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# Social Relationships and Use of Outpatient Health Services among Middle-Aged and Older People

Dissertation

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# LIST OF TABLES AND FIGURES

# LIST OF ABBREVIATIONS

HSU = health services use

PHS = preventive health services

SR = social relationships

GP = general practitioner

SHARE = Survey of Health, Ageing and Retirement

DEAS = Deutscher Alterssurvey (German Ageing Survey)

# LIST OF PUBLICATIONS

### Chapter 2

**Bremer, D**[1], Inhestern, L[2], & von dem Knesebeck, O[3] (2017). Social relationships and physician utilization among older adults—A systematic review. PloS one, 12(9), e0185672.

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### Chapter 3

**Bremer, D**[1], Lüdecke, D[2], Vonneilich, N[2], & von dem Knesebeck, O[2] (2018). Social relationships and GP use of middle-aged and older adults in Europe: a moderator analysis. BMJ open, 8(4), e018854.

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### Chapter 4

**Bremer, D**[1], Lüdecke, D[2] & von dem Knesebeck, O[2] (2019). Social relationships, age and the use of preventive health services: Findings from the German Ageing Survey. International Journal of Environmental Research and Public Health, 16(4272), doi:10.3390/ijerph16214272.

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# 1 SYNOPSIS

The overarching aim of this cumulative dissertation is to foster the understanding of factors linked to health services use among middle-age and older people with a focus on social relationships. Since the 1960s, research on health services use has made progress, substantially in identifying key drivers of health services use and the amount of use. Mainly, the preceding research concentrated on the obvious factors connected to health services use, e.g. health status, socio-economic status, health insurance status or gender aspects. In English-speaking countries, questions of race and ethnicity were also highly relevant from a health policy perspective. In the 1980s and 1990s, research began to take a closer look at characteristics of communities, households and family structures, and linked them to health behavior and to the use of different types of health services. Until today, the associations between health services use among middle-aged and older people and their social relationships have not been assessed systematically. Furthermore, various aspects of this topic, especially potential interactions between different factors on health services use, have not been investigated at all. To gain a better understanding on if and how health services use is linked to social relationships, three studies were conducted: a systematic review on this topic (chapter 2), a moderator analysis on a European study population (chapter 3) and a German study on the use preventive health services (chapter 4). Chapter 1 offers an introduction into the field of health services use research, theoretical models and research status focusing on topic-related aspects followed by the research objectives collated for this thesis. Data, measures and analyses used for the three studies are described in the section “Materials and methods”. Subsequently, summaries of the study results are presented. Finally, chapter 1 ends by discussing results, strengths and limitations of the studies and theirs implications for further research and practice.

## 1.1 BACKGROUND

The demographic change in many industrial and post-industrial countries, caused by simultaneous processes of increasing life expectancies and low birth rates, is defined by an increasing old-age dependency ratio[1] [1]. In Germany, for example, the old-age dependency ratio increased from 27 (2000) to 34 (2013) and will further increase to 50 (2030) [1]. Beyond that, ageing societies have to deal with further challenges, e.g. increasing numbers of single-person-households and an increasing risk of loneliness and social isolation in older age [2].

The consequences for social structures, labor markets, social security and health care systems are interdependent, fundamental and varying. While the resources of the health care system, finances and personnel in particular, will decrease, the demand for health services will increase due to rising old age specific diseases, chronic conditions and comorbidities [3]. Individuals in their fifties or older, compared with younger cohorts, show more chronic illnesses and increased rates of health care use [4]. Some illnesses can be prevented or positively influenced by preventive health services [5]. Following Fries et al. [6], a systematic and strategic use of the full spectrum of preventive measures could potentially lead to a compression of morbidity. The principal source of health care in most health care systems is represented by outpatient health services, including primary and secondary care. By taking into account the political and scientific debate of shifting health care services from inpatient to outpatient settings, outpatient health services will be of growing importance in the future [7, 8]. In particular, the sector of primary health care is affected by these developments, since general practitioners (GPs) are mostly the first contact to health care, acting as gatekeepers and authorizers of access to specialty care, hospital care and diagnostic tests [9].

Health services research has shown that the use of outpatient health services and preventive health services depends on a variety of factors. In the Behavioral Model of Health Services Use, Andersen divides the factors into predisposing, enabling and need characteristics [10]. The health status, for example, is defined as a crucial need factor for health services use in older age [11-15]. Recurrently, these factors modify over the life course, since need factors

[1] Old-age dependency ratio = ratio of people older than 64 to the working-age population ages 20-64.

can expand, while levels of autonomy, mobility and social participation decrease due to chronic conditions and physical limitations in older age [16].

Consequently, the use of health services is integrated into complex patterns of social interactions and social relationships. Research indicates the significance of social relationships by enhancing patient care, improving compliance with medical schemes, and aim for shorter hospital stays [17-19]. Different dimensions of social relationships can be predisposing or enabling determinants of whether or not elderly individuals do consult health care services [20, 21]. The underestimated power of social relationships and theirs substantial impact on morbidity and mortality were shown in various international studies [22-25].

In consequence, the question if social relationships increase or decrease the use of health services came up [26-32]. This question has not yet been clearly and fully answered. Potentially, social relationships may be a direct or indirect measure to determine use of health services, especially for vulnerable groups, e.g. older people. By that, social relationships could help to reduce the risk of underuse of health services in general and of preventive health services in particular. On the other hand, they could support the health care system by helping to avoid overuse of health services. Last but not least, social relationships may not be strongly associated to the use of health services in either way.

For Andersen, the founder of the Behavioral Model, this must not be bad news at all, since he would call that “equitable access” to health care [10]. In the next chapter, Andersen’s model and other theoretical approaches to explain health services use are presented.

### 1.1.1 Theoretical approaches of health services use

Research on health services use has been based on theoretical models, especially sociological models. The models used in empirical research are shaped by the image of the homo oeconomicus, rational choice theory and economic approaches [33, 34].

## Economic Approaches of Health Services Use

An economic approach to explain health services use is the concept of health capital [35]. The aim is to model the demand of the commodity "good health" to shed light on empirically existing health differences [35]. Referring to the human capital theory, the use of health services is defined as an investment into the health capital stock which decreases by age [36]. With regard to health services, the model can be criticized, since visiting a doctor does not have to reflect the investment of an actor into his or her health capital stock, but rather represents neglected health investments. In consequence, literature applying Grossman's model mainly deals with the demand for medication [37].

Another perspective is taken by models based on the principal-agent theory [38]. This approach deals with the challenge of asymmetric information in the relationship between principal and agent. The role of the principal is assigned to the role of the patient and the health practitioner represents the agent [39]. In contrast to Grossman's model, the key role deciding on health services use does not lie on the patient's side but on the doctor's side. The model hypothesize that doctors act as managers of the scarce resources in the health system following the principle of utility maximization. In spite of the Hippocratic oath, doctor's behavior can be defined as economic, since they are interested in securing their income [40]. In consequence, the risk of supply-induced use of health services, going beyond the adequate health care for patients, is present [41, 42].

Pohlmeier and Ulrich [43] try to combine the models of health capital and principal-agent interaction. They assume that the decision of using health services can be designed as a two-stepped process in which decisions are shaped by different decision-makers. In the German system of statutory health insurance, they hypothesize that only the patient decides if he or she visits a doctor or not. This first step can be defined as health relevant behavior and as an investment into the commodity "good health". In the second step, the following health services and the frequency of health services use are shaped by the doctor. In their integrative economic model, doctors are defined as determined agents following their utility-maximizing strategy of action and fabricating the demand of health services by themselves [43].

Due to their under-complexity, the application of economic approaches is questionable, since the demand-side (patients) as well as the supply-side (health care providers) are characterized and influenced by many more factors than utility maximization.

## The Behavioral Model and Access to Medical Care

One of the most disseminated and applied models in health services use research is the Behavioral Model of Health Services Use by Andersen [10, 44]. It offers specific starting points for operationalization of relevant variables for empirical research. Originally, the model was developed in the 1960s and was refined until the 1990s. It examines the decisive determinants of health services use and tries to arrange them in a universal model. The objective of Andersen was to predict the use of health services and to explain the behavior of health services use, and by that promote equitable access to health care [10]. Until today, the model can be defined as the reference framework of international health services use research [42].

Following Andersen and Newman [45], three characteristics have to be considered for the operationalization of health services use: (1) the type of health services, (2) the purpose of health services use and (3) the unit of analysis. It might be reasonably assumed that a hospital stay is explained by different factors than a dentist visit (type of health service). Furthermore, preventive health services have another purpose than health services in case of acute illnesses (purpose of health service). Moreover, it is important to note whether a contact to health services was existent and to which extent (unit of analysis).

Concerning the determinants of health services use, the Behavioral Model differentiates between three levels: (1) societal determinants (technology, norms), (2) health services system (resources, organization) and (3) the individual determinants (predisposing, enabling, illness) [45]. On the one hand, the societal determinants influence the individual determinants, e.g. by using medical technology and defining adequacy and intensity of health care. On the other hand, the health services system, defined by the distribution of resources and acting organizations, is linked to the individual determinants. Finally, individual characteristics determine health services use and its characteristics.

On the level of the individual, the framework of Andersen suggests a division into three determinants: (1) predisposing, (2) enabling and (3) need factors [10, 45]. The authors of the model assume that the three factors are associated with health services use, but in different strengths. Presumably, predisposing characteristics give only little information on health services use, whereas enabling factors and even more need factors have the potential to essentially explain health services use [45]. Predisposing characteristics are defined as demographics (e.g. age, gender, marital status), social structure (e.g. education, occupation, family size) and beliefs (e.g. values, attitudes and knowledge towards health and health services) [45]. Enabling factors cover family (e.g. income, health insurance, type of and access to regular source of care) and community aspects (e.g. ratios of health personnel and facilities to population, price of health services, region) [45]. Need factors, also called illness level, include perceived (e.g. disability, symptoms, diagnoses, general state) and evaluated health status (e.g. symptoms, diagnoses) [10, 45]. Although the model takes different social variables into account, it is criticized for its failure to capture essential features of social life, since "social interaction is the basis of social life, and social networks provide the mechanism (interaction) through which individuals learn about, come to understand, and attempt to handle difficulties" [20]. This thesis addresses this problem by including various social aspects in the studies on health services use (chapters 2-4).

Andersen not only developed hypotheses about the components of the predisposing, enabling and need factors, but also mapped their degree of mutability [10]. The mutability of the model components demographics and social structure (both predisposing factors) as well as need factors are rated as low, whereas the changeability of health beliefs is estimated as medium [10]. The possibility of modification of the model component enabling resources is valued as high. Since, social relationships could be defined as enabling resources, potential associations between social relationships and health services use may play an important role, especially with regard to access to care and equity.

The Behavioral Model was developed to understand why people use health services, to define and to measure equitable access to health care as well as to assist in generating policies to

promote equitable access [10]. Consequently, Andersen defined different measures of access: (1) potential, (2) realized, (3) equitable and (4) inequitable access [10]. The presence of enabling resources, e.g. social relationships, can be defined as potential access, since it offers the tools for use and it increases the probability of use [10]. The factual use of health services can be named realized access [10]. Whether access is equitable or inequitable depends on the primary predictors of realized access. Equitable access exists when demographic and need factors explain most of the variance in the use of health services [46]. If social structure, health beliefs and enabling resources are the main predictors on health services use, it is reasonable to speak of inequitable access [10]. Do social relationships show characteristics of inequitable access? Or do they have the opportunity to decrease inequity?

The theoretical background of this thesis is based on the Behavioral Model. Andersen's model offers a framework that is linkable to a wide range of research questions in the field of health services research by offering a holistic approach. In contrast to the economic approaches presented above, it is able to illustrate multiple factors and models a high degree of complexity.

### 1.1.2 The "power" of social relationships

Social relationships exist, for example, between family members, friends and acquaintances. They are embedded into social networks in which individuals are directly involved with a set of people [47]. Direct involvement means that there is a social relationship between two individuals defined by repeated interactions and a mental understanding of the relationship itself on both sides [48].

Basically, social relationships can be categorized into structural and functional elements [22]. "Despite striking differences, three major components of social relationships are consistently evaluated: (a) the degree of integration in social networks, (b) the social interactions that are intended to be supportive (i.e., received social support), and (c) the beliefs and perceptions of support availability held by the individual (i.e., perceived social support). The first sub-construct

represents the structural aspects of social relationships and the latter two represent the functional aspects" [22]. This concept of social relationships is used for this thesis.

Looking at the function of social relationships, they have an effect on people by providing social support, social influence, social commitment and attachment, and accessing resources and material goods [49]. Commonly, social relationships create favorable effects for individual's well-being, health, and mastery of life tasks [50-54]. International studies have shown that social relationships have a substantial impact on morbidity and mortality [22-25].

Social relationships can be subject to transformation due to age-specific phases and life events across the life span, especially in older age, as they are affected and modified by events, such as widowhood, unemployment or retirement [55-57]. A meta-analysis showed "that people's networks of social relationships change from adolescence to adulthood to old age, and these changes are similar to changes related to experiencing age-specific life events. At the same time, a stable convoy of family relationships and few close confidants accompanies people through positive and negative life events and as they grow older" [55]. Though, "[c]urrent evidence also indicates that the quantity and/or quality of social relationships in industrialized societies are decreasing. For instance, trends reveal reduced intergenerational living, greater social mobility, delayed marriage, dual-career families, increased single-residence households, and increased age-related disabilities. More specifically, over the last two decades there has been a three-fold increase in the number of Americans who report having no confidant - now the modal response. Such findings suggest that despite increases in technology and globalization that would presumably foster social connections, people are becoming increasingly more socially isolated" [22].

In this light, understanding the nature and extent of the association between social relationships and use of health services among middle-aged and older people gain importance for research in health services use given the significance and trends concerning social ties. By preventive care-seeking, acquisition of knowledge about potential treatments, and post-treatment recovery and rehabilitation, health service utilization behavior can be considered a health-protective action influenced by structural and functional aspects of social relationships

[26]. Moreover, research indicates the significance of social relationships by enhancing patient care, improving compliance with medical schemes, and enabling shorter hospital stays [17-19].

Until today, research on health services use has shown an ambiguous role of social relationships [31, 58-60]. Studies showed that different measures of structural and functional elements of social relationships are associated with the probability and the frequency of health services consultations within a certain time span [28, 61-63]. Chapter 2 presents an elaborated study, a systematic review of the research literature, to present this diverse research status on the association between social relationships and outpatient health services use.

### 1.1.3 Health, social relationships and health services

Taking up the Behavioral Model, social relationships may have an enabling function on health services use, e.g. GP use. Beyond this, the model suggests a variety of interactions between predisposing, enabling and need factors on health services use, but only a few studies considered analyses to integrate potential moderating associations [26, 30, 64-68].

In a path analysis, Rosner et al. [67] found direct and indirect effects of predisposing, enabling and need factors referring on Andersen's Behavioral Model. The only two factors with direct effects were income and perceived severity of symptoms, whereas race, gender, education, number of symptoms and living arrangements influenced physician use indirectly [67].

Schafer [26], for example, investigated the interaction between various social ties (partner, child, other kin and non-kin) and the likelihood to discuss health on the frequency of physician visits. He found that older people, having a partner with whom they are very likely to have discussions on health, have more physician visits [26]. This association is stronger among men than women [26]. Child ties were also found to be predictors of physician visits, but only when the older adults were likely to discuss health issues with them. Other kin-based ties, besides partners and children, did not significantly predict physician visits, even when individuals were likely to discuss health [26].

In his study on stressful life events and physician use, Krause [30] showed that “social support buffers or reduces the effects of the global stress index on physician use but that these effects are largely restricted to visits for check-ups or physical examinations. More specifically, the data […] suggest that, in times of high stress, those older adults with a high amount of informational support tended to visit their physician for check-ups less frequently […] than did those respondents with low levels of informational support […]” (p. S58). Furthermore, Krause demonstrated that respondents with external locus of control beliefs were more likely to visit a physician due to physical complaints in times of high stress [30]. With respect to physician visits, the results suggest that social as well as psychological resources have a stress-buffering function [30].

Cafferata [68] conducted a path analysis to examine the joint influence of marital status and living arrangements on the use of health services among elderly persons. “The literature suggest that living arrangements may affect the use of health services independently of marital status. However, the substitutability of family resources (the presence of a spouse or adult child who can care for an elderly person) for health care resources (such as physician visits) should depend on the needs of the older person” [68].

International studies showed that the health status, defined as a crucial need factor, is strongly associated with the use of health services, especially in older age [11-15]. This holds true for various dimensions of health. Korten et al. [13], for example, found that need variables like physical health, disability and anxiety were the most important predictors of GP service use in a community survey of an elderly Australian sample. in the Swedish study about aging and care Rennemark et al. [14] showed that comorbidity was most strongly related to frequent usage of primary healthcare services in old age. Physical ill health, measured by self-perceived general health and a disease score, was also the most important predictor of consultation rates in primary care among older people in London, England [12]. In a Spanish sample, Fernández-Olano et al. [11] found that a negative self-reported health status was an important factor influencing the use of health care services, even though they controlled for several other need

variables (self-reported morbidity, medication use, functional status mental health and lifestyle habits).

Health is not only one of the key drivers of health services use, but also closely linked to social relationships [22-25, 69, 70]. In a systematic review of prospective cohort studies, Hemingway & Marmot [24] investigated psychosocial factors in aetiology and prognosis of coronary heart disease. “Five of the eight prospective cohort studies that investigated aspects of social support in relation to the incidence of coronary heart disease were positive […]. Nine of the 10 prognostic studies were positive […]” [24] (p. 1466). Melchior et al. [69] showed in a prospective analysis of the French Gazel cohort, that social relations have an independent effect on self-reported health. A lack of social support and dissatisfaction with social relations represent predictors of poor health status in men and women. An interdisciplinary review of primary evidence on social capital and mental health demonstrated that social capital can be an asset as well as a liability regarding mental health of those receiving and providing social bonding (between individuals in a group) and social bridging (between groups) [70]. Holt-Lunstad et al. [22] concluded in their meta-analytic review on social relationships and mortality risk: “Data across 308,849 individuals, followed for an average of 7.5 years, indicate that individuals with adequate social relationships have a 50% greater likelihood of survival compared to those with poor or insufficient social relationships. The magnitude of this effect is comparable with quitting smoking and it exceeds many well-known risk factors for mortality (e.g., obesity, physical inactivity). These findings also reveal significant variability in the predictive utility of social relationship variables, with multidimensional assessments of social integration being optimal when assessing an individual’s risk for mortality and evidence that social isolation has a similar influence on mortality to other measures of social relationships. The overall effect remained consistent across a number of factors, including age, sex, initial health status, follow-up period, and cause of death, suggesting that the association between social relationships and mortality may be general, and efforts to reduce risk should not be isolated to subgroups such as the elderly” [22] (p. 14).

Consequently, social relationships may influence the scope of action, such as using GP services, depending on varying self-rated health status, In other words, social relationships may moderate the association between health and the use of health services. Until today, this has not been investigated. Chapter 3 shows the study on that research question.

### 1.1.4 Age, social relationships and health services

In the previous chapter, the links between health, social relationships and health services are presented. This chapter adds “age” to the equation, since people in their fifties or older, compared with younger cohorts, may show more chronic illnesses and increased rates of health care use [4]. More specifically, the direction of the association between age and the use of health services depends on the type of health service. On the one hand, drug, alcohol and mental health services were used more likely by younger people than elderly [71, 72]. Mackenzie et al. concluded in their study that there may be a “need for education to improve men’s help-seeking attitudes and to enhance older adults’ willingness to seek specialty mental health services” [73]. On the other hand, older people showed higher probabilities to consult with GPs, but were less likely to contact specialists [74-76]. With regard to hospitalization, Blackwell et al. found gender-specific associations between age and being hospitalized [76]. Middle-aged men were more likely to be hospitalized than younger and older men, and middle-aged women showed a lower probability of having inpatient stays than younger and older women [76].

In ageing societies characterized by changing health needs and chronic conditions, there is not only a potentially increasing demand for health services but also for preventive health services [3, 77]. Preventive health services can prevent or positively influence some diseases [5]. In health care, prevention is understood as targeted measures and activities to prevent disorders or damage to one’s health, to decrease the risk of disease or to delay the incidence of the illness [5]. Preventive measures can be categorized into primary, secondary or tertiary prevention depending on the timing of their use [5]. Primary prevention aims at reducing the risk of the onset of a disease [5]. Flu vaccinations, for example, are part of primary prevention.

They can block serious infectious diseases and can prevent unnecessary hospitalizations and premature deaths [5, 78]. Cancer screenings, for example, can be defined as primary and secondary prevention with respect to the stage of cancer [5]. Secondary prevention aims at detecting and treating diseases as early as possible. Consequently, cancer screening is especially important, since cancer is responsible for a vast number of deaths worldwide [79]. To a large extent, tertiary prevention is congruent with the field of medical rehabilitation [5]. It aims at reducing consequences of illnesses, to prevent a relapse of diseases or to stop a deterioration of disorders [5].

International studies showed that predisposing, enabling and need characteristics of the Behavioral Model can also be applied to the use of preventive health services [80-83]. Sudano et al. [80] demonstrated, for example, that periods without health insurance coverage lead to lower use rates of preventive health services. Focusing on the use of adolescents' use of preventive medical care, Stella et al. [83] found that the lack of insurance, low family income, and low parental education are linked to the lack of preventive health services. Furthermore, Scott et al. [81] showed that people with inadequate health literacy were more likely to report they had never received the influenza or pneumococcal vaccination, and women were less likely to have had a mammogram or Papanicolaou smear after adjusting for demographics, years of school completed, income, number of physician visits, and health status.

For cancer screenings, different patterns of usage could be identified depending on sociodemographic features [84, 85], health needs [86, 87] and socioeconomic or psychological factors [84, 88-90]. In their study on cancer screening among Latino subgroups in the United States, Gorin & Heck [87] found that Dominican women had a 2.4 times greater likelihood of having had mammography than other Latinos. Also, Latino women aged 50–69 with more years of education, a personal history of cancer, who were not current smokers, had health insurance, had used primary care services over the last 12 months, and had another screening test had greater use of mammography [87]. Furthermore, older age, more years of education, being male, history of visiting a health care provider in the past 12 months, use of other screening tests, and better health status influenced the probability of colorectal cancer

screening [87]. With regard to the German middle-aged and older population, it was shown that, the use of cancer screening is positively associated with decreased loneliness, cognitive well-being, optimism, self-efficacy, self-esteem, self-regulation, perceived autonomy, decreased perceived stress, decreased perceived social exclusion, and positive affect by adjusting for sociodemographic factors, self-rated health, morbidity and lifestyle factors [90].

The use of flu vaccinations also varies by sociodemographic and psychological factors [91, 92], health status [78, 92] and socioeconomic characteristics [93-95]. Tanjani et al. [95] investigated the influenza vaccination uptake and its socioeconomic determinants in the older Iranian population. He found that having an occupation and having complementary health insurance for outpatient services are associated with an increased influenza vaccine uptake [95]. For European countries, Schmitz & Wübker [92] showed that age, health status, lifestyle, labor-force status, as well as the family structure and the physician quality are significantly associated with flu shots. Using a large-scale survey in Japan, Tsutsui et al. [91] demonstrated that individuals decide rationally, taking into account the costs and benefits of vaccination. They consider the probability of infection, severity of the disease, as well as the effectiveness and side effects of vaccination [91]. Furthermore, behavioral variables such as altruism and overconfidence were also important [91].

Age as a predisposing characteristic plays a major role regarding the use of preventive health services, e.g. cancer screenings and flu vaccinations, since they are recommended by health authorities and being paid for [10, 45]. With the age of 50, for example, the statutory health insurance pays for mammography screenings every two years. Men are able to use prostate screenings on a yearly basis reaching the age of 45. The statutory health insurance also covers colorectal cancer screening starting with 50 years of age for both sexes. Starker & Saß [84] demonstrated that overall 67.2% of women and 40.0% of men participate regularly in cancer screenings in Germany. The use of cancer screenings is more likely for women than men. The difference in participation rates between women and men becomes smaller, since participation rates improve with increasing age [84]. Flu vaccination, on the other hand, is a paid service for everybody and recommended for individuals aged 60 and older. All in all, health institutions

are interested in higher rates of preventive health services use when reaching certain ages. Taking Andersen's principle of a low degree of mutability of predisposing characteristics for granted, it is necessary to look for different mechanisms to influence the association between age and preventive health services [10].

Since ageing populations not only have to deal with changes in the use of health services, but also with social phenomena like the increasing numbers of single-person-households and the increasing risk of loneliness and social isolation among older people [2]. Consequently, age is not merely linked to health services use, but also to social relationships. In general, social relationships undergo constant change across the life span depending on age and life events, since need factors can expand, while levels of autonomy, mobility and social participation decrease due to chronic conditions and physical limitations in older age [16, 55].

Until today, only a small number of studies investigated the use of preventive health services and its links to social relationships [96-101]. Therefore, it is still unknown how structural and functional aspects of social relationships are associated with preventive health services (see chapter 4). With respect to the association between age and preventive health services, it has not been analyzed whether social relationships have a moderating link to that association (see chapter 4). Accordingly, we investigated the associations between social relationships, age and the use of preventive health services among German adults aged forty years and older in chapter 4.

### 1.1.5 Objectives

In consideration of the current research status and the Behavioral Model of Andersen, this thesis aims at different aspects of social relationships and health services use among middle-aged and older people.

As outlined above, there is evidence on associations between social relationships and the use of health services. Though, the role of social relationships with regard to the probability and frequency of health services use, especially outpatient health services, is still unclear and ambiguous [31, 58-60]. Referring to the Behavioral Model, do social relationships (= enabling

factor) show characteristics of inequitable access to outpatient health services [46]? In consequence, the 1st study provides a systematic review of studies dealing with outpatient care utilization among older adults associated with various dimensions of social relationships and an evaluation of the magnitude and consistency of the associations between social ties and health services use (chapter 2).

Furthermore, there is a lack of studies including moderation or mediation, although Andersen's model suggests a variety of interactions between predisposing, enabling and need factors on health services use [26, 30, 64-68]. As shown above, social relationships might influence the scope of action, such as using GP services, depending on varying self-rated health status. The association between social relationships, self-rated health and GP visits among middle-aged and older adults is poorly understood. Chapter 3 shows the study on that research question. Following the Behavioral Model, it is investigated, if social relationships in- or decrease equitable access to health care [46].

Finally, only a small number of studies investigated the use of preventive health services and its links to social relationships [96-101]. Due to health policy, age is closely connected to preventive health services. With respect to the association between age and preventive health services, it has not been analyzed whether social relationships have a moderating link to that association (see chapter 4).Hence, the associations between social relationships, age and the use of preventive health services among German adults aged forty years and older are investigated (chapter 4).

In gaining a better understanding of the associations between social relationships and health services use, conclusions for further research and practical implications can be drawn to measure and design use of and access to health services for middle-aged and older people.

## 1.2 DATA AND METHODS

In this chapter, data (chapter 1.2.1), measures (chapter 1.2.2) and analyses (chapter 1.2.3) of the three studies are presented. Since the first study is a systematic review (chapter 2), the search strategy and the inclusion criteria as well as the data extraction, the quality assessment and the analysis strategy are described. The categories of "measures" (chapter 1.2.2) and "analyses" (chapter 1.2.3) do not fit perfectly to the components of a systematic review. Nevertheless, the components of the systematic review were adjusted as much as possible to the consistent systematics. Study number two (chapter 3) and three (chapter 4) are based on secondary survey data and include quantitative data analyses.

### 1.2.1 Data

Each of the three studies has its own database presented in the following section.

**Data of the 1st study (Systematic review: search strategy and inclusion criteria)**

For the first study, the systematic review (chapter 2), seven databases were used after developing the research question, performing a pilot run of literature search and publishing a study protocol on PROSPERO (Annex: Chapter 2, S1 File). The databases were searched for the keywords and various synonyms "social relationships", "utilization", "outpatient care" and "aged" in title and abstract including MeSH-terms and limiters adapted to each electronic database (Tab. 1).

**Tab. 1-1: Search syntax on "Title" and "Abstract" for PubMed**

| |
|---|
| (social relation* OR social support OR social network* OR social capital OR social integration OR social contact* OR social tie* OR family network* OR family support OR network analysis OR support network OR social inequalit* OR social disparit*) **AND** (visit* OR consultation* OR help seek* OR usage OR utilisation OR utilization OR uptake OR "health care use" OR "health service use" OR "health services use" OR "utilization" OR "health services needs and demand") **AND** (primary care* OR outpatient care* OR ambulatory care* OR general practi* OR family practi* OR family doctor* OR family physician* OR physician* OR geriatric* OR internal medicine OR general medicine OR family medicine) **AND** (old* OR elder* OR aged OR ageing OR aging OR oldest old OR community-dwelling) **AND** (english OR german) |

Additionally, references of relevant articles were searched for further matching studies. In the first step, titles and abstracts of all articles identified by electronic and reference search were screened. Secondly, a predefined set of inclusion criteria on all relevant articles by performing a full text screening by two independent reviewers was applied. In case of disagreement between the reviewers, a third investigator was consulted and the study was discussed until consensus was accomplished. Within the full text screening, articles had to pass five predefined inclusion criteria: records were checked for (1) “peer-reviewed journal articles in German or English”, (2) three different quantitative observational study designs (cross-sectional, case-control and cohort studies), (3) “community-dwelling or noninstitutionalized individuals fifty years and older”, (4) use and/or frequency of use of outpatient care services as the dependent or outcome variable, and (5) including and analyzing social relationship variables. See detailed information on the rationale for the inclusion criteria in chapter 2.

