social isolation in their study. This led to their argument that the emotional and subjective experience of loneliness may not explain the adverse effects of social isolation on mortality risk, but rather that the experience of loneliness may be characteristic of people with pre-existing health issues. However, Holwerda et al. (2012) find in their study with social isolation and loneliness that after a ten year follow-up more older men died when lonely. Social isolation did not lead to a higher mortality risk.

These partly contrasting results on the effect of loneliness indicate that the relation between social isolation and mortality and loneliness and mortality is not clear cut, as some

variation is found in the previous results. However, the results are based on different sample sizes and samples with older adults from different countries which lead to different interpretations. Also, the different operationalization of key concepts such as social isolation and loneliness make that researchers may find different results and interpret these differently. It is, however, notable that the results amongst research is different even though the theoretical underpinning is mostly similar.

Finding other pathways how loneliness and social isolation is associated with mortality can be used to gain understanding in this area. The degree of urbanity may influence the life of older adults and their experience of feeling lonely or socially isolated. Somewhat limited research on the different degrees in urbanity and loneliness and social isolation can be found. Whilst some research finds older age loneliness or increased social isolation to be associated with living in rural area (Drennan et al., 2008 ; Jivraj et al., 2012), others find urban areas to be associated with loneliness, especially when populated with younger people (Van Groenou, Van Tilburg and De Jong Gierveld, 1999). Rural areas are characterised by less accessibility and fewer amenities in the neighbourhood (De Koning, Stathi & Richards, 2016). Adding to that, people living in a large rural area may be more scattered as opposed when living in the city, which may amplify the influence of loneliness (Burholt, 2011). However, visiting friends, relatives or neighbours has a stronger positive influence on subjective well-being for rural residents than their urban counterparts (Mair & Thivierge-Rikard, 2010). Urban areas are increasingly centred around the needs of younger people (Phillipson, 2007), have limited accessibility and may cause safety issues for elderly in traffic, and also feelings of exclusion and less assistance make urban cities less popular for the elderly to go outside (Amato, 1993; Buffel, Phillipson, & Scharf, 2012). Other health-related disparities between rural and urban areas are that rural older residents may have to travel farther to obtain care, or there may be less transportation to reach care, or less health care available in the region (Larson & Fleishman, 2003, Rosenthal & Fox, 2000). In general rural areas have fewer amenities and less health facilities. Added together the expectation for elderly is that *rural areas have a negative moderating effect on the relation between social isolation and mortality risk* (H3). However, rural areas may also provide more assistance and a more positive effect of strong ties than in urban areas. Socially isolated are expected to have little contact, but those who are lonely can still have contact with others. For the reason that rural as well urban areas have their negative sides it is expected that *rural areas do not have a positive*

or negative moderating effect when compared to urban areas on the relation between loneliness and mortality risk (H4).

Level of religiosity has been associated with lower levels of loneliness and social isolation (Rote et al, 2013). In Germany the two most prevalent religious churches are the Roman Catholic Church and Protestant Church. In the 2011 census counting over 24 million Catholics and over 23 million Protestants.¹ The pathways through which religion could help older people with loneliness are through individual religious practices and through social religious practices. Individual practices can be activities such as praying and bible reading, which can act as a way to cope with negative emotions of a lack of support by providing comfort and belief. Social practices can be religious group activities or church attendance, which can also be a source of social support through exchanges on the subject of worship. In this way religion can be a way of providing social integration and social support which helps with loneliness and social isolation (Rote et al., 2013; Schirmer and Michailakis, 2016). Although religion is theorized to help against loneliness and social isolation, some of these associations may be partially spurious due to religious people being more healthy, or have a personality or way of thinking which makes it easier for them to be in contact with other people and more optimistic (Rote et al., 2013). Also Christians have a higher fertility rate than non-religious people in Germany which may mean that they have access to more strong ties for support.² Considering these mechanisms it is expected that *religiosity has a positive moderating effect on the relation between social isolation and mortality risk (H5)*, and *religiosity has a positive moderating effect on the relation between loneliness and mortality risk (H6)*.

2.2 Conceptual model

The conceptual model (figure 2.1) is based on the previous paragraphs which discuss the expected relationships between the concepts. First, social isolation and loneliness is thought to influence an individual's health, and their lifestyle and health behaviour and psychological states which in turn influence the health of the individual. When the health of the individual is worsened this is thought to increase the mortality risk. Secondly, the level of religiosity and the degree of urbanity is thought to influence this relation with social relations and health. Degree of urbanity is also thought to have an influence on the relationship with health and

¹ https://ergebnisse.zensus2011.de/?locale=en#StaticContent:00,BEK_4_1_6,m,table

² <http://www.pewresearch.org/fact-tank/2017/04/05/christians-remain-worlds-largest-religious-group-but-they-are-declining-in-europe>

mortality risk for the reason that a difference between health facilities in rural and more urban areas may have an influence on the mortality risk.

