Chapter 10
How Do Socioeconomic Factors Influence the Amount and Intensity of Service Utilization by Family Caregivers of Elderly Dependents?

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Introduction

As in nearly all European countries, demographic developments in Germany have led to both a relative and an absolute increase in the country's elderly population. Reasons for this trend include increased life expectancy, thanks to lower infant mortality rates, medical advancements, overall better living conditions in terms of nutrition and hygiene, and lower birth rates resulting in steadily increasing old-age dependency ratios. Germany's age dependency ratio (the ratio between the retirement-age population and the working-age population) is currently around 34 %,[1] but is projected to increase to 62 % in 2040 and to 67 % in 2060 (Statistisches Bundesamt 2009).

Increasing longevity and an aging population mean an increase in both the number of elderly citizens in need of long-term care and the length of time between when care is initially needed and death. In Germany, the number of people in need of long-term care is predicted to increase from 2.34 million in 2009 to 3.4 million in 2030. At the same time, the number of people over age 80 is expected to nearly double from 3.6 million to an estimated 6.3 million (DESTATIS 2008; Statistisches Bundesamt 2011).

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[1] The German Federal Statistical Office (Statistisches Bundesamt) defines "working age" as 20–64 years when calculating the old-age dependency ratio. Population calculations in other countries often use an age range of 15–64 years.

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Both in Germany and in the rest of Europe, the care and support needed by these people is primarily provided by relatives or friends and close acquaintances within the home environment (Mestheneos and Triantafillou 2005). As numerous studies have shown, these responsibilities are often sources of great physical and mental burdens for caregivers (Di Rosa et al. 2011; Schulz and Beach 1999). Caring for elderly people with cognitive impairments, in particular, places extraordinary demands on caregivers and takes a significant toll on their health (Barinaga 1998; Gräßel 1998; Gräßel 1996; Kofahl et al. 2009; MacDonald and Dening 2002; Pinquart and Sorensen 2003). Those with multimorbidity or a form of dementia often require full-time, round-the-clock care. At the same time, not only has the age of those in need of care been increasing, there has also been an increase in the age of the relatives caring for them (Kofahl et al. 2007; Lamura et al. 2008). Because of their age, these older caregivers are more liable to become ill themselves. On the other hand, younger family caregivers who are still gainfully employed are often faced with multiple burdens when forced to juggle work, caregiving, and family responsibilities.

In Germany, 69 % of all people in need of long-term care receive care at home (Pfaff 2011). In over 90 % of these cases, care and assistance are provided by family members. Home care provided by family is provided by the family alone, that is, without the help of professional care services, in 71 % of cases. Only 29 % of family home-care arrangements involve the use of such services (Pfaff 2011). Most family caregivers are women, especially daughters and daughters-in-law. However, the number of male caregivers is rising. Whereas in 1991 men represented a mere 17 % of primary caregivers, the proportion of male caregivers increased to 27 % in 2002 (Schneekloth and Wahl 2005), and according to data from the German Socio-economic Panel, it has reached 35 % in 2006 (Rothgang et al. 2008). As most male caregivers tend to be caring for their elderly wives, they themselves are already advanced in age at the time of caregiving, and their age statistically far surpasses the average age of female caregivers (Rothgang et al. 2008).

Most care recipients wish to be cared for at home for as long as possible. Given the enormous costs associated with residential care, this is also a goal of social policy and of long-term care insurance. In order to achieve this, it is crucial that family caregivers are provided with situation-specific services that support them and relieve their burden of care. Unfortunately, however, family caregivers usually take better care of their needy relatives than of themselves and, as a result, often put off or fail to make timely use of health promotion, prevention, and relief services for their own well-being. A mere one-third of all family caregivers turn to ambulatory services for support (Haug et al. 1999; Rauch 2000).

Informal caregiving networks, on the other hand, have been gaining in significance, and the development of more need-based services is becoming increasingly important for at-home care. The major challenges for society are therefore to sustain, promote, and support informal resources and to provide the opportunity to use services aimed at assisting and relieving the burden of family caregivers. Consequently, the main social policy goals of the current German long-term care insurance reform are to promote self-help, civic engagement, and the balance between career and caregiving. The reasons for this are obvious. Caregivers who experience less of a burden and less of a decrease in their income and pensions provide care at home for a longer time. Since the main reasons for care facility placement are that primary caregivers feel overburdened and/or experience problems with their own health, reducing caregiver burden may make it possible to shorten the length of a stay in a care facility or avoid a stay altogether (Barinaga 1998; Barusch 1988; Gräßel 2000).

This is particularly true for family caregivers of those with dementia. Various studies have demonstrated the positive effects of counseling and training programs for family caregivers, including a significant delay in care facility placement (Brodaty et al. 1997; Kurz 2011; Mittelman et al. 1996). Caregivers were able to provide care at home for up to twice as long as in the studies' control groups. Other positive effects of such programs include less mental stress and improved health knowledge among family caregivers as well as improvements in the mood of those suffering from dementia —though not in the burden on caregivers (Brodaty et al. 2003).