**Data of the 2nd study (SHARE: Survey of Health, Ageing and Retirement)**

The analyses of the study presented in chapter 3 are based on data from the fourth wave of SHARE, the Survey of Health, Ageing, and Retirement in Europe [102-105]. Data was collected in 2010 and 2011 from sixteen European countries (please see chapter 3). Based on population registers, SHARE uses probability samples within the countries and includes non-institutionalized adults aged 50 years or older. Further exclusion criteria are being imprisoned, moved abroad, unable to speak the language of questionnaire, deceased, hospitalized, moved to an unknown address or not residing at sampled address [103, 105]. Furthermore, SHARE offers a substantial sample size (wave four: 56,989 main interviews of respondents aged 50 years or older). SHARE uses an ex-ante harmonization regarding the survey design, which means that questionnaires and field procedures are standardized across countries to maximize options for cross-national comparisons [106]. To ensure the ex-ante harmonization of the survey, three measures were applied: (1) the SHARE Model Contract providing the legal framework for standards and quality control, (2) the SHARE Survey Specifications defining the quality standards of the survey ex ante, and (3) the SHARE Compliance Profiles reporting

adherence to those standards ex post [106]. In the fourth wave, contact rates were satisfactory in almost all countries, both in panel and refreshment samples (>=90%). The refusal rates ranged from 22% to 49% and were the prime reason for not providing an interview [106]. To handle possible selection and participation biases, SHARE offers sample design weights [102, 105]. Please see information on ethics and conditions of use of SHARE in chapter 3.

**Data of the 3rd study (DEAS: German Ageing Survey)**

The database of the third study (chapter 4) is the public release of the DEAS provided by the German Centre of Gerontology (DZA) and funded by the Federal Ministry for Family Affairs, Senior Citizens, Women and Youth (BMFSFJ) [107, 108]. The population-based survey started in 1996 and included individuals 40 years and older. After the initial survey, other waves followed in 2002, 2008, 2011 and 2014. The interviews cover information on health, occupational status, income, SRs, life events, psychological well-being and much more [109]. 2014, in the fifth wave, 7,952 individuals filled out the drop-off questionnaire. 4,295 individuals are part of the refreshers sample (54%). The drop-off questionnaire contained the items on the use of PHSs (cancer screening and flu vaccination). The response rate of the longitudinal sample was 61% in 2014. The response rate of the refreshers sample was 25%. These rates are comparable to other surveys conducted in Germany [110]. Our analyses are based on the fifth wave of the German Ageing Survey which included cross-sectional data on perceived informational support, having a partner and social network size for a representative sample of the middle-aged and older population of Germany [110]. A written informed consent was given by every survey participant prior to the interview. The survey respects the Declaration of Helsinki [111].

### 1.2.2 Measures

In the following paragraph, the measures used in each of the three studies are described.

**Measures of the 1st study (Systematic review: data extraction and quality assessment)**

The data of the systematic review (chapter 2) was extracted using a standardized form including information about the author, year, country, research design, study year (follow-up if applicable), sample size, response rate, age, gender, outcome, social relationship variables, and confounders in the fully adjusted model. The reporting of the data was based on the PRISMA checklist [112] (Annex: Chapter 2, S1 Table).

The quality assessment, including the methodological and reporting quality, was based on the Newcastle-Ottawa-Scale [113] and its adaptation of Herzog, Alvarez-Pasquin [114] (Tab. 1-2).

**Tab. 1-2: Checklist quality assessment**

| Assessment of the methodological and reporting quality of studies | | | |
|---|---|---|---|
| SELECTION | | | |
| 1. Is the representativeness of the sample/ exposed cohort truly or somewhat representative of the average in the target population? | yes | no | unclear |
| 2. Is the comparability between respondents and non-respondents characteristics established, and is the response rate is satisfactory? | yes | no | unclear |
| 3. Is the sample size justified and satisfactory? | yes | no | unclear |
| 4. Is the ascertainment of exposure based on secure records, structured or written self-report? | yes | no | unclear |
| 5. Is the instrument for exposure validated or described? | yes | no | unclear |
| COMPARABILITY & CONFOUNDERS | yes | no | unclear |
| 6. Does the study control for more than one confounding factor, and are they comparable in different groups/ cohorts? | yes | no | unclear |
| OUTCOME | yes | no | unclear |
| 7. Is the assessment of outcome based on or supported by registered medical utilization data? | yes | no | unclear |
| 8. Is the follow-up long enough for outcome to occur? (ONLY COHORT) | yes | no | unclear |
| 9. Is the follow-up of cohorts adequate (attrition bias)? (ONLY COHORT) | yes | no | unclear |
| 10. Is the statistical test used to analyze the data clearly described and appropriate, and is the measurement of the association presented? | yes | no | unclear |

The checklist includes the three sections “selection”, “comparability and confounders” and “outcome”. It consists of ten (cohort studies) respectively eight items (cross-sectional studies) which can be answered with “yes”, “no” or “unclear”. Instead of reporting a sum score, a global rating was preferred [115]. The quality of cross-sectional studies which met three or less criteria were ranked as “low”, four or five as “medium” and six or more as “high”. Cohort studies with

four or less fulfilled criteria were rated as “low” quality, five to seven as “medium” and eight or more as “high”.

**Measures of the 2nd study (SHARE: Survey of Health, Ageing and Retirement)**

In chapter 3, the following measures were used. Interviews of the fourth SHARE wave included several items concerning health care. Before asking explicitly for **GP visits**, the following more general question was asked:

‘*During the last twelve months, about how many times in total have you seen or talked to a medical doctor about your health (exclude: dentist visits and hospital stays, include emergency room or outpatient clinic visits)?*’.

If respondents accounted for more than 98 contacts, the number 98 was documented. The dependent variable, **GP visits**, was assessed by the reported number of contacts with general practitioners or doctors at health care centers in the last twelve months prior to the interview:

**‘*How many of these contacts were with a general practitioner or with a doctor at your health care center?*’**

Predictors were self-rated health and social relationships with a focus on structural (social integration index, social contact frequency in the social network) and functional (number of emotionally close ties) dimensions.

The **Social Integration Index** by Berkmann et al. [116] has shown to be a reliable and robust approach to represent the multidimensional construct of social integration. The index consists of three domains: (1) marital status and cohabitation, (2) contacts with friends and family, (3) affiliation with voluntary associations. Each domain scored from zero to two ranging from zero to six. With zero points meaning low and six points meaning high integration into their social environment.

First domain: if the respondent was single, divorced or widowed, zero points were given, and two points, if the person was married or living with a partner.

**‘*What is your marital status?***
*1. Married and living together with spouse,*
*2. Registered partnership,*
*3. Married, living separated from spouse,*
*4. Never married,*

*5. Divorced,*
*6. Widowed*'.

This item was dichotomized to having a partner or not. Second domain: the **number of social ties** to different people was counted and transformed into three categories connected to different scores:

*0. 0 contacts,*
*1. 1-2 contacts,*
*2. 3 or more contacts.*

This categorization is based on the answers to the following question:

**'*Please give me the first name of the person with whom you often discuss things that are important to you*'.**

Respondents could name up to seven people. Third domain: the affiliation with voluntary organizations was measured by activities in any of the five social groups:

**'*Which of the activities have you done in the past twelve months?***
*1. Done voluntary or charity work,*
*2. Attended an educational or training course,*
*3. Gone to a sport, social or other kind of club,*
*4. Taken part in activities of a religious organization (church, synagogue, mosque etc.),*
*5. Taken part in a political or community-related organization*'.

Being part of no organization resulted in a score of zero, one organization meant one point and two or more memberships scored two points. Furthermore, the survey included items on the characteristics of social relationships, e.g. social contact frequency and emotional closeness to people in the personal network. This module was based on other similar studies, such as the National Social Life, Health, and Aging Project (NSHAP) [117], the American General Social Survey and the Longitudinal Aging Study Amsterdam [118-120]. **Social contact frequency** was assessed by the following question:

**'*During the past twelve months, how often did you have contact with [person XY] either personally, by phone or mail?***
*1. Daily,*
*2. Several times a week,*
*3. About once a week,*
*4. About every two weeks,*
*5. About once a month,*
*6. Less than once a month or never*'.

The analyses include the **average social contact frequency** in the personal network. The question on emotional closeness to the personal network members is:

**'*How close do you feel to [person XY]?***
*1. Not very close,*
*2. Somewhat close,*
*3. Very close,*
*4. Extremely close*'.

For the analyses, the number of very or extremely close people in the personal network was counted (range: 0 to 7). Consequently, it represents not only a structural, but also functional dimension of social relationships.

We used **self-rated health** on a five-point-scale to assess the peoples' health status:

**'*Would you say your health is...?'***
*0. Poor,*
*1. Fair,*
*2. Good,*
*3. Very good,*
*4. Excellent*

Sociodemographic (gender, age) and socioeconomic (education, employment status, income: make ends meet) factors were used as covariates. Education was based on the *International Standard Classification of Education (ISCED 1997)* and ranged from 0 to 6 (low to higher education). **Employment status** was split into five categories:

*0. Employed,*
*1. Retired,*
*2. Unemployed,*
*3. Permanently sick or disabled and*
*4. Homemaking respondents*.

Material well-being of individuals was measured by the question:

*'Thinking of your household's total monthly income, would you say that your household is able to make ends meet…?'*
*0. with great or some difficulty,*
*1. fairly easy or easy*.

Please find detailed information on the level of confounding within the analyses, rated as low to moderate, in chapter 3 and the annex.

**<u>Measures of the 3rd study (DEAS: German Ageing Survey)</u>**

In chapter 4, the use of **preventive health services** was assessed by asking for regular use of **flu vaccination** and **cancer screening** in the past years (no; yes). The predictors in focus

were structural (having a partner, size of the social network) and functional aspects of social relationships (perceived informational support) and age.

***Having a partner*** was dichotomized:
0. *Having no partner*,
1. *Having a partner*.

'*Having no partner*' includes singles, divorced, widowed and separated individuals. '*Having a partner*' is defined by married people and registered partnerships living together. **Size of the social network** was assessed by asking:

**'*People who are important to you and who you maintain regular contact with. These can include co-workers, neighbors, friends, acquaintances, relatives, and members of your household. Which people are important to you?*' (*The respondents could name the people;* 0 '*no one*' to 9 '*nine and more people*').**

**Perceived informational support** was measured by asking:
**'*When you have important personal decisions to make, do you have anyone you can ask for advice?*'**
0. *No*,
1. *Yes*.

**Age** was measured in years. Health indicators and other socio-demographic factors were included as covariates. In the current study, self-perceived health was measured on a five-point scale as one health indicator:

'*How would you rate your present state of health?*'
1. V*ery good*',
2. *Good*,
3. *Average*,
4. *Bad* and
5. *Very bad*

Furthermore, we included information on pre-existing diseases by taking into account the number of diseases: **'Which of the following diseases and health problems do you have?'** The list of diseases covered fourteen chronic, somatic illnesses, for example, cardiac and circulatory disorders, respiratory problems/ asthma/ shortness of breath, cancer or diabetes.
The respondent's sex was coded by male (= 0) and female (= 1). Education was based on the International Standard Classification of Education (ISCED 1997) and ranged from 1 to 3 (low to higher education).

### 1.2.3 Analyses

In the following section, the analyses, used for the three studies, are presented.

**Analyses of the 1st study (Systematic review: analysis strategy)**

The results of the literature search were descriptively and systematically synthesized. All reported associations between social relationships and utilization of physicians were extracted and categorized. Each social relationship variable was assigned to a social relationship category (e.g. social network size) and dimension (e.g. structural). For a better overview, closely related indicators were aggregated within categories (e.g. social support). Moreover, social relationship variables were classified as “structural” or “functional” dimension [22]. The functional dimension was split into “received support” and “provided support”. To answer our two research questions, we comprehensively looked at all associations between social relationships and physician use. For a clear and presentable picture, we focused on the statistically significant associations ($p<0.05$) in the results tables (chapter 2). Due to the heterogeneity of the included studies a meta-analysis was not performed. Instead, we decided to complement our descriptive analysis by assessing the quality of the studies and by presenting a full description of the relevant quantitative data to maximize transparency and to enable rating the certainty of the results [121]. Since the binary question of physician use (yes / no) and the frequency of practitioner visits present different levels of information, the results are reported separately.

**Analyses of the 2nd study (SHARE: Survey of Health, Ageing and Retirement)**

In the 2nd study (chapter 3), regression models were used to analyze the associations between GP use (frequency of GP visits) and the predictors (self-reported health, social relationship variables and employment status) described before (chapter 1.2.2 measures). The dependent variable “reported number of GP visits in the last 12 months” is a discrete count variable following a Poisson distribution [122]. As the variance of the dependent variable is greater than its mean, negative binomial regression was used to account for the significant evidence of

overdispersion [122]. Furthermore, negative binomial regression models include a parameter that reflects unobserved heterogeneity among observations [122].

Due to the complex sample structure, including individual level, household level and country level, a survey design was implemented [102, 123]. To account for within-household correlations and between-country differences, households were defined as primary sampling unit and countries as strata. Furthermore, to adjust for variation in selection probabilities by design and for variation in participation probabilities caused by non-response, sample design weights were used [105]. In the case of Stata the survey command and in R the survey-package were used to adequately handle weighted and stratified data [124-126].

As this study aimed to analyze potential moderation of social relationships on the association between self-rated health and GP use, interaction terms were introduced [127]. Three different **two-way interaction terms** were calculated:

1) Self-rated health **x** social integration index,
2) Self-rated health **x** average of social contact frequency in social network and
3) Self-rated health **x** emotional closeness in social network.

Finally, **three-way interactions** were computed to elaborate the role of the employment status within the interaction between health and social relationships (health*social relationship*employment status):

1) Self-rated health **x** social integration index **x** employment status,
2) Self-rated health **x** average of social contact frequency in social network **x** employment status and
3) Self-rated health **x** emotional closeness in social network **x** employment status.

The analyses were performed with Stata 12 and were replicated with R [128].

**Analyses of the 3rd study (DEAS: German Ageing Survey)**

In the 3rd study (chapter 4), logistic regression models were used to measure the associations between the dependent variable “use of preventive health services” and the predictors, since “preventive health services use” is binary (no / yes) . To adjust for disproportional stratifications of the baseline sample and selective panel mortality, weights were used [107, 129, 130]. To analyze a potential moderation of social relationships on the association between age and use

of preventive health services, **two-way interaction terms** were introduced [127]. Three interaction terms were calculated:

1) Age **x** informational support,
2) Age **x** having a partner and
3) Age **x** social network size.

In terms of cancer screening, age is added as cubic term to the model, since the relationship between the probability of using cancer screening and age was found to be non-linear. The analyses were performed with Stata 12 and were replicated with R [131]. Marginal effects plots were created using the *ggeffects*-package [132].

## 1.3 RESULTS

In the following sections, the results of the three studies are presented.

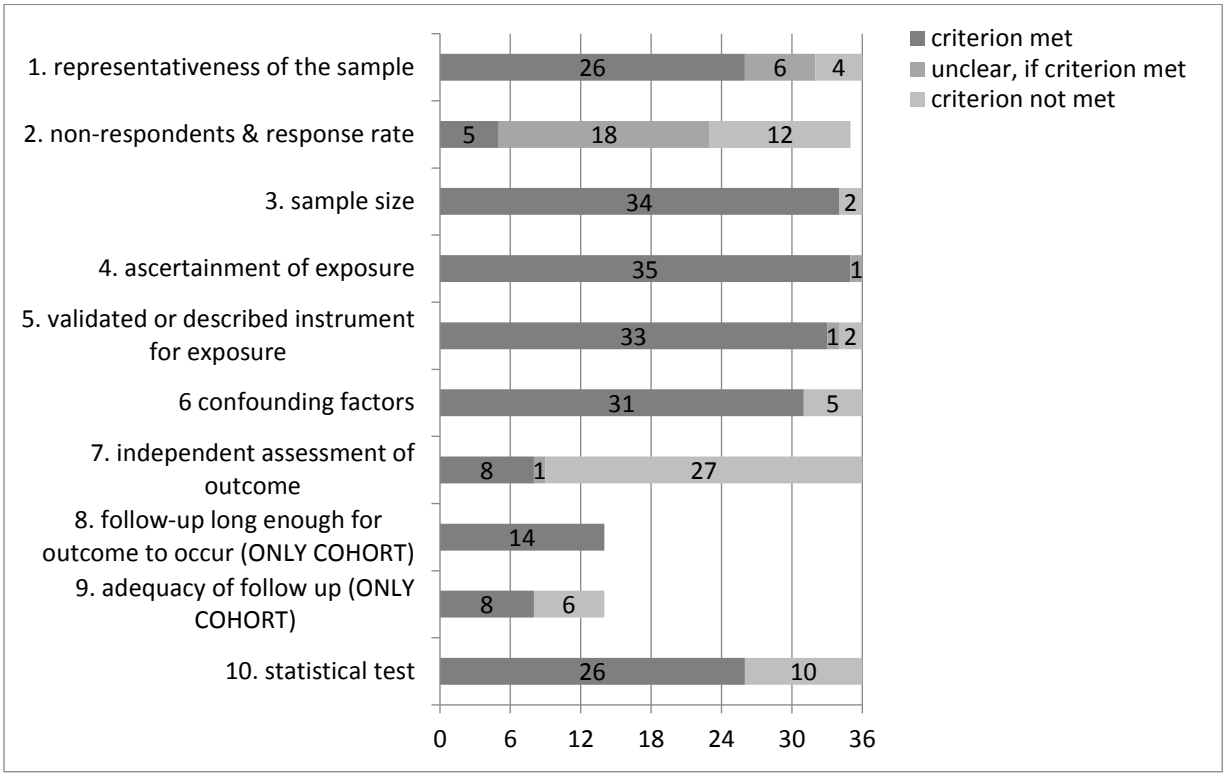
### 1.3.1 Social relationships and physician utilization among older adults: A systematic review

The systematic review on social relationships and physician use among older adults provides a thorough overview and advances the understanding of the association between social relationships and outpatient health services use among older adults. The two objectives of the review were:

1) to systematically review social relationships associated with the utilization of outpatient care services of older people, and
2) to evaluate magnitude and consistency of the associations between social ties and health services use.

We included 36 records in 35 different studies reporting structural and functional dimensions of social relationships linked to the utilization of health services into our analyses. The methodological and reporting quality of the records was categorized: 47.2% = “high”, 44.4% = “medium” and 8.3% = “low” (Chapter 2: Tab. 2). Apart from criterion two (non-respondents and response rate) and criterion seven (independent assessment of outcome), the majority of the articles met the criteria of methodological and reporting quality (Fig. 1-1; Chapter 2: Tab. 2; Annex: S1 Figure, S2 Table).

**Fig. 1-1: Methodological and reporting quality of included records**




Criterion two (non-respondents and response rate) was met only by five articles [14, 21, 31, 32, 61] and criterion seven (independent assessment of outcome) by eight records [12, 14, 21, 58, 133-136].

In most cases empirical evidence was insufficient, and for several of the social tie variables inconsistent results were found. Taking into account the fully adjusted model, associations between use measures and social relationship variables were for the most part weak and statistically insignificant. Potentially, associations were underestimated by that strict criterion.

Overall, most of the studies focused on associations between social ties and frequency of physician use (compared to the probability of use). The structural dimension of social relationships and its association with physician visits (use and frequency of use) was investigated far more often than the functional dimension. Though a substantial number of social relationship dimensions were explored until today, none of the included studies included a holistic approach of social tie measures (degree of integration, received and perceived social support) [22] and their links to health services utilization.

The majority of the associations between structural dimensions of social relationships and the use of physicians were positive and moderate in strength. The associations between functional dimensions of social relationships and the probability of using physician services were inconsistent and varied in strength. For the most part, social relationship variables assigned to the structural dimension were associated positively and weakly to moderately with the frequency of physician visits. Functional aspects of social relationships also tended to have positive associations with the frequency of physician utilization. The associations were weak or moderate in strength.

### 1.3.2 Social relationships and GP use of middle-aged and older adults in Europe: A moderator analysis

Focusing on older adults in Europe, this was the first study to investigate:

1) How social relationships are associated with the frequency of GP visits,
2) If social ties moderate the association between self-rated health and GP use, and
3) How these associations vary in subgroups of different employment status.

Regarding research question 1), the structural (social integration, social contact frequency) and functional (number of emotionally close contacts) dimensions of social relationships under investigation are not statistically significantly associated with GP use frequency, since the analyses did not reveal significant associations of functional and structural aspects of SR with frequency of GP visits (SII: IRR=0.99, 95%CI 0.97-1.01, social contact frequency: IRR=1.04, 95%CI 1.00-1.07, emotional closeness: IRR=1.02, 95%CI 1.00-1.04).

Relating to research question 2), the analyses show hardly any substantial and statistically significant moderating effects of different aspects of social relations on the link between self-rated health and frequency of GP visits. Only for older adults with poor self-rated health, an increase of the number of emotionally close members in the social network is associated with a growing rate of GP visits. Older adults with very good or excellent health show a higher rate of GP visits with an increase of their social contact frequency in the social network, while social contact frequency seems to play a less important role for people with poorer health. Potentially, a higher density of social networks fosters the GP use by providing support and resources, but

only for people with better health. The differences are statistically significant, but they have a lower magnitude.

Three way interaction analyses concerning research question 3) indicate employment status-specific behavioral patterns with regard to social relationships and GP use, but coefficients were mostly not significant. Analyses focusing on older people who are retired, unemployed, permanently sick or disabled, or homemakers, show various results. All in all, the groups of retired, unemployed, permanently sick/disabled and homemaking people show a higher estimated average number of GP visits. Comparing those groups with each other also presents diverging patterns of associations. A higher level of social integration was associated with lower rates of GP use for retirees, but was associated with a higher frequency of visits for unemployed older adults, especially for unemployed older people with a poor self-rated health. "Having a partner", which is included in the social integration index, contributed the most to this association. Homemakers make more GP visits, if their social contact frequency is higher, especially, if their health status is rated as fair or good. This also holds true for retirees with a higher self-rated health status. The more emotionally close contacts are present, the higher the use of GP doctors by retired and permanently sick or disabled people with lower health status.

### 1.3.3 Social relationships, age and the use of preventive health services: Findings from the German Ageing Survey

This study investigates the associations between social relationships, age and the use of preventive health services among German adults aged forty years and older.

It revealed that a functional aspect of SR (perceive informational support) was associated with a higher probability of using flu vaccination and cancer screening in a German sample of people aged 40 years and older. On the one hand, associations between structural factors of SR and the use of PHS were statistically significant (having a partner), and on the other hand, not significant (size of the social network). Having a partner (OR = 1.20, 95% CI: 1.07–1.34) and perceived informational support (OR = 1.38, 95% CI: 1.13–1.69) were associated with a

higher probability of getting flu vaccination regularly over the past years. Informational support (OR = 1.42, 95% CI: 1.17–1.72) and having a partner (OR = 1.57, 95% CI: 1.41–1.75) were positively associated with regular cancer screening over the past years. Associations between the size of the social network and use of preventive health services were not statistically significant. Moreover, associations between the use of preventive health services and social relationships varied by age. The probability of using flu vaccination increased by age. Considering the use of cancer screening, the odds were increased by age among those aged 40 to 63. After the age of 63 people were less likely to use cancer screening. Furthermore, the associations between the use of PHS and age varied by different dimensions of SR. With regards to the use of flu vaccination, perceiving informal support seems to be supportive factor especially for the age group of 60 to 75. This held also true for people in their early 40s up to 66 with regard to cancer screening. Having a partner seems to encourage the use of cancer screening, especially for people aged 50 years and older.

## 1.4 DISCUSSION

This thesis focuses on social relationships and use of outpatient health services among middle-aged and older people in order to gain a deeper understanding of prevalent patterns of health services use and different moderations linked to social ties and to receive indications for potential inequalities and over- or underuse.

**Summary and scientific classification**

The first article „Social relationships and physician utilization among older adults - A systematic review" examines the associations of structural and functional dimensions of social relationships with outpatient health services use of older adults. In most cases empirical evidence was insufficient and for several of the social tie variables inconsistent results were found. Taking into account the fully adjusted model, associations between use measures and social relationship variables were for the most part weak and statistically insignificant. Potentially, associations were underestimated by that strict criterion. Overall, most of the studies focused on associations between social ties and frequency of physician use. The structural dimension of social relationships and its association with physician visits (use and frequency of use) was investigated far more often than the functional dimension. Though a substantial number of social relationship dimensions were explored until now, none of the included studies included a holistic approach of social tie measures (degree of integration, received and perceived social support) [22] and theirs links to health services utilization. The majority of the associations between structural dimensions of social relationships and the use of physicians were positive and moderate in strength. The associations between functional dimensions of social relationships and the probability of using physician services were inconsistent and varied in strength. For the most part, social relationship variables assigned to the structural dimension were positively and weakly to moderately associated with the frequency of physician visits. Functional aspects of social relationships also tended to have positive associations with the frequency of physician utilization. The associations were weak

or moderate in strength. All in all, the current status of quantitative data was insufficient to draw precise and generalizable conclusions.

The second publication “Social relationships and GP use of middle-aged and older adults in Europe: a moderator analysis” investigates (i) how social relationships (SR) relate to the frequency of visits to general practitioners (GP) among middle-aged and older adults in Europe, (ii) if SR moderate the association between self-rated health and GP visits, and (iii) how the associations vary regarding employment status. Firstly, the structural (social integration, social contact frequency) and functional (number of emotionally close contacts) dimensions of social relationships under investigation are not statistically significantly associated with GP use frequency. On the one hand, our results are in line with a number of studies on structural and functional aspects of social relationships [14, 32, 62, 135, 137]. On the other hand, empirical results are inconsistent until now. Various studies on outpatient care use showed that older people living alone are more likely to consult a physician [61, 134, 138]. One study showed that married older people have a lower probability of using GP services [62]. Others demonstrated that older people living in a marriage or with their children present a higher frequency of physician consultations [28, 63]. With regard to the size of the social network, studies found negative associations [31, 58], and others ambiguous [59] or positive associations [60]. International studies on functional dimensions of social relationships demonstrated that different aspects of received social support (e.g., material, instrumental and informational support) are positively linked with GP use [12, 29, 30]. Secondly, the analyses show hardly any substantial and statistically significant moderating effects of different aspects of social relations on the link between self-rated health and frequency of GP visits. Only for older adults with poor self-rated health, an increase of the number of emotionally close members in the social network is associated with a growing rate of GP visits. Furthermore, older adults with very good or excellent health show a higher rate of GP visits with an increase of their social contact frequency in the social network, while social contact frequency seems to play a less important role for people with poorer health. Thirdly, results indicate employment status-specific behavioral patterns with regard to social relationships and GP use, but

coefficients were mostly not significant. Analyses focusing on older people who are retired, unemployed, permanently sick or disabled or homemakers, show various results. All in all, the groups of retired, unemployed, permanently sick/disabled and homemaking people show a higher estimated average number of GP visits.

The third article “Social relationships, age and the use of preventive health services: Findings from the German Ageing Survey” deals with the associations between social relationships (SR), age and the use of preventive health services (PHS) among German adults. It revealed that a functional aspect of social relationships (perceived informational support) was associated with a higher probability of using flu vaccination and cancer screening in a German sample of people aged 40 years and older. The association between one structural factor of social relationships and the use of preventive health services was statistically significant (having a partner), the other one was not (size of the social network). Kinney, Bloor, Martin et al. reported that people who were structurally well integrated, had a higher chance of reporting recent use of colorectal cancer screening [97]. Functional and instrumental support, representing functional aspects of social relationships, were not associated with the use of colorectal cancer screening. While the findings on the positive association between social relationships and cancer screening were in line with our results, we also found statistically significant associations between functional aspects of social ties and preventive health services. Allen, Sorensen, Stoddard et al. investigated the relationship between social network characteristics and breast cancer screening among employed women [96]. In their multivariable analyses, social network characteristics did not predict using regular screening. Only the perception that screening is socially desirable led to increased usage. Potentially, our results on social network size could be in line with these findings. With regard to the use of flu vaccination, perceiving informal support seems to be a supportive factor especially for the age of 60 to 75. This is in line with other studies on social factors and vaccination uptake [139, 140]. Being married or living with others has been associated with vaccination acceptance in some studies [141, 142]. Furthermore, several studies on barriers and facilitators of getting influenza immunization indicated that advice from and health discussions with family and

friends may trigger the acceptance and use of flu vaccination [99-101, 143]. The moderator analyses showed that social relationships moderate the link between age and the use of preventive health services. In the case of flu vaccination, individuals, aged 60–75 and perceiving informational support, had a higher chance of use. With regard to cancer screening, informational support increased the probability of use in the age group 43–66 and living in a partnership promoted the chance of use among those 50 years and older. Moreover, we found that the probability of using flu vaccination increased by age. Considering the use of cancer screening, the odds were increasing by age among those aged 40 to 63. After the age of 63 people were less likely to use cancer screening.

