Research report

Direct costs associated with depression in old age in Germany

Melanie Luppaa,⁎, Sven Heinrichb, Herbert Matschingera, Hagen Sandholzerc, Matthias C. Angermeyera, Hans-Helmut Königb, Steffi G. Riedel-Hellerac

a Department of Psychiatry, University of Leipzig, Johannisallee 20, D-04317 Leipzig, Germany
b Health Economics Research Unit, Department of Psychiatry, University of Leipzig, Johannisallee 20, D-04317 Leipzig, Germany
c Department of Primary Health Care, University of Leipzig, Philipp-Rosenthal-Straße 27a, D-04103 Leipzig, Germany

Received 1 March 2007; received in revised form 14 May 2007; accepted 14 May 2007
Available online 12 June 2007

Abstract

Background: Depression in old age is common. Only few studies, exclusively conducted in the USA, have examined the impact of depression on direct costs in the elderly (60+). This study aims to determine the effect of depression on direct costs of the advanced elderly in Germany from a societal perspective.

Methods: 451 primary care patients aged 75+ were investigated face-to-face regarding depressive symptoms (Geriatric Depression Scale), chronic medical illness (Chronic Disease Score) and resource utilisation and costs (cost diary). Resource utilisation was monetarily valued using 2004/2005 prices.

Results: Mean annual direct costs of the depressed (€5241) exceeded mean costs of non-depressed individuals (€3648) by one third (p<.01). Significant differences were found for pharmaceutical costs, costs for medical supply and dentures, and for home care. Only few costs were caused by depression treatment. Depression has a significant impact on direct costs after controlling for age, gender, education, chronic medical illness and cognitive functions. A one-point increase in the GDS-Score was associated with a €336 increase in the annual direct costs.

Limitations: Reported costs can be considered as rather conservative estimates. There were no nursing home residents and no patients with dementia disorders in the sample. Furthermore, recall bias cannot be ruled out completely.

Conclusion: Depression in old age is associated with a significant increase of direct costs, even after adjustment for chronic medical illness. Future demographic changes in Germany will lead to an increase in the burden of old age depression. Therefore health policy should promote the development and use of cost-effective treatment strategies.

© 2007 Elsevier B.V. All rights reserved.

Keywords: Cost-of-illness; Direct costs; Economic burden; Old age depression

Declaration of interest: All authors declare that they have no conflicts of interest. Description of author’s role: M. C. Angermeyer, H. H. König, H. Sandholzer and S. G. Riedel-Heller designed the study and formulated the research questions. M. Luppaa conducted the literature search and wrote the manuscript. M. Luppaa, S. Heinrich, H. Matschinger and H. H. König analysed and interpreted the data. S. Heinrich, H. Matschinger, M. C. Angermeyer, H. H. König, S. G. Riedel-Heller revised the article. The funding sources had no further role in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

⁎ Corresponding author. Tel.: +49 341 9724530; fax: +49 341 9724539.
E-mail address: Melanie.Luppa@medizin.uni-leipzig.de (M. Luppaa).

0165-0327/$ - see front matter © 2007 Elsevier B.V. All rights reserved.
doi:10.1016/j.jad.2007.05.008
1. Introduction

Depression in old age is common. Prevalence rates of depression among elderly people seen in primary care range from 13 to 17% (Callahan et al., 1994; Unützer et al., 1997; Katon et al., 2003). Depression in old age is associated with an increased functional impairment (Beekman et al., 1997), reduced quality of life (Unützer et al., 2000), increased suicide rates (Wærn et al., 2002) and non-suicidal mortality (Schulz et al., 2002), as well as with more “non-specific” medical complaints (Katon et al., 2003). All of these may contribute substantially to higher direct costs of depressed individuals in the health care system. So far only four studies, exclusively conducted in the USA, especially have examined the impact of depression on direct costs in patients aged 60 years and older (Callahan et al., 1994; Unützer et al., 1997; Luber et al., 2001; Katon et al., 2003; Luppa et al., 2007). This study aims to determine the direct costs associated with depression in primary care patients aged 75 years and older in Germany from a societal perspective.