Objectives

The EUROFAMCARE[2] project provides an overview of the situation of family caregivers of elderly dependents in Europe in terms of the existence, awareness, availability, use, and acceptance of support services. The project comprised two large substudies. As part of one substudy, national background reports on the current situation of family caregivers were generated in 23 European countries based on secondary data analyses. For the other substudy, approximately 1,000 family caregivers were surveyed in each of six countries (Germany, Greece, Italy, Poland, Sweden, and the United Kingdom) considered representative of the different cultural and welfare systems in Europe.

In this chapter, we aim to analyze the utilization of support services regarding the impact of different socioeconomic factors of family caregivers as well as care situation characteristics on service utilization. Two different models have been calculated, distinguishing between the frequency of service use (units per 6 months) on the one hand and the number of service types on the other. To reveal the underlying structure and detect the most influential factors on service utilization, a regression-tree algorithm has been conducted for data analysis.

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[2] The EUROFAMCARE project was funded by the European Union (EU) (contract no.: QLK6-CT-2002-02647) and coordinated by the Department of Medical Sociology at the University of Hamburg (www.uke.de/eurofamcare).

Methods

Sampling

In 2004, 5,923 family caregivers from the six countries named above were interviewed at home about their experiences. Included in the study were primary caregivers providing at least 4 h of personal care or support per week to a relative aged 65 years or older. Subjects providing solely financial support were excluded. The unique aspect of the study's sampling approach was that family caregivers were recruited directly and not through those in need of care and assistance, thereby avoiding preselection bias based on the particular care needs or level of dependency ("care level," CL) of care recipients.

Data were collected using a mixed recruitment strategy. Various means of contacting potential interview partners were chosen including making contacts through social and health services, physicians, pharmacies, Alzheimer's associations, advertisements in newspapers, and word of mouth. This sampling procedure was chosen based on cultural and religious aspects and the fact that available services vary between sites. The spectrum of recruitment strategies should be as broad as possible to ensure that all types of care situations are found in our sample. For this purpose, all EUROFAMCARE partners agreed to employ a common saturation method, i.e., the sampling strategy aimed at covering all facets of family caregiving rather than taking a representative sample in a strict statistical sense. Sampling was conducted at least in predefined chosen sample communities or, if possible, nationwide by parallel or consecutive application of any suitable recruitment strategy covering the three types of areas: "metropolitan," "urban," and "rural."

The interviews were conducted by interviewers from our university centers and from a social research institute with a nationwide network of interviewers to achieve a population-based sample. In the end, the interviewers achieved a total sample size of 1,003 family caregivers (Lüdecke et al. 2008). The comparison of the socioeconomic indicators, the care situations, and the caregiver and care recipient characteristics of the German EUROFAMCARE data with those of the representative MUG III Study of 2002 ("Potential and Limitation of Independent Living in Private Households in Germany") (Schneekloth and Wahl 2005) showed strong consistencies in both studies (Lüdecke et al. 2008).

Measures

When developing the survey questionnaire, we preferred scales that had already proven reliable and valid in international studies. To systematically assess care recipients' need of support, instruments from the Geriatric Assessment were used (McKee et al. 2008). Activities of daily living (ADL) status was measured with the Barthel Index (Mahoney and Barthel 1965), and instrumental activities of daily living (IADL) were measured using selected items from the Older American Resources and Services Questionnaire (OARS; Fillenbaum and Smyer 1981). The total dependency of the cared-for person is a sum-score of the Barthel Index and the IADL score of each cared-for person with a range from 0 (physically independent) to 17 (severely dependent). Cognitive impairments were assessed through questions asking whether the dependent has memory problems or has been diagnosed with dementia. Data on behavioral disturbances were collected using a three-item short version of the Behavioural and Instrumental Stressors in Dementia (BISID; Keady and Nolan 1996).

Caregiver burden was measured using the Carers of Older People in Europe Index (COPE Index), which is available in several different languages and contains three subscales: one assessing the negative impact of caregiving, one assessing the positive value of caregiving, and one assessing the quality of the support received during caregiving (Balducci et al. 2008; McKee et al. 2008; McKee et al. 2003). Information on caregiver well-being and subjective quality of life were obtained using the WHO-5 Well-Being Index (Bech 2008; World Health Organization 1998) and two items from the SF-36 (Health-Related Quality of Life; Brazier et al. 1992).