**Limitations and challenges**

The three studies are characterized by different limitations which need to be taken into account, since they restrict the explanatory power of the results.

In the review, the risk of publication bias is existent, although we minimized the risk of missing relevant articles by including seven medical and sociological databases. As the majority of the studies were conducted in North America the findings cannot be generalized. Furthermore, most study designs were cross-sectional. Consequently, conclusions concerning causal relations are not possible.

Due to some quality criterion violations (representativeness, non-responder and response rates) the results were only moderately robust. The methodological and reporting quality of the studies was mostly categorized as medium or high (92%). The range of the utilization variable was substantial between the studies (from 15 days to two years). Most of the studies referred to one year of physician use. Considering the older age of the interviewed individuals and the long time span in some studies, the risk of memory bias was existent, in particular if the information on consultations was not compared to medical records.

Due to inconsistent measures of predictors (social relationships) and outcome variables (use and frequency of outpatient care visits), data was analyzed systematically, but descriptively. A high level of accordance across the included studies regarding independent and dependent

variable measures and data analysis approaches, is a prerequisite of meta-analyses [144]. Since the included studies are too heterogeneous with regard to study designs, sampling procedures, data collection methods, definition of outcome and exposure variables, confounders, quality of studies, statistical analysis and reporting a meta-analysis was not performed. In most cases the associations were small and statistically not significant. Overall, the current status of evidence is insufficient and partly inconsistent.

Both quantitative studies, based on SHARE or the German Ageing Survey, used cross-sectional data, forbidding statements on causal directions and changes over time. For SHARE data, the cross-sectional design was chosen due to the inclusion of social relationship variables from SHARE's "social networks" module which was applied only in wave four [102, 103, 145]. Due to changes of the measurement of preventive health services between the waves of the German Ageing Survey, only cross-sectional data was used for the analyses [109].

Although SHARE is an international survey aiming for high methodological standards by using ex-ante harmonization [106], the schedule for data collection was only partly synchronized and household response rates vary substantially between countries. Due to unit non-response and panel attrition, sample selection bias is a potential problem limiting the representativeness of the data and the generalizability of results [103]. Nevertheless, non-response analyses showed only little evidence for non-response bias [105].

Moreover, the question in SHARE to assess the use of GP doctors over 12 months is established in health services research [13, 31, 59], but has some methodological drawbacks (e.g., risk of memory bias [146]). The items of the German Ageing Survey on preventive health services were also based on self-reports and on a rather vague time span. The time span covering preventive health services can be quite long, and considering the older age of some respondents, risk of memory bias could be existent regarding the use of preventive health services [146]. Moreover, the item on using cancer screening did not specify which type of cancer screening was meant. It was worded in general terms. Consequently, further subgroup analyses were not possible.

The limited level of information of self-reported data holds also true for all other variables in our analyses, especially for the variable “self-rated health” [147]. Self-rated health status is based on a single item, but it is considered a suitable summary of health status corresponding to objective health status regardless of different cultures and social conditions [148-153].

Furthermore, both surveys did not provide information on the motives for use, quality and adequacy of health care services. In consequence, the reported number of GP visits and the use of preventive health services are only approximates “realized access” [10].

The concepts of social relationships which were used in our study were only indirect measures of structural and functional aspects of social relationships. Especially in the German Ageing Survey, the partner variable was only a rough measure for social connectedness and the feeling of belonging and being cared for. Our data did not include information on the quality of the partnership which could be differentiated into costs and benefits, or in other words, positive and negative functioning leading to different health and health behavior outcomes [154]. Although, both surveys aimed to combine the indirect (referring on socio-demographic proxies) and direct (linking meaningfulness and importance to social relations) approach of social network analysis, they do not offer sufficient and longitudinal data on functional and qualitative aspects of social relationships [145, 155]. Combining the approaches still lacks valuable information about the quality of social relationships and perceived support.

Besides methodological limitations, there is an ongoing debate on the effectiveness or harmfulness of PHS, especially concerning cancer screenings and flu vaccination [156-158]. It is important to keep that in mind, when discussing the use of PHS in general.

## Conclusions - Implications and perspectives

The thesis’ results imply several conclusions for practice and research. The studies demonstrated a complex and partially an ambiguous picture regarding the associations between social relationships and use of outpatient health services. Overall, the results showed a tendency to conclude that social relationships are facilitators of health services use. People who are structurally or functionally integrated by social relationships seem to be more likely to

use outpatient health services. This indicates potential inequalities in outpatient health services use due to different dimensions and characteristics of social relationships, especially for certain subgroups. On the other hand, the magnitude of the associations is relatively low and some of the investigated associations are statistically insignificant. Consequently, the clinical and practical relevance can be rated as low as well. Nevertheless, social ties have an impact on the patient's motives for a consultation and on the patient's compliance regarding future visits for treatment, prevention or rehabilitation [159, 160]. They could offer informational, instrumental and emotional resources with regard to health, health care services and treatments. Considering increasing numbers of single-person-households and an increasing risk of loneliness and social isolation in older age [2], this could be a future societal challenge for health care systems, as older individuals who are not socially integrated may not find adequate access to health care services.

The variety of dimensions of social relationships presented in this thesis illustrates that utilization of outpatient health care services is a complex social process. Besides methodological challenges, the multifaceted picture of the impact of social ties on health care utilization may be grounded on the observation that relationships are not always of positive virtue [161, 162]. In contrary, "some of the most powerful impacts on health [and health services use] that social relationships may have, are through acts of abuse, violence, and trauma" [49]. This consideration may represent a possible explanation for the inconsistent pattern of social relationships on health services use among older adults.

In health care, it is necessary to decide in line with the patient on the adequacy of treatment and to incorporate the patient's needs and resources. Therefore, health care providers may want to know if a patient is socially integrated or isolated, and may want to evaluate whether a patient needs or wants more or less social support. Conceivably, health care practitioners could consider to incorporate information on patient's social environment into their clinical routine systematically. Nurses and physicians could assess social networks among the elderly screening for social resources or social needs of support. Furthermore, relevant stakeholders (e.g., physicians, public health institutions and health insurance companies) need to find ways

to ensure that older adults can use outpatient care services regardless of their structural and functional level of social integration. If health policy and health professionals want to increase, for example, preventive health behavior and the use of preventive health services, it is necessary to integrate information on social relationships into routine care and to strengthen sources of social support.

In the future, it may be useful to facilitate access to health services for socially isolated elderly by following approaches like collaborative care, case managers and patient navigators, to secure orientation and guidance in health care systems [163-166]. It can be helpful to create low-threshold services by expanding community- and social space-based entry points to health care and prevention, e.g. through “diabetes consultation on wheels” [167] and blood-pressure measurement in barbershops [168].

For further research, the sometimes inconclusive results demonstrate that measuring social relationships in general and their influence on health services use in particular is a challenging methodological endeavor. Future health services research should accentuate social relationship variables more in detail, and not only in terms of structure and function, but also according to perception and quality aspects of social relationships. The studies have a cross-sectional design investigating a number of possible social relationships of health services use. It is crucial to determine social ties for health services use more clearly and to identify causal relations, especially in the form of longitudinal studies. Methodologically, it can be constructive to directly connect the question of social relationships and health care utilization to the scientific debate of health care inequalities by conducting mediator or moderator analyses to create further clarity [66, 69, 169-171]. This may complement the identification and understanding of social inequalities in health services utilization. In the future, this can be directed into new approaches to reduce social inequalities in health services utilization and to offer needs-based access to health care. To define potential improvements in health systems and to inform health policy makers and health practitioners adequately, health services research needs to integrate information on the patient’s motives for visits. Also levels, quality and outcomes of the treatments should be included as vital part of information in surveys on health services.

Finally, this thesis showed that the Behavioral Model of Andersen still represents a suitable framework for research on access to and use of outpatient health services. The studies demonstrated that social relationships can be defined as “enabling resources” which increase “potential access” [10]. Social relationships do not show characteristics of “inequitable access”, as demographic and need factors still explain most of the variance in the use of health services [10]. Following the results of this thesis, the ability of social relationships to decrease inequity in health services use is low.

# 2 SOCIAL RELATIONSHIPS AND PHYSICIAN UTILIZATION AMONG OLDER ADULTS: A SYSTEMATIC REVIEW

## 2.1 ABSTRACT

**Background:** In older age health needs and demand for health services utilization increase. Individual's social relationships can play a decisive role regarding the utilization of outpatient health care services. This systematic review examines the associations of structural and functional dimensions of social relationships with outpatient health services use of older adults.

**Methods:** The databases PubMed, CINAHL, SocINDEX, PsycINFO, International Bibliography of the Social Sciences (IBSS), Sociological Abstracts, and Applied Social Sciences Index and Abstracts (ASSIA) were searched in February 2016. The methodological and reporting quality of the articles was assessed and the results were synthesized descriptively and systematically.

**Results:** Out of 1.392 hits, 36 articles (35 studies) were included in the systematic review. The methodological and reporting quality of the included articles was reasonable. Various structural and functional characteristics of social relationships were associated with the use (yes/no) and the frequency of using outpatient care among older adults. The majority of the associations between structural dimensions of social relationships and the use of physicians were positive and moderate in strength. The associations between functional dimensions of social relationships and the probability of using physician services were inconsistent and varied in strength. For the most part, social relationship variables assigned to the structural dimension were positively and weakly to moderately associated with the frequency of physician visits. Functional aspects of social relationships also tended to have positive associations with the frequency of physician utilization. The associations were weak to moderate in strength.

**Conclusions:** Measuring social relationships and their influence on health services use is a challenging methodological endeavor indicated by the inconclusive results. The results

suggest that the outpatient care utilization behavior of older individuals being structurally and functionally integrated in social relationships is different to older adults being socially isolated or having no social support. All in all, the current status of quantitative data was insufficient. Future health services research should accentuate social ties in more detail, especially according to quality aspects of social relationships.

## 2.2 BACKGROUND

Rapidly ageing populations generate increasing health needs and chronic conditions in Western industrial countries associated with a rising demand for health services [3]. Compared with younger cohorts, individuals within their fifties or older show more chronic illnesses and increased rates of health care use [4]. Utilization of health services is influenced by a variety of factors, e.g. predisposing, enabling and need characteristics [10]. These are constantly changing over the life course. Due to chronic conditions and physical limitations in older age need factors can expand, while levels of autonomy, mobility and social participation decrease [16]. The use of health services is embedded into a complex structure of social networks and interactions. Social relationships can be an enabling determinant of whether or not elderly individuals do consult health care services [20, 21]. Consequently, the question if social relationships buffer or foster the use of medical care has been raised within health services research [26-32]. Social relationships may be an opportunity to enable the use of health services, especially for vulnerable groups. Moreover, they can be used to support or substitute formal health services, and by that, release restricted resources in health care systems.

Following Berkman, Glass [49] social ties have an effect on individuals by providing social support, social influence, social engagement and attachment, and accessing resources and material goods. Beyond that, international studies have shown that social relationships have a substantial impact on morbidity and mortality [22-25]. In general, social relationships can be divided into structural and functional elements [22]. The degree of social network integration, a more quantitative measure, represents the structural dimension of social relationships (e.g. living arrangements, social network size, and frequency of social participation). The functional

perspective is captured by received and perceived social support, and includes aspects of financial, instrumental, informational or emotional support. Through preventive care-seeking, acquisition of knowledge about potential treatments, and post-treatment recovery and rehabilitation, health service utilization behavior can be considered a health-protective action influenced by structural and functional aspects of social relationships [26]. A principal element in most health care systems is presented by outpatient health services, including primary and secondary care. Although, the first contact to health care is realized routinely through primary care services (e.g. in the US and UK), the close linkage to specialists and ambulatory health services is a ubiquitous characteristic within health care systems. By taking into account the political and scientific debate of shifting health care services from inpatient to outpatient settings, outpatient health services will be of growing importance in the future.

To date, no systematic review on this topic has been conducted. Therefore, the first aim of this systematic review was to provide an overview of studies dealing with outpatient care utilization among older adults associated with various dimensions of social relationships. The second aim was to evaluate magnitude and consistency of the associations between social ties and health services use.

## 2.3 METHODS

A systematic review on studies dealing with social relationships and the utilization of outpatient care physicians among older adults was conducted. The performance of this review was based on the PRISMA checklist [112] and a study protocol including all preliminary specifications published on PROSPERO, registration number CRD42016036004 (Annex: S1 File, S1 Table).

### Search strategy and inclusion criteria

After developing the research question and performing a pilot run of literature search, seven databases were used (February 11th 2016). The databases PubMed, CINAHL, SocINDEX, PsycINFO, International Bibliography of the Social Sciences, Sociological Abstracts, and Applied Social Sciences Index and Abstracts were searched for the keywords and various synonyms “social relationships”, “utilization”, “outpatient care” and “aged” in title and abstract

(Annex: S1 Text). MeSH-terms and limiters were adapted to each electronic database. In addition, references of relevant articles were searched for further matching studies.

At first, one reviewer (DB) screened the titles and abstracts of all articles identified by electronic and reference search. In a second step, two independent reviewers (DB and LI) applied a predefined set of inclusion criteria on all relevant articles by performing a full text screening. In case of disagreement between the reviewers, a third investigator (OK) was consulted and the study was discussed until consensus was accomplished.

Within the full text screening, articles had to pass five predefined inclusion criteria. Firstly, records were controlled for the criterion “peer-reviewed journal articles in German or English”. Peer-reviewed journal articles represent good scientific practice to secure quality, to foster objectivity and to provide transparency. Due to language skills and a reasonable use of resources of the reviewers, German and English articles were screened. Secondly, records were checked for three different study designs: quantitative observational 1) cross-sectional, 2) case-control and 3) cohort studies. Thirdly, full texts were inspected for the criterion “community-dwelling or noninstitutionalized individuals fifty years and older”. The rationale behind this population was to extract a reference group still active on the labor market, and to expand the number of potentially relevant studies. Compared with younger cohorts, individuals within their fifties or older show more chronic illnesses and increased rates of health care use [4]. The fourth inclusion criterion was the accounting for utilization or frequency of use of outpatient care services as the dependent or outcome variable. These measures of use are solidly established in health services research and increase the chance of comparability. Finally, studies had to include and analyze social relationship variables. To gather information on the full spectrum of social relationships including structural and functional aspects this broad term was implemented.

**Data extraction and quality assessment**

The data was extracted using a standardized form including information about the author, year, country, research design, study year (follow-up if applicable), sample size, response rate, age, gender, outcome, social relationship variables, and confounders in the fully adjusted model.

The quality assessment, including the methodological and reporting quality, was based on a checklist following the Newcastle-Ottawa-Scale [113] and its adaptation of Herzog, Alvarez-Pasquin [114]. The checklist included the three sections “selection”, “comparability and confounders” and “outcome”. It consisted of ten (cohort studies) respectively eight items (cross-sectional studies) which could be answered by “yes”, “no” or “unclear”. Instead of reporting a sum score, a global rating was preferred [115]. The quality of cross-sectional studies which met three or less criteria were ranked as “low”, four or five as “medium” and six or more as “high”. Cohort studies with four or less fulfilled criteria were rated as “low” quality, five to seven as “medium” and eight or more as “high”.

**Analysis strategy**

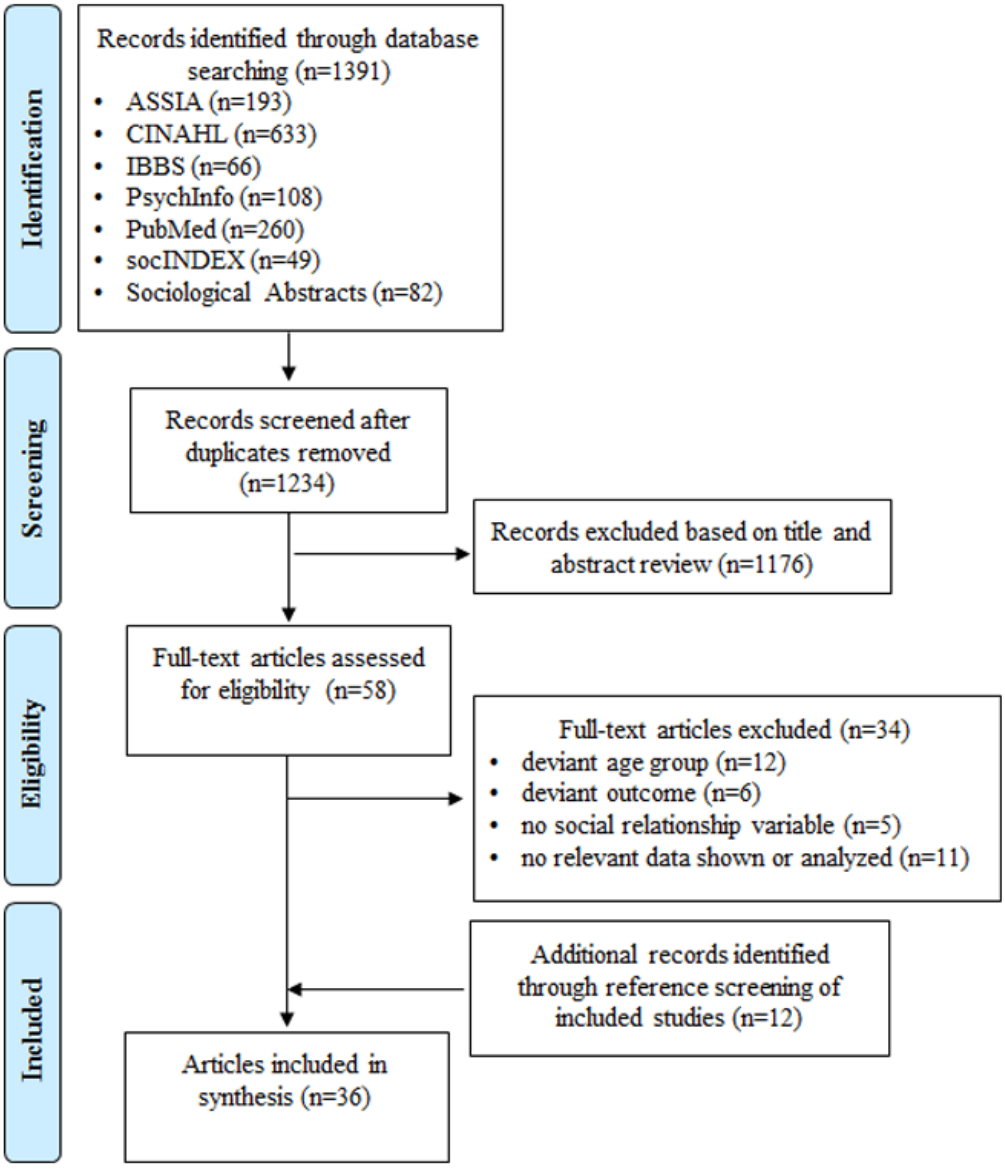
The results were descriptively and systematically synthesized. All associations between social relationships and utilization of physicians were extracted and categorized. Each social relationship variable was assigned to a social relationship category and dimension. For a better overview, closely related indicators were aggregated within categories (e.g., marital status or social support). Moreover, social relationship variables were classified as “structural” or “functional” [22]. The functional dimension was split into “received support” and “provided support”. To answer our two research questions, we looked comprehensively at all associations between social relationships and physician use. For the sake of clarity and presentation, we focused on the statistically significant associations in our following tables ($p<0.05$). Due to the heterogeneity of the included studies a meta-analysis was not performed. Instead, we decided to complement our descriptive analysis by assessing the quality of the studies and by presenting a full description of the relevant quantitative data to maximize transparency and to enable rating the certainty of the results [121]. Since use (yes/no) and frequency of practitioner visits show a distinct level of information and have different meanings, the results are reported separately.

## 2.4 Results

**Literature search**

A total of 1,392 publications were identified through database search. After removing 158 duplications, 1,234 articles remained for title and abstract screening (Fig. 2-1).

**Fig. 2-1: Flow chart of systematic literature search.**




1,176 publications were excluded based on title and abstract screening. Fifty-eight full-text articles were assessed for eligibility (Annex: S3 Table). Thirty-four were eliminated due to various reasons (deviant age group, deviant outcome, no social variable, none relevant data shown or analyzed). Twelve records were identified through reference search of included articles. In the full text screening inter-rater agreement on study inclusion was 88 %. In the

end, thirty-six publications based on thirty-five studies were included in the review and the synthesis. Though two articles [27, 172] were based on the same study, their methodological and reporting quality was evaluated separately and their results were analyzed independently due to differing samples and data sets.

**Overview of included records**

The articles were published between 1981 and 2015 (Tab. 2-1). More than half of the records were from the USA (20; 55.6%). Eight articles were from Europe (22.2%), five from Asia (13.9%), two from Canada (5.6%) and one from Australia (2.8%). The sample sizes ranged from N = 40 to N = 824,952 and mean age ranged from 63 to 81 years. Two studies focused on women only [29, 173], the others had quota of women of 45 % to 66 %. Twenty-two studies were cross-sectional and fourteen were prospective cohort studies. Twenty-three studies analyzed the frequency of physician visits (ordinal, metric or count variables). Nine studies researched the use of physicians (yes vs. no). Four articles [31, 61, 138, 174] reported both outcomes and therefore, they were listed in the "use" and "frequency" section. The period of outpatient care use ranged from fifteen days to two years. More than half of the articles focused explicitly on GP visits [12, 13, 133, 134, 138, 175, 176], primary care [14, 58, 60, 177], ambulatory services [27, 136, 172, 178-180], and outpatient physician visits [26, 181, 182]. The other records used more implicit terms like "physicians" [e.g. 63], "doctors" [e.g. 62] and "consultations" [e.g. 12] in contrast to inpatient health care services (e.g. hospital days, hospital nights).

The methodological and reporting quality of 47.2% of the records was categorized as "high", 44.4% as "medium" and 8.3% as "low" (Tab. 2-2). Apart from criterion two (non-respondents and response rate) and criterion seven (independent assessment of outcome), the majority of the articles met the criteria of methodological and reporting quality (Tab. 2-2, Annex: S1 Figure, S2 Table). Criterion two (non-respondents and response rate) was met only by five articles [14, 21, 31, 32, 61] and criterion seven (independent assessment of outcome) by eight records [12, 14, 21, 58, 133-136].

**Tab. 2-1: Overview of characteristics of included studies**

| Author(s), year, country | Research design (specific population) | Study year (follow-up) | Sample size | Response rate in % | Age | Female in % | Covariates in fully adjusted model |
|---|---|---|---|---|---|---|---|
| Arling, 1985, USA [27] | cross-sectional study | 1979 | 2,051 | 87 | 60-64: 29%<br>65-74: 47%<br>75-84: 19%<br>85+: 5% | 59 | medical conditions, ADL impairment, psychosomatic symptoms, emotional symptoms, economic deprivation, insurance coverage, medical care source, age, education, sex, race |
| Branch et al., 1981, USA [179] | cross-sectional study | 1974 | 1,625 | 79 | 73.2 (mean) | 60 | age, gender, race, education, income, occupation, health insurance, regular physician, transportation problems, perceived health status, activities of daily living, physical activity performance, ability to climb stairs, ability to walk half a mile, health problem |
| Cafferata, 1987, USA [68] | cross-sectional study | 1977 | 4,560 | n.a. | 73.5 (mean) | 60 | race, education, chronic condition, health insurance, density of physicians, health, worry, physicians usual source of care, bed-disability days |
| Coulton & Frost, 1982, USA [136] | cohort study | 1975 (1976) | 1,834 (1,519) | n.a. | 74.2 (mean) | 65 | perceived service need, level of impairment, income, education, insurance, case management, gender, age, race, psychic stress |
| Counte & Glandon, 1991, USA [174] | cohort study (health maintenance organization members and fee-for-service clients) | 1986 (+6 months) | 402 | 74 & 44 (87 & 85) | 72.5 (mean) | 63 | health status, life stress, insurance, SES, gender |
| Crespo-Cebada & Urbanos-Garrido, 2012, Spain [138] | cross-sectional study | 2006/07 | 1,860 | n.a. | n.a. | n.a. | age, gender, longillness, symptoms, chronic diseases, limitations, depression, orientation, health, physical activity, education, job status, insurance, income, homecare |
| Dalsgaard et al., 2012, Denmark [133] | cohort study (diabetes cohort) | 2003 (2009) | 824,952 | n.a. | 55-64: 33.4%<br>65-79: 40.6% | 45 | sex, age, education, occupation, income |
| Eve, 1988, USA [173] | cohort study (older women cohort) | 1969 (1979) | 3,013 (1,849) | 62.9 (61.4) | 70.4 (mean) | 100 | age, education, race, head of household, retirement status, income, satisfied with way of living, able to get along on income, health insurance, metropolitan area, handicapped/disabled, health compared to others, previous use of health services |
| Ezeamama et al., 2015, USA [62] | cross-sectional study | 2010/11 | 4,562 | 80 | 50-55: 22.36%<br>56-60: 25.71%<br>61-65: 24.38%<br>66-70: 27.55% | 57.8 | history of loss, age, sex, education, smoking, BMI, physical activity level, US-born, fall, trouble sleeping, race, cumulative lifetime adversity, global mastery, domain-specific mastery, importance of religion, comorbidities, retirement status |
| Foreman et al., 1998, China [28] | cross-sectional study | 1998 | 350 | n.a. | 71.6 (mean) | 51.4 | gender, age, education, alcohol |
| Fritel et al., 2014, France [29] | cohort study (urinary incontinence cohort, women only) | 2000 (2008) | 2,640 (2,273) | n.a. (86) | 63 (mean) | 100 | age, parity, urinary incontinence (UI) severity at baseline, UI type, quality of life, consultation with GP in the last 12 months, neurologic disease, hypertension or cardiovascular disease |
| Gobbens & van Assen, 2012, The Netherlands [175] | cohort study | 2008 (2009, 2010) | 245 (179, 141) | 53 (73, 58) | 80.3 (mean) | 54.7 | sex, age, lifestyle, multimorbidity, physical frailty, psychological frailty, social frailty, BMI, activities, fatigue, mobility, balance, hand grip strength, depression, anxiety, coping, mental state |

| Author(s), year, country | Research design (specific population) | Study year (follow-up) | Sample size | Response rate in % | Age | Female in % | Covariates in fully adjusted model |
|---|---|---|---|---|---|---|---|
| Goldsteen et al., 1992, USA [181] | cohort study | 1986 (+6 months) | 402 (346) | 59.6 (86.1) | 72.5 (mean) | 63 | age, sex, race, education, religion, health locus control, physician visits t0, desirable life events, activities, health problems, HMO, Eldercare |
| Hand et al., 2014, Canada [58] | cross-sectional study (frequent health services user) | n.a. | 40 | 44.9 | 81.3 (mean) | 55 | health status |
| Harris et al., 2004, UK [12] | cohort study | 2000 (2001) | 1,565 | 75 (92) | 65-69: 24%<br>70-74: 25%<br>75-79: 22%<br>80-84: 15%<br>85+: 14% | 62 | age, sex, practice, general health, disease score, anxiety score |
| Jordan et al., 2006, UK [134] | cohort study (knee pain cohort) | 2000 (-/+18 months) | 1,797 | 77 (100) | n.a. | n.a. | knee-related factors, general health, sex, age, education |
| Korten & Jacomb, 1998, Australia [13] | cohort study | 1990/91 (1994) | 897 (624) | 65 (85) | 76.4 (mean) | n.a. | number of current illnesses, level of pain |
| Krause, 1988, USA [30] | cohort study (stress cohort) | 1984 (+18 months) | 351 (265) | n.a. (75.5) | n.a. | n.a. | age, sex, education, physical health status |
| Levkoff et al., 1987, USA [135] | cohort study (middle-aged and aged cohorts) | n.a. | 152 | 88 (n.a.) | n.a. | n.a. | gender, education, has preventive outlook, thinks appropriate to talk to doctor about personal problems |
| Li & Chi, 2011, China [31] | cross-sectional study | 2000 | 20,255 | 98.6 | 69.1 (mean) | 47 | age, gender, education, place of residence, income, health insurance, convenience of visiting a physician, self-rated health, functional health |
| Liao et al., 2012, Taiwan [182] | cohort study (introduction of national health insurance cohort) | 1993 (1996) | 2,230 (1,504) | 90 (67.4) | 69.7-71.1 (means) | 35-62 | age, gender, education, employment status, lifestyle behaviors, ethnicity, health/chronic conditions |
| Miltiades & Wu, 2008, China & USA [59] | cross-sectional study (chinese immigrants) | 2000-03 | 597 | 88,5 & 91 | 69.7-71.8 (means) | 62.1 & 59.3 | education, traditional chinese medicine, self-rated health, depression (CES-D), chronic conditions, income, insurance, residence |
| Park, 2012, South Korea [60] | cross-sectional study | 2003 | 6,591 | 94.1 | n.a. | n.a. | age, gender, education, religion, self-perceived health status, cognitive condition, income, health insurance |
| Pourat et al., 2000, USA [178] | cross-sectional study (korean immigrants) | 1993 | 424 | n.a. | 73-75 (means) | 60 & 65 | demographics, health, functioning, income, insurance, perceptions of health/other beliefs |
| Rennemark et al., 2009, Sweden [14] | cross-sectional study (frequent health services user) | 2001-03 | 643 | 72.8 | 66 (mean) | 54.2 | age, gender, functional ability, comorbidity, education, sense of coherence, internal locus of control |
| Ryvicker et al., 2012, USA [177] | cross-sectional study | 2008 | 1,260 | 76.7 | 75.4 (mean) | 65 | supply quartile, neighborhood safety, use public transit, age, female, nonwhite, non-English speaking, education, health insurance, usual source of care, number of chronic conditions, number of ADL/IADL needs |
| Schafer, 2013, USA [26] | cross-sectional study | 2005/06 | 3,005 | 75.5 & 84 | 69.3 (mean) | 52 | sex, age, education, ethnicity, self-rated health, disease, regular place for health care, health insurance, alternative medicine |

| Author(s), year, country | Research design (specific population) | Study year (follow-up) | Sample size | Response rate in % | Age | Female in % | Covariates in fully adjusted model |
|---|---|---|---|---|---|---|---|
| Schmitz et al., 1997, USA [21] | cohort study | n.a. | 226 | 55 (n.a.) | n.a. | n.a. | daily hassles, age, depression, physical health, number of health problems |
| Stoller, 1982, USA [61] | cross-sectional study | 1979 | 753 | 71 | 73.2 (mean) | 57 | symptoms, cancer effects, heart disease effects, stroke effects, worry about health, health interferes, ill in bed, health insurance, finances tight, care at MD's office, availability inconvenient, MD/population ratio, health attitudes, education, rural/urban, age, sex |
| Strain, 1990, Canada [32] | cross-sectional study | 1985 | 705 | 75 | 71 (mean) | 59 | perceived health, number of chronic conditions, functional disability, health beliefs, age, gender, education, occupation, ethnic identity, religion, income |
| Suominen-Taipale et al., 2004, Norway & Finland [176] | cross-sectional study | 1995-97 | 9,202 | 71 & 86 | 65-69: 49-57% 70-74: 43-51% | 53 & 33 | sex, age, self-rated health, education, region |
| Wan & Arling, 1983, USA [172] | cross-sectional study (functionally impaired, subsample Arling 1985) | 1979 | 772 | n.a. | 72.6 (mean) | 62.2 | age, sex, race, residential background, occupation, education, income, health insurance, regular physician, perceived service needs having been met, transportation barriers, ADL, IADL, health disorders, Mental Status Questionnaire, psychological symptoms, perceived health |
| Wan & Odell, 1981, USA [180] | cross-sectional study | 1978 | 1,182 | n.a. | 55-75: 75% 75+: 25% | 60 | sex, age, education, retired, economic dependency, ADL, IADL, depression, perceived need for service, transportation barriers, knowledge of service, health insurance coverage |
| Wolinsky & Coe, 1984, USA [63] | cross-sectional study | 1978 | 1,5899 | n.a. | 69.9 (mean) | 57 | sex, age, race, education, retired, labor force, regular source of care, telephone, income, health insurance, region, metropolitan area, limited activity, overall health, BMI |
| Wolinsky & Johnson, 1991, USA [183] | cross-sectional study | 1984 | 5,151 | n.a. | 78 (mean) | 63.2 | age, female, race, telephone, education, health worries and control, healt insurance, residentially stable, population density, social security dependent, perceived health, ADL, body limitations |
| Wolinsky et al., 1983, USA [137] | cross-sectional study | 1980 | 401 | n.a. | 74.2 (mean) | 66 | perceived health, mental orientation, ADL, IADL, sensory functions, nutritional risk, mental health, income, supplemental insurance, preventive care (MD, dentist), locus of control, sex, race, age, index of social position, nutritional knowledge |