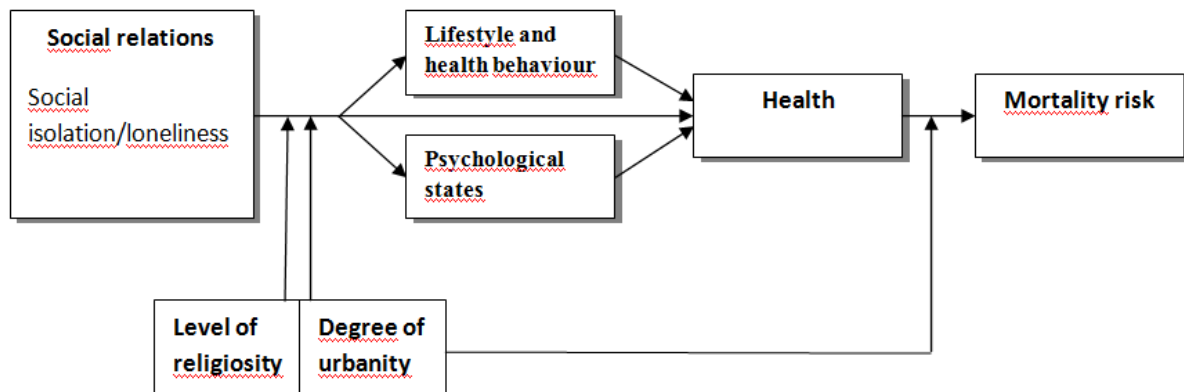


Figure 2.1 Conceptual model

2.3 Two-dimensional diagram

Valtorta, Kanaan, Gilbody and Hanratty (2016) present a novel way to classify and compare measures of social relationships with their two-dimensional model. Their aim is to help interpret literature on loneliness and social isolation, and to present a guide to choose the right measuring tool for researchers. Specifically, the authors provide a framework which includes a classification that allows for comparisons of concepts made by researchers from different disciplines. This classification is based on the difference between functional (qualitative) and structural (quantitative) aspects of social relationships. Another focus of the authors is to be able to compare questions based on the degree of subjectivity which is expected from the respondents. This is based on in which way the items of the survey were formulated. The relevance of the two-dimensional model by is fourfold.

1. The framework provides a way to distinguish between objective and subjective measures of social relationships. A distinction in this research will be made to capture the structural and functional side by approaching the two differently. This will help study the multifaceted sides of social relationships.
2. Other research on social relationships can be sorted by their focus on the functional or structural side of social relationships. Classification will help to interpret the existing literature on loneliness and social isolation. Also, it can be used to understand if other researchers actually measured what they outlined in their research.

3. The two-dimensional model schematises research scales and their focus, which is helpful in deciding which variables will be included in this research. The typologies provide the criteria for which tool to use to capture the two different perspectives.
4. The model provides a way to reflect on the subjectivity of the measures and scales used.

The classification model (figure 2.2) consists of two dimensions. The first dimension, which is placed on the vertical axis, has two parts. The top part represents the *structure* and the bottom part the *function* of social relationships. Structural characteristics cover the number of contacts and the type of people the subject interacts with, the diversity, density and reciprocity of a person's social network, and frequency and duration of contact between individuals. Functional aspects focus on qualitative and behavioural characteristics of interactions and exchanges between people. The focus is on the purpose and nature of relationships, where most literature focuses on beneficial functions (Valtorta et al., 2016), e.g. persons who provide social support to one another.

The second dimension shows the degree of subjectivity asked of the respondents. The side on the right shows the most subjectivity in questions of surveys. However, all self-reported questions involve some subjectivity (Valtorta et al., 2016). In what amount the subjectivity varies depend on the formulation of the questions. The authors defined four typologies how research on social relationships formulate questions. Starting from the most objective they conclude with the most subjective typology.

1. *Involvement in social relationships*

The most objective approach used is to ask questions to capture the access to social relationships. This is done by quantifying the social relationships with numerical questions which attempt to gauge the size and range of social relationships in which a person is involved.

2. *Perceived availability of social relationships*

The second type of access is measured by asking whether social relationship support is available to the respondent. The questions do not measure how many or whether social relationships are available to the respondent directly, but are a measure of availability as perceived by respondents.

3. *Perceived adequacy of social relationships*

Research which focus on the satisfaction with the quality and/or quantity of their interactions. Respondents appraise their social relationships against their expectations.

4. *Feelings relating to social relationships*

The most subjective measures are the questions which focus on feelings associated with social relationships. These questions can cover positive and negative feelings, and ask how people feel about the quality as well as the quantity of their relationships.

The two-dimensional diagram (figure 1) is now adequate to classify measures used in social relationship and cardiovascular disease research. Questionnaires are placed on the diagram according to whether they contain questions focusing on the structural, functional or both aspects of relationships (vertical axis) and according to the degree of subjectivity asked of respondents (horizontal axis).