Data Entry and Analyses

To better determine which factors influence family caregivers' use of support services, we implemented a conditional graphical model, a so-called conditional inference tree (Hothorn et al. 2006a; Hothorn et al. 2006b) based on a learning tree algorithm which embeds tree-structured regression models. The conditional inference-tree algorithm is predicated on recursive binary partitioning embedded in a framework of permutation tests introduced by Strasser and Weber (1999). At each node, a global null hypothesis $H_0 : f(Y \mid X_j) = f(Y)$ is tested on a prespecified α level of 0.05. In case of acceptance, the tree algorithm interrupts and no further data split will be performed, which means the algorithm has detected all significant impact factors on the dependent variable for this certain group of cases represented by the tree branch. Otherwise, the covariate X_j with the strongest influence on Y will be selected as a new node, and the null hypothesis will be tested in each subset of the tree again, which means *all* covariates are tested for the strongest influence on the dependent variable Y again, including the selected covariate X_j. Due to this recursive approach, covariates may appear several times in the course of a tree branch via a new data split in the "subranges" of a scale,[3] for instance, when subgroups, as characterized by a certain covariate, are differentiated into further sub-subgroups, depending on the answer categories or values of the covariate. The distribution in each terminal node is shown as a boxplot.

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[3] For example: If a scale ranging from 0 to 10 points is split into a = 0–5 and b = 6–10, the subranges a and b may be split again, for example, into c (0–2) and d (3–5) as well as e (6–8) and f (9–10).

Table 10.1 Variables included in the model and their related Andersen categories

Variable	Andersen category
Variables characterizing the family caregivers	
Age of the family caregiver	Predisposing
Gender of the family caregiver	Predisposing
Job demands (work hours) per week (in hours)	Predisposing
Restrictions in employment as a result of caregiving	Predisposing
Level of education attained by the caregiver (1 = low, 3 = high)	Predisposing
Degree of relationship between caregiver and care recipient	Predisposing
Subjectively perceived burden of care (COPE Index (negative impact), higher score = heavier burden)	Need
Self-reported health (SF-36)	Need
Subjectively perceived positive effects of caregiving (COPE Index (positive value), higher score = more positive perception)	Enabling
Feeling well supported as caregiver	Enabling
Variables characterizing the care situation	
Time spent on caregiving per week (in hours)	Need
Care recipient's need of assistance and support (dependency) as assessed by the Barthel Index and IADL Score (0–17, higher score = greater need of care and higher dependency)	Need
Length of caregiving (time since the caregiver took on caregiving responsibilities)	Need
Locality (metropolitan, urban, rural)	Enabling

Tree-based models are recommended as an alternative to logistic regression analyses (Nagy et al. 2010) in order to detect the underlying structure and most influential variables on the dependent variable "service utilization." Furthermore, they allow detecting nonlinear relationships and interactions between the factors (independent variables).

The variables for calculating the tree model were chosen according to the following criteria: on the one hand, the variables should characterize both the family caregivers and the care situation to provide a comprehensive picture of the care settings. On the other hand, the chosen variables should reflect contextual and individual factors that influence service utilization (Andersen and Davidson 2001). The variables included in the model are shown in Table 10.1.

Caregiver household income was not included in the analyses because of too many missing responses for that variable and lack of adequate imputation criteria for a flawless substitution of these missing data.

Data entry was performed using Data Entry™ 3.0. Descriptive statistics were performed with SPSS™ 20, while the tree-based model was computed using the R statistics tool (R Development Core Team 2009) using the *party* package (Hothorn and Zeileis 2009).

Table 10.2 Sample characteristics of the German sample

Characteristic	Percentage/mean
Total caregivers	N=1,003 (100 %)
Female caregivers	76 %
Female cared-for elderly	69 %
Average age of caregiver	53.8 years (SD=13.4 years)
Average age of cared-for elderly	79.7 years (SD=8.3 years)
Elderly with classified care level	60 % (n=602)
Thereof Care Level 1	33 %
Thereof Care Level 2	42 %
Thereof Care Level 3	25 %
Memory problems (undiagnosed)	22 %
Diagnosed dementia	34 %

Results

The following section presents the results of the interviews carried out with the 1,003 family caregivers in the German substudy.

Description of the German Sample

At the time of interview, the average age of the surveyed family caregivers was 54 years (standard deviation (SD) = 13.4 years). Three-quarters were women (76 %), and a large percentage was working; these employed family caregivers worked an average of 32 h per week (42 %). The average age of the elderly care recipients was 80 years (SD = 8.3 years), and 69 % of them were women. Although 72 % of family caregivers considered their elderly dependents to be in moderate-to-severe need of assistance (operationalized by limitations in ADLs and IADLs), only 60 % of these dependents were receiving long-term care insurance benefits.[4] Of these, 33 % were classified as CL 1, 42 % as CL 2, and 25 % as CL 3. In a good 30 % of cases, benefits had not yet been applied for, and in approximately 10 % of cases, the application had been rejected or was still being processed (Lüdecke et al. 2008). Dementia had been diagnosed in 34 % of care recipients, and another 22 % suffered from memory problems that had not (yet) been formally diagnosed (see Table 10.2).

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[4] Long-term care insurance is a type of social insurance which covers the risk of a future need for care. The majority of the German population has statutory long-term care insurance coverage. In the event that care is needed, covered individuals may obtain cash benefits for the "informal" caregivers and/or benefits-in-kind like professional care from the long-term care insurance funds. However, eligibility depends on the level of need for care. Following an assessment to determine an individual's level of dependency, he or she is then classified under one of three care levels (CLs) needed.