**Tab. 2-2: Results of the quality assessment of the included records (+ = yes, - = no, 0 = unclear)**

| Author, year | 1. repre-sentative-ness of the sample | 2. non-respon-dents & response rate | 3. sample size | 4. ascer-tainment of expo-sure | 5. validated or described instrument for exposure | 6. compara-bility and confounders | 7. indepen-dent assess-ment of outcome | 8. follow-up long enough for outcome to occur (only cohort) | 9. adequacy of follow up (only cohort) | 10. statis-tical test | Global assessment of methodological and reporting quality |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Arling, 1985 [27] | + | 0 | + | + | + | + | - | | | - | medium |
| Branch et al., 1981 [179] | + | 0 | + | + | + | + | - | | | + | high |
| Cafferata, 1987 [68] | + | 0 | + | + | + | + | - | | | - | medium |
| Coulton & Frost, 1982 [136] | + | 0 | + | + | - | + | + | + | - | + | medium |
| Counte & Glandon, 1991 [174] | 0 | 0 | + | + | + | + | - | + | - | + | medium |
| Crespo-Cebada & Urbanos-Garrido, | + | 0 | + | + | + | + | - | | | + | high |
| Dalsgaard et al., 2012 [133] | + | n.a. | + | + | + | - | + | + | + | + | high |
| Eve, 1988 [173] | + | - | + | + | + | + | - | + | - | + | medium |
| Ezeamama et al., 2015 [62] | + | 0 | + | + | + | + | - | | | + | high |
| Foreman et al., 1998 [28] | - | 0 | + | + | + | + | - | | | + | medium |
| Fritel et al., 2014 [29] | 0 | - | + | + | + | + | - | + | + | + | medium |
| Gobbens & van Assen, 2012 [175] | + | - | + | + | + | + | - | + | + | + | high |
| Goldsteen et al., 1992 [181] | + | - | + | + | + | + | - | + | + | + | high |
| Hand et al., 2014 [58] | - | 0 | - | + | + | - | + | | | - | low |
| Harris et al., 2004 [12] | + | - | + | + | 0 | + | + | + | + | + | high |
| Jordan et al., 2006 [134] | + | 0 | + | + | + | + | + | + | - | - | medium |
| Korten & Jacomb, 1998 [13] | 0 | 0 | + | + | + | - | - | + | - | - | low |
| Krause, 1988 [30] | + | 0 | + | + | + | + | - | + | + | - | medium |
| Levkoff et al., 1987 [135] | + | - | - | + | + | - | + | + | - | - | medium |
| Li & Chi, 2011 [31] | + | + | + | + | + | + | - | | | + | high |
| Liao et al., 2012 [182] | + | - | + | + | + | + | - | + | + | + | high |
| Miltiades & Wu, 2008 [59] | - | - | + | + | + | + | - | | | + | medium |
| Park, 2012 [60] | 0 | - | + | + | - | + | - | | | - | low |
| Pourat et al., 2000 [178] | 0 | 0 | + | + | + | + | - | | | + | medium |
| Rennemark et al., 2009 [14] | + | + | + | + | + | + | + | | | + | high |
| Ryvicker et al., 2012 [177] | + | - | + | + | + | + | - | | | + | high |
| Schafer, 2013 [26] | + | 0 | + | + | + | + | - | | | + | high |
| Schmitz et al., 1997 [21] | - | + | + | + | + | + | + | + | + | - | high |
| Stoller, 1982 [61] | + | + | + | + | + | + | - | | | + | high |
| Strain, 1990 [32] | + | + | + | + | + | + | - | | | + | high |
| Suominen-Taipale et al., 2004 [176] | + | - | + | + | + | - | - | | | + | medium |
| Wan & Arling, 1983 [172] | 0 | 0 | + | + | + | + | - | | | + | medium |
| Wan & Odell, 1981 [180] | + | - | + | 0 | + | + | 0 | | | + | medium |
| Wolinsky & Coe, 1984 [63] | + | 0 | + | + | + | + | - | | | + | high |
| Wolinsky & Johnson, 1991 [183] | + | 0 | + | + | + | + | - | | | - | medium |
| Wolinsky et al., 1983 [137] | + | 0 | + | + | + | + | - | | | + | high |

**Associations between social relationships and physician utilization (yes vs. no)**

Fourty associations between social relationships and the use of physicians were found in thirteen articles (Annex: S4 Table). In seven articles, fourteen associations were statistically significant (Tab. 2-3). In other words, two thirds of the associations were statistically insignificant.

Seven out of these fourteen associations included variables of the structural dimension of social ties [31, 60, 176, 177, 182]. Suominen-Taipale, Koskinen [176] found consistent and relatively strong negative associations between being single, widowed, divorced or separated and the probability of physician utilization compared to older adults who are married and cohabiting. Li and Chi [31] reported a strong positive association between living with at least one child and the physician use. Regarding the social network size, Park [60] observed a moderate positive association between having social network members and the use of physicians, while Liao, Chang [182] found a weak negative association between the household size and the probability of visiting a physician.

Seven out of fourteen associations included variables of the functional dimension of social relationships [29, 31, 183]. Wolinsky and Johnson [183] found consistently positive, but weak associations between nonkin or kin social support and physician consultations. Fritel, Panjo [29] showed a higher probability of using outpatient care doctors for older people with weak social support. Otherwise, discussing health with friends or close relatives was associated strongly and positively with using health services [29]. Li and Chi [31] analyzed specific forms of social support in their study. For older people receiving or providing financial support or providing instrumental support they observed consistent and strong negative links to the utilization of physicians [31].

**Tab. 2-3: Statistically significant associations between social relationship (SR) indicators and physician use (yes/no)**

| No. | SR dimension | SR category | SR indicator | Author, Year | Statistics | SR coeff. (95%CI, p) |
|---|---|---|---|---|---|---|
| 1. | Structural | Marital status - single | Single (0=married/cohabiting, 1=single) | Suominen-Taipale et al., 2004 [176] | Odds Ratio | 0.6 (0.5 - 0.8, p<0.05) |
| 2. | | Marital status - widowed | Widow (0=married/cohabiting, 1=widow) | Suominen-Taipale et al., 2004 [176] | Odds Ratio | 0.9 (0.7 - 1.0, p<0.05) |
| 3. | | Marital status - divorced/separated | Divorced/separated (0=married/cohabiting, 1=divorced/separated) | Suominen-Taipale et al., 2004 [176] | Odds Ratio | 0.7 (0.6 - 1.0, p<0.05) |
| 4. | | Living with others | Living with at least one child (0=no, 1=yes) | Li and Chi, 2011 [31] | Odds Ratio | 1.38 (1.03 - 1.84, p<0.05) |
| 5. | | Social network size | Social network members (0=none, 1=one or more) | Park, 2012 [60] | Odds Ratio | 1.28 (n.r., p<0.05) |
| 6. | | | Household size | Liao et al., 2012 [182] | Random-effect probit model | -0.011 (n.r., p<0.05) |
| 7. | | Social cohesion | Neighborhood social cohesion score (range: 5-20) | Ryvicker et al., 2012 [177] | Odds Ratio | 1.04 (1.00 - 1.09, p<0.05) |
| 8. | Functional | Social support (unspecified) | Nonkin supports scale (five items) | Wolinsky and Johnson, 1991 [183] | Unst. OLS coeff. | 0.017 (n.r., p<0.05) |
| 9. | | | Kin supports scale (two items) | Wolinsky and Johnson, 1991 [183] | Unst. OLS coeff. | 0.034 (n.r., p<0.05) |
| 10. | | | Social support scale (0=strong, 1=weak) | Fritel et al., 2014 [29] | Odds Ratio | 1.4 (1.0 - 2.0, p<0.05) |
| 11. | | Financial support | Receiving financial support (0=no, 1=yes) | Li and Chi, 2011 [31] | Odds Ratio | 0.47 (0.34 - 0.65, p<0.001) |
| 12. | | Health discussions with others | Discuss health with friends or close relatives (0=no, 1=yes) | Fritel et al., 2014 [29] | Odds Ratio | 1.5 (1.0 - 2.1, p<0.05) |
| 13. | | Providing financial support | Providing financial support (0=no, 1=yes) | Li and Chi, 2011 [31] | Odds Ratio | 0.49 (0.33 - 0.73, p<0.001) |
| 14. | | Providing instrumental support | Providing instrumental support (0=no, 1=yes) | Li and Chi, 2011 [31] | Odds Ratio | 0.73 (0.54 - 0.99, p<0.01) |

SR = social relationship; CI = confidence interval; p = p-value; n.r. = not reported; coeff. = coefficient; Unst. = unstandardized; OLS = ordinary least squares

**Associations between social relationships and frequency of physician utilization**

Ninety-two associations between social relationships and the frequency of physician use were found in twenty-eight articles (Annex: S5 Table). In seventeen articles, thirty-seven associations were statistically significant (Tab. 2-4). Consequently, more than half of the associations were statistically insignificant.

Twenty-two out of these thirty-seven associations included variables of the structural dimension of social ties. Three studies found positive associations between being married and the frequency of physician visits [28, 59, 63] and one article reported a positive association between being widowed and the frequency of physician consultations [63]. Furthermore, living alone was positively and weakly associated with a higher frequency of using outpatient health services in three records [61, 63, 138]. Dalsgaard, Vedsted [133] found no, positive and negative differences for older adults who are living alone depending on their age and gender. Living with others (e.g., child or others except spouse) was associated negatively with the frequency of utilizing physicians in three studies [31, 61, 68]. Foreman, Yu [28] reported a strong and positive association between living with children and the frequency of health services use. The size of the social network was positively and strongly associated with a higher frequency of physician visits [13]. Counting friends or neighbors amongst their social networks, older adults reported a higher number of physician consultations [178]. Coulton and Frost [136] found out that socially isolated older people showed a lower number of physician contacts than socially integrated older adults. Moreover, Harris, Cook [12] and Militades and Wu [59] observed positive associations between higher contact frequencies in social networks and the frequency of physician use.

Fifteen out of thirty-seven associations included variables of the functional dimension of social relationships. Two studies showed positive and weak associations between received social support and the frequency of physician utilization [21, 27]. Financial, instrumental or informational support was associated weakly with more physician visits [30, 31]. Emotional support was associated with less consultations [31]. Schafer [26] reported moderate to strong and positive associations between the likelihood of discussing health and the frequency of

physician use taking several social ties into consideration (partner, children, non-kin). Harmonious social relationships decreased the frequency of physician visits [28] and respectful social ties increased the use rate [178].

Li and Chi [31] investigated the association between providing social support and the frequency of using physicians. Providing instrumental support was associated negatively and weakly. The provision of financial support was linked positively and weakly.

**Tab. 2-4: Statistically significant associations between social relationship (SR) indicators and frequency of physician visits**

| No. | SR dimension | SR category | SR indicator | Author, Year | Statistics | SR coeff. (95%CI, p) |
|---|---|---|---|---|---|---|
| 1. | Structural | Marital status - married | Married (0=not married, 1=married) | Foreman et al., 1998 [28] | Weighted OLS coeff. | 20.454 (n.r., p<0.05) |
| 2. | | | Married (0=no, 1=yes) | Wolinsky and Coe, 1984 [63] | Unst. OLS coeff. | 0.091 (n.r., p<0.001) |
| 3. | | | Married (0=otherwise, 1=married) | Miltiades and Wu, 2008 [59] | St. OLS coeff. | 0.160 (n.r., p<0.01) |
| 4. | | Marital status - widowed | Widowed (0=no, 1=yes) | Wolinsky and Coe, 1984 [63] | Unst. OLS coeff. | 0.069 (n.r., p<0.01) |
| 5. | | Living alone | Alone (0=otherwise, 1=lives alone) | Crespo-Cebada and Urbanos-Garrido, 2012 [138] | Count model (elasticity) | 0.0149 (n.r., p<0.1) |
| 6. | | | Lives alone (0=lives with spouse, 1=lives alone) | Stoller, 1982 [61] | Unst. OLS coeff. | 0.07 (n.r., p<0.1) |
| 7. | | | Single (0=cohabiting, 1=single) | Dalsgaard et al., 2012 [133] | Rates; absolute difference | 0.4 (0.2 - 0.5, p<0.05) |
| 8. | | | lives alone (0=no, 1=yes) | Wolinsky and Coe, 1984 [63] | Unst. OLS coeff. | 0.128 (n.r., p<0.001) |
| 9. | | | Single (0=cohabiting, 1=single) | Dalsgaard et al., 2012 [133] | Rates; absolute difference | -0.5 (-0.7 - -0.3, p<0.05) |
| 10. | | | Single (0=cohabiting, 1=single) | Dalsgaard et al., 2012 [133] | Rates; absolute difference | 0.0 (-0.2 - 0.2, p<0.05) |
| 11. | | | Single (0=cohabiting, 1=single) | Dalsgaard et al., 2012 [133] | Rates; absolute difference | 0.0 (-0.2 - 0.2, p<0.05) |
| 12. | | Living with others | Living with children (0=not living with children, 1=living with children) | Foreman et al., 1998 [28] | Weighted OLS coeff. | 14.533 (n.r., p<0.05) |
| 13. | | | living with at least one child (0=no, 1=yes) | Li and Chi, 2011 [31] | Count model coeff. | -0.06 (-0.1 - -0.01, p<0.01) |
| 14. | | | lives with others (0=lives with spouse, 1=lives with others) | Stoller, 1982 [61] | Unst. OLS coeff. | -0.08 (n.r., p<0.05) |
| 15. | | | Living arrangement (1=lives with others except spouse) | Cafferata, 1987 [68] | Unst. OLS coeff. | -0.9 (n.r., p<0.05) |
| 16. | | Frequency of social interaction | Telephone contact with friends or relatives (0=monthly or less, 1=weekly) | Harris et al., 2004 [12] | Ordered logistic coeff. | 1.7 (1.3 - 2.3, p<0.001) |
| 17. | | | Telephone contact with friends or relatives (0=monthly or less, 1=daily) | Harris et al., 2004 [12] | Ordered logistic coeff. | 1.8 (1.4 - 2.5, p<0.001) |
| 18. | | | Social network (two items on contact frequency, score range 1-12) | Miltiades and Wu, 2008 [59] | St. OLS coeff. | 0.219 (n.r., p<0.01) |
| 19. | | Social network size | Social support: network (extent of subject's social network) | Korten and Jacomb, 1998 [13] | St. OLS coeff., Odds Ratio | 2.682, 14.6 (2.72 - 78.39, p<0.05) |
| 20. | | Social network (unspecified) | Lubben Social Network Scale: friend (revised) | Pourat et al., 2000 [178] | Exponential Betas | 1.11 (n.r., p<0.05) |
| 21. | | | Lubben Social Network Scale: neighbor (revised) | Pourat et al., 2000 [178] | Exponential Betas | 0.93 (n.r., p<0.05) |
| 22. | | Social isolation | social isolation (index of social contacts, high score=almost no contact) | Coulton and Frost, 1982 [136] | St. OLS coeff. | -0.6 (n.r., p<0.05) |

SR = social relationship; CI = confidence interval; p = p-value; n.r. = not reported; coeff. = coefficient; St. = standardized; Unst. = unstandardized; OLS = ordinary least squares

| No. | SR dimension | SR category | SR indicator | Author, Year | Statistics | SR coeff. (95%CI, p) |
|---|---|---|---|---|---|---|
| 23. | Functional | Social support (unspecified) | Reliable alliance social provision | Schmitz et al., 1997 [21] | St. OLS coeff. | 0.13 (n.r., p<0.05) |
| 24. | | | Social support (10 forms of assistance) | Arling, 1985 [27] | St. OLS coeff. | 0.14 (n.r., p<0.001) |
| 25. | | Emotional support | filial piety (1= not filial - 4= very filial) | Li and Chi, 2011 [31] | Count model coeff. | -0.05 (-0.08 - -0.02, p<0.001) |
| 26. | | Financial support | receiving financial support (0=no, 1=yes) | Li and Chi, 2011 [31] | Count model coeff. | 0.05 (0.01 - 0.10, p<0.01) |
| 27. | | Instrumental support | Tangible support | Krause, 1988 [30] | St. OLS coeff. | 0.184 (n.r., p<0.01) |
| 28. | | Informational support | Informational support | Krause, 1988 [30] | St. OLS coeff. | 0.144 (n.r., p<0.05) |
| 29. | | Social ties & health discussions | Partner tie - very likely to discuss health (0=no, 1=yes) | Schafer, 2013 [26] | Unst. OLS coeff. | 1.49 (n.r., p<0.01) |
| 30. | | | Partner tie - less likely to discuss health (0=no, 1=yes) | Schafer, 2013 [26] | Unst. OLS coeff. | 1.27 (n.r., p<0.05) |
| 31. | | | Child ties - very likely to discuss health (0=no, 1=yes) | Schafer, 2013 [26] | Unst. OLS coeff. | 0.34 (n.r., p<0.05) |
| 32. | | | Non-kin ties - very likely to discuss health (0=no, 1=yes) | Schafer, 2013 [26] | Unst. OLS coeff. | 0.37 (n.r., p<0.05) |
| 33. | | | Non-kin ties - less likely to discuss health (0=no, 1=yes) | Schafer, 2013 [26] | Unst. OLS coeff. | 0.27 (n.r., p<0.05) |
| 34. | | Harmony of social interaction | Relationships with family are harmonious (0=no, 1=yes) | Foreman et al., 1998 [28] | Weighted OLS coeff. | -19.538 (n.r., p<0.01) |
| 35. | | Respect in social interaction | Receive as much respect from family as deserved (0=some, little or very little respect, 1=very much) | Pourat et al., 2000 [178] | Exponential Betas | 1.38 (n.r., p<0.05) |
| 36. | | Providing instrumental support | providing instrumental support (0=no, 1=yes) | Li and Chi, 2011 [31] | Count model coeff. | -0.07 (-0.12 - -0.01, p<0.01) |
| 37. | | Providing financial support | Providing financial support (0=no, 1=yes) | Li and Chi, 2011 [31] | Count model coeff. | 0.10 (0.04 - 0.15, p<0.001) |

SR = social relationship; CI = confidence interval; p = p-value; n.r. = not reported; coeff. = coefficient; St. = standardized; Unst. = unstandardized; OLS = ordinary least squares

## 2.5 DISCUSSION

### Summary of findings

This review provides a comprehensive overview and furthers the understanding of the association between social relationships and health services use among older adults (50 years and older). The first objective of this study was to systematically review social relationships associated with the utilization of outpatient care services of older people. The second aim was to evaluate magnitude and consistency of the associations between social ties and health services use.

We included thirty-six records on thirty-five different studies reporting structural and functional dimensions of social relationships linked to the utilization of health services into our analyses. In most cases empirical evidence was insufficient and for several of the social tie variables inconsistent results were found. Taking into account the fully adjusted model, associations between use measures and social relationship variables were for the most part weak and statistically insignificant. Potentially, associations were underestimated by that strict criterion.

Overall, most of the studies focused on associations between social ties and frequency of physician use. The structural dimension of social relationships and its association with physician visits (use and frequency of use) was investigated far more often than the functional dimension. Though a substantial number of social relationship dimensions were explored until now, none of the included studies included a holistic approach of social tie measures (degree of integration, received and perceived social support) [22] and theirs links to health services utilization.

The majority of the associations between structural dimensions of social relationships and the use of physicians were positive and moderate in strength. The associations between functional dimensions of social relationships and the probability of using physician services were inconsistent and varied in strength. For the most part, social relationship variables assigned to the structural dimension were positively and weakly to moderately associated with the frequency of physician visits. Functional aspects of social relationships also tended to have

positive associations with the frequency of physician utilization. The associations were weak or moderate in strength. All in all, the current status of quantitative data was insufficient to draw precise and generalizable conclusions.

Our review reveals that the link between various social relationship indicators and health care use as well as frequency of use have been investigated in few studies. This clearly indicates that further research is needed.

**Limitations**

Including a broad range of seven medical and sociological databases, we were able to minimize the risk of missing relevant articles. Nevertheless, the risk of publication bias is still existent. More than half of the studies (64%) were performed in North America, and therefore, findings cannot be generalized. Since the majority of included studies (61%) had cross-sectional design, conclusions concerning causal relations are not possible.

Due to the fact that ten studies did not (four studies) or did not clearly meet (six studies) the quality criterion of representativeness and thirty articles did not (twelve studies) or did not clearly report (eighteen studies) information on non-respondents and response rate, the results were moderately robust. Overall, the methodological and reporting quality of the studies was mostly categorized as medium or high (92%).

Most of the studies referred to one year of physician use. Still, the range of the utilization variable was substantial between the studies (from 15 days to two years). As the time span was quite long in some studies, and considering the older age of the interviewed individuals, risk of memory bias was existent, particularly, if the information on consultations was not compared to medical records (twenty-seven studies).

Since there were no consistent measures of predictors (social relationships) and outcome variables (use and frequency of outpatient care visits), data was analyzed systematically, but descriptively. A prerequisite of meta-analyses is a high level of accordance across the included studies regarding independent and dependent variable measures and data analysis approaches [144]. Due to the heterogeneity of the included studies (e.g. study designs,

sampling procedures, data collection methods, definition of outcome and exposure variables, confounders, quality of studies, statistical analysis and reporting) a meta-analysis was not conducted. In most cases the associations were small and statistically not significant. The current status of evidence is insufficient and partly inconsistent.

Unfortunately, analyses of group-differences concerning age, gender, and chronic conditions could not conducted on the basis of the review material.

## 2.6 CONCLUSIONS

Social relationships can increase or decrease the probability to consult a physician, and they can influence the frequency of visits. All in all, older people who are structurally integrated by social relationships are more likely to consult a physician at all and to contact a physician more often. Functional aspects of social relationships, depending on the form of social support, can increase or decrease the probability of physician use. Older adults who are experiencing social support tend to have a higher rate of physician visits than older people without any or less support.

On the one hand, this could be read as good news, since structural and functional aspects of social relationships tend to enable the utilization of health services, and thereby potentially foster older adults' health. Social relationships could offer informational, instrumental and emotional resources with regard to health, health care services and treatments. On the other hand, considering increasing numbers of single-person-households and an increasing risk of loneliness and social isolation in older age [2], this could be interpreted as a cause of concern, since older individuals who are not socially integrated may not find their way to health care services. The results do not include information about the adequacy of health care regarding access to health services, extent of health treatment, and quality of health care.

Social ties have an impact on the patient's motives for a consultation and on the patient's compliance regarding future visits for treatment, prevention or rehabilitation [159, 160]. Consequently, health care practitioners should consider information on patient's social environments into their clinical routine. By default, physicians should assess social networks

among the elderly screening for social resources or social needs of support. Furthermore, relevant stakeholders (e.g., physicians, public health institutions and health insurance companies) need to find ways to ensure that older adults can use outpatient care services regardless of their structural and functional level of social integration.

The variety of dimensions of social relationships presented in this review illustrates that utilization of outpatient health care services is a complex social process. Besides methodological challenges, the complex picture of social tie's impact on health care utilization bases on the fact that relationships are not always of positive virtue [161, 162]. In contrary, "some of the most powerful impacts on health [and health services use] that social relationships may have, are through acts of abuse, violence, and trauma" [49]. This fact may represent a possible explanation for the inconsistent pattern of social relationships on health services use among older adults.

Furthermore, the inconclusive results demonstrate that measuring social relationships and their influence on health services use is a challenging methodological endeavor. Future health services research should accentuate social relationship variables more in detail, and not only in terms of structure and quantity, but also according to functional and quality aspects of social relationships.

The relatively low number of included studies indicates a deficit of elaborated observational studies dealing with the role of social relationships for the utilization of health services among older populations. The majority of the identified studies have a cross-sectional design investigating a number of possible social relationships of health services use. It is crucial to determine social ties for health services use more clearly and to identify causal relations, especially in the form of prospective cohort studies.

Methodologically, it can be constructive to directly connect the question of social relationships and health care utilization to the scientific debate of health care inequalities [66, 69, 169-171] by conducting mediator or moderator analyses to create further clarity. This may complement the identification and understanding of social inequalities in health services utilization. In the

future, this can be directed into new approaches to reduce social inequalities in health services utilization and to offer needs-based access to health care and adequate levels of treatment.

# 3 SOCIAL RELATIONSHIPS AND GP USE OF MIDDLE-AGED AND OLDER ADULTS IN EUROPE: A MODERATOR ANALYSIS

## 3.1 ABSTRACT

**Objectives:** This paper investigates (i) how social relationships (SR) relate to the frequency of general practitioners (GP) visits among middle-aged and older adults in Europe, (ii) if SR moderate the association between self-rated health and GP visits, and (iii) how the associations vary regarding employment status.

**Methods:** Data stem from the SHARE-project (wave 4, 56,989 respondents, 50 years or older). GP-use was assessed by frequency of contacts with GPs in the last 12 months. Predictors were self-rated health and structural (social integration index (SII), social contact frequency) and functional (emotional closeness) aspects of SR. Regressions were used to measure the associations between GP-use and those predictors. Sociodemographic and socioeconomic factors were used as covariates. Additional models were computed with interactions.

**Results:** Analyses did not reveal significant associations of functional and structural aspects of SR with frequency of GP visits (SII: IRR=0.99, 95%CI 0.97-1.01, social contact frequency: IRR=1.04, 95%CI 1.00-1.07, emotional closeness: IRR=1.02, 95%CI 1.00-1.04). Moderator analyses showed that “high social contact frequency people” with better health had statistically significant more GP visits than “low social contact frequency people” with better health. Furthermore, people with poor health and an emotionally close network showed a significantly higher number of GP visits compared to people with same health, but less close networks. Three way interaction analyses indicated employment status-specific behavioral patterns with regard to SR and GP-use, but coefficients were mostly not significant. All in all, the not-employed groups showed a higher number of GP visits.