2. Method

2.1. Sample

The study is a part of a prospective longitudinal study on early detection of mild cognitive impairment and dementia founded by the German Research Network on Dementia. Fig. 1 shows the sample selection at the...
different steps of the survey. A total of 1133 randomly selected individuals from 20 general medical practices in Leipzig meeting the inclusion criteria received a postal invitation from their General Practitioner (GP) to participate in the study. Inclusion criteria were being 75 years of age or older and at least one visit of the patient to the GP within the last 12 months. Exclusion criteria were GP consultations only through home visits, residence in a nursing home, severe illness which, according to the GP, would prove fatal within three months, insufficient ability to speak German, deafness or blindness, lacking ability to consent and being only an irregular patient of the participating practice.

531 individuals (46.9%) consented to participate and were successfully investigated with the comprehensive assessment battery of the German Research Network on Dementia. This sample was subject to the health economic evaluation. 451 patients (84.9%) completed the health economic interview (HEI) between May 2004 and December 2005. 51 patients (9.6%) refused to participate in the HEI, 17 (3.2%) had died before the interview, 11 patients (2.1%) with a dementia disorder were excluded and one patient (0.2%) did not complete the interview. In order to analyse possible non-response bias data on age and gender were collected. Participants in the HEI (n=451) did differ significantly from the remainder of the sample (n=682) in terms of age (Z=−4.207, p<0.001) and gender (χ²=5.397, p<0.05). Non-participants were somewhat older than participants (mean 80.7 vs. 79.6 years), and women were more likely to refuse participation (70.2% vs. 63.6%).

### 2.2. Instruments

Depressive Symptoms were measured using a short version of the Geriatric Depression Scale (GDS-15), a 15-item screening instrument, developed by Sheikh and Yesavage (1986) to identify elderly patients with significant depressive symptoms. We defined significant depressive symptoms as a score of 6 or greater on the GDS (range 0–15), yielding the best sensitivity (84.0%) and specificity (88.9%), as recommended for the German version by Gauggel and Birkner (1999). Moreover, the Major Depression Inventory (MDI) (Bech et al., 1997; Bech and Wermuth, 1998) as a brief self-rating scale and a diagnostic tool for Major Depression as defined by DSM-IV and ICD-10 criteria was applied.

Chronic medical illness was measured by the Chronic Disease Score (CDS) developed by Von Korff et al. (1992). The CDS classifies each patient according to the presence or absence of chronic medical conditions.
to the number of drug agents for treating chronic medical conditions or progressive diseases (e.g. heart disease, hypertension, diabetes, cancer). Psychotropic medications and medications used primarily for symptom management (e.g. analgesics) are not included in the index. The individual CDS is calculated from the sum of scores for prescribed medication in the different medication classes.

Cognitive functioning was assessed with the Mini-Mental State Examination (MMSE) (Folstein et al., 1975) testing cognitive areas such as orientations, memory, attention and language on the basis of 30 items, and was often used as screening instrument for cognitive impairment.

2.3. Resource utilisation

Medical and non-medical resource utilisation was assessed face-to-face with a structured interview applying a cost diary. The cost diary was based on cost diaries used in earlier studies (Becker et al., 2001; Rösch et al., 2002; Roick et al., 2001; Stark et al., 2006) which were adapted to the purposes of the present study. Resource utilisation was assessed retrospectively over different time periods to control for recall difficulties, i.e. more memorable and consistent resources recorded over longer periods (Johnston et al., 1999). Time periods were three month for outpatient services, use of outpatient non-physician provider, medical supply and dentures, pharmaceuticals and transport to medical treatments, six month for inpatient care and assisted living, and twelve month for use of home care. Depending on the service, measures of utilisation, i.e. type, frequency of use or mean duration were recorded (Table 1). The instrument is available from the authors.