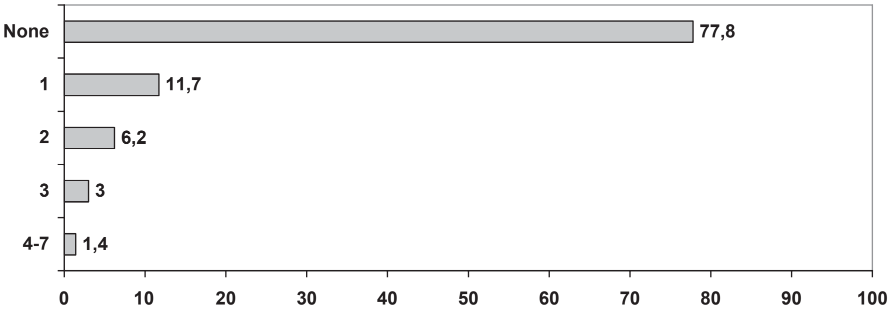

Fig. 10.1 How many special services for family caregivers are being utilized? (Number of services specifically for caregivers, in %, $N = 1{,}003$)

Utilization of Professional Services

As part of the study, family caregivers were surveyed about their use of different support services, with a distinction being made between services aimed directly at caregivers (e.g., self-help groups, support groups for family caregivers, counseling services, and caregiving courses) and services primarily directed at those in need of care (e.g., primary care physicians and physician specialists, ambulatory care services, inpatient and semi-inpatient care facilities, and meals on wheels). Below, we will examine the types of support services used by caregivers that can help ease their burden of care.

Looking solely at services specifically for family caregivers, we notice that the overall utilization level of this type of services is very low. Nearly 78 % do not make use of any of these services at all, about 12 % use at least one service, and only a small portion (approximately 10 %) use two services or more (see Fig. 10.1).

Although certain support offers and services are aimed primarily at those in need of care (e.g., outpatient care services or semi-inpatient facilities), it can be assumed that these types of services also directly or at least indirectly ease the burden of caregivers. Figure 10.2 presents the results for the use of both types of services—that is, both services specifically aimed at caregivers and services whose main target group is those in need of care.

Even after expanding the range of potential services by services primarily addressing the dependent elderly, nearly half of the surveyed caregivers were found to make no use of any (professional) support services. While only one-third of those surveyed used one service, approximately one-fourth were found to take advantage of two services or more (see Fig. 10.2).

The support services reportedly used by family caregivers can be broken down into the following areas (multiple responses possible):

- Ambulatory care: 26 %
- Household help: 11 %
- Meals on wheels: 11 %

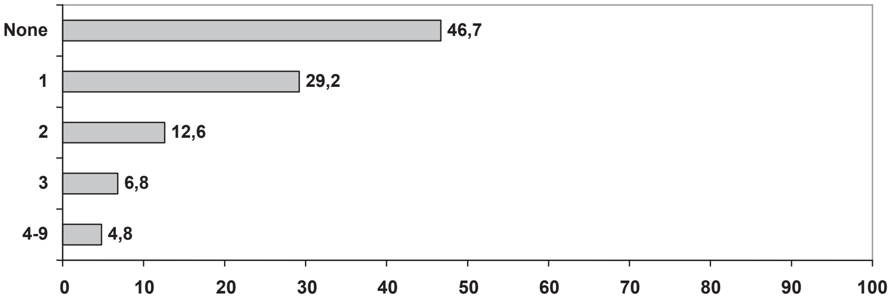

Fig. 10.2 How many services that ease the burden of care are being used by family caregivers? (Services for caregivers and for those in need of care, in %, $N=1{,}003$)

Table 10.3 Utilization of professional services by care level of the care recipients (only those collecting long-term care insurance benefits, $n=579$, $\chi^2=1.77$, df=2, $p=0.413$)

Utilization of professional services	CL 1 ($n=193$, 33.3 %)	CL 2 ($n=240$, 41.5 %)	CL 3 ($n=193$, 25.2 %)	Total ($N=579$, 100 %)
Yes (%)	67.4	65.4	71.9	67.7
No (%)	32.6	34.6	28.1	32.3
Total (%)	100	100	100	100

- Medical counseling: 8 %
- Counseling on social laws: 6 %
- Advisory centers, adult day-care centers, and private in-home caregivers/nurses: each 4 %
- Support groups for family caregivers and Internet-based information: each 3 %
- Self-help groups, caregiving courses, assistance services, and home visits by social service providers: each 2 %

Service Use by Dependency Care Level

Family caregivers may be in need of support when their responsibilities become too great and physically demanding. Their use of assistance or support services is presumed to vary depending on the level of care needed by their dependents, since a greater need of care increases the likelihood that benefits-in-kind from the long-term care insurance will be used. Of all surveyed family caregivers, 58 % are caring for a relative who is collecting long-term care insurance benefits. Whereas a good two-thirds of these caregivers (68 %) make use of professional support services, the other one-third do not use any such services (see Table 10.3). No significant differences in support service utilization were found by the CL of the care recipients. Among the care recipients receiving long-term care insurance benefits, one-third had been classified into CL 1, about 42 % into CL 2, and 25 % into CL 3.