**Conclusions:** Different indicators of SR showed statistically insignificant associations with GP visits. Consequently, the relevance of SR may be rated rather low in quantitative terms for investigating GP-use behavior of middle-aged and older adults in Europe. Nevertheless,

investigating the two- and three-way interactions indicated potential inequalities in GP-use due to different characteristics of SR accounting for health and employment status.

## 3.2 INTRODUCTION

According to the "Behavioral Model of Health Services Use" by Andersen, utilization of health services is influenced by a variety of predisposing, enabling and need characteristics [10]. Existing literature has highlighted that health status, defined as a "need factor", is the most powerful predictor of health services use in older age [11-15]. Furthermore, adults within their fifties or older show more chronic illnesses and increased rates of health care use compared with younger cohorts [4]. Consequently, health care systems are challenged by increasing health needs and rising demands for health services in ageing societies [3]. In particular, the sector of primary health care is affected by these developments, since general practitioners (GPs) are the first contact to health care acting as gatekeepers and navigators.

Within Andersen's model, social relationships are defined as "enabling resources" for health and the use of health services [10]. International studies suggest substantial impact of social relationships on morbidity and mortality [22, 24, 69, 184]. Moreover, research indicates the significance of social relationships by enhancing patient care, improving compliance with medical schemes, and fostering shorter hospital stays [17-19]. Social relationships can be divided into structural and functional elements [22]. Structural aspects of social relationships, e.g., the degree of social network integration, are assessed by quantitative measures (e.g. living arrangements, social network size, and frequency of social participation). Received and perceived social support is defined as a functional element, and includes aspects of financial, instrumental, informational or emotional support. Both aspects of social relationships can be subject to change due to life events across the life span, especially in older age [55], as they are affected and modified by events, such as widowhood, unemployment or retirement [55-57].

Up to now, studies on older adults' GP use have shown an ambiguous role of social relationships [31, 58-60]. In most cases, regression models were applied to show that various aspects of social relationships are associated with the frequency of health services consultations within a certain time span [28, 61-63]. Andersen's model suggests a variety of interactions between predisposing, enabling and need factors on health services use, but only a few studies adopted analyses to capture potential moderating or mediating action [26, 30, 64-68]. As mentioned before, health status is strongly associated with the frequency of using health services, on the one hand. On the other hand, social relationships are closely linked to health [24, 69, 70]. Consequently, social relationships might influence the scope of action, such as using GP services, depending on varying self-rated health status. Do social relationships have an impact on the strong link between self-rated health and health services use? And, if applicable, does that implicate anything for public health policy and health care providers? So far, the association between social relationships, self-rated health and GP visits among middle-aged and older adults is poorly understood.

Focusing on adults 50 years or older, this paper investigates (i) how social relationships relate to the frequency of GP visits and (ii) if social relationships moderate the association between self-rated health and GP visits. Since, social relationships are subject to change due to age-related life events, such as retirement, unemployment and permanent disability, this study additionally analyzes (iii) how the associations vary through subgroups of different employment status. Hence, this study may contribute to a better understanding of the behavioral patterns of using GP services within the middle-aged and older[2] European population.

[2] For the sake of readability, we refer to "middle-aged and older adults" or "adults 50 years or older" when we write about "older adults" in this paper.

## DATA AND METHODS

### Data

Analyses are based on data from the fourth wave of SHARE, the Survey of Health, Ageing, and Retirement in Europe [102-105]. "SHARE has been submitted to, and approved by, the ethics committee at the University of Mannheim which was the legally responsible entity for SHARE during wave four" [105]. Following the SHARE conditions of use, the ethical approval for the SHARE study also applies to this analysis [185]. Data was collected in 2010 and 2011 from sixteen European countries (Austria, Germany, Sweden, Netherlands, Spain, Italy, France, Denmark, Switzerland, Belgium, Czech Republic, Poland, Hungary, Portugal, Slovenia and Estonia). Based on population registers, SHARE uses probability samples within the countries and includes non-institutionalized adults aged 50 years or older and, if available, their partners. Further exclusion criteria are being incarcerated, moved abroad, unable to speak the language of questionnaire, deceased, hospitalized, moved to an unknown address or not residing at sampled address [103, 105]. By focusing on an older age group, SHARE matches our research questions very well, since health needs increase significantly and crucial changes in the life course occur (e.g., retirement). Furthermore, SHARE offers a substantial sample size (wave four: 56,989 main interviews of respondents aged 50 years or older in 39,807 households).

SHARE uses an ex-ante harmonization regarding the survey design, which means that questionnaires and field procedures are standardized across countries to maximize options for cross-national comparisons [106]. To ensure the ex-ante harmonization of the survey, "[…] SHARE employs three instruments: the SHARE Model Contract provides the legal framework for standards and quality control; the SHARE Survey Specifications define the quality standards of the survey ex ante; and the SHARE Compliance Profiles report adherence to those standards ex post" [106]. In wave four, "[…] contact rates of households were satisfactory (>=90%) in almost all countries, both in panel and refreshment samples. Refusal rates ranged from 22% to 49% and were the prime reason for sampled households not providing an

interview" [106]. To handle possible selection and participation biases, SHARE offers sample design weights [102, 105] (for further details please see analyses section).

**Patient and Public Involvement**

Patients and public were not involved in the development of the research question and the selection of outcome measures. On the basis of the SHARE documentation there is no detailed information available on the role of patients and the public designing and conducting the study [186, 187]. All in all, SHARE is based on the U.S. Health and Retirement Study (HRS) and the English Longitudinal Study of Ageing (ELSA) [186].

**Measures**

Interviews of the fourth SHARE wave included several items concerning health care. Before asking explicitly for GP visits, the following more general question was asked: '*During the last twelve months, about how many times in total have you seen or talked to a medical doctor about your health (exclude: dentist visits and hospital stays, include emergency room or outpatient clinic visits)?*'. If respondents accounted for more than 98 contacts, the number 98 was entered. The dependent variable, GP visits, was assessed by the reported number of contacts with general practitioners or doctors at health care centers in the last twelve months prior to the interview: '*How many of these contacts were with a general practitioner or with a doctor at your health care center?*'.

Predictors were self-rated health and social relationships with a focus on structural (social integration index, social contact frequency in the social network) and functional (number of emotionally close ties) dimensions.

The Social Integration Index by Berkmann et al. [116] has been shown to be a reliable and robust approach to represent the multidimensional construct of social integration. The index consists of three domains (1: marital status and cohabitation, 2: contacts with friends and family, 3: affiliation with voluntary associations; each scored from zero to two) ranging from

zero to six, with zero points meaning low and six points meaning high integration into their social environment.

First domain: if the respondent was single, divorced or widowed, zero points were given, and two points, if the person was married or living with a partner. '*What is your marital status? 1. Married and living together with spouse, 2. Registered partnership, 3. Married, living separated from spouse, 4. Never married, 5. Divorced, 6. Widowed*'. This item was dichotomized to having a partner or not. Second domain: the number of social ties to different people was counted and transformed into three categories connected to different scores (0: 0 contacts, 1: 1-2 contacts, 2: 3 or more contacts). This categorization is based on the answers to the following question: '*Please give me the first name of the person with whom you often discuss things that are important to you*'. Respondents could name up to seven people. Third domain: the affiliation with voluntary organizations was measured by activities in any of the five social groups: '*Which of the activities have you done in the past twelve months? 1. Done voluntary or charity work, 2. Attended an educational or training course, 3. Gone to a sport, social or other kind of club, 4. Taken part in activities of a religious organization (church, synagogue, mosque etc.), 5. Taken part in a political or community-related organization*'. Being part of no organization resulted in a score of zero, one organization meant one point and two or more memberships scored two points.

Furthermore, the survey included items on the characteristics of social relationships, e.g. social contact frequency and emotional closeness to people in the personal network. This module was based on other similar studies, such as the National Social Life, Health, and Aging Project (NSHAP) [117], the American General Social Survey and the Longitudinal Aging Study Amsterdam [118-120]. Social contact frequency was assessed by the following question: '*During the past twelve months, how often did you have contact with [person XY] either personally, by phone or mail? 1. Daily, 2. Several times a week, 3. About once a week, 4. About every two weeks, 5. About once a month, 6. Less than once a month or never*'. The analyses include the average social contact frequency in the personal network. The question on emotional closeness to the personal network members is: '*How close do you feel to [person*

*XY]? 1. Not very close, 2. Somewhat close, 3. Very close, 4. Extremely close*'. For the analyses, the number of very or extremely close people in the personal network was counted (range: 0 to 7). Consequently, it represents not only a structural, but also functional dimension of social relationships.

We used self-rated health ('*Would you say your health is...?')* on a five-point-scale ('*0. Poor, 1. Fair, 2. Good, 3. Very good, 4. Excellent*') to assess the peoples' health status.

Sociodemographic (gender, age) and socioeconomic (education, employment status, income: make ends meet) factors were used as covariates (Annex: Chapter 3, Supplement Table 1). Education was based on the *International Standard Classification of Education (ISCED 1997)* and ranged from 0 to 6 (low to higher education). Employment status was split into five categories *(0 = employed, 1 = retired, 2= unemployed, 3= permanently sick or disabled and 4 = homemaking respondents)*. Material well-being of individuals was measured by the question: *'Thinking of your household's total monthly income, would you say that your household is able to make ends meet…?'* (*0 = with great or some difficulty, 1 = fairly easy or easy*).

The correlation matrix of the covariates did not reveal strong or very strong associations between similar variables (Annex: Chapter 3, Supplement Table 1). The highest correlation was found between education and financial distress (r = 0.22). Hence, the level of confounding within the following analyses can be rated as low to moderate.

**Analyses**

Regression models were used to analyze the associations between GP use and the predictors. The dependent variable "reported number of GP visits in the last 12 months" is a discrete count variable following a Poisson distribution. As the variance of the dependent variable is greater than its mean, negative binomial regression was used to account for the significant evidence of overdispersion. Furthermore, negative binomial regression models include a parameter that reflects unobserved heterogeneity among observations [122].

Due to the complex sample structure, including individual level, household level and country level, a survey design was implemented [102, 123].To account for within-household

correlations and between-country differences, households were defined as primary sampling unit and countries as strata. Furthermore, to adjust for variation in selection probabilities by design and for variation in participation probabilities caused by non-response, sample design weights were used [105]. In the case of Stata the survey command and in R the survey-package were used to adequately handle weighted and stratified data [124-126].

Since this study aimed to analyze potential moderation of social relationships on the association between self-rated health and GP use, interaction terms were introduced [127]. Three different two-way interaction terms were calculated: 1) self-rated health*social integration index, 2) self-rated health*average of social contact frequency in social network and 3) self-rated health* number of very to extremely close people in social network. Finally, three-way interactions were computed to elaborate the role of the employment status within the interaction between health and social relationships (health*social relationship*employment status). The analyses were performed with Stata 12 and were replicated with R [128].

## 3.3 Results

Our descriptive results are based on the unweighted sample (Tab. 3-1). The median of the reported number of GP visits in the last 12 months was 3. More than half of the participants were female and the mean age was about 66.4 years. 26% were employed and 39% had difficulty to make ends meet with regard to their income.

**Tab. 3-1: Descriptive statistics of the sample (SHARE, wave four, 2011, 16 countries).**

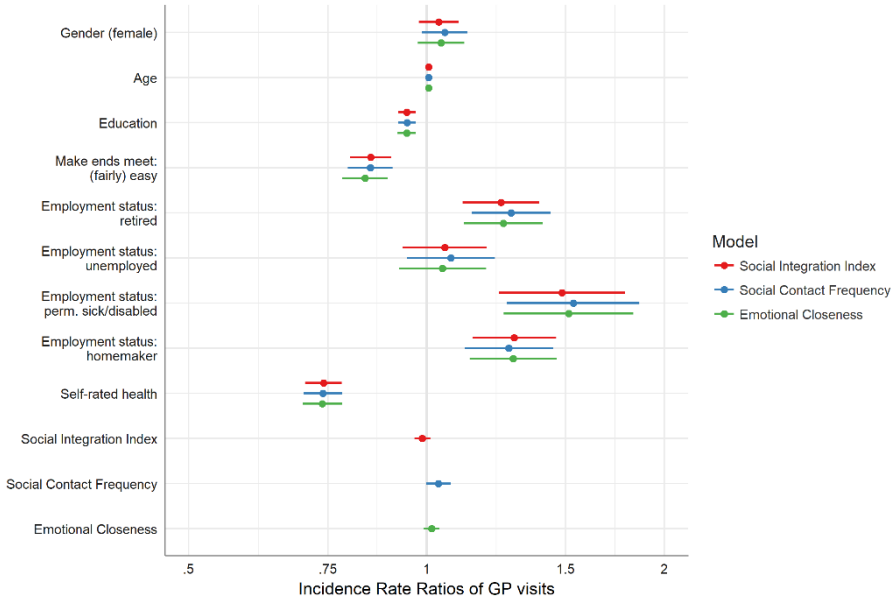
| **Variables** | |
|---|---|
| GP visits[a]: Median / 25%-Percentile / 75%-Percentile / Mean (SD) | 3 / 2 / 6 / 5.08 (7.38) |
| Female: N (%) | 31,969 (56.10) |
| Age in years[b]: Mean (SD) | 66.37 (10.05) |
| Education[c] (ISCED-1997 Coding: 0=low – 6=high): Mean (SD) | 2.77 (1.44) |
| *Pre-primary* | 1,682 (2.95) |
| *ISCED-1997 Code 1 (primary)* | 10,943 (19.20) |
| *ISCED-1997 Code 2 (lower-secondary)* | 10,804 (18.96) |
| *ISCED-1997 Code 3 (upper-secondary)* | 18,751 (32.90) |
| *ISCED-1997 Code 4 (post-secondary and non-tertiary)* | 2,597 (4.56) |
| *ISCED-1997 Code 5 (first stage of tertiary)* | 10,514 (18.45) |
| *ISCED-1997 Code 6 (second stage of tertiary)* | 454 (0.80) |
| Job status[d]: N (%) | |
| *Employed* | 14,736 (25.86) |

| | |
|---|---|
| *Retired* | 35,207 (61.78) |
| *Unemployed* | 1.821 (3,20) |
| *permanently sick or disabled* | 1.863 (3.27) |
| *Homemaker* | 2,265 (3.97) |
| Income: make ends meet[e]: N (%) | |
| *with great or some difficulty* | 22,319 (39.16) |
| *fairly easy or easy* | 33,157 (58.18) |
| Self-rated health (0=poor – 4=excellent)[f]: Mean (SD) | 1.74 (1.08) |
| *Poor* | 7,307 (12.82) |
| *Fair* | 16,841 (29.55) |
| *Good* | 19,754 (34.66) |
| *very good* | 9,066 (15.91) |
| *Excellent* | 3,744 (6.57) |
| Social integration index (0=low – 6=high)[g]: Mean (SD) | 3.55 (1.39) |
| Average of social contact frequency in social network (0=less than once per month or never – 5=daily)[h]: Mean (SD) | 4.07 (0.99) |
| Number of very to extremely close people in social network (0-7)[i]: Mean (SD) | 2.16 (1.45) |
| Unweighted sample (= number of observations) | n = 56,989 |
| *Missing values (out of 56,989): [a] 7,296, [b] 5, [c] 1,244, [d] 1,097, [e] 1,513, [f] 277, [g] 1,024, [h] 4,451, [i] 3,385* | |

### *i) Associations between social relationships and GP visits*

To answer research question (i), Fig. 3-1 shows the forest plots of incidence rate ratios of negative binomial regression models for GP use, for the different social relationship indicators (Model 1: social integration index, Model 2: average social contact frequency in social network and Model 3: number of emotionally very close contacts).

**Fig. 3-1: Forest plots of incidence rate ratios for GP use**

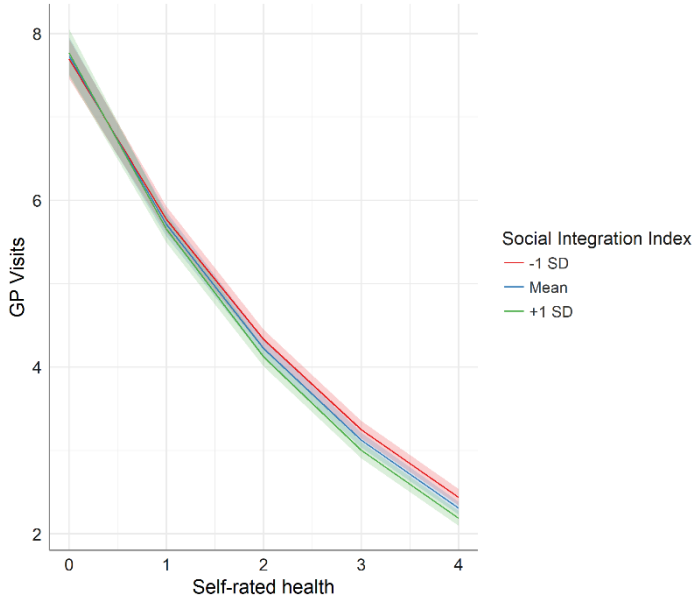


The regression analysis of Model 1 (Fig. 3-1, Annex: Chapter 3, Supplement Table 2) shows that the social integration index is not statistically significantly associated with the rate of GP visits (IRR=0.99, 95%CI 0.97-1.01). Better self-rated health (IRR=0.74, 95%CI 0.70-0.78), easily making ends meet (IRR=0.85, 95%CI 0.80-0.90) and higher educational status (IRR=0.94, 95%CI 0.92-0.97) are strongly associated with lower frequency of GP visits. Older age shows a slightly positive association with a higher rate of GP visits (IRR=1.01, 95%CI 1.0-1.01). Not-employed persons show higher frequency of GP visits (employed: reference, retired: IRR=1.24, 95%CI 1.11-1.39, unemployed: IRR=1.05, 95%CI 0.93-1.19, permanently sick or disabled: IRR=1.48, 95%CI 1.24-1.78, homemaker: IRR=1.29, 95%CI 1.14-1.46). The regression analysis of Model 2 (Fig. 3-1, Annex: Chapter 3, Supplement Table 2) shows that the social contact frequency within a social network is not statistically significantly associated with the rate of GP visits (IRR=1.04, 95%CI 1.00-1.07). The regression analysis of Model 3 (Fig. 3-1, Annex: Chapter 3, Supplement Table 2) indicates that being closely connected is not statistically significantly associated with the rate of GP visits (IRR=1.02, 95%CI 0.99-1.04). In all three models, social relationship coefficients showed low magnitude and narrow confidence intervals.

### *ii) Moderation of social relationships on health and GP use*

To answer research question (ii), Fig. 3-2 shows the expected number of GP visits depending on the two way interaction between health status and social integration index (Annex: Chapter 3, Supplement Table 3). The blue line represents people with a mean level of social integration. The red line is based on a lower level of social integration (mean minus one standard deviation), whereas the green line stands for a higher level of social integration (mean plus one standard deviation).

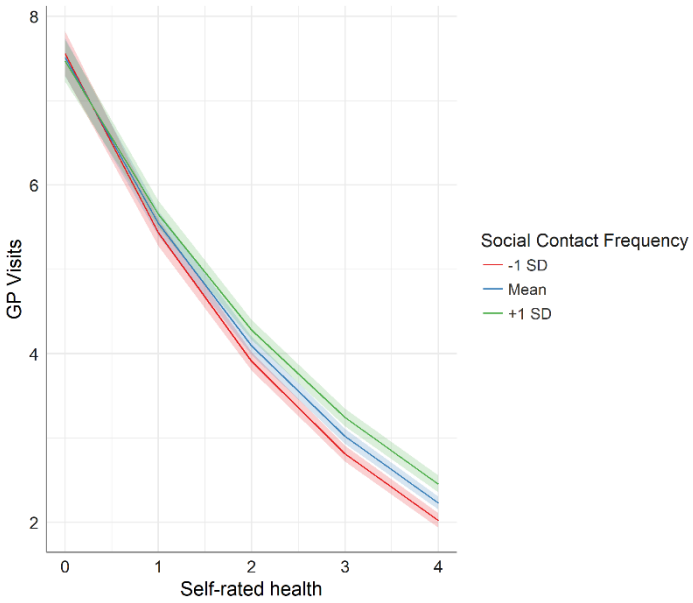
**Fig. 3-2: Number of GP visits on health & social integration**




Starting at nearly eight visits per year for people with poor health, the estimated average number of visits steadily decreases with better health status, ending at about two visits for people with excellent self-rated health. This trend can be observed for all three levels of social integration, but taking the confidence intervals into account, the divergence of the groups is not statistically significant at any level of health status. Nevertheless, the largest slope is detected for less socially integrated people and the smallest slope is documented for more socially integrated people.

Fig. 3-3 shows the number of GP visits in dependence of health and social contact frequency in social networks (Annex: Chapter 3, Supplement Table 3).

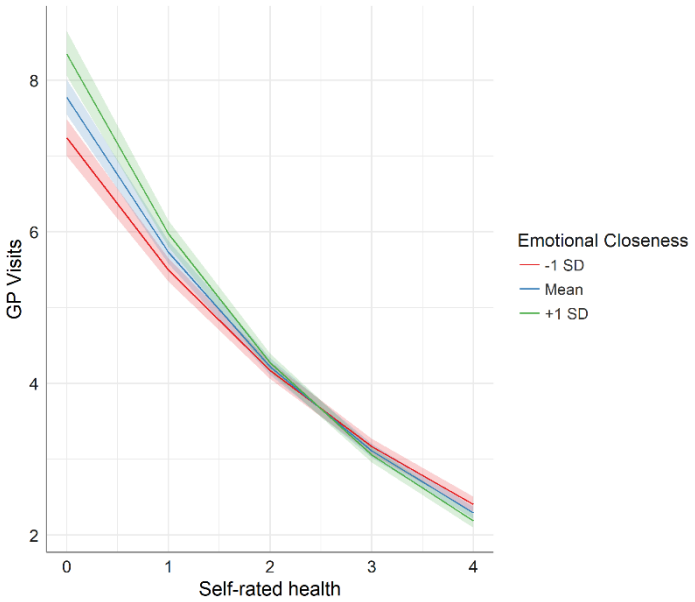
**Fig. 3-3: Number of GP visits on health & social contact frequency**




All in all, the patterns are similar to Fig. 3-2, but the slopes of the groups with lower and higher contact frequencies are the other way round. The slope of estimated number of GP visits on self-rated health is steeper for those with lower social contact frequency. This association is statistically significant for people with a very good and excellent health, although the differences in the slopes are relatively small.

Fig. 3-4 shows the expected number of GP visits according to various levels of subjective health and the number of very close people in social networks (Annex: Chapter 3, Supplement Table 3).

**Fig. 3-4: Number of GP visits on health & emotional closeness**



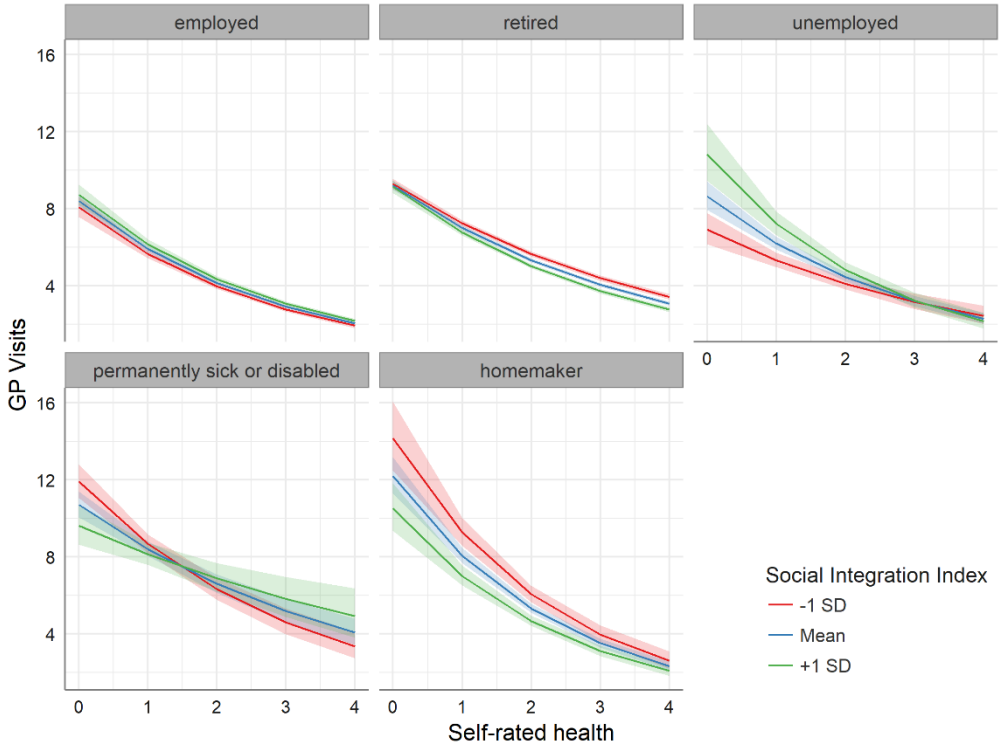

Again, we see the downward trend of estimated average number of GP visits from poor to excellent health. In contrary to Fig. 3-3, group differences are only observable for people with poor health. People with poor health and an emotionally close network show a significantly higher number of GP visits compared to people with poor health and less closeness.

***iii) Moderation of social relationships and employment types on health and GP visits***

To answer research question (iii), Fig. 3-5, 3-6 and 3-7 incorporate the three way interactions between health, social relationships and employment status in relation to the number of GP visits.

Fig. 3-5 shows the expected number of GP visits depending on the three-way interaction between health, social integration index and employment status based on the full sample (Annex: Chapter 3, Supplement Table 4).

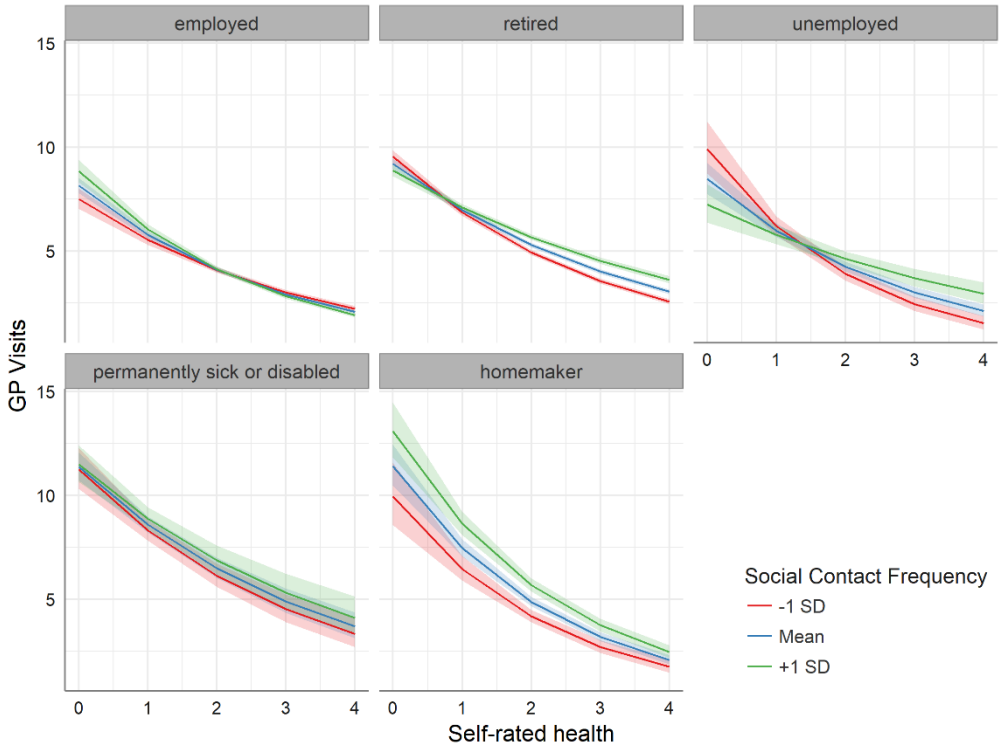
**Fig. 3-5: Number of GP visits on health, social integration & employment status**




The slopes of the different employment status groups are very diverse, in particular, when the disparate levels of social integration are taken into account. Retired, unemployed, permanently sick or disabled and homemaking people show higher numbers of GP visits on average compared to employed people. Furthermore, the diverging slopes of various social integration indices of those groups also indicate more between-group differences than employed people. Retired people with good, very good or excellent health, for instance, have more GP visits if they are less integrated than retirees who are socially well integrated. This association is inverse with regard to unemployed people with a lower health status.

Considering the social contact frequency, group differences depending on employment status and different grades of contact frequencies in social networks are similar to those seen for social integration (Fig. 3-6, Annex: Chapter 3, Supplement Table 4).