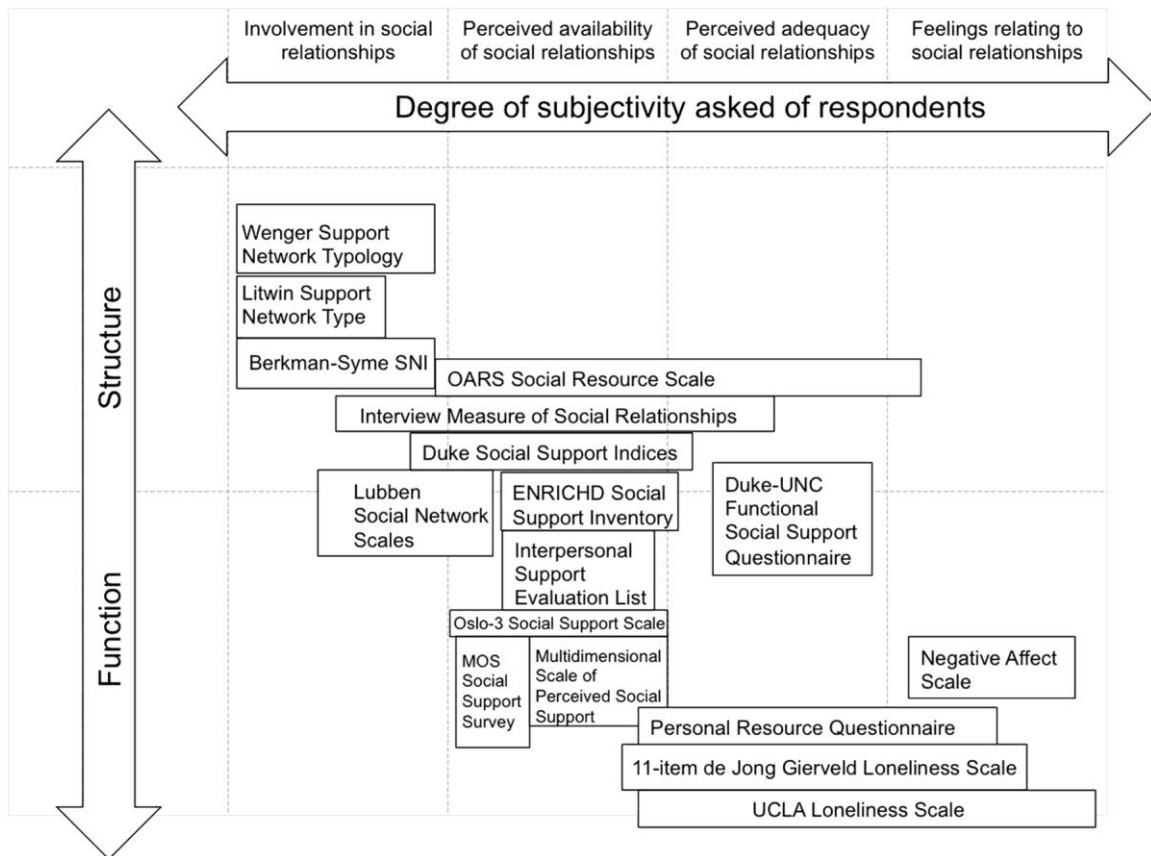


Figure 2.2 Classification model from Valtora et al. (2016)

3 Data

3.1 Survey

For this research the German Ageing Survey (DEAS) is used which is collected by the German Centre of Gerontology (DZA – Deutsches Zentrum für Altersfragen). The main goal is to provide a national database that contains information on the living conditions of the middle-aged and older population, and the multiscalar processes of ageing whilst also showing the diversity and the processes of social change in Germany. The data that is collected by DZA is available for decision-makers, scientific research and the general public. The first survey wave took place in 1996, further waves followed in 2002, 2008, 2011, and 2014 (Engstler & Schmiade, 2013, and Klaus & Engstler, 2016).

3.2 Sample

Table 3.1 shows the analysed number of participants for each survey year and from which year they first started participating. In parentheses are the number of not included respondents because of missing data. The sample includes data from three waves: 1996, 2002 and 2008. The baseline sample from 1996 includes 4,838 persons.

Table 3.1 The number of analysed respondents in each wave of the total sample since their first participation.

	1996	2002	2008
Year of first participation			
1996	3979 (859)	1524 (244)	994 (303)
2002		3670 (424)	1001 (271)
2008			6205 (1814)
n=	4838	5194	8200

Table 3.2 shows the amount of participants of the analysed sample with the vital status is dead in 2015. From the survey in 2002 (n=367) of the baseline survey in 1996 and (n=413) from the base sample of 2002 died. From the survey in 2008 (n=90) died whom participated since 1996, (n=88) since 2002 and (n=417) died from the base survey in 2008.

Table 3.2 Participants with vital status 'dead' in 2015 and their share of the analysed sample.

	Survey year	
	2002	2008
Year of first participation		
1996	367 (7.1%)	90 (1.1%)
2002	413 (8%)	88 (1.1%)
2008		417 (5.1%)
n=	4526	5812

Table 3.3 shows the analysed sample descriptives of the participants in 1996, 2002, and 2008. An analysis of the descriptives is found in chapter 4.1. Table 3.4 shows the descriptive statistics of the participants of those in 1996, 2002 and 2008 who were not included in the analysis due to missing data on the loneliness and social isolation variables. Of the baseline sample (4,838) 859 respondents were removed, of the 2002 sample (5194) 668 respondents were removed, and of the 2008 sample (8200) 2388 respondents were removed. Descriptives of the missing data are shown for the variables gender, age, education, religion, and degree of urbanity. All the respondents amongst the missing data had answered questions on age, education, and degree of urbanity. However, the number of respondents amongst the missing data who answered survey questions on religious affiliation was below 50 respondents. Catholics are more common in the missing data than Protestants or non-religious respondents, but because less than 50 responded it is not clear if this is representative. Amongst the respondents for the missing data more lower educated and less higher educated are represented than in the analysed data sample. According to some studies more educated people are more likely to fill in surveys and easier to locate for later waves of a panel survey (Chang and Krosnick, 2009; Mulry-Liggan, 1983; Schejbal and Lavrakas, 1995). Also for the

1996 sample there are more people living in urban cities and less in large cities than in the analysed sample. Lower response rates are found more commonly for urban residents than rural areas (Lim, Immerwahr, Lee & Harris, 2013; Stoop, 2004; van Goor, Jansma & Veenstra, 2005), however it does not explain the lower large cities missing data.

Table 3.3 The descriptives of the data.

	1996	2002	2008
Gender			
Male	49%	49%	49%
Female	51%	51%	51%
Average age	60	61	63
Education			
Low	16%	15%	10%
Medium	58%	54%	54%
High	26%	31%	36%
Religion			
Catholic	32%	29%	26%
Protestant	36%	36%	37%
Degree of urbanization			
Large city	30%	27%	24%
Urban city	33%	37%	34%
Urban-rural	19%	18%	22%
Rural area	18%	18%	20%
n=	3979	4526	5812

Table 3.4 The descriptives of the missing data.

	1996	2002	2008
Gender			
Male	51%	53%	49%
Female	49%	47%	51%
Average age	60	61	62
Education			
Low	21%	24%	14%
Medium	58%	50%	54%
High	20%	26%	32%
Religion*			
Catholic	53%	32%	23%
Protestant	28%	26%	33%
Degree of urbanization			
Large city	21%	29%	23%
Urban city	41%	34%	36%
Urban-rural	19%	19%	23%
Rural area	19%	17%	18%
n=	859	668	2388

* The number of respondents who filled in religious affiliation was below 50 respondents.

3.3 Methods

The research hypotheses are tested with a binary logistic regression. The dependent variable in the analysis will be mortality risk. The main variables of interest will be social isolation and loneliness.

Mortality risk is covered by the vital status of the participant in 2015 with 0 denoting alive and 1 dead. The (control) variables included are: gender, age, education, state of health, religion, and degree of urbanity.