As evidenced by these results, dependent CL and associated degree of need of care do not have a significant impact on the utilization of professional services.

Determinants on Amount and Intensity of Service Utilization

In this section, we distinguish two models of service utilization.

First, we used the tree algorithm to analyze impact factors on the *intensity* of service utilization. We asked the family caregivers which kind of services they or their dependent elderly had utilized in the last 6 months and how often this service was utilized (daily, weekly, etc.) or how many units of a service had been received in the preceding 6 months. Answers have been recoded into the following categories:

- Daily
- More than once a week but less than daily
- Once a week
- Twice a month
- Once a month
- Less than once a month

A count variable was computed to indicate the total number of units of all services utilized in the preceding 6 months. This measure was used as a dependent variable for the first model, where we looked for factors influencing the intensity of service utilization.

Then, we used the same tree algorithm to analyze impact factors influencing the amount of different services used. This variable and its characteristics have already been described above (see above, Utilization of professional services).

Factors Influencing the Intensity of Service Utilization (Used Units per 6 Months)

The first tree-based model[5] reveals the structure of factors that influence the intensity of service utilization for relieving the burden on family caregivers. The algorithm found three different service utilization groups. Only two characteristics have been identified as significant predictors of service utilization (see Fig. 10.3).

Group 1: Less-Educated Caregivers with Lower Perceived Burden (Node 3) Negative impact of care (node 1, $p < 0.001$) generates the first split and divides the sample into one group with lower (negative impact score of 14 or less) and another group with higher perceived burden (negative impact score of above 14). At a lower negative impact, the next significant determinant on the intensity of service utilization is education status (node 2, $p < 0.001$). Less-educated family caregivers with lower

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[5] Including the listed variables in Table 10.1 as independent variables and intensity of service utilization as dependent variable.