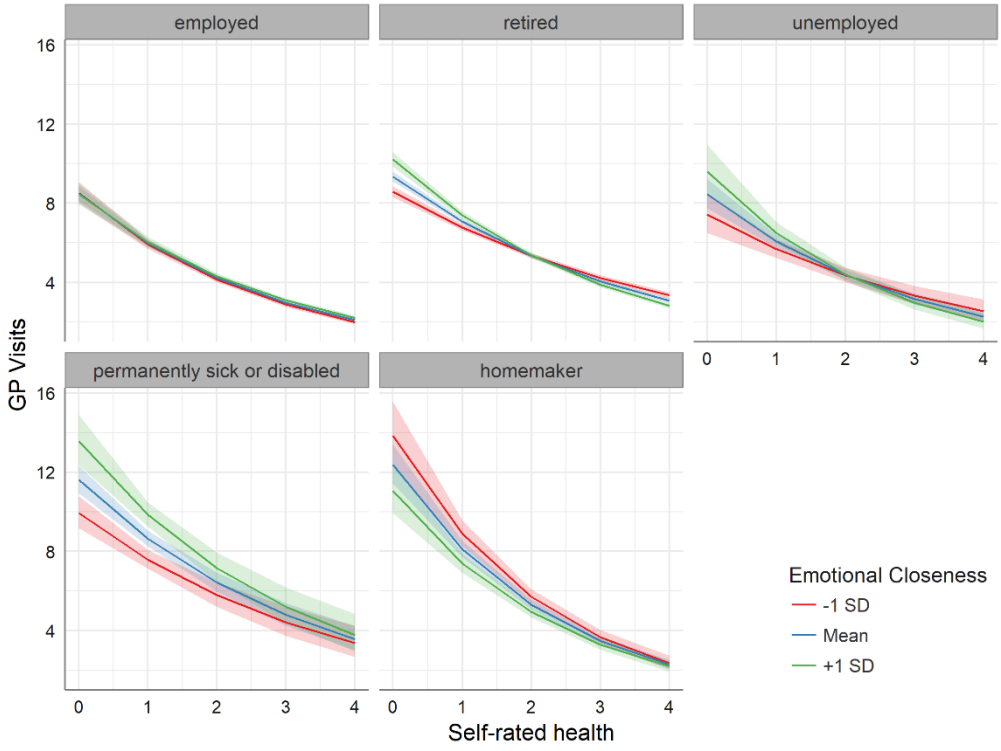
**Fig. 3-6: Number of GP visits on health, social contact frequency & employment status**




Retired people with good to excellent health, for example, show more GP visits if their social contact frequency in their social network is high on average compared to lower contact frequencies. This association is also observable for homemaking people with an intermediate health status.

Fig. 3-7 shows the estimated average number of GP visits depending on the three-way interaction between health, number of very close contacts and employment status (Annex: Chapter 3, Supplement Table 4).

**Fig. 3-7: Number of GP visits on health, closeness & employment status**




The slopes in the group of retired people show statistically significant differences between various levels of emotional closeness. A higher number of emotionally close contacts increases the expected number of GP visits, if retired people are characterized by poor or fair self-rated health. This association is also shown within the group of permanently sick or disabled people.

## 3.4 Discussion

**Summary**

Focusing on older adults in Europe, this was the first study to investigate (i) how social relationships are associated with the frequency of GP visits, (ii) if social ties moderate the

association between self-rated health and GP use, and (ii) how these associations vary in subgroups of different employment status.

Regarding research question (i), the structural (social integration, social contact frequency) and functional (number of emotionally close contacts) dimensions of social relationships under investigation are not statistically significantly associated with GP use frequency. On the one hand, our results are in line with a number of studies on structural and functional aspects of social relationships [14, 32, 62, 135, 137]. Studies on structural aspects of social relationships, e.g. marital status, living arrangements and family size, showed no statistically significant associations with the frequency of physician use [32, 135, 137]. Furthermore, studies on functional aspects of social relationships, e.g. social anchorage, social support and emotional, instrumental and informational support, demonstrated no statistically significant associations with regard to the use of primary care services [14, 62]. On the other hand, and with regard to structural measures of social relationships, empirical results are inconsistent until now. Various studies on outpatient care use showed that older people living alone are more likely to consult a physician [61, 134, 138]. One study showed that married older people have a lower probability of using GP services [62]. Others demonstrated that older people living in a marriage or with their children present a higher frequency of physician consultations [28, 63]. With regard to the size of the social network, studies found negative associations [31, 58], and others ambiguous [59] or positive associations [60]. Moreover, Kim & Konrath [188] did not find a statistically significant association between volunteering and the frequency of doctor visits. A possible explanation for these inconsistent empirical patterns can be seen in the quality dimension of social relationships to partners, family and social network members. For instance, Foreman et al. [28] found a negative association between harmonious family relationships and the number of physician visits. International studies on functional dimensions of social relationships demonstrated that different aspects of received social support (e.g., material, instrumental and informational support) are positively linked with GP use [12, 29, 30]. Frequent and close social contacts are not only a potential source of social support, but also

for psychological distress and physical discomfort, conceivably leading to higher GP use rates [189, 190].

Regarding research question (ii), the analyses show hardly any substantial and statistically significant moderating effects of different aspects of social relations on the link between self-rated health and frequency of GP visits. Only for older adults with poor self-rated health, an increase of the number of emotionally close members in the social network is associated with a growing rate of GP visits (Fig. 3-4). Furthermore, older adults with very good or excellent health show a higher rate of GP visits with an increase of their social contact frequency in the social network (Fig. 3-3), while social contact frequency seems to play a less important role for people with poorer health. Potentially, a higher density of social networks fosters the GP use by providing support and resources, but only for people with better health. The differences are statistically significant, but they have a lower magnitude.

Three way interaction analyses regarding research question (iii) indicate employment status-specific behavioral patterns with regard to social relationships and GP use, but coefficients were mostly not significant. Analyses focusing on older people who are retired, unemployed, permanently sick or disabled or homemakers, show various results. All in all, the groups of retired, unemployed, permanently sick/disabled and homemaking people show a higher estimated average number of GP visits. Comparing those groups with each other also presents diverging patterns of associations. A higher level of social integration was associated with lower rates of GP use for retirees, but was associated with a higher frequency of visits for unemployed older adults, especially for unemployed older people with a poor self-rated health (Fig. 3-5). “Having a partner”, which is included in the social integration index, contributed the most to this association. Atkinson et al. [57] showed that unemployment has a negative effect on marital and family support and a positive effect on the utilization of external help including emotional support, information or advice and concrete assistance. Potentially, unemployed people struggle not only with their psychological well-being but also with their social relationships. Consequently, they use more external help including the consultation of GPs. Homemakers use more GP visits, if their social contact frequency is higher, especially, if their

health status is rated as fair or good. This holds also true for retirees with a higher self-rated health status (Fig. 3-6). The more emotionally close contacts are present, the higher is the use for GP doctors by retired and permanently sick or disabled people with lower health status (Fig. 3-7).

**Limitations**

When interpreting the results, some methodological limitations need to be taken into account. Firstly, our analyses were based on cross-sectional data, forbidding statements on causal directions and changes over time. The cross-sectional design was chosen due to the inclusion of social relationship variables from SHARE's "social networks" module which was applied only in wave four [102, 103, 145]. Therefore, the postulated buffer function of social integration (of retirees and homemakers) on the reported number of GP visits in the last 12 months, for instance, is only one possible explanation. Another scenario may be the healthy user effect due to volunteering activities which are included in the social integration index. Healthier people with less GP visits have more resources to invest into their social integration. Furthermore, some of the differences between employment types may be related to temporary resources, since employed people have less time available to consult their GP.

SHARE is an international survey aiming for high methodological standards by using ex-ante harmonization to minimize "artifacts in cross-national comparisons that are created by country-specific survey design" [106], but the schedule for data collection in wave 4 was only partly synchronized and household response rates vary between countries (39% to 63 %). Due to unit non-response and panel attrition, sample selection bias is a potential problem limiting the representativeness of the data and the generalizability of results [103]. However, non-response analyses taking various variables into account (gender, age, health, employment, number of children, and income) showed only little evidence for non-response bias (e.g., a slightly larger number of males among respondents than non-respondents) [105].

The question to assess the use of GP doctors across 12 months is established in health services research [13, 31, 59, 175], but has some methodological drawbacks. The question is

narrowed to the reported number of GP or doctor visits in a health care center. Contacts with nurses at GP practices are not taken into account. Potentially, the level of using primary care is underestimated. The time span covering the GP contacts is quite long, and considering the older age of the interviewed individuals, risk of memory bias is existent with regard to self-reported utilization [146]. Bhandari and Wagner found in their systematic review on self-reported utilization of health care services that "[…] age was the most consistent demographic factor associated with self-report inaccuracy […]" by older adults underreporting their use [146]. Consequently, intercepts and age coefficients in our models could be potentially underestimated.

The limited level of information of self-reported data holds also true for all other variables in our analyses, especially for the variable "self-rated health" [147]. Self-rated health status is based on a single item, but it is considered a suitable summary of health status [148]. Studies on several representative samples showed that self-rated health ratings can be used as valid measures of health status regardless of different cultures and social conditions [149-151] and that they may correspond well to the objective health status [152, 153]. Caution is needed drawing conclusions from analyses using self-rated health. The same holds true for the variable "make ends meet", since the assessment of self-perceived financial distress compared to income represents an adequate and direct measure of the economic situation of individuals, especially among older individuals [191].

Furthermore, SHARE data did not provide information on the reasons for using health services or the quality and adequacy of health care services. Consequently, the reported number of GP visits in the last 12 months represents a proxy for "realized access" [10] only.

Another point that can be discussed is that one out of three domains of the social integration index focused on marital and partnership status and cohabitation. That focus cannot capture the whole variety of non-married or non-partner cohabiting household structures. Potentially, this lack of information is buffered by the other two domains, and especially, by the second domain of the social integration index by including the number of social ties. Nevertheless, the

level of social integration could be slightly higher than illustrated by our index. In particular, this could be true for countries with a higher number of “non-traditional” living arrangements.

Finally, and though SHARE strived to combine the indirect and direct approach of social network analysis [145], it does not offer sufficient and longitudinal data on functional and qualitative aspects of social relationships [155]. The synthesis of the indirect approach (referring on socio-demographic proxies) and the direct approach (linking meaningfulness and importance to social relations) still lacks valuable information about the quality of social relationships and perceived support.

## 3.5 CONCLUSIONS

Our results demonstrate that different indicators of social relationships are not associated with higher or lower frequency of GP visits. The magnitude of the associations is relatively low and most of the investigated associations are statistically insignificant. Nevertheless, the investigation of the two- and three-way interactions showed a complex, but interesting picture. This study indicates potential inequalities in GP use due to different dimensions and characteristics of social relationships, especially considering self-rated health and employment status of older adults.

Since, social relationships influence patient’s motives for visits and the patient’s compliance with regard to future visits for treatment, prevention and rehabilitation [159, 160], it may be helpful for health care providers to assess information on the patient’s “social background”. A patient, for instance, characterized by poor health and no emotionally close ties, visits a GP less frequently than his/her counterpart with poor health and closely connected within a social network. Potentially, these differences may produce inequalities in medical care and treatments. In health care, it is obligatory, e.g. for treatment planning, to decide in line with the patient on the adequacy of treatment and to incorporate the patient’s needs and resources to reach that goal. Therefore, the GP may want to know if a patient is socially integrated or isolated, and may want to evaluate if a patient needs or wants more or less social support. It

is important to emphasize that the observed behavioral differences of GP use, within the limits of the SHARE dataset, do not implicate inadequacies in GP doctor services, such as over- or underuse.

Future surveys should aim at assessing functional and quality dimensions of social relationships linked to health services use to shed more light on the underlying mechanisms. Finally, to define potential improvements in health systems and to inform health policy makers and health practitioners adequately, health services research needs to integrate information on the patient's motives for visits and on the levels, quality and outcomes of the treatments.

# 4 SOCIAL RELATIONSHIPS, AGE AND THE USE OF PREVENTIVE HEALTH SERVICES: FINDINGS FROM THE GERMAN AGEING SURVEY

## 4.1 ABSTRACT

This paper investigates the associations between social relationships, age and the use of preventive health services among German adults. Data stem from the German Ageing Survey (10,324 respondents). The use of preventive health services was assessed by asking for regular use of flu vaccination and cancer screening in the past years. Predictors of interest were structural (having a partner, size of the social network) and functional aspects of social relationships (perceived informational support) and age. Logistic regression models were used to measure the associations between preventive health services use and these predictors. Self-perceived health, gender and education were considered as covariates. Having a partner (OR = 1.20, 95% CI: 1.07–1.34) and perceived informational support (OR = 1.38, 95% CI: 1.13–1.69) were associated with a higher probability of getting flu vaccination regularly over the past years. Informational support (OR = 1.42, 95% CI: 1.17–1.72) and having a partner (OR = 1.57, 95% CI: 1.41–1.75) were positively associated with regular cancer screening over the past years. Associations between the size of the social network and use of preventive health services were not statistically significant. Associations between the use of preventive health services and social relationships varied by age. Structural and functional aspects of social relationships may support preventive health behavior. To increase preventive health behavior and the use of preventive health services, it is necessary to integrate information on social relationships into routine care and to strengthen sources of social support.

## 4.2 BACKGROUND

One of the tasks of the statutory health insurance in Germany is to prevent diseases and to promote health and healthy ageing regardless of peoples' gender and social status [77]. Ageing populations with changing health needs and chronic conditions are associated with a rising demand for health services [3]. Some disorders can be prevented or influenced positively by preventive interventions [5]. Primary prevention aims at reducing the risk of the onset of a disease. Flu vaccinations, for example, are part of primary prevention, since they have the capability to obviate different serious infectious diseases and to prevent unnecessary hospitalizations and premature deaths [5, 78]. Secondary prevention aims at detecting and treating diseases as early as possible. In the case of cancer, screening is especially important, since cancer is responsible for a vast number of deaths worldwide [79].

Following the 'Behavioral Model of Health Services Use' by Andersen, use of health services, a measure for health care access, is connected to a multitude of predisposing (e.g., age and gender), enabling (e.g., education, income and social status) and need characteristics (e.g., disease, symptoms and pain) [10]. Various studies showed that Andersen's framework also applies to the use of preventive health services [80-83]. For cancer screenings, different patterns of usage could be identified depending on sociodemographic features [84, 85, 192-194], health needs [86, 87, 195] and socioeconomic or psychological factors [84, 88-90, 193, 196-200]. The use of flu vaccinations also varies by sociodemographic factors [91, 92], health status [78, 92] and socioeconomic characteristics [93-95]. Since preventive health services are recommended by health authorities and paid for certain ages and risk groups by the statutory health insurance in Germany, age (as a predisposing characteristic) plays an important role regarding the use of cancer screenings and flu vaccinations [10]. From the age of 50, for example, the statutory health insurance pays for mammography screenings every two years [201]. For men, reaching the age of 45, the yearly use of prostate screenings is covered by the statutory health insurance [201]. Statutory health insurance also covers colorectal cancer screening starting with 50 years of age for both sexes [201]. Flu vaccination is a paid service for everybody and recommended for individuals aged 60 and older. Consequently, health

institutions are interested in higher rates of preventive health services use reaching certain ages. In Germany, the Federal Joint Committee (G-BA) decides which health and preventive health services (e.g., early detection programs on cancer) are covered by the statutory health insurance [202]. “In its assessments, the G-BA examines patient benefit […]. Patient benefit is defined as recovery, relief from pain or discomfort, improvement in quality of life, extension of life, or reduction of side effects” [202]. The age limits of preventive health services are part of the G-BA assessment.

Within the Behavioral Model of Andersen, enabling resources (e.g., education and family) can play a supportive role in the sense of creating potential access and foster realized access to health services [10]. Enabling resources also include the social environment, such as social relationships, that are known to be connected to health, health promotion and the use of health services [10, 203-205]. Social relationships are characterized by the individuals’ social support, social influence, social engagement and attachment, and have an impact on how they access resources [49]. In addition, international studies have shown that social relationships have a considerable influence on morbidity and mortality [22, 206]. Social relationships comprise structural and functional elements [22]. Structural aspects are assessed by quantitative measures (e.g., living arrangements, social network size and frequency of social participation). Functional aspects include elements of financial, instrumental, informational or emotional support.

To date, few international studies investigated the use of preventive health services in conjunction with dimensions of social relationships [96-101]. However, it is not clear how structural and functional aspects of social relationships are linked to preventive health services. Furthermore, it has not been investigated to which extent social relationships do have an impact on the link between age and preventive health services. Therefore, this paper investigates the associations between social relationships, age and the use of preventive health services among German adults aged forty years and older.

## 4.3 METHODS

### Data

Data stem from the public release of the fifth wave, in 2014, of the German Ageing Survey (DEAS), provided by the Research Data Centre of the German Centre of Gerontology (DZA) and funded by the Federal Ministry for Family Affairs, Senior Citizens, Women and Youth (BMFSFJ) [107, 108]. The population-based survey started in 1996 and included and was representative for individuals 40 years and older in Germany. After the initial survey, other waves followed in 2002, 2008, 2011 and 2014. The interviews covered information on health, occupational status, income, social relationships, life events, psychological well-being and much more [109]. In the fifth wave (2014) 7952 individuals filled out the 'drop-off' questionnaire, a questionnaire which was filled by the respondents without an interviewer. Due to panel attrition, each wave introduced new respondents to 'refresh' and to stabilize the absolute number of respondents in the sample. As such, 4295 individuals are part of this so-called refreshers sample (54%). The drop-off questionnaire contained items on the use preventive health services (cancer screening and flu vaccination). The response rate of the sample was 61% in 2014. These rates are comparable to other surveys executed in Germany [110]. Our analyses are based on the fifth wave of the German Ageing Survey which included cross-sectional data on perceived informational support, having a partner and social network size for a representative sample of the middle-aged and older population of Germany [110]. A written informed consent was given by every survey participant prior to the interview. The survey respected the Declaration of Helsinki [111].

### Measures

The use of preventive health services was assessed by asking for regular use of flu vaccination and cancer screening in the past years (no, yes). The predictors in focus were structural (having a partner, size of the social network) and functional aspects of social relationships (perceived informational support) and age. Having a partner was dichotomized (0 'having no partner', 1 'having a partner'). 'Having no partner' includes singles, divorced, widowed and

separated individuals. 'Having a partner' is defined by married people and registered partnerships living together. Size of the social network was assessed by asking for 'people who are important to you and who you maintain regular contact with'. 'These can include co-workers, neighbors, friends, acquaintances, relatives, and members of your household. Which people are important to you?' (the respondents could name the people; the names were counted and coded as 0 'no one' to 9 'nine or more people'). Perceived informational support was measured by asking 'When you have important personal decisions to make, do you have anyone you can ask for advice?' (0 'no', 1 'yes'). Age was measured in years.

Health indicators and other socio-demographic factors were included as covariates. In the current study, self-perceived health ('How would you rate your present state of health?') was measured on a five-point scale (1 'very good', 2 'good', 3 'average', 4 'bad' and 5 'very bad') as one health indicator. Furthermore, we included information on pre-existing diseases by taking into account the number of diseases ('Which of the following diseases and health problems do you have?'). The list of diseases covered fourteen chronic, somatic illnesses, for example, cardiac and circulatory disorders, respiratory problems/ asthma/ shortness of breath, cancer or diabetes. The respondent's sex was coded by male (= 0) and female (= 1). Education was based on the International Standard Classification of Education (ISCED 1997) and ranged from 1 to 3 (low to higher education). Low education is defined by ISCED 0–2 (= respondents without formal vocational qualification). Medium education based on ISCED 3–4 (= respondents with vocational training including respondents with higher general school certificate without professional training. Higher education represented ISCED 5–6 (= respondents with completed university studies or with completed professional development training).

**Analyses**

Since the two dependent variables "use of preventive health services" (flu vaccination and cancer screening) are binary (no/yes), two logistic regression models were used to measure the associations between each type of preventive health services use and the predictors (flu

vaccination = model 1; cancer screening = model 2). To adjust for disproportional stratifications of the baseline sample and selective panel mortality, weights were used [107, 129, 130]. To analyze a potential moderation of social relationships on the association between age and the two types of preventive health services, two-way interaction terms were introduced [127]. Three interaction terms were calculated for each of the two types of preventive health services: (1) age * informational support (model 1.1 and model 2.1), (2) age * having a partner (model 1.2 and model 2.2) and (3) age * social network size (model 1.3 and 2.3). In terms of cancer screening, age is added as cubic term to the model, since the relationship between the probability of using cancer screening and age was found to be non-linear. We defined $p < 0.05$ as threshold whether an association was considered statistically significant or not. The analyses were performed with Stata 12 [207] and were replicated with R 3.6.1 [131]. Marginal effects plots were created using the ggeffects-package 0.12.0 [132].

## 4.4 Results

Table 1 shows that 42.5% of the respondents used flu vaccinations regularly in the past years, and 63.3% used cancer screenings. Additionally, 69.9% of the respondents had a partner and 93% reported informational support. On average, social networks included 5.2 important persons with regular contact. More than half of the participants were female and the mean age was 64.5 years. Results also show that 51.6% attained a higher education (ISCED-1997 Coding) and 53.7% reported a good or very good health. On average, respondents reported 2.6 physical diseases.

**Tab. 4-1: Descriptive statistics of the sample by drop-off questionnaire (n= 7.952, German Ageing Survey), 2014).**

| Variables | N (%), Mean (SD) |
|---|---|
| Female: *N* (%) | 4056 (51.01) |
| Age: Mean (SD) | 64.54 (11.24) |
| Education[a] (ISCED-1997 Coding): *N* (%) | |
| *ISCED-1: low* | 521 (6.55) |
| *ISCED-2: medium* | 4100 (51.56) |
| *ISCED-3: high* | 3329 (41.86) |
| Self-perceived health[b]: *N* (%) | |
| *Very good* | 641 (8.06) |

| | |
|---|---|
| *Good* | 3631 (45.66) |
| *Average* | 2857 (35.93) |
| *Bad* | 670 (8.43) |
| *Very bad* | 145 (1.82) |
| Number of physical diseases [c]: Mean (SD) | 2.6 (1.89) |
| Having a partner (= yes)[d]: *N* (%) | 5556 (69.87) |
| Social network size: Mean (SD) | 5.22 (2.70) |
| Perceived informational support (= yes)[e]: *N* (%) | 7396 (93.01) |
| Regular flu vaccination in the past years (= yes)[f]: *N* (%) | 3383 (42.54) |
| Regular cancer screening in the past years (= yes)[g]: *N* (%) | 5034 (63.30) |
| *Missing values (out of 7952): [a] 1, [b] 8, [c] 148, [d] 16, [e] 22, [f] 202, [g] 279* | |

**Associations between SRs, age and PHS use**

Having a partner (OR = 1.20, 95% CI: 1.07–1.34) and perceived informational support (OR = 1.38, 95% CI: 1.13–1.69) were associated with a higher probability of getting flu vaccination regularly over the past years (Table 2). There was no statistically significant association between the size of the social network and flu vaccination. The probability of using flu vaccination increased by age (OR = 1.06, 95% CI: 1.05–1.06). Reporting a very good (OR = 0.50, 95% CI: 0.40–0.62) or good (OR = 0.73, 95% CI: 0.65–0.82) health was associated with a lower probability of getting flu vaccination regularly, whereas a very bad self-perceived health (OR = 1.70, 95% CI: 1.20–2.40) was connected to a higher probability. Furthermore, the probability of using flu vaccination increased by the number of reported physical diseases (OR = 1.08, 95% CI: 1.04–1.11).

**Tab. 4-2: Logistic regression models for flu vaccination (Model 1) and cancer screening (Model 2) (German Ageing Survey, 2014).**

| **Variables** | **Seasonal Flu Vaccination (Model 1)** | | **Cancer Screening (Model 2)** | |
|---|---|---|---|---|
| **Predictors** | **Odds Ratio** | **95% CI** | **Odds Ratio** | **95% CI** |
| Partner (Ref. no): yes | **1.20** | 1.07–1.34 | **1.57** | 1.41–1.75 |
| Social network size (number of important persons with regular contact) | 0.99 | 0.97–1.01 | 1.02 | 1.00–1.04 |
| Informational support (Ref. no): yes | **1.38** | 1.13–1.69 | **1.42** | 1.17–1.72 |
| Gender (Ref. male): female | 1.03 | 0.93–1.15 | **2.38** | 2.14–2.64 |
| Age in years | **1.06** | 1.05–1.06 | **1.34** | 1.29–1.40 |
| Age in years (cubic term) | | | 1.00 | 1.00–1.00 |
| Education (ISCED-1997) (Ref. ISCED-2: medium) | | | | |
| ISCED-1: low | 0.89 | 0.75–1.06 | 0.87 | 0.73–1.04 |
| ISCED-3: high | 1.03 | 0.93–1.15 | **1.14** | 1.02–1.27 |

| | | | | |
|---|---|---|---|---|
| Self-perceived health (Ref. average) | | | | |
| Very good | **0.50** | 0.40–0.62 | **0.78** | 0.64–0.95 |
| Good | **0.73** | 0.65–0.82 | 1.07 | 0.95–1.20 |
| Bad | 1.07 | 0.89–1.29 | **0.78** | 0.65–0.94 |
| Very bad | **1.70** | 1.20–2.40 | 0.77 | 0.55–1.08 |
| Number of physical diseases | **1.08** | 1.04–1.11 | **1.05** | 1.01–1.08 |
| Intercept | 0.01 | 0.01–0.02 | 0.00 | 0.00–0.00 |
| Number of observations | | 7588 | | 7515 |

Respondents with perceived informational support (OR = 1.42, 95% CI: 1.17–1.72) and having a partner (OR = 1.57, 95% CI: 1.41–1.75) were more likely to use cancer screening (Table 2). The odds ratios of the size of the social network and of education on using cancer screenings were not statistically significant. Furthermore, we found a statistically significant relationship between age and the use of cancer screening (age: OR = 1.34, 95% CI: 1.29–1.40; age 2: OR = 1.00, 95% CI: 1.00–1.00). Age was positively associated with the use of cancer screening up to around 63 years. However, ageing 63 and older the association is negative. Individuals with a higher education (OR = 1.14, 95% CI: 1.02–1.27) were more likely to utilize cancer screening. Moreover, reporting a very good health (OR = 0.78, 95% CI: 0.64–0.95) or a bad health status (OR = 0.78, 95% CI: 0.65–0.94) was associated with a lower probability of getting cancer screenings regularly. Furthermore, the probability of using cancer screening slightly increased by the number of reported physical diseases (OR = 1.05, 95% CI: 1.01–1.08).

**Moderation of SRs on age and PHS use**

The associations between the use of preventive health services (flu vaccination, cancer screening) and age varied by social relationships (having a partner, perceived informational support). The proportion of respondents using flu vaccination increased by age. We found a difference if someone perceived informational support or not for the age group of 60 to 75 years old (Fig. 4-1). Within that age group, respondents who perceived informational support showed a significantly higher chance of getting flu shots. The proportion of people using cancer screening increased within the age group of 40 to 65 years, then decreasing constantly until

the age of 95 (Fig. 4-2). The chance of using cancer screenings is significantly higher for people aged 43 to 66 if they perceived informational support.

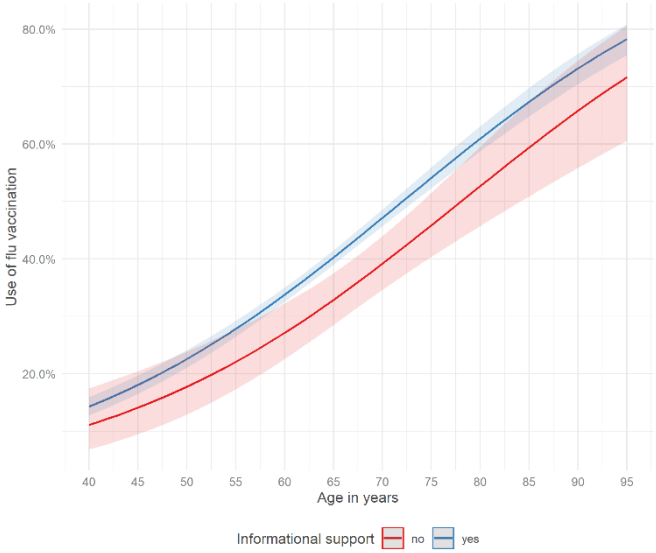



**Fig. 4-1: Use of flu vaccination (Model 1.1) on age and informational support (German Ageing Survey, 2014).**


**Fig. 4-2: Use of cancer screening (Model 2.1) on age and informational support (German Ageing Survey, 2014).**

Fig. 4-3 shows the use of flu vaccination by age and having a partner. People having a partner only had a slightly higher chance of using flu shots than people without a partner. In both groups, the proportion of demanding flu vaccination increased by age. For cancer screenings, Fig. 4-4 shows a different picture. From 50 up to 95 years, the ratio of people using cancer screening was higher if respondents reported having a partner. The highest proportion of cancer screening users could be measured at 65 years if a partner was present (75%) and at around 60 years if not having a partner (65%).