Social isolation will be constructed based on the Berkman-Syme Social Network Indices. The index measures degree of social isolation, taking into account not only the number of social connections but also their relative importance. The index has four levels, low, medium, medium-high and high. Loneliness is measured using the Gierveld and de Jong loneliness scale. The score of this scale ranges from 1-4 with 1 representing low loneliness and 4 high loneliness.

After constructing the variables the binary logistic regression is performed. The binary logistic regression for the 2002 and 2008 survey year shows the basic association between the independent variables and the dependent variable. After performing the binary logistic regression for the basic association the control variables gender, age, health and education are added. In the final logistic regression the interactions religion and degree of urbanity are added.

3.4 Variables

3.4.1 Dependent variable

The variable *mortality risk* in this study is based on the vital status information on the respondent in 2015. If the respondent was alive in 2015 then the answer would be alive, which is coded as 0. If the person had died by 2015 then the answer would be dead, which is coded as 1.

3.4.2 Independent variables

The variable *social isolation* was measured with an index based on the Berkman-Syme Social Network Indices. The index consists of four variables, namely *married*, *sociability*, *church frequency*, and *group membership*. Three outcomes are possible namely low social isolation, average social isolation, and high social isolation. The scores are coded according to the SNI. Married is coded as 1 for married and 0 for not being married. Sociability is the amount of

important persons the respondent has, which can range from 0 to 9. When the respondent has less than three important persons around him it is coded as 0 which implies few important persons. Three or more important persons is coded as 1. Church frequency is self-reported frequency of going to church, which ranges from 'several times a week', 'once a week', '1 – 3 times per month', 'several times a year', 'less often', 'never'. Less often and never get coded as 0 and the rest as 1. Group membership is measured by the question if a person participates in groups and organizations with 'yes' or 'no' as an answer category. Yes is coded as 1 and no as 0. Membership of religious groups is excluded. The scores are summed up which gives values between 0 and 5. The values 0 to 1 are coded as high social isolation, 2 as average social isolation, and 3 to 4 as low social isolation.

The variable *loneliness* was measured with the De Jong Gierveld & Van Tilburg 6-Item Loneliness Scale. Six statements are posited to the respondent where he or she can answer with 'strongly agree', 'agree', 'disagree', and 'strongly disagree', which is coded 1 to 4. The following statements are included in the scale, 'I experience a general sense of emptiness', 'There are plenty of people I can rely on when I have problems', 'There are many people I can trust completely', 'I miss having people around', 'There are enough people I feel close to', 'I often feel rejected'. When summed up the scores can be read as follows: 1 to 2 is coded as low loneliness, 2 to 3 as average loneliness, and 3 to 4 as high loneliness.

The variable *degree of urbanity* (indicator of regional context) consists of three dummy variables and one reference category which represent the four different types of residence the respondent can live in. The dummy variables are large city, urban city, urban-rural area, and the reference category is rural area. The values given for the areas are 1 for large city, 2 for urban city, 3 for urban-rural area, and 4 for rural area. This categorization is based on the four governance districts from the BBSR (Bundesinstitut für Bau-, Stadt- und Raumforschung). The first category is large cities which are classified as such when having a population of at least 100,000 residents. The urban district is classified as such when the population density reaches at least 50 per cent in the middle and large cities, and the region excluding the middle and large cities of at least 150 residents per square kilometre. The rural-urban district is classified as such when the population density reaches 50 per cent or higher, and when between 100 and 150 residents live per square kilometre. The thinly populated rural areas are districts with a population share below 50 per cent in the large and middle cities and less than 100 residents per square kilometre.

The variable *religiosity* consists of the dummies *Catholic* and *Protestant* which represent two of the three major forms of Christianity namely the Roman Catholic Church and the Protestant Church. Almost sixty per cent of total population in Germany belonged to one of either churches in the 2011 census³. The respondent was given seven possible answers to the question which religious group they were part of. Possible answer categories were ‘The Roman Catholic Church’, ‘The Protestant Church (not including free churches)’, ‘An Evangelical Free Church’, ‘The Islamic Religious Community’, ‘The Jewish Religious Community’, ‘Another Religious Community’, ‘No Religious Group’.

3.4.3 Control variables

The variable *gender* is based on the variable if the respondent was a woman or man. The values given were 0 for men and 1 for women.

The variable *age* was calculated from the birth year the respondent has provided. The values are rounded to years.

The variable *education* was measured by the question what education the respondent received. Answer categories range from ‘low’, ‘medium’, and ‘high’. Low is coded as 1, medium as 2, and high as 3.

The variable *state of health* is the assessment of a person their health. The respondent is given five answer categories ‘very good’, ‘good’, ‘average’, ‘bad’, and ‘very bad’. The values given to these answers range from 1 for very good and 5 for very bad. Self-rated health has been found to be a reliable source of health rating in relation with mortality (Idler & Benyamini, 1997).

4 Results

4.1 Descriptive results

Table 4.1 (1996), table 4.2 (2002) and table 4.3 (2008) the distribution and sociodemographic characteristics of the loneliness and social isolation groups are summarized. The descriptives for the 2002 wave are as follows: the wave consists of 4526 respondents, whereof the loneliness group is divided between the low loneliness group (65.7%), average (30.9%) and very lonely (3.4%) and the social isolation group between low social isolation (46.3%), average social isolation (32.7%), and very isolated (21%) individuals. Women are

³ https://ergebnisse.zensus2011.de/?locale=en#StaticContent:00,BEK_4_2_6,m,table

overrepresented in the high loneliness (57.4%) and high isolation group (54.1%). The high loneliness and high isolation respondents also have an older profile than the rest of the subgroups in the sample. On average these two subgroups tend to have a lower education although intermediate education is the most common amongst all groups. Highly isolated persons are predominantly not religious and protestant, however, religious affiliation is fairly balanced amongst the loneliness groups. Most of the respondents live in the urban and large cities, and low and average isolated individuals live mostly in the cities, whereas the highly isolated people percentagewise live more in the rural areas than the large cities.