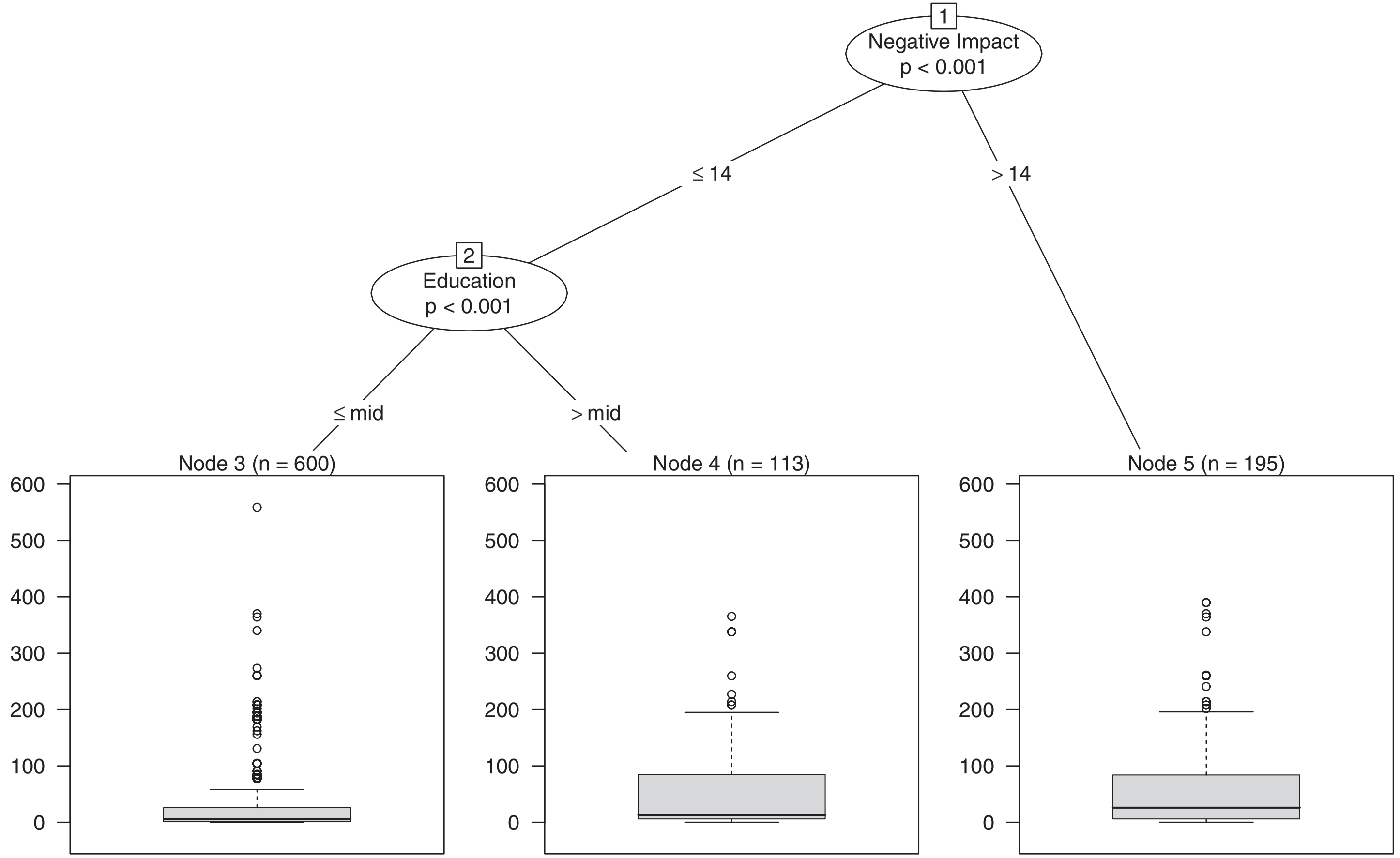

Fig. 10.3 How many times were services that ease the burden of care utilized in the preceding 6 months? ($n = 911$)

subjectively perceived burden of care (node 3, $n=600$) have a lower service utilization rate than the other groups. On average, these family caregivers utilized 33 "service units" in the last 6 months. Looking at the boxplot for this group, we can see a median score of 6 used service units, with the lower and upper quartile ranging from 1 to 26 service units.

Group 2: Higher Educated Caregivers with Lower Perceived Burden (Node 4) In case of lower negative impact and a higher educational status of family caregivers (node 4, $n=113$), service utilization increased in comparison to Group 1 up to an average of 60 "service units" used in the last 6 months. That means while family caregivers with lower educational status tend to use services less frequently when they perceive a lower subjective burden, caregivers with higher educational status use services more frequently even if they perceive the same burden of care as less-educated caregivers. For this group, we find a median score of 13 service units, the lower quartile beginning with 6 service units and the upper quartile ranging to 85 service units.

Group 3: High-Burdened Caregivers (Node 5) Subjectively perceived high burden of care (node 1, $p<0.001$) is a strong, significant predictor of the intensity of service utilization, independent of all other variables included in our model. That means that no other variable had a more significant impact to explain a high frequency of service utilization, i.e., the tree algorithm did not find any more significant interactions between negative impact and intensity of service utilization. This group (node 5, $n=195$) with an average of 60 "service units" that have been used in the last 6 months is simply characterized by a high subjectively perceived burden of care. The boxplot shows a median score of 26 service units, with the lower and upper quartile ranging from 6 to 8 service units.

Summary To summarize, higher educational status of family caregivers and/or high perceived burden of care (negative impact) predict higher frequency of service utilization. Less-educated family caregivers with a lower negative impact tend to utilize services less frequently.

Factors Influencing the Number of Different Services Used

This tree-based model[6] reveals a structure of factors that influence the number of different services used to relieve the burden on family caregivers. The algorithm found seven different types of service utilization (see Fig. 10.4), which are described in detail below.

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[6] Including the same variables as in the first model as independent variables and *number of different services utilized* as a dependent variable.