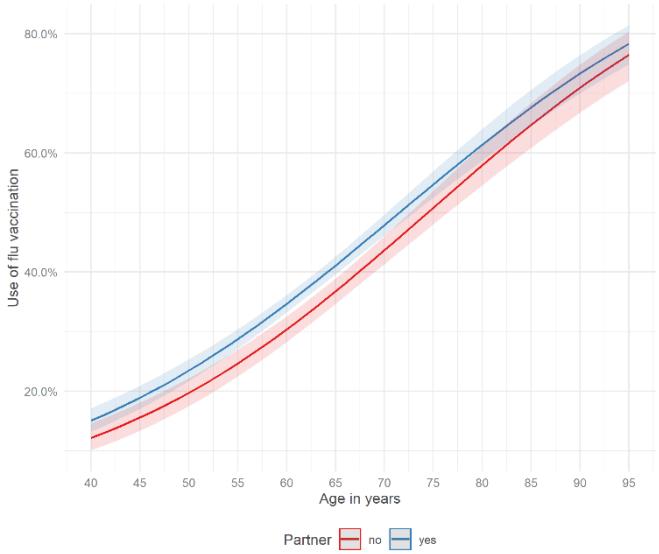



**Fig. 4-3: Use of flu vaccination (Model 1.2.) on age and having a partner (German Ageing Survey, 2014).**

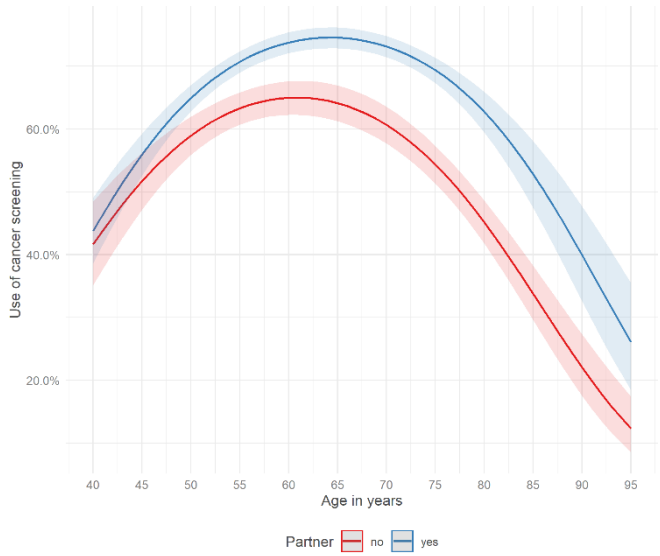
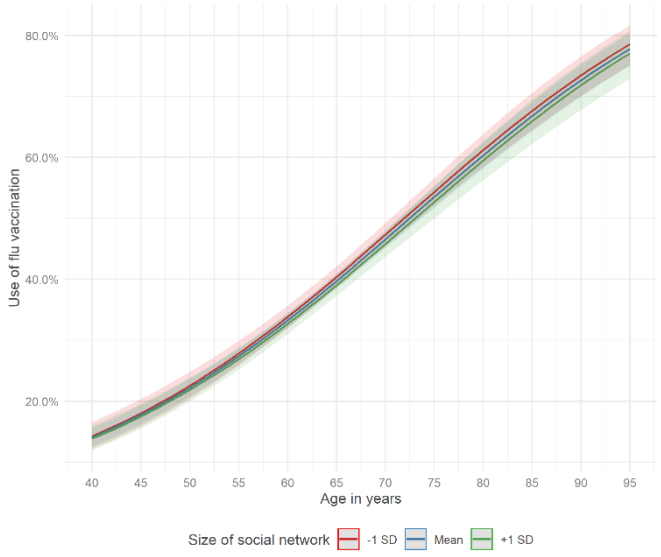



**Fig. 4-4: Use of cancer screening (Model 2.2.) on age and having a partner (German Ageing Survey, 2014).**

Fig. 4-5 and Fig. 4-6 do not show any major differences in using preventive health services (flu vaccination and cancer screening) taking age and the size of the social network into account. Merely, the use of cancer screenings demonstrated some small gaps between the subgroups (of social network size) in certain age intervals (Fig. 4-6). The general curve characteristics in Fig. 4-5 and Fig. 4-6 were similar to the figures above. The figures, shown above, based on interaction models which are presented in the supplementary material (Annex, chapter 4, supplement table S1).

**Fig. 4-5: Use of flu vaccination (Model 1.3) on age and social network size (German Ageing Survey, 2014).**



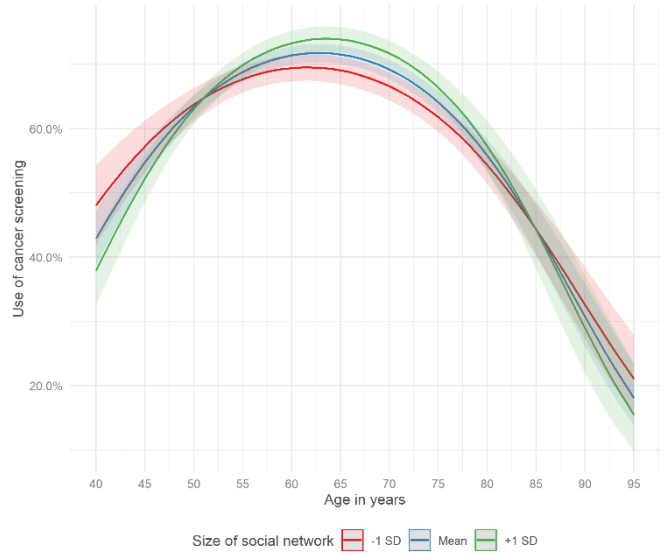




**Fig. 4-6: Use of cancer screening (Model 2.3) on age and social network size (German Ageing Survey, 2014).**

## 4.5 DISCUSSION

**Summary**

This study revealed that a functional aspect of social relationships (perceived informational support) was associated with a higher probability of using flu vaccination and cancer screening in a German sample of people aged 40 years and older. The association between one structural factor of social relationships and the use of preventive health services was statistically significant (having a partner), the other one was not (size of the social network). Moreover, the probability of using flu vaccination increased by age. Considering the use of cancer screening, the odds were increasing by age among those aged 40 to 63. After the age of 63 people were less likely to use cancer screening. Potentially, this observation could be partly explained by recommended age limits with regard to certain cancer screening types in Germany (e.g., colon, rectum and mammography screening) [208]. Furthermore, the associations between the use of preventive health services and age varied by different dimensions of social relationships. With regards to the use of flu vaccination, perceiving informal support seems to be a supportive factor especially for the age of 60 to 75. This held also true for people in their early 40s up to 66 with regard to cancer screening. Having a partner seemed to encourage the use of cancer screening, especially for people aged 50 years and older.

Kinney, Bloor, Martin et al. reported that people who were structurally well integrated, had a higher chance of reporting recent use of colorectal cancer screening [97]. Functional and instrumental support, representing functional aspects of social relationships, were not associated with the use of colorectal cancer screening. While the findings on the positive association between social relationships and cancer screening were in line with our results, we also found statistically significant associations between functional aspects of social ties and preventive health services. Allen, Sorensen, Stoddard et al. investigated the relationship between social network characteristics and breast cancer screening among employed women [96]. In their multivariable analyses, social network characteristics did not predict using regular screening. Only the perception that screening is socially desirable led to increased usage.

Potentially, our results on social network size could be in line with these findings. Suarez, Ramirez, Villareal et al. formed an index on social integration including structural and functional elements of social relationships (number of close relatives and friends, frequency of contact, church membership) and linked it to various types of cancer screenings among four U. S. Hispanic groups (Mexican, Central-American, Cuban and Puerto Rican) [98]. Their results showed a complex picture of no, weak and strong associations depending on the type of screening and the four Hispanic groups.

Like other studies, we found that age was associated with vaccination uptake [139, 140]. Being married or living with others has been associated with vaccination acceptance in some studies [141, 142]. Furthermore, several studies on barriers and facilitators of getting influenza immunization indicated that advice from and health discussions with family and friends may trigger the acceptance and use of flu vaccination [99-101, 143]. Consequently, our results concerning the positive associations between functional aspects of social relationship could support and add to the existing literature on social ties and the use of flu vaccination.

All in all, functional and structural aspects of social relationships were associated with a higher probability of using preventive health services. Living in a partnership and perceiving informational support seem to enable individuals to access preventive health services and to support their preventive health behavior. Furthermore, the results showed that age played a crucial role in using preventive health services. In the age curves of preventive health services, fundamental differences between flu vaccination and cancer screening could be shown. While the age curve of flu vaccination almost showed a linear trend, the age curve of cancer screening was concave. The moderator analyses showed that social relationships moderate the link between age and the use of preventive health services. In the case of flu vaccination, individuals, aged 60–75 and perceiving informational support, had a higher chance of use. With regard to cancer screening, informational support increased the probability of use in the age group 43–66 and living in a partnership promoted the chance of use among those 50 years and older. Consequently, functional and structural aspects of social relationships seem to have the potential to enable the use of preventive health services, especially of cancer screening.

**Limitations**

Methodological limitations need to be taken into account, when interpreting the results. Due to changes of the measurement of preventive health services between the waves of the German Ageing Survey, only cross-sectional data were used for the analyses [109]. Therefore, it is not possible to comment on changes over time and causal directions. Secondly, the items on using preventive health services were based on self-reports and on a rather vague time span by asking for regular use of flu vaccination and cancer screening in the past years. The time span covering the preventive health services can be quite long, and considering the older age of some respondents, risk of memory bias could be existent regarding the use of preventive health services [146]. Moreover, the item on using cancer screening did not specify which type of cancer screening was meant. It was formulated in general terms. Consequently, further subgroup analyses were not possible. Moreover, the German Ageing Survey did not provide information on the motives for using preventive health services, their quality and adequacy. Consequently, our preventive health services item represents a proxy for "realized access" [10] only.

Besides methodological limitations, there is an ongoing debate on the effectiveness or harmfulness of preventive health services, especially, concerning cancer screenings and flu vaccination [156-158]. It is important to keep that in mind, when discussing the use of preventive health services in general. Simonsen et al. questioned the effectiveness of flu vaccination, for example, concerning mortality benefits of flu vaccination in elderly people, since frailty selection bias, the use of non-specific endpoints could have resulted in exaggerating vaccine benefits in cohort studies [158]. They conclude that "the remaining evidence base is currently insufficient to indicate the magnitude of the mortality benefit, if any, that elderly people derive from the vaccination programme" [158]. Furthermore, flu vaccination may have side-effects for health. Kwok stated that "vaccines do carry risks, ranging from rashes or tenderness at the site of injection to fever-associated seizures […] and dangerous infections in those with compromised immune systems" [209], although severe complications are unusual and it is difficult to show that a vaccine is the cause for them [209]. With regard to

the controversy over cancer screenings, radiation risks are one part of it [156]. The controversy also includes arguments on over-treatment and over-diagnosis of cancer. Esserman et al. noted that “screening and patient awareness have increased the chance of identifying a spectrum of cancers, some of which are not life threatening. Policies that prevent or reduce the chance of overdiagnosis and avoid overtreatment are needed, while maintaining those gains by which early detection is a major contributor to decreasing mortality and locally advanced disease” [210].

Concepts of social relationships which were used in our study (having a partner, informational support and social network size) were only indirect measures of structural (having a partner, social network size) and functional aspects (informational support) of social relationships. Especially, the partner variable or the size of social networks were only rough measures for social connectedness and the feeling for belonging and being cared for. Our data did not include information on the qualitative partnership or social network functioning which could be differentiated into costs (e.g., psychological distress, destructive conflicts) and benefits (e.g., belonging, meaning). Since social relationships could have positive and negative aspects, they could lead to different health and health behavior outcomes [154]. Although the indirect approach (referring on socio-demographic proxies) and the direct approach (linking meaningfulness and importance to social relations) are used in the German Ageing Survey, specific information about the quality of social relationships and the level of social support were missing [155].

## 4.6 Conclusions

Having a partner and perceived informational support were associated with a higher probability of using preventive health services. The social environment, like structural and functional aspects of social relationships, may support preventive health behavior, especially within certain age groups (flu vaccination: informational support and age of 60–75; cancer screening: informational support and age of 43–66, having a partner and age of 50–95). If health policy and health professionals want to increase preventive health behavior and the use of preventive

health services, it is necessary to integrate information on social relationships into routine care and to strengthen sources of social support.

# 5 ANNEX

## Chapter 2

Social relationships and physician utilization among older adults: A systematic review

S1 File. Protocol PROSPERO

https://doi.org/10.1371/journal.pone.0185672.s001

S1 Text. Search syntax for PubMed

https://doi.org/10.1371/journal.pone.0185672.s002

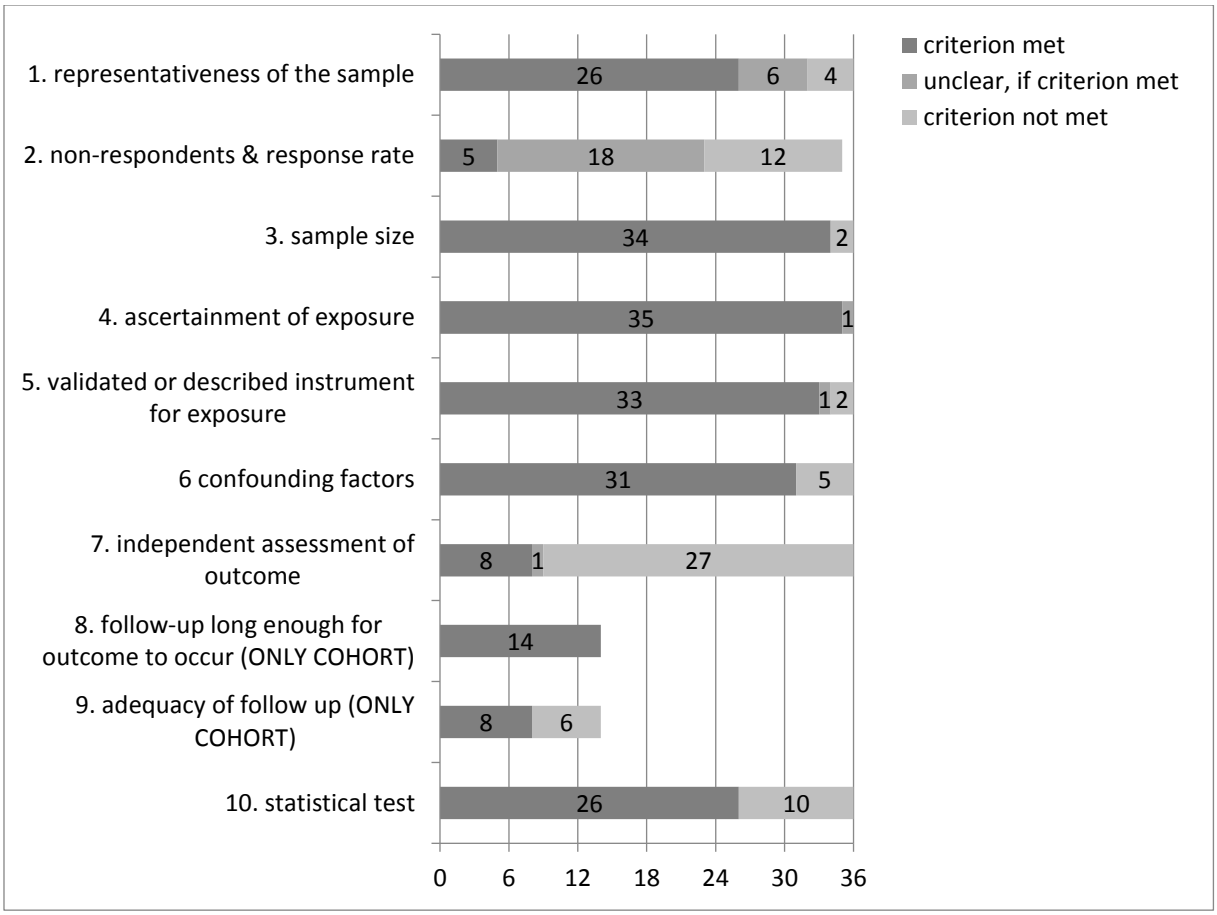
**Search syntax on "Title" and "Abstract" for PubMed**

(social relation* OR social support OR social network* OR social capital OR social integration OR social contact* OR social tie* OR family network* OR family support OR network analysis OR support network OR social inequalit* OR social disparit*) **AND** (visit* OR consultation* OR help seek* OR usage OR utilisation OR utilization OR uptake OR "health care use" OR "health service use" OR "health services use" OR "utilization" OR "health services needs and demand") **AND** (primary care* OR outpatient care* OR ambulatory care* OR general practi* OR family practi* OR family doctor* OR family physician* OR physician* OR geriatric* OR internal medicine OR general medicine OR family medicine) **AND** (old* OR elder* OR aged OR ageing OR aging OR oldest old OR community-dwelling) **AND** (english OR german)

S1 Figure. Methodological and reporting quality of included records

https://doi.org/10.1371/journal.pone.0185672.s003

**Methodological and reporting quality of included records**




S1 Table. PRISMA checklist

https://doi.org/10.1371/journal.pone.0185672.s004

S2 Table. Checklist quality assessment

https://doi.org/10.1371/journal.pone.0185672.s005

**Checklist quality assessment**

| Assessment of the methodological and reporting quality of studies | | | |
|---|---|---|---|
| SELECTION | | | |
| 1. Is the representativeness of the sample/ exposed cohort truly or somewhat representative of the average in the target population? | yes | no | unclear |
| 2. Is the comparability between respondents and non-respondents characteristics established, and is the response rate is satisfactory? | yes | no | unclear |
| 3. Is the sample size justified and satisfactory? | yes | no | unclear |
| 4. Is the ascertainment of exposure based on secure records, structured or written self-report? | yes | no | unclear |
| 5. Is the instrument for exposure validated or described? | yes | no | unclear |
| COMPARABILITY & CONFOUNDERS | yes | no | unclear |
| 6. Does the study control for more than one confounding factor, and are they comparable in different groups/ cohorts? | yes | no | unclear |
| OUTCOME | yes | no | unclear |
| 7. Is the assessment of outcome based on or supported by registered medical utilization data? | yes | no | unclear |
| 8. Is the follow-up long enough for outcome to occur? (ONLY COHORT) | yes | no | unclear |
| 9. Is the follow-up of cohorts adequate (attrition bias)? (ONLY COHORT) | yes | no | unclear |
| 10. Is the statistical test used to analyze the data clearly described and appropriate, and is the measurement of the association presented? | yes | no | unclear |

S3 Table. Included and excluded full-text studies

https://doi.org/10.1371/journal.pone.0185672.s006

S4 Table. Associations with physician use

https://doi.org/10.1371/journal.pone.0185672.s007

S5 Table. Associations with frequency of physician use

https://doi.org/10.1371/journal.pone.0185672.s008

## Chapter 3

Social relationships and GP use of middle-aged and older adults in Europe: A moderator analysis

Supplement Table 1 Pairwise correlations

https://bmjopen.bmj.com/content/bmjopen/8/4/e018854/DC1/embed/inline-supplementary-material-1.pdf?download=true

Supplement Table 1 pairwise correlations

| | GP visits | gender | age | education | make ends meet | employment status | health | social integration | contact frequency |
|---|---|---|---|---|---|---|---|---|---|
| **gender** | 0.0200 | | | | | | | | |
| **age** | 0.1192 | 0.0089 | | | | | | | |
| **education** | -0.1297 | -0.0809 | -0.2345 | | | | | | |
| **make ends meet** | -0.1231 | -0.0414 | 0.0339 | 0.2156 | | | | | |
| **employment status** | 0.1044 | 0.1287 | 0.0709 | -0.1895 | -0.1304 | | | | |
| **health** | -0.2585 | -0.0460 | -0.2478 | 0.2496 | 0.2650 | -0.1756 | | | |
| **social integration** | -0.0984 | -0.0917 | -0.2636 | 0.2637 | 0.2119 | -0.0692 | 0.2574 | | |
| **contact frequency** | 0.0446 | -0.0650 | -0.0522 | -0.1362 | -0.1141 | 0.0216 | -0.0594 | -0.0631 | |
| **emotional closeness** | -0.0098 | 0.1232 | -0.0793 | 0.0962 | 0.0755 | 0.0008 | 0.1032 | 0.3924 | -0.1698 |

Supplement Table 2 Models 1-3

https://bmjopen.bmj.com/content/bmjopen/8/4/e018854/DC2/embed/inline-supplementary-material-2.pdf?download=true

SUPPLEMENT Table 2

Model 1 - Negative binomial regression models based on full sample (social integration index)

| *Variable* | *irr* | *std.error* | *conf.low* | *conf.high* | *p.value* |
|---|---|---|---|---|---|
| **Gender: female (male = Ref.)** | 1.0362 | 0.0298 | 0.9773 | 1.0986 | 0.2338 |
| **Age** | 1.0064 | 0.0028 | 1.001 | 1.0119 | 0.0205 |
| **Education (ISCED-1997 Coding: 0=low – 6=high)** | 0.9439 | 0.0132 | 0.9197 | 0.9687 | 0.000 |
| **Income: make ends meet: fairly easy or easy (with great or some difficulty = Ref.)** | 0.8499 | 0.0305 | 0.8006 | 0.9024 | 0.000 |
| **Employment status (employed = Ref.)** | | | | | |
| *retired* | 1.2417 | 0.0567 | 1.111 | 1.3877 | 1e-04 |
| *unemployed* | 1.054 | 0.0622 | 0.933 | 1.1907 | 0.3982 |
| *permanently sick or disabled* | 1.4841 | 0.0938 | 1.2349 | 1.7836 | 0.000 |
| *homemaker* | 1.291 | 0.0623 | 1.1427 | 1.4586 | 0.000 |
| **Self-perceived health (0=poor – 4=excellent)** | 0.7405 | 0.0272 | 0.7021 | 0.781 | 0.000 |
| **Social integration index (0=low – 6=high)** | 0.9876 | 0.0118 | 0.965 | 1.0106 | 0.288 |
| Intercept | 8.9883 | 0.0626 | 7.9503 | 10.1618 | 0.000 |
| Alpha | 0.6091 | 0.0251 | 0.5618 | 0.6604 | |
| n – unweighted | | | 47,066 | | |
| N – weighted | | | 119,390,189 | | |
| Number of strata (countries) | | | 16 | | |
| Number of primary sampling units (households) | | | 34,623 | | |

IRR = incidence rate ratio
95%-confidence interval
alpha = estimate of dispersion parameters
Age, social integration, contact frequency and closeness are centered at the mean
n = number of observations; N = population size based on survey design
Observations with missing values were dropped (listwise deletion).

Model 2 - Negative binomial regression models based on full sample (contact frequency)

| *variable* | *irr* | *std.error* | *conf.low* | *conf.high* | *p.value* |
|---|---|---|---|---|---|
| **Gender: female (male = Ref.)** | 1.0548 | 0.0341 | 0.9867 | 1.1276 | 0.1174 |
| **Age** | 1.0059 | 0.0029 | 1.0002 | 1.0116 | 0.041 |
| **Education (ISCED-1997 Coding: 0=low – 6=high)** | 0.945 | 0.013 | 0.9212 | 0.9694 | 0.000 |
| **Income: make ends meet: fairly easy or easy (with great or some difficulty = Ref.)** | 0.8487 | 0.0333 | 0.7951 | 0.9058 | 0.000 |
| **Employment status (employed = Ref.)** | | | | | |
| *retired* | 1.2792 | 0.0588 | 1.1401 | 1.4353 | 0.000 |
| *unemployed* | 1.0731 | 0.0656 | 0.9436 | 1.2204 | 0.2821 |
| *permanently sick or disabled* | 1.5336 | 0.0984 | 1.2646 | 1.8599 | 0.000 |
| *homemaker* | 1.271 | 0.0657 | 1.1174 | 1.4457 | 3e-04 |
| **Self-perceived health (0=poor – 4=excellent)** | 0.7391 | 0.0286 | 0.6989 | 0.7817 | 0.000 |
| **Average of contact frequency in social network (0=less than once per month or never – 5=daily)** | 1.0351 | 0.0182 | 0.9988 | 1.0726 | 0.058 |
| Intercept | 8.7504 | 0.0655 | 7.696 | 9.9492 | 0.000 |
| alpha | 0.6055 | 0.0266 | 0.5556 | 0.6600 | |
| n – unweighted | | | 43,962 | | |
| N – weighted | | | 110,219,002 | | |
| Number of strata (countries) | | | 16 | | |
| Number of primary sampling units (households) | | | 32,616 | | |

IRR = incidence rate ratio
95%-confidence interval
alpha = estimate of dispersion parameters
Age, social integration, contact frequency and closeness are centered at the mean
n = number of observations; N = population size based on survey design
Observations with missing values were dropped (listwise deletion).

Model 3 - Negative binomial regression models based on full sample (emotional closeness)

| *variable* | *irr* | *std.error* | *conf.low* | *conf.high* | *p.value* |
|---|---|---|---|---|---|
| **Gender: female (male = Ref.)** | 1.0432 | 0.0344 | 0.9752 | 1.1158 | 0.219 |
| **Age** | 1.0064 | 0.0028 | 1.0009 | 1.012 | 0.0228 |
| **Education (ISCED-1997 Coding: 0=low – 6=high)** | 0.9434 | 0.0136 | 0.9187 | 0.9689 | 0.000 |
| **Income: make ends meet: fairly easy or easy (with great or some difficulty = Ref.)** | 0.8354 | 0.0335 | 0.7823 | 0.8921 | 0.000 |
| **Employment status (employed = Ref.)** | | | | | |
| *retired* | 1.2502 | 0.0587 | 1.1143 | 1.4028 | 1e-04 |
| *unemployed* | 1.0476 | 0.0648 | 0.9226 | 1.1896 | 0.4729 |
| *permanently sick or disabled* | 1.5124 | 0.0962 | 1.2524 | 1.8262 | 0.000 |
| *homemaker* | 1.2873 | 0.0649 | 1.1334 | 1.462 | 1e-04 |
| **Self-perceived health (0=poor – 4=excellent)** | 0.7381 | 0.0292 | 0.697 | 0.7817 | 0.000 |
| **Number of very to extremely close people in social network (0-7)** | 1.0151 | 0.0115 | 0.9925 | 1.0381 | 0.193 |
| Intercept | 9.0879 | 0.0635 | 8.0245 | 10.2921 | 0.000 |
| alpha | 0.6112 | 0.0270 | 0.5605 | 0.6666 | |
| n – unweighted | | | 44,840 | | |
| N – weighted | | | 112,626,161 | | |
| Number of strata (countries) | | | 16 | | |
| Number of primary sampling units (households) | | | 33,160 | | |

IRR = incidence rate ratio
95%-confidence interval
alpha = estimate of dispersion parameters
Age, social integration, contact frequency and closeness are centered at the mean
n = number of observations; N = population size based on survey design
Observations with missing values were dropped (listwise deletion).

Supplement Table 3 Models 4-6

https://bmjopen.bmj.com/content/bmjopen/8/4/e018854/DC3/embed/inline-supplementary-material-3.pdf?download=true

SUPPLEMENT Table 3

Model 4 - Negative binomial regression models based on full sample - 2-way interaction (social integration index)

| *Variable* | *irr* | *std.error* | *conf.low* | *conf.high* | *p.value* |
|---|---|---|---|---|---|
| **Gender: female (male = Ref.)** | 1.0378 | 0.0301 | 0.9784 | 1.1008 | 0.2175 |
| **Age** | 1.0065 | 0.0028 | 1.001 | 1.0121 | 0.0208 |
| **Education (ISCED-1997 Coding: 0=low – 6=high)** | 0.9441 | 0.0132 | 0.92 | 0.9688 | 0.000 |
| **Income: make ends meet: fairly easy or easy (with great or some difficulty = Ref.)** | 0.8492 | 0.0303 | 0.8002 | 0.9012 | 0.000 |
| **Employment status (employed = Ref.)** | | | | | |
| *retired* | 1.2398 | 0.0572 | 1.1082 | 1.3869 | 2e-04 |
| *unemployed* | 1.0508 | 0.0616 | 0.9312 | 1.1856 | 0.4216 |
| *permanently sick or disabled* | 1.4829 | 0.094 | 1.2332 | 1.783 | 0.000 |
| *homemaker* | 1.2876 | 0.0626 | 1.139 | 1.4556 | 1e-04 |
| **Self-perceived health (0=poor – 4=excellent)** | 0.7391 | 0.0262 | 0.7022 | 0.778 | 0.000 |
| **Social integration index (0=low – 6=high)** | 1.0032 | 0.0215 | 0.9617 | 1.0464 | 0.8831 |
| **Self-perceived health * Social integration index** | 0.9902 | 0.0096 | 0.9716 | 1.0091 | 0.3059 |
| Intercept | 9.0466 | 0.0621 | 8.0092 | 10.2184 | 0.000 |
| Alpha | 0.6090 | 0.0250 | 0.5618 | 0.6601 | |
| n – unweighted | | | 47,066 | | |
| N – weighted | | | 119,390,189 | | |
| Number of strata (countries) | | | 16 | | |
| Number of primary sampling units (households) | | | 34,623 | | |

IRR = incidence rate ratio
95%-confidence interval
alpha = estimate of dispersion parameters
Age, social integration, contact frequency and closeness are centered at the mean
n = number of observations; N = population size based on survey design
Observations with missing values were dropped (listwise deletion).