The 2008 wave (5812) is similar to the 2002 wave (4526) in most respects. Some differences can be seen in the higher age profile, an on average higher education, and a larger percentagewise share of people living in rural areas and less in the urban city and large city areas.

Table 4.1 Demographic and Socioeconomic characteristics of the baseline sample (1996).

	Loneliness			Social isolation			Total
	Low	Average	High	Low	Average	High	
Group size, <i>n</i>	2,409	1,379	191	1,739	1,321	919	3,979
Gender, % female	49.8	45.6	54.4	45.3	58.4	55.9	48.9
Age, %							
<50 years	25.1	24.9	16.8	29.1	23.2	17.4	21.5
50-59 years	25.8	28.5	25.7	28.8	26.4	22.9	24.7
60-69 years	22.6	18.6	22.0	20.8	22.2	20.7	25.9
70-79 years	20.7	22.3	23.6	18.0	21.9	28.0	21.3
80+ years	5.8	5.7	12.0	3.3	6.3	10.9	6.7
Education, %							
Low education	13.9	17.5	22.0	14.6	13.5	21.7	15.1
Intermediate	59.2	55.2	55.5	56.4	59.3	56.1	54.1
Higher education	26.9	27.1	22.5	28.9	27.1	22.0	30.7
Religion, %							
Catholic	31.8	32.3	31.9	43.8	24.6	22.7	28.5
Protestant	36.4	34.2	36.6	37.1	34.7	35.0	35.9
Other or no religion	29.0	30.3	29.8	16.2	38.3	40.7	35.6
Area of residence, %							
Large city	29.6	30.6	30.3	24.8	33.7	34.3	27.4
Urban city	33.6	30.8	33.5	38.9	29.2	25.9	37.1

Urban-rural	19.3	19.4	20.9	19.5	17.7	20.9	18.0
Rural	17.5	19.2	15.2	16.9	19.4	18.9	17.5

Table 4.2 Demographic and socioeconomic characteristics of the sample (2002).

	Loneliness			Social isolation			Total
	Low	Average	High	Low	Average	High	
Group size, <i>n</i>	2,973	1,398	155	2,097	1,481	948	4,526
Gender, % female	49.1	47.6	57.4	45.5	50.6	54.1	48.9
Age, %							
<50 years	21.0	22.6	19.4	23.4	20.7	18.4	21.5
50-59 years	24.4	25.8	20.7	27.2	24.2	19.9	24.7
60-69 years	27.1	23.8	21.3	27.5	26.7	21.0	25.9
70-79 years	21.6	20.1	25.8	18.8	20.7	27.6	21.3
80+ years	5.8	7.8	12.3	3.1	7.8	12.9	6.7
Education, %							
Low education	12.9	18.3	30.3	12.0	15.0	22.4	15.1
Intermediate	54.8	52.7	57.0	53.3	55.4	54.0	54.1
Higher education	32.3	29.0	16.1	34.8	29.6	23.5	30.7
Religion, %							
Catholic	28.9	28.3	22.6	38.4	21.3	17.9	28.5
Protestant	36.2	35.3	36.1	35.2	34.2	34.3	35.9
Other or no religion	34.9	36.5	41.3	23.8	44.5	47.8	35.6
Area of residence, %							
Large city	27.2	27.5	30.3	23.5	30.2	31.8	27.4
Urban city	36.4	38.6	36.2	44.9	33.6	25.2	37.1
Urban-rural	18.7	16.9	14.8	18.1	18.2	17.5	18.0
Rural	17.7	17.1	18.7	13.5	18.1	25.5	17.5

Table 4.3 Demographic and socioeconomic characteristics of the sample (2008).

	Loneliness			Social isolation			Total
	Low	Average	High	Low	Average	High	
Group size, <i>n</i>	3,577	2,063	172	2,570	1,940	1,302	5,812
Gender, % female	51.6	44.2	52.3	45.2	50.6	53.5	48.9
Age, %							
<50 years	16.7	20.1	23.8	18.4	17.6	18.4	18.1
50-59 years	24.9	26.6	20.4	27.7	25.4	20.7	25.3
60-69 years	27.4	27.2	27.9	28.8	27.5	24.3	27.4
70-79 years	24.4	20.7	22.7	21.2	23.1	26.6	23.0
80+ years	6.6	5.4	5	4	6.4	9.9	6.1
Education, %							
Low education	8.3	10.9	19.2	6.8	9.7	14.6	9.5
Intermediate	54.9	53.1	57.0	51.5	55.3	58.3	54.3
Higher education	36.9	36.1	23.8	41.7	35	27.1	36.2
Religion, %							
Catholic	25.4	27.6	25	34.8	22.0	15	26.1
Protestant	38.6	32.9	34.3	40.3	34.1	33.7	36.8
Other or no religion	36.2	38.6	40.7	24.9	43.9	51.3	37.2
Area of residence, %							
Large city	23.3	26.2	27.9	22.1	26.4	23.4	23.8
Urban city	33.8	35.3	35.5	40.4	31.8	26.6	34.4
Urban-rural	22.1	21.3	15.7	21.4	21.8	21.9	21.6
Rural	21.8	17.2	20.9	16.2	20.1	28.1	20.2

4.2 Association between mortality risk and independent variables

Before the regression analysis is discussed the correlation matrix in table 4.4 is shown in order to test for correlations between social isolation and loneliness. Amongst the social isolation variables the correlations are moderately strong. Amongst loneliness it can be seen that there is a very strong correlation between low and average loneliness. This shows that there is evidence to suggest that low loneliness and average loneliness measure a similar construct. High loneliness is only weakly correlated with low and average loneliness. Between the social isolation and loneliness variables there is only a weak correlation noticeable. This is also found in to be the case in other research (Coyle & Dugan, 2012; Perissinotto & Covinsky, 2014). Holt-Lundstad et al. (2015) suggests that this might mean

that these two constructs are independent from each other. One could be socially isolated but be content with little contact and another may have frequent contact but feel lonely.