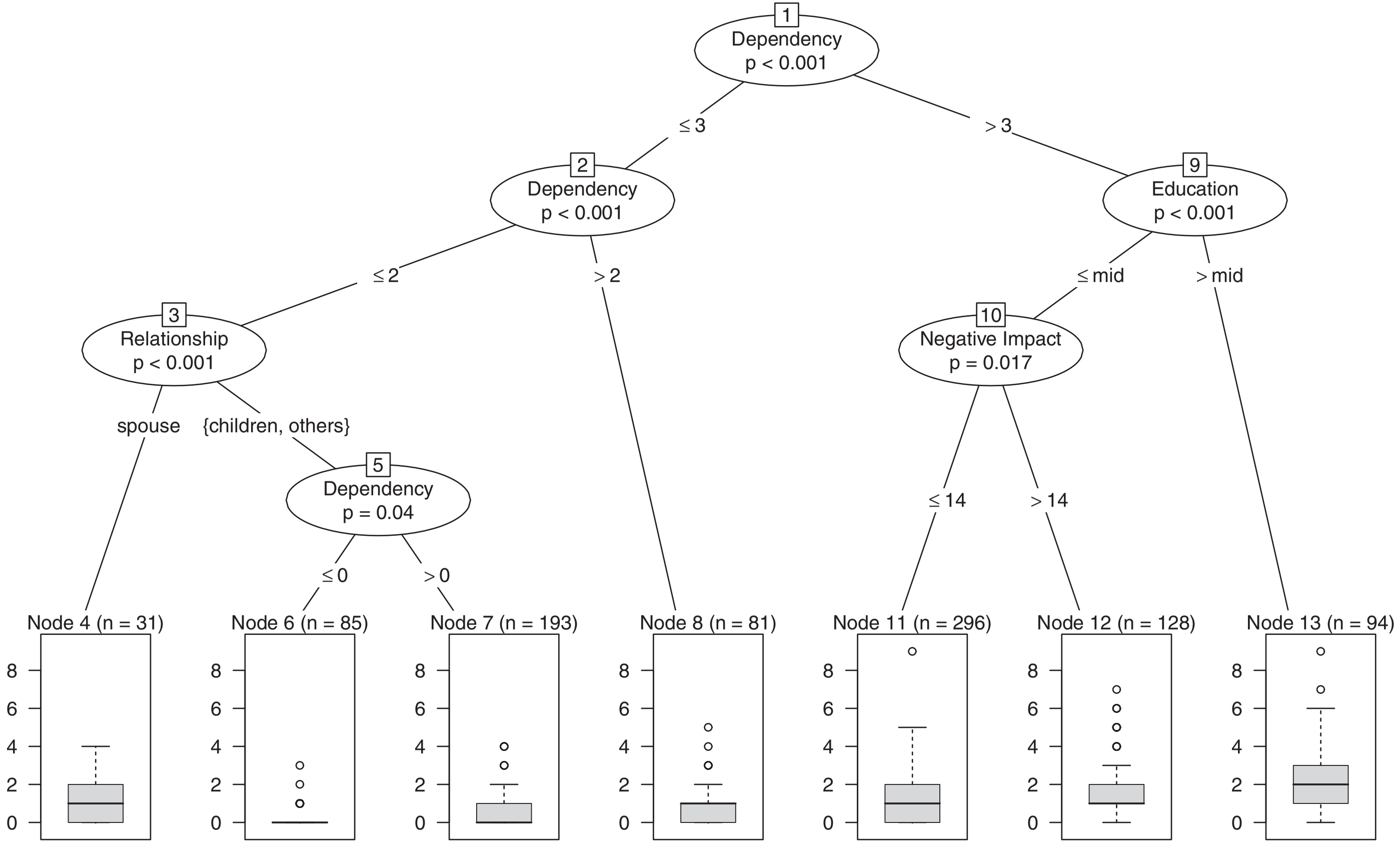

Fig. 10.4 How many different services that ease the burden of care are being utilized by family caregivers? ($n=908$)

Service Utilization for Slightly Dependent or Physically Independent Elderly

Group 1: Slight Dependency (Node 8) First of all, the dependency (node 1, $p<0.001$) of the care recipient has the strongest influence on service utilization. The performed split divides the sample into a group of family caregivers who care for elderly persons with a low dependency score (dependency score less than 4 (range from 0 to 17)) and another group of those who care for elderly with a moderate or high score (dependency score at least 4). If the elderly person is slightly dependent, the dependency (node 2, $p<0.001$) again predicts the service utilization. At a dependency value of exactly 3 (which means the elderly are slightly dependent), we found a group (node 8, $n=81$) that we may call "slight dependency" with an average of 0.9 utilized services. The resulting boxplot for this group shows a median score of 1 and the lower and upper quartile ranging from 0 to 1 utilized service. According to our results, only the characteristic "slight dependency" of the cared-for persons predicts service utilization for this group, independent from other (socioeconomic) variables.

Group 2: Married Older Caregivers in Need of Support (Node 4) If the elderly person is (almost) physically independent, the relationship between the family caregiver and care recipient (node 3, $p<0.001$) influences service utilization. Caregivers and care recipients who are married or have live-in partners (node 4, $n=31$) utilize an average of 1.2 services, even though the cared-for person is (almost) physically independent. The boxplot shows a median score of 1 and the lower and upper quartile range from 0 to 2 utilized services. This shows that especially older family caregivers are using support services even if the care dependency is comparatively low.

Groups 3 and 4: Relatives Caring for Physically Independent or Slightly Dependent Elderly (Nodes 6 and 7) If the family caregivers are relatives other than spouses or partners, services were only utilized when the care recipient was slightly dependent (node 7, $n=193$, with an average service utilization of 0.5 services). The boxplot for this group shows a median score of 0 and the lower and upper quartile ranging from 0 to 1 utilized service.

If the elderly person is physically independent, family caregivers other than spouses or partners have an average utilization of 0.2 services (node 6, $n=85$). According to the boxplot for this group, the median as well as the lower and upper quartile are 0.

Summary To summarize, we found an interaction between dependency and the relationship between family caregiver and care recipient in terms of service utilization in those cases where the care recipients are only slightly (physically) dependent or even not at all.

Service Utilization for Moderately or Highly Dependent Elderly

Group 5: Higher Educated Family Caregivers (Node 13) If the elderly person is moderately or severely dependent, the educational status of the family caregiver (node 9, $p < 0.001$) is the strongest predictor of service utilization. If the caregivers are higher educated, we find an average of 2 utilized services (node 13, $n = 94$), independent from the subjectively perceived burden as measured with the negative impact scale of the COPE Index.[7] The boxplot shows a median score of 2, with the lower and upper quartiles ranging from 1 to 3 used services.