Model 5 - Negative binomial regression models based on full sample - 2-way interaction (contact frequency)

| *variable* | *irr* | *std.error* | *conf.low* | *conf.high* | *p.value* |
|---|---|---|---|---|---|
| **Gender: female (male = Ref.)** | 1.0568 | 0.0336 | 0.9895 | 1.1287 | 0.0997 |
| **Age** | 1.0062 | 0.0028 | 1.0007 | 1.0117 | 0.0268 |
| **Education (ISCED-1997 Coding: 0=low – 6=high)** | 0.9458 | 0.0124 | 0.9231 | 0.969 | 0.000 |
| **Income: make ends meet: fairly easy or easy (with great or some difficulty = Ref.)** | 0.8498 | 0.0331 | 0.7965 | 0.9068 | 0.000 |
| **Employment status (employed = Ref.)** | | | | | |
| *retired* | 1.2739 | 0.056 | 1.1416 | 1.4216 | 0.000 |
| *unemployed* | 1.068 | 0.0645 | 0.9411 | 1.2119 | 0.3082 |
| *permanently sick or disabled* | 1.5354 | 0.0977 | 1.2678 | 1.8596 | 0.000 |
| *homemaker* | 1.2687 | 0.0657 | 1.1154 | 1.4431 | 3e-04 |
| **Self-perceived health (0=poor – 4=excellent)** | 0.738 | 0.027 | 0.6999 | 0.7781 | 0.000 |
| **Average of contact frequency in social network (0=less than once per month or never – 5=daily)** | 0.9941 | 0.0441 | 0.9118 | 1.0839 | 0.8938 |
| **Self-perceived health * contact frequency** | 1.026 | 0.0248 | 0.9773 | 1.0771 | 0.3007 |
| Intercept | 8.7676 | 0.0642 | 7.7315 | 9.9425 | 0.000 |
| alpha | 0.6049 | 0.0259 | 0.5562 | 0.6579 | |
| n – unweighted | | | 43,962 | | |
| N – weighted | | | 110,219,002 | | |
| Number of strata (countries) | | | 16 | | |
| Number of primary sampling units (households) | | | 32,616 | | |

IRR = incidence rate ratio
95%-confidence interval
alpha = estimate of dispersion parameters
Age, social integration, contact frequency and closeness are centered at the mean
n = number of observations; N = population size based on survey design
Observations with missing values were dropped (listwise deletion).

Model 6 - Negative binomial regression models based on full sample - 2-way interaction

| *variable* | *irr* | *std.error* | *conf.low* | *conf.high* | *p.value* |
|---|---|---|---|---|---|
| **Gender: female (male = Ref.)** | 1.0444 | 0.0346 | 0.9761 | 1.1176 | 0.2083 |
| **Age** | 1.0063 | 0.0028 | 1.0008 | 1.0119 | 0.0253 |
| **Education (ISCED-1997 Coding: 0=low – 6=high)** | 0.944 | 0.0133 | 0.9198 | 0.9688 | 0.000 |
| **Income: make ends meet: fairly easy or easy (with great or some difficulty = Ref.)** | 0.8345 | 0.0332 | 0.782 | 0.8906 | 0.000 |
| **Employment status (employed = Ref.)** | | | | | |
| *retired* | 1.2499 | 0.0595 | 1.1123 | 1.4045 | 2e-04 |
| *unemployed* | 1.0445 | 0.0642 | 0.9209 | 1.1847 | 0.4979 |
| *permanently sick or disabled* | 1.5056 | 0.0938 | 1.2528 | 1.8094 | 0.000 |
| *homemaker* | 1.2846 | 0.0658 | 1.1291 | 1.4615 | 1e-04 |
| **Self-perceived health (0=poor – 4=excellent)** | 0.7371 | 0.0279 | 0.6979 | 0.7785 | 0.000 |
| **Number of very to extremely close people in social network (0-7)** | 1.0486 | 0.0233 | 1.0017 | 1.0977 | 0.042 |
| **Self-perceived health * emotional closeness** | 0.9804 | 0.0137 | 0.9544 | 1.0072 | 0.1506 |
| Intercept | 9.118 | 0.0624 | 8.0685 | 10.3041 | 0.000 |
| alpha | 0.6105 | 0.0265 | 0.5607 | 0.6648 | |
| n – unweighted | | | 44,840 | | |
| N – weighted | | | 112,626,161 | | |
| Number of strata (countries) | | | 16 | | |
| Number of primary sampling units (households) | | | 33,160 | | |

IRR = incidence rate ratio
95%-confidence interval
alpha = estimate of dispersion parameters
Age, social integration, contact frequency and closeness are centered at the mean
n = number of observations; N = population size based on survey design
Observations with missing values were dropped (listwise deletion).

Supplement Table 4 Models 7-9

https://bmjopen.bmj.com/content/bmjopen/8/4/e018854/DC4/embed/inline-supplementary-material-4.pdf?download=true

SUPPLEMENT Table 4

Model 7 - Negative binomial regression models based on full sample – 3-way interaction (social integration index)

| *Variable* | *irr* | *std.error* | *conf.low* | *conf.high* | *p.value* |
|---|---|---|---|---|---|
| **Gender: female (male = Ref.)** | 1.033 | 0.029 | 0.9759 | 1.0935 | 0.263 |
| **Age** | 1.0061 | 0.0029 | 1.0003 | 1.0119 | 0.0377 |
| **Education (ISCED-1997 Coding: 0=low – 6=high)** | 0.9441 | 0.0127 | 0.9209 | 0.9678 | 0.000 |
| **Income: make ends meet: fairly easy or easy (with great or some difficulty = Ref.)** | 0.851 | 0.0293 | 0.8035 | 0.9014 | 0.000 |
| **Employment status (employed = Ref.)** | | | | | |
| *retired* | 0.7027 | 0.0285 | 0.6645 | 0.7432 | 0.000 |
| *unemployed* | 1.0258 | 0.0564 | 0.9185 | 1.1456 | 0.6519 |
| *permanently sick or disabled* | 1.0986 | 0.1099 | 0.8857 | 1.3625 | 0.3923 |
| *homemaker* | 1.0305 | 0.1441 | 0.7769 | 1.3668 | 0.8349 |
| **Self-perceived health (0=poor – 4=excellent)** | 1.2763 | 0.1287 | 0.9917 | 1.6426 | 0.058 |
| **Social integration index (0=low – 6=high)** | 1.4546 | 0.1577 | 1.068 | 1.9813 | 0.0175 |
| **Self-perceived health * Social integration index** | 1.0028 | 0.0229 | 0.9587 | 1.0489 | 0.9033 |
| **Self-perceived health * employment status** | | | | | |
| *Self-perceived health * retired* | 1.0807 | 0.0447 | 0.9901 | 1.1797 | 0.0823 |
| *Self-perceived health * unemployed* | 1.0201 | 0.0683 | 0.8922 | 1.1663 | 0.7708 |
| *Self-perceived health * permanently sick or disabled* | 1.1167 | 0.0874 | 0.9408 | 1.3254 | 0.207 |
| *Self-perceived health * homemaker* | 0.9394 | 0.0692 | 0.8202 | 1.0758 | 0.366 |
| **Social integration index * employment status** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| *Social integration index * retired* | 0.9694 | 0.061 | 0.8602 | 1.0925 | 0.6107 |
| *Social integration index * unemployed* | 1.1323 | 0.0829 | 0.9626 | 1.3321 | 0.1337 |
| *Social integration index * permanently sick or disabled* | 0.908 | 0.1141 | 0.7261 | 1.1355 | 0.3977 |
| *Social integration index * homemaker* | 0.8828 | 0.1035 | 0.7206 | 1.0814 | 0.2284 |
| **Self-perceived health * social integration index * employment status** | | | | | |
| *Self-perceived health * social integration index * retired* | 0.9805 | 0.0251 | 0.9334 | 1.0299 | 0.4327 |
| *Self-perceived health * social integration index * unemployed* | 0.9504 | 0.041 | 0.877 | 1.0299 | 0.2147 |
| *Self-perceived health * social integration index * permanently sick or disabled* | 1.0483 | 0.0796 | 0.8969 | 1.2253 | 0.5532 |
| *Self-perceived health * social integration index * homemaker* | 1.0033 | 0.0466 | 0.9157 | 1.0993 | 0.9438 |
| Intercept | 9.8174 | 0.0854 | 8.3046 | 11.6058 | 0.000 |
| alpha | 0.6045 | 0.0240 | 0.5596 | 0.6539 | |
| n – unweighted | | | 47,066 | | |
| N – weighted | | | 119,390,189 | | |
| Number of strata (countries) | | | 16 | | |
| Number of primary sampling units (households) | | | 34,623 | | |

IRR = incidence rate ratio
95%-confidence interval
alpha = estimate of dispersion parameters
Age, social integration, contact frequency and closeness are centered at the mean
n = number of observations; N = population size based on survey design
Observations with missing values were dropped (listwise deletion).

Model 8 - Negative binomial regression models based on full sample – 3-way interaction (social contact frequency)

| *Variable* | *irr* | *std.error* | *conf.low* | *conf.high* | *p.value* |
|---|---|---|---|---|---|
| **Gender: female (male = Ref.)** | 1.0574 | 0.0326 | 0.992 | 1.1271 | 0.0867 |
| **Age** | 1.0066 | 0.0028 | 1.0011 | 1.0121 | 0.018 |
| **Education (ISCED-1997 Coding: 0=low – 6=high)** | 0.9464 | 0.0117 | 0.9249 | 0.9684 | 0.000 |
| **Income: make ends meet: fairly easy or easy (with great or some difficulty = Ref.)** | 0.8477 | 0.0317 | 0.7966 | 0.9021 | 0.000 |
| **Employment status (employed = Ref.)** | | | | | |
| *retired* | 0.7102 | 0.0284 | 0.6718 | 0.7509 | 0.000 |
| *unemployed* | 1.0848 | 0.0757 | 0.9352 | 1.2584 | 0.2823 |
| *permanently sick or disabled* | 1.1295 | 0.1135 | 0.9042 | 1.4108 | 0.2834 |
| *homemaker* | 1.0391 | 0.1435 | 0.7845 | 1.3765 | 0.7889 |
| **Self-perceived health (0=poor – 4=excellent)** | 1.3951 | 0.1594 | 1.0207 | 1.9067 | 0.0367 |
| **Average of contact frequency in social network (0=less than once per month or never – 5=daily)** | 1.4007 | 0.191 | 0.9633 | 2.0367 | 0.0777 |
| **Self-perceived health * Contact frequency** | 0.9626 | 0.0284 | 0.9104 | 1.0177 | 0.1796 |
| **Self-perceived health * employment status** | | | | | |
| *Self-perceived health * retired* | 1.0681 | 0.0455 | 0.977 | 1.1676 | 0.1475 |
| *Self-perceived health * unemployed* | 0.9969 | 0.0685 | 0.8716 | 1.1402 | 0.9635 |
| *Self-perceived health * permanently sick or disabled* | 1.0637 | 0.1135 | 0.8516 | 1.3287 | 0.586 |
| *Self-perceived health * homemaker* | 0.9208 | 0.0822 | 0.7838 | 1.0817 | 0.3153 |
| **Contact frequency * employment status** | | | | | |
| *Contact frequency * retired* | 0.8891 | 0.0948 | 0.7384 | 1.0706 | 0.2149 |
| *Contact frequency * unemployed* | 0.7879 | 0.1516 | 0.5853 | 1.0605 | 0.1158 |
| *Contact frequency * permanently sick or disabled* | 0.9316 | 0.1271 | 0.7262 | 1.1952 | 0.5774 |

| | | | | | |
|---|---|---|---|---|---|
| *Contact frequency * homemaker* | 1.0568 | 0.1504 | 0.787 | 1.419 | 0.7134 |
| **Self-perceived health * Contact frequency * employment status** | | | | | |
| *Self-perceived health * Contact frequency * retired* | 1.0949 | 0.0464 | 0.9998 | 1.1992 | 0.0506 |
| *Self-perceived health * Contact frequency * unemployed* | 1.1731 | 0.0742 | 1.0144 | 1.3567 | 0.0314 |
| *Self-perceived health * Contact frequency * permanently sick or disabled* | 1.0632 | 0.0622 | 0.9412 | 1.2011 | 0.3242 |
| *Self-perceived health * Contact frequency * homemaker* | 1.0475 | 0.0663 | 0.9199 | 1.1928 | 0.4838 |
| Intercept | 9.4885 | 0.0848 | 8.0361 | 11.2034 | 0.000 |
| Alpha | 0.6009 | 0.0245 | 0.5547 | 0.6509 | |
| n – unweighted | | | 43,962 | | |
| N – weighted | | | 110,219,002 | | |
| Number of strata (countries) | | | 16 | | |
| Number of primary sampling units (households) | | | 32,616 | | |

IRR = incidence rate ratio
95%-confidence interval
alpha = estimate of dispersion parameters
Age, social integration, contact frequency and closeness are centered at the mean
n = number of observations; N = population size based on survey design
Observations with missing values were dropped (listwise deletion).

Model 9 - Negative binomial regression models based on full sample – 3-way interaction (emotional closeness)

| *Variable* | *irr* | *std.error* | *conf.low* | *conf.high* | *p.value* |
|---|---|---|---|---|---|
| **Gender: female (male = Ref.)** | 1.0428 | 0.0338 | 0.9759 | 1.1143 | 0.2152 |
| **Age** | 1.0066 | 0.0029 | 1.0008 | 1.0124 | 0.0258 |
| **Education (ISCED-1997 Coding: 0=low – 6=high)** | 0.9437 | 0.0126 | 0.9206 | 0.9673 | 0.000 |
| **Income: make ends meet: fairly easy or easy (with great or some difficulty = Ref.)** | 0.834 | 0.032 | 0.7833 | 0.888 | 0.000 |
| **Employment status (employed = Ref.)** | | | | | |
| *retired* | 0.7057 | 0.0287 | 0.6671 | 0.7465 | 0.000 |
| *unemployed* | 0.997 | 0.0447 | 0.9133 | 1.0884 | 0.9462 |
| *permanently sick or disabled* | 1.1027 | 0.1153 | 0.8797 | 1.3823 | 0.3964 |
| *homemaker* | 0.9959 | 0.1493 | 0.7433 | 1.3345 | 0.9781 |
| **Self-perceived health (0=poor – 4=excellent)** | 1.3689 | 0.1537 | 1.0128 | 1.8503 | 0.0411 |
| **Number of very to extremely close people in social network (0-7)** | 1.4595 | 0.1588 | 1.0691 | 1.9926 | 0.0173 |
| **Self-perceived health * Contact frequency** | 1.0089 | 0.016 | 0.9778 | 1.041 | 0.5778 |
| **Self-perceived health * employment status** | | | | | |
| *Self-perceived health * retired* | 1.0726 | 0.0458 | 0.9804 | 1.1734 | 0.1264 |
| *Self-perceived health * unemployed* | 1.0202 | 0.0701 | 0.8891 | 1.1705 | 0.7758 |
| *Self-perceived health * permanently sick or disabled* | 1.0548 | 0.1132 | 0.845 | 1.3167 | 0.6374 |
| *Self-perceived health * homemaker* | 0.9282 | 0.0666 | 0.8145 | 1.0576 | 0.2632 |
| **Emotional closeness * employment status** | | | | | |
| *Emotional closeness * retired* | 1.0632 | 0.0543 | 0.9558 | 1.1827 | 0.2594 |
| *Emotional closeness * unemployed* | 1.0921 | 0.1072 | 0.8851 | 1.3476 | 0.4111 |
| *Emotional closeness * permanently sick or disabled* | 1.1124 | 0.1122 | 0.8927 | 1.3861 | 0.3427 |

| | | | | | |
|---|---|---|---|---|---|
| *Emotional closeness * homemaker* | 0.931 | 0.0929 | 0.776 | 1.1168 | 0.4412 |
| **Self-perceived health * Emotional closeness * employment status** | | | | | |
| *Self-perceived health * Emotional closeness * retired* | 0.963 | 0.0261 | 0.9151 | 1.0135 | 0.1483 |
| *Self-perceived health * Emotional closeness * unemployed* | 0.9513 | 0.05 | 0.8625 | 1.0493 | 0.3181 |
| *Self-perceived health * Emotional closeness * permanently sick or disabled* | 0.9751 | 0.0761 | 0.84 | 1.1318 | 0.7401 |
| *Self-perceived health * Emotional closeness * homemaker* | 1.0038 | 0.0401 | 0.9279 | 1.086 | 0.9247 |
| Intercept | 9.9586 | 0.0854 | 8.4236 | 11.7733 | 0.000 |
| alpha | 0.6074 | 0.0255 | 0.5594 | 0.6595 | |
| n – unweighted | | | 44,840 | | |
| N – weighted | | | 112,626,161 | | |
| Number of strata (countries) | | | 16 | | |
| Number of primary sampling units (households) | | | 33,160 | | |

IRR = incidence rate ratio
95%-confidence interval
alpha = estimate of dispersion parameters
Age, social integration, contact frequency and closeness are centered at the mean
n = number of observations; N = population size based on survey design
Observations with missing values were dropped (listwise deletion).

## Chapter 4

Social relationships, age and the use of preventive health services: Findings from the German Ageing Survey

Supplement Table S1 Interaction models.

https://www.mdpi.com/1660-4601/16/21/4272/s1

**Logistic regression models for flu vaccination (Model 1.1) and cancer screening (Model 2.1) with interaction terms between informational support and age (German Ageing Survey, 2014).**

| | Seasonal flu vaccination (Model 1.1) | | Cancer screening (Model 2.1) | |
|---|---|---|---|---|
| ***Predictors*** | *Odds Ratios* | *95% CI* | *Odds Ratios* | *95% CI* |
| **(Intercept)** | 0.01 | 0.00-0.04 | 0.00 | 0.00-0.00 |
| **Gender (Ref. male): female** | 1.03 | 0.93-1.15 | 2.37 | 2.14-2.63 |
| **Age in years** | 1.06 | 1.04-1.08 | 1.38 | 1.17-1.63 |
| **Informational support (Ref. no): yes** | 1.28 | 0.38-4.50 | 5.77 | 0.03-1598.26 |
| **ISCED-1: low** | 0.89 | 0.75-1.06 | 1.00 | 1.00-1.00 |
| **ISCED-3: high** | 1.03 | 0.93-1.15 | 0.87 | 0.73-1.04 |
| **Number of physical diseases** | 1.08 | 1.04-1.11 | 1.13 | 1.02-1.26 |
| **Very good** | 0.50 | 0.40-0.62 | 1.05 | 1.01-1.08 |
| **Good** | 0.73 | 0.65-0.82 | 0.78 | 0.64-0.94 |
| **Bad** | 1.07 | 0.89-1.29 | 1.06 | 0.94-1.19 |
| **Very bad** | 1.69 | 1.20-2.40 | 0.77 | 0.64-0.93 |
| **Partner (Ref. no): yes** | 1.20 | 1.07-1.34 | 0.77 | 0.55-1.08 |
| **Social network size (number of important persons with regular contact)** | 0.99 | 0.97-1.01 | 1.57 | 1.41-1.75 |
| **Age*informational support** | 1.00 | 0.98-1.02 | 1.02 | 1.00-1.04 |
| **Age in years (cubic term)** | | | 0.98 | 0.82-1.15 |
| **Age in years (cubic term)*informational support** | | | 1.00 | 1.00-1.00 |
| **Observations** | 7,588 | | 7,515 | |

**Logistic regression models for flu vaccination (Model 1.2) and cancer screening (Model 2.2) with interaction terms between having a partner and age (German Ageing Survey, 2014).**

| | Seasonal flu vaccination (Model 1.2) | | Cancer screening (Model 2.2) | |
|---|---|---|---|---|
| ***Predictors*** | *Odds Ratios* | *95% CI* | *Odds Ratios* | *95% CI* |
| **(Intercept)** | 0.01 | 0.01-0.02 | 0.00 | 0.00-0.00 |
| **Gender (Ref. male): female** | 1.03 | 0.93-1.14 | 2.44 | 2.19-2.70 |
| **Age in years** | 1.06 | 1.05-1.07 | 1.31 | 1.23-1.39 |
| **Informational support (Ref. no): yes** | 1.42 | 0.78-2.58 | 0.52 | 0.04-7.02 |
| **ISCED-1: low** | 0.89 | 0.74-1.06 | 1.00 | 1.00-1.00 |
| **ISCED-3: high** | 1.03 | 0.93-1.15 | 0.87 | 0.73-1.05 |
| **Very good** | 1.08 | 1.04-1.11 | 1.14 | 1.02-1.26 |
| **Good** | 0.50 | 0.40-0.62 | 1.05 | 1.02-1.08 |
| **Bad** | 0.73 | 0.65-0.82 | 0.78 | 0.64-0.95 |
| **Very bad** | 1.07 | 0.89-1.29 | 1.07 | 0.95-1.20 |
| **Partner (Ref. no): yes** | 1.70 | 1.20-2.40 | 0.77 | 0.64-0.93 |
| **Social network size (number of important persons with regular contact)** | 1.38 | 1.13-1.70 | 0.76 | 0.54-1.08 |
| **Age*partner** | 0.99 | 0.97-1.01 | 1.41 | 1.16-1.71 |
| **Age in years (cubic term)** | | | 1.02 | 1.00-1.04 |
| **Age in years (cubic term)*partner** | | | 1.02 | 0.94-1.11 |
| **Observations** | 7,588 | | 7,515 | |

**Logistic regression models for flu vaccination (Model 1.3) and cancer screening (Model 2.3) with interaction terms between social network size and age (German Ageing Survey, 2014).**

| | Seasonal flu vaccination (Model 1.3) | | Cancer screening (Model 2.3) | |
|---|---|---|---|---|
| ***Predictors*** | *Odds Ratios* | *95% CI* | *Odds Ratios* | *95% CI* |
| **(Intercept)** | 0.01 | 0.01-0.02 | 0.00 | 0.00-0.04 |
| **Gender (Ref. male): female** | 1.03 | 0.93-1.15 | 2.38 | 2.15-2.64 |
| **Age in years** | 1.06 | 1.05-1.07 | 1.20 | 1.10-1.31 |
| **Informational support (Ref. no): yes** | 1.00 | 0.90-1.11 | 0.51 | 0.31-0.82 |
| **ISCED-1: low** | 0.89 | 0.74-1.06 | 1.00 | 1.00-1.00 |
| **ISCED-3: high** | 1.03 | 0.93-1.15 | 0.87 | 0.73-1.04 |
| **Very good** | 1.08 | 1.04-1.11 | 1.14 | 1.02-1.27 |
| **Good** | 0.50 | 0.40-0.62 | 1.05 | 1.01-1.08 |
| **Bad** | 0.73 | 0.65-0.82 | 0.79 | 0.65-0.95 |
| **Very bad** | 1.07 | 0.89-1.29 | 1.07 | 0.95-1.20 |
| **Partner (Ref. no): yes** | 1.69 | 1.20-2.40 | 0.78 | 0.65-0.94 |
| **Social network size (number of important persons with regular contact)** | 1.38 | 1.13-1.70 | 0.77 | 0.55-1.09 |
| **Age*network size** | 1.20 | 1.07-1.34 | 1.40 | 1.15-1.69 |
| **Age in years (cubic term)** | | | 1.58 | 1.41-1.76 |
| **Age in years (cubic term)*network size** | | | 1.02 | 1.01-1.04 |
| **Observations** | 7,588 | | 7,515 | |

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# 7 SUMMARY

Social relationships are powerful resources to access various societal contexts. Even morbidity and mortality are influenced by social relationships. In health services research, the role of social relationships have not been fully understood to date. Therefore, the three studies in this thesis investigated various associations between the use of outpatient health services and structural and functional dimensions of social relationships focusing on middle-aged and older people. The data for the systematic review was collected by the author and the data for study number two and three stem from two large-scale surveys (SHARE and DEAS).

The systematic review showed that older people who are structurally integrated by social relationships are more likely to consult a physician at all and to contact a physician more often. The role of functional aspects of social relationships seems to be more ambiguous. Depending on the measure of social support, they can slightly increase or decrease or do not change the probability of physician use. Our results on SHARE suggest that different indicators of social relationships are not linked to the frequency of GP visits among middle-aged and older Europeans. Nevertheless, the results indicate potential inequalities in GP use due to different characteristics of social relationships with respect to health and employment status. The DEAS results demonstrate that structural and functional aspects of social relationships may support preventive health behavior, especially within certain age groups.

Consequently, health care providers and stakeholders need to find ways to ensure that older adults can use outpatient care services regardless of their structural and functional level of social integration. Health care providers, for example, may integrate information on patient's social environments into their clinical routine. Especially with regard to preventive health services, health policy and health professionals need to integrate information on social relationships into routine care and to strengthen sources of social support, if they want to increase the use of preventive health services.

# 8 ZUSAMMENFASSUNG

Soziale Beziehungen sind wirkungsvolle Ressourcen, um Zugang zu unterschiedlichen Gesellschaftsbereichen zu erhalten. So werden z. B. Morbidität und Mortalität durch soziale Beziehungen beeinflusst. Im Bereich der Versorgungsforschung und bei der Erforschung von der Inanspruchnahme gesundheitlicher Leistungen ist die Rolle von sozialen Beziehungen noch unklar. Folglich wurden im Rahmen dieser Arbeit drei Studien zu unterschiedlichen Zusammenhängen zwischen der Inanspruchnahme ambulanter Versorgungsleistungen und strukturellen und funktionalen Dimensionen sozialer Beziehungen mit dem Fokus auf das mittlere und höhere Lebensalter durchgeführt. Die Daten der systematischen Literaturarbeit wurden vom Autor dieser Arbeit erhoben und die Daten der zweiten und dritten Studie stammen jeweils von groß angelegten Befragungen (SHARE und DEAS).

Die systematische Literaturarbeit zeigte, dass ältere Menschen, die durch soziale Beziehungen strukturell integriert sind, tendenziell eine höhere Wahrscheinlichkeit und Häufigkeit haben, den Allgemeinarzt zu konsultieren. Die Rolle der funktionalen Aspekte sozialer Beziehungen erscheint unklarer. Abhängig vom Messinstrument für soziale Unterstützung können sie die Kontaktwahrscheinlichkeit erhöhen, senken oder nicht verändern. Die Ergebnisse der SHARE-Studie suggerieren, dass verschiedene Indikatoren sozialer Beziehungen nicht mit der Inanspruchnahme-Frequenz von Allgemeinarztbesuchen zusammenhängen – bezogen auf das mittlere und höhere Lebensalter der Europäischen Bevölkerung. Nichts desto trotz indizieren die Ergebnisse potentielle Ungleichheiten bei der Inanspruchnahme von Allgemeinärzten, hervorgerufen durch unterschiedliche Merkmale sozialer Beziehungen hinsichtlich von Gesundheit und Erwerbsstatus. Die Ergebnisse der DEAS-Studie zeigten, dass das Vorhandensein struktureller und funktionaler Aspekte sozialer Beziehungen die Inanspruchnahme von präventiven Gesundheitsleistungen wahrscheinlicher macht.

Folglich sollten Gesundheitsversorger und Stakeholder Wege finden, um die Inanspruchnahme von ambulanten Gesundheitsleistungen durch ältere Menschen

sicherzustellen, unabhängig vom strukturellen und funktionalen Ausmaß sozialer Beziehungen. Gesundheitsversorgung, zum Beispiel, könnten Informationen über die soziale Umwelt ihrer Patienten in ihre klinische Routine integrieren. Insbesondere mit Blick auf präventive Gesundheitsleistungen sollten Gesundheitspolitik und Gesundheitsversorger Informationen zu sozialen Beziehungen berücksichtigen und Quellen sozialer Unterstützung stärken, wenn sie die Inanspruchnahme dieser Leistungen erhöhen möchten.

# 9 EXPLANATION OF THE CONTRIBUTION TO THE PUBLICATIONS

The author developed the idea for the overarching topic and the research interests of the present thesis. The thesis is not funded and is not part of a research project. The author do not have any conflict of interests.

All publications are published in peer-reviewed journals and are written by the author in lead authorship. The lead authorship includes the following contributions:

- Specification of the research questions
- Literature search
- Data management
- Selection of the statistical methods
- Performance of the analyses
- Writing the manuscripts
- Interpretation of the results
- Correspondence with the editors and peer-reviewers

The co-authors added their knowledge and perspective on the steps named above, e.g. discussing research questions, analyses and results as well as proofreading.

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# 11 CURRICULUM VITAE

Lebenslauf entfällt aus datenschutzrechtlichen Gründen.

# 12 STATUTORY DECLARATION

Ich versichere ausdrücklich, dass ich die Arbeit selbständig und ohne fremde Hilfe verfasst, andere als die von mir angegebenen Quellen und Hilfsmittel nicht benutzt und die aus den benutzten Werken wörtlich oder inhaltlich entnommenen Stellen einzeln nach Ausgabe (Auflage und Jahr des Erscheinens), Band und Seite des benutzten Werkes kenntlich gemacht habe.

Ferner versichere ich, dass ich die Dissertation bisher nicht einem Fachvertreter an einer anderen Hochschule zur Überprüfung vorgelegt oder mich anderweitig um Zulassung zur Promotion beworben habe.

Ich erkläre mich einverstanden, dass meine Dissertation vom Dekanat der Medizinischen Fakultät mit einer gängigen Software zur Erkennung von Plagiaten überprüft werden kann.

Hamburg, 29.01.2020

City, Date, Signature: .....

Daniel Bremer