The second step is to establish the link between the independent variables loneliness and social isolation and the dependent variable mortality risk by using a multivariate regression. In tables 4.5 and 4.6 the association between loneliness and social isolation and mortality risk is shown. High loneliness with the data from 2002 is positively associated with the likelihood for mortality risk ($b=.498, p<.05$). The regression results show a higher mortality risk for the average and highly isolated than those who are little to not socially isolated ($b=.404, p<.01, b=.853, p<.001$). Similar to the results from the 2002 data, the 2008 wave results show that high loneliness ($b=.833, p<.001$) and average and high social isolation is associated with higher mortality risk ($b=.329, p<.01, b=.932, p<.001$). When tested it seemed that average and high social isolation levels were not significantly different from each other. Moderate loneliness does not have a significant association with mortality risk for the data from the 2002 and 2008 waves.

When loneliness and social isolation are combined in the same model, high loneliness in the 2002 wave loses its significance with its association with higher mortality risk. High loneliness is associated with mortality risk for the respondents from the 2008 wave ($b=.616, p<.05$). Average and high social isolation is associated with higher mortality risk for the 2002 wave ($b=.398, p<.001, b=.834, p<.001$) and high isolation in the 2008 wave ($b=.861, p<.001$). From the results it is clear that social isolation is detrimental to older adults because it increases their mortality risk. Very lonely older adults from the 2008 wave have an increased mortality risk, however when loneliness and social isolation are combined in the same model this association is lost for the 2002 model.

Table 4.4 Correlation matrix with social isolation and loneliness variables.

Measure	1	2	3	4	5
1. Low isolation	—				
2. Average isolation	-.63	—			
3. High isolation	-.48	-.33	—		
4. Low loneliness	.06	.01	-.07	—	
5. Average loneliness	.03	.00	.03	.94	—
6. High loneliness	.08	-.03	.12	-.22	-.13

Table 4.5 The associations of loneliness and social isolation with mortality risk without control variables (2002).

	Model 1		Model 2		Model 3	
	B	SE	B	SE	B	SE
Intercept	-2.074***	.069	-1.754***	.051	-2.066***	.073
Average isolation	.404***	.099			.398***	.100
High isolation	.853***	.103			.834***	.106
Average loneliness			.036	.089	-.035	.704
High loneliness			.498**	.196	.214	.294
N	4526		4526		4526	

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4.6 The associations of loneliness and social isolation with mortality risk without control variables (2008).

	Model 1		Model 2		Model 3	
	B	SE	B	SE	B	SE
Intercept	-2.973***	.092	-2.718***	.068	-3.037***	.101
Average isolation	.263*	.131			.255	.131
High isolation	.904***	.127			.861***	.128
Average loneliness			.196	.107	.145	.110
High loneliness			.833***	.229	.616*	.238
N	5812		5812		5812	

* $p < .05$. ** $p < .01$. *** $p < .001$.

4.3 Models with control variables

Table 4.7 shows the results of the binary regression model for the 2002 model after adding the demographic variables gender, age, education, and state of health. After controlling for these variables, the association between average social isolation and fairly to high social isolation and mortality risk has been reduced for the 2002 model ($b=.289, p<.05, b=.561, p<.001$) but are still significant. Table 4.8 shows the results of the 2008 data, which shows that the association between high loneliness and mortality risk is reduced ($b=.771, p<.05$). Also, the association between high social isolation and mortality risk has been reduced ($b=.719, p<.001$). When controlling for demographics average social isolation, relative to not being isolated, is insignificant.

Older men have a higher mortality risk, which is also found in other research (Holwerda, et al., 2012). In the 2002 wave medium and higher educated people were association with having a higher mortality risk, which is contrary what is generally found in the literature. Worse rated health was more associated with mortality risk.

With model 1 in table 4.7 and 4.8, the first two hypotheses are tested. Social isolation has an association with mortality risk, resulting in support for the first hypothesis: *social isolation leads to a higher mortality risk* (H1). High loneliness has an association with mortality risk, but moderately lonely respondents have no significant association. For this reason it can be expected that only very lonely people have an increased risk of mortality risk, resulting in some support for the second hypothesis: *loneliness leads to a higher mortality risk* (H2).

4.4 Interactions

Interactions were tested with both social isolation and loneliness, however the interaction with loneliness was insignificant in the combinations with religion and degree of urbanity. For this reason the focus lies on the interaction with social isolation. The interaction between urban-rural districts and average social isolation is associated with mortality risk ($b=-.978$, $p<.05$). The interaction between urban cities and average social isolation is associated with mortality risk ($b=-1.023$, $p<.01$). The interaction between large cities and average social isolation is associated with mortality risk ($b=-.893$, $p<.05$). The association between the residential location and mortality risk shows that being moderately isolated in rural districts is more detrimental than in more urbanized areas. A possible explanation from the literature is that rural areas provide fewer amenities and health venues, and is characterised by less accessibility, which may be detrimental for social isolated elderly. No association is found between high social isolation and the degree of urbanization. An interpretation of this is that high social isolation is detrimental to health in both rural or urban areas, but for medium social isolation the detrimental effect can be softened by a more populated area such as in cities of urban areas. The interactions of the urbanization variables and social isolation did not reveal significant associations for the 2008 data (table 4.8) and did not give insight into the understanding of mortality risk. Neither did the interaction between social isolation and religion for the 2002 (table 4.7) or 2008 (table 4.8) data.

With the last model the remaining hypotheses are tested. Rural areas have a significantly more negative association on the relation between average social isolation and mortality risk, however these results are not found for the 2008 respondents. Although the literature shows negative health associations for rural as well as for urban areas, most of it is associated with rural areas. This could be explained from the literature as that rural areas are more difficult to reach due to their infrastructure and have less health care available (Larson & Fleishman, 2003, Rosenthal & Fox, 2000). The found association provides some support for the third hypothesis: *rural areas have a negative moderating effect on the relation between social isolation and mortality risk* (H3). No significant difference was found for different urbanized areas between social isolation and mortality risk, resulting in that the fourth hypothesis is not rejected: *rural areas do not have a positive or negative moderating effect when compared to urban areas on the relation between loneliness and mortality risk* (H4). No support has been found for the fifth hypothesis: *religiosity has a positive moderating effect on the relation between social isolation and mortality risk* (H5) and sixth hypothesis, *religiosity has a*

positive moderating effect on the relation between loneliness and mortality risk (H6) as the interactions with loneliness did not reveal significant associations.