2.4. Unit costs

To determine direct costs, unit costs from a societal perspective were calculated for all service used, and for all pharmaceuticals and medical supply/dentures privately purchased or prescribed. Costs were extrapolated to annual costs and calculated in EURO at 2004/2005 price levels. If cost data were only available for previous years, costs were inflated to the year 2004 using the consumer price index (FSO, 2006). Detailed information regarding determination of resource utilisation and monetary valuation is shown in Table 1. Outpatient physician costs were calculated using mean costs per minute, differentiated by type of physician (Brenner and Bogumil, 2002; Federal Association of Fund Dentists, 2003). Costs for outpatient non-physician providers were calculated according to an established billing catalogue of the largest statutory sickness fund of the region (Allgemeine Ortskrankenkasse, AOK), where most of the participants were insured. Costs for inpatient care were calculated using hospital type-specific mean rates per diem for the region (Statistical Office of the Free State of Saxony, 2005; German Hospital Federation, 2006; German Social Security Association, 2004). Pharmaceutical costs were calculated using prices from the German catalogue of drugs (Red List, 2004). Costs for medical supply and dentures were calculated using market prices. Cost for home care and assisted living were calculated using the reimbursement rates of compulsory long-term care insurance, and the privately paid expenses were calculated according to patients specifications. Costs of car travel were calculated according to the number of kilometres travelled multiplied by a flat rate of €0.30 per kilometre (according to the tax-deductible rate allowed for trips to and from work, Income tax act, 2006). Costs for travel on public transport or in taxis were calculated according to patients specifications.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>t-test/χ²-test</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years, mean (s.d.)</td>
<td>Study participants with depression (n=63)</td>
<td>80.98 (4.04)</td>
<td>80.88 (3.63)</td>
</tr>
<tr>
<td>Gender, n (%)</td>
<td>Study participants without depression (n=388)</td>
<td>148 (38.1)</td>
<td>240 (61.9)</td>
</tr>
<tr>
<td>Male</td>
<td>16 (25.4)</td>
<td>72 (18.6)</td>
<td>77 (19.8)</td>
</tr>
<tr>
<td>Female</td>
<td>47 (74.6)</td>
<td>6 (9.5)</td>
<td>1.8 (1.6)</td>
</tr>
<tr>
<td>Education, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>44 (69.8)</td>
<td>239 (61.6)</td>
<td>χ²=3.806</td>
</tr>
<tr>
<td>Middle</td>
<td>13 (20.6)</td>
<td>72 (18.6)</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>6 (9.5)</td>
<td>77 (19.8)</td>
<td></td>
</tr>
<tr>
<td>GDS-Score, mean (s.d.)</td>
<td></td>
<td>7.5 (1.6)</td>
<td>1.8 (1.6)</td>
</tr>
<tr>
<td>CDS-Score, mean (s.d.)</td>
<td></td>
<td>5.0 (2.6)</td>
<td>4.8 (2.7)</td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.01.
2.5. Analyses

Statistical analyses were performed using STATA (Release 9; StataCorp, 2005). Differences in demographic characteristics (age and gender) between participants and non-participants and between depressed and non-depressed individuals (age, gender, education, CDS, GDS and costs) were investigated using two-sided $t$-test, Mann and Whitney $U$-test and $\chi^2$-analysis.

A common problem for health economic studies is a non-normal distribution of cost variables skewed to the right. For that reason, and since using a log or any other exponential transformation of cost data regression parameters and predicted values are much more difficult to interpret (Manning, 1998). It was shown elsewhere (Kilian et al., 2002) that log transformation not necessarily results in homoscedasticity of the error, so we decided to employ a multiple linear regression model with non-parametric bootstrapped standard errors (3000 replications) and bias-corrected confidence intervals (Efron and Tibshirani, 1986; Davison and Hinkley, 1997) with total direct costs as the dependent variable. The explanatory variables were: age in years, gender, education (classified according to the revised version of the international CASMIN educational classification system in low, middle and high; Braun and Steinmann, 1999), the CDS as measurement of chronic medical illness (range in the current sample: 0–13), the MMSE as measurement of cognitive functions (range in the current sample: 15–30) and the GDS as measurement of depression status (range in the current sample: 0–13).