Groups 6 and 7: Less-Educated Family Caregivers with Low and High Subjectively Perceived Burden of Care (Nodes 11 and 12) Only when the family caregiver is less educated (node 9, $p < 0.001$) is the negative impact of care (node 10, $p < 0.017$) a relevant predictor of service utilization. Less-educated family caregivers who care for moderately or severely dependent elderly persons tend to use fewer services when they feel less burdened by the care work (node 11, $n = 296$). On average, this group uses about 1.1 services, while the median score is 1 and the lower and upper quartiles range from 0 to 2.

Service utilization increases when less-educated family caregivers perceive a high subjective burden of care (node 12, $n = 128$). In this case, the average amount of utilized services is about 1.6, the median score for this group is 1, and the lower and upper quartiles range from 1 to 2 services.

Summary In case of moderate or severe dependency of care recipients, we found interactions between higher dependency and higher education as predictors for service utilization, independent of whether the higher educated caregivers perceive a higher or lower burden of care. The negative impact only interacts with lower education: moderate or severe dependency, combined with lower education status, leads to increased service utilization if the perceived burden is higher.

Discussion

We have chosen the partition-tree algorithm because this method—compared to traditional analytical methods—facilitates the presentation of highly dimensional data and allows direct interpretation. Furthermore, missing values could be integrated in the analysis instead of using complex multiple imputation algorithms. The tree algorithm allows "the construction of interpretable tree structures not suffering a systematic tendency towards covariates with many possible splits or many missing values" (Hothorn et al. 2006b) and thus "is applicable to any kind of data—whether it does or does not contain missing values" (Hapfelmeier et al. 2012).

The utilization of support services aimed directly at family caregivers is very low. According to Brodaty et al. (2005), this is true even if the caregiver is aware

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[7] As a reminder: If there were an interaction between higher educational level, (higher or lower) subjectively perceived burden of care and service utilization, the covariate "negative impact" would have been significant and split the tree path from node 9 to 13 into two more subgroups. Thus, we can assume that services are utilized by higher educated caregivers, regardless of the negative impact of care.

of the services. Including certain services not only aimed primarily at those in need of care but also often served as a source of relief for family caregivers slightly increased the percentage of caregivers using support services.

Among socioeconomic characteristics, we mainly found *need* and *predisposing* factors, as defined by the Andersen model, as predictors for service utilization.

Looking at the *number of service units used*, only two factors were relevant to explain service utilization. The higher educational status of family caregivers (predisposing factor) and/or the high perceived burden of care (negative impact, need factor) are predictors of a higher frequency of service utilization.

Regarding the *number of different services used,* a more differentiated picture is revealed. In case of lower dependency of the cared-for person, service utilization is very low. However, there seems to be an interaction between dependency and the relationship between family caregiver and care recipient in terms of service utilization. In cases where the care recipients and caregivers are married or live-in partners (which is associated with a higher age of the caregivers), services are used independently of whether the cared-for persons are only slightly (physically) dependent or even not at all dependent. This might indicate that elderly family caregivers have trouble managing the care due to their own age-related deterioration of physical health even if the frail, cared-for person is almost independent. Thus, *older* family caregivers can be seen as a vulnerable subgroup among family caregivers, with special needs for assistance and support (Bolin et al. 2008; Lee 2011; Shahly et al. 2012; Taggart et al. 2012).

In case of moderate or severe dependency of care recipients, interactions have been found between higher dependency and higher education as predictors for service utilization. Higher educated caregivers tend to use more services even when their perceived burden of care is low, while family caregivers with lower educational level only seem to use services in case of higher perceived burden of care. Thus, the negative impact only interacts with lower education: moderate or severe dependency combined with lower education status leads to increased service utilization if the perceived burden is higher.

In addition to older caregivers, *less-educated caregivers* are a vulnerable group. According to the education level of family caregivers, it seems that better educated caregivers can more easily access services due to better information about available help, for instance, how or where to find and access the necessary services or how to manage bureaucratic barriers when applying for such help (Chiu and Eysenbach 2011; Lamura et al. 2006). Another explanation is the high costs of services (Lamura et al. 2006), which can be seen as a barrier for service utilization by lower educated family caregivers. Taking opportunity costs into account (Carmichael and Charles 2003; Heitmueller and Inglis 2007), higher educated people are more likely to occupy well-paid jobs and prefer to pay for services instead of reducing career advancements.

To summarize, four important factors mainly impact service utilization:

- Need factors: dependency of elderly person and negative impact
- Predisposing factor: educational level of family caregiver and (high) age of family caregiver (or relationship)

Policymakers can particularly address predisposing factors to support informal care structures. Among less-educated family caregivers, increased service utilization is likely when available information and support services are more easily accessible. In addition, not only the availability of support services but also their advantages and benefits for the affected caregivers must be emphasized to increase the motivation for service utilization.

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