Table 4.7 The influence of loneliness and social isolation on the mortality risk of the elderly in Germany (results of the binary logistic regression for the 2002 wave).

	Model 1		Model 2		Model 3	
	B	SE	B	SE	B	SE
Intercept	-9.278***	.373	-9.269***	.378	-10.075***	.444
Loneliness (Ref not lonely)						
Average Loneliness	-.014	.102	-.206	.192	-.205	.243
High Loneliness	.134	.232	.374	.354	.299	.492
Social isolation (Ref not isolated)						
Average social isolation	.323**	.113	.320	.114	1.070***	.290
High social isolation	.618***	.125	.640	.126	.850**	.295
Gender (Ref Female)	.695***	.100	.690***	.101	.686***	.100
Age	.095***	.005	.095***	.005	.099***	.00
Education (Ref low education)						
Medium	.384**	.138	.397**	.139	.381**	.138
High	.351**	.157	.372*	.158	.334*	.156
State of health	.083**	.025	.087***	.025	.211***	.05
Religion						
Catholic	.150	.128	.135	.156		
Protestant	.235*	.115	.154	.141		
Area of residence (Ref rural)						
Large city	.107	.138			.533	.283
Urban city	-.048	.134			.422	.263
Urban-rural	.017	.152			.351	.300
Interaction with religion						
Average isolation*Catholic			-.322	.308		
Average isolation*Protestant			.273	.281		
High isolation*Catholic			-.227	.325		
High isolation*Protestant			.116	.292		
Interaction with area of residence						
Average isolation*Large city					-.893*	.360
Average isolation*Urban city					-1.023**	.340
Average isolation*Urban-rural					-.978*	.389
High isolation*Large city					-.197	.369

High isolation*Urban city									-0.360	.366
High isolation*Urban-rural									-0.554	.405

N										
		4526							4513	

*p <.05. **p <.01. ***p <.001.

Table 4.8 The influence of loneliness and social isolation on the mortality risk of the elderly in Germany (results of the binary logistic regression for the 2008 wave).

	Model 1		Model 2		Model 3	
	B	SE	B	SE	B	SE
Intercept	-9.935***	.505	-9.951***	.514	-10.928***	.572
Loneliness (Ref not lonely)						
Average Loneliness	.188	.119	.141	.201	-.205	.243
High Loneliness	.737**	.264	.027	.511	.299	.492
Social isolation (Ref not isolated)						
Average social isolation	.206	.140	.200	.140	1.070***	.290
High social isolation	.756***	.144	.765***	.144	.850**	.295
Gender (Ref Female)	.756***	.125	.753***	.125	.686***	.100
Age	.091***	.006	.091***	.007	.099***	.000
Education (Ref low education)						
Medium	-.051	.175	-.046	.176	.381**	.138
High	-.130	.193	-.121	.194	.334*	.156
State of health	.110***	.029	.113***	.029	.211***	.000
Religion						
Catholic	.135	.151	-.035	.200		
Protestant	.058	.134	.038	.172		
Area of residence (Ref rural)						
Large city	-.075	.138			-.363	.338
Urban city	.078	.156			-.225	.298
Urban-rural	.004	.173			.046	.330
Interaction with religion						
Average isolation*Catholic			.359	.359		
Average isolation*Protestant			-.476	.350		
High isolation*Catholic			-.152	.391		

High isolation*Protestant		.131	.328		
Interaction with area of residence					
Average isolation*Large city				.805	.437
Average isolation*Urban city				.590	.399
Average isolation*Urban-rural				-.188	.444
High isolation*Large city				.356	.419
High isolation*Urban city				.208	.380
High isolation*Urban-rural				-.532	.418
<hr/>					
N	5218		5218		5218
* $p < .05$. ** $p < .01$. *** $p < .001$.					

5 Conclusion

The aim of this study was to see whether socially isolated and lonely persons have an increased mortality risk. Furthermore, to see if religiosity and the degree of urbanity of residence influences the differences in mortality risk between the lonely and non-lonely and the socially isolated and non-isolated group. The research question was: To what extent does social isolation and loneliness increase the risk of mortality of German older adults? It was tested if social isolation and loneliness has an influence on mortality risk. The analysis of the data for 2002 and 2008 showed support for the first hypothesis: *social isolation leads to a higher mortality risk* (H1). The analysis of the data for 2002 and 2008 showed that moderate loneliness does not lead to an increase in mortality risk. Only very lonely persons from the 2008 wave had an increase in mortality risk which results in some support for the second hypothesis: *loneliness leads to a higher mortality risk* (H2). The difference in mortality risk is only relevant between the most lonely and those who are little or not lonely at all.

It was tested with interaction effects whether the degree of urbanity had an influence on the relation between loneliness and mortality risk and social isolation and mortality risk. For the 2002 wave it was found that rural areas are a stronger modifier on the relation between average social isolation and mortality risk than the non-rural areas. The found association provides some support for the third hypothesis: *rural areas have a negative moderating effect on the relation between social isolation and mortality risk* (H3). No association was found for the interaction between urbanization and loneliness which means the fourth hypothesis is not rejected: *rural areas do not have a positive or negative moderating effect when compared to urban areas on the relation between loneliness and mortality risk* (H4). It was tested whether religion has an influence on the relation between loneliness and mortality risk and between social isolation and mortality risk. No significant association was found between social isolation and mortality risk or loneliness and mortality risk with religion as a modifier, resulting in no support for the fifth hypothesis: *religiosity has a positive moderating effect on the relation between social isolation and mortality risk* (H5) and sixth hypothesis: *religiosity has a positive moderating effect on the relation between loneliness and mortality risk* (H6).

6 Discussion

The results show that socially isolated, and in some cases very lonely persons, have an increased mortality risk. Associations between the interactions of the degree of urbanity and social isolation show that the association between social isolation and mortality risk may have some complexity added to them. The research question can be answered with that for both average and high social isolation an association with increased mortality risk can be found, however the two are not found significantly different from each other. Only high loneliness for the 2008 respondents was found to be associated with increased mortality risk after taking the control variables into account. It was not found in the literature that average loneliness was less harmful than high loneliness. However, in the sample data low loneliness and average loneliness were highly correlated, and average lonely people may still have access to some social support.

Interactions showed associations that rural areas were more harmful for averagely socially isolated older adults than their urban counterpart. Literature showed evidence for that rural areas have less accessibility to health venues and are harder to reach for those who provide care (Larson & Fleishman, 2003, Rosenthal & Fox, 2000). What was unexpected was that loneliness was not associated with rural or urban areas even though some researchers found associations with one or the other because of the area characteristics (Drennan et al., 2008, Van Groenou, Van Tilburg and De Jong Gierveld, 1999). Level of religiosity was not found to be an influence on the relationship between social isolation and mortality risk. This could be because there is no relation, or another possible reason may be the way of measuring the concept and measuring social isolation. For the level of religiosity the respondent their religious affiliation was noted down, and for the SNI index to measure social isolation one of the components is church frequency. This makes the use of social isolation and level of religiosity together complicated and may have resulted in no associations between the two.

The findings for social isolation and to a lesser extent for loneliness add to the established understanding in the field that social isolation and loneliness are detrimental to health. Not much research was found which included variables on rural and urban areas with loneliness and social isolation, so the results with social isolation and the degree of urbanity for German older adults could be seen as an addition to the literature.

The results of this research show more consistent results for social isolation than for loneliness. This could be because loneliness is less related with mortality risk than social

isolation. Another reason could be that it is related to the way the two concepts are measured. The two are theoretically differently conceptualized, as social isolation measures the actual (lack of) contact between individuals and loneliness measures the subjective experience of missing people. The first focuses on the objective differences between individuals as it counts the amount and frequency of contact, and the second is subjectively oriented as individuals can answer in how much they agree or disagree to certain statements.

The two concepts are weakly correlated suggesting that social isolation and loneliness may occur without the other. This would intuitively make sense as an individual who has little contact with others could have no feelings of loneliness and someone with frequent contact can feel lonely. As (Holt-Lunstad et al., 2015) note, the two different pathways may influence how policy interventions can be made. However, as mentioned the two concepts yield different results. The SNI index tries to capture the persons social network and also their participation whereas the De Jong Gierveld & Van Tilburg 6-Item Loneliness Scale tries to capture the social loneliness and the emotional loneliness aspect. Both scales are well used in research (Holt-Lunstad et al., 2015; De Jong Gierveld, van Tilburg, & Dykstra, 2016), and the results before adding control variables in the model suggest that loneliness has some association with mortality risk. As both measurements are used in research it is unclear if the different measurements were the reason for these results. However, the outcomes were more clear cut for the measurement of social isolation, and give some evidence what Steptoe et al. (2012) and Tanskanen et al. (2016) found, namely that social isolation is the main way to explain an increase in mortality risk, and that loneliness may be characteristic of those with pre-existing health problems. However, also after controlling for health variables, the 2008 results in this research still show an increase in the mortality risk association for high loneliness. As it is theorized that social isolation and loneliness are distinct it is advised to include both concepts in research on mortality risk. However, if only one tool would be used it would make sense to use social isolation as this gave more consistent results.

The results have to be interpreted with the knowledge that there are some limitations. The first limitation is the lack of data on family relations, and the distance between them. Family members can be a potential source of social support and contact between family members is important for the wellbeing of older adults (van Diepen & Mulder, 2009). The measurement of social isolation takes into important persons into account, but it is unclear if respondents name family members and how often they are included. The distance between family members is found to have an influence on the support received (Mulder & van der Meer,

2009). The second limitation is that the research did not include direct measurements of health state (e.g. smoking behaviour, disability, amount of health facilities in the local district). Although self-rated health has been found to be a reliable source of health rating in relation with mortality (Idler & Benyamini, 1997), excluding direct measurements may give a less complete picture. A third issue is that there is not controlled for when people became lonely or socially isolated, had health issues, or died. This makes it difficult if loneliness or isolation was a cause of health issues or mortality. For religion and the residential location it is not clear how long they were religious or how long they lived in a certain area. A fourth issue is that the models in this research do not account for health inequalities in Germany. At the level of the individual there is variation in health behaviours and socioeconomic position regionally which are related to mortality risks. On the macro-level there can be differences between societal institutions and health care institutions (Kibele, Klüsener & Scholz, 2015). This makes it hard to generalize these results over the whole of Germany or other countries as determinants of mortality risk may differ amongst regions. Despite these limitations, the results that are presented are indicating that there is a negative indicating that rural areas may be extra detrimental for isolated older adults, also whilst controlling for individual level variables. The case of older adults in Germany have illustrated that loneliness might be more complex than social isolation is, and may not be associated with mortality risk when controlling for other variables. For policy makers this may imply that the effectiveness of policy aimed at lonely individuals may depend on the demographic characteristics of the person. Another important factor would be to target isolated elderly who live in rural areas. Future research should focus on whether the associations found for German older adults are also generalizable to other countries. Most research is done with samples from countries as the Netherlands, the United Kingdom and the United States of America, and research would benefit if other countries are included. Furthermore, to find if associations with mortality risk for socially isolated elderly in rural areas can be replicated. This way an understanding of loneliness and social isolation and its consequences for the elderly can be found which can be used to develop effective policies to contribute to the healthy ageing of older adults.

7 References

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