3. Results

3.1. Sample characteristics

Table 2 presents socio-demographic and clinical characteristics of depressed and non-depressed individuals. 63 (14.0%) individuals of the 451 patients completing the HE-interview were classified as depressed with a GDS-Score of 6 or greater. Depressed and non-depressed individuals did not differ significantly regarding age, gender, education and medical comorbidity.

From depressed individuals, 9 (2.0%) fulfilled the criteria of major depression according to DSM-IV measured with the MDI. But in view of this small sample size, we refrained from further analyses of data of this sub-sample.

3.2. Service utilisation

Fig. 2 shows the service utilisation by sector of depressed and non-depressed participants. 98% of the...
depressed and non-depressed individuals had used at least one outpatient physician service during the preceding 3 month. Mental health specialists were used by 14% of depressed individuals and 8% of non-depressed individuals. The main utilised mental health specialist was the neurologist, used by 8% of depressed and 7% of non-depressed individuals. Second in utilisation was the psychiatrist, used by 5% of depressed and 1% of non-depressed individuals ($p<0.05$). Psychologists were used by 2% of depressed and 0.5% of non-depressed individuals.

Inpatient care was utilised by 16% of the depressed and 17% of non-depressed individuals during the preceding 6 month. Depressed patients had been admitted to hospitals with an average length of stay of 20.7 days. Average length of stay of non-depressed individuals were 13.0 days ($p<0.05$). Only one depressed (1.6%) and no non-depressed patient used a specialised hospital for psychiatric and neurological care.

98% of depressed and non-depressed participants used at least one pharmaceutical during the preceding 3 month. On average, depressed patients utilised 6 different drugs, non-depressed used 5 different drugs ($p<0.05$). Only 21% of the depressed individuals were treated with antidepressants. Home care was used by 38% of depressed and 20% of non-depressed individuals during the preceding 12 month ($p<0.01$). 17% of depressed and 4% of non-depressed individuals were provided with benefits from compulsory long-term care insurance ($p<0.001$). Medical supply and dentures were used by 25% of depressed and 14% of non-depressed individuals ($p<0.05$).

### 3.3. Health care costs

Table 3 presents the mean unadjusted direct costs arranged according to components of utilisation for the depressed and non-depressed participants.

The mean direct costs per patient were €5241 per year for depressed and €3648 per year for non-depressed individuals. Thus, the direct costs of depressed individuals exceeded the costs of those without depression by 30%. If the cost estimates were adjusted by using the age and gender distribution of the old age population of the year 2004 in Germany (FSO, 2005), annual mean costs were €5422 for depressed individuals and €3624 for non-depressed. Absolute mean costs of depressed individuals were higher in each of the component costs except outpatient costs. Statistically significant differences were found for pharmaceutical costs, costs for medical supply and dentures, and costs for home care. Differences in pharmaceutical costs were caused by the mean annual quantity of different prescriptions for depressed and non-depressed individuals. For medical supply and dentures, cost differences occurred, since more depressed as non-depressed patients were given such prescriptions. Differences in costs for home care were caused, since more depressed as non-depressed patients were provided with benefits from the long-term care insurance. In a comparison of direct costs of depressed treated ($n=13$) and untreated individuals ($n=50$) no significant differences were found ($Z=-1.647$, $p=0.099$).

The most relevant cost driver of the direct costs of the depressed elderly were inpatient costs with 40% (for patients without depression 35%), followed by costs of pharmaceuticals (27% vs. 28%) and home care (15% vs. 8%). Outpatient costs amounted to 7% (vs. 16% for non-depressed individuals) of the direct costs being rather low.

As shown in Fig. 3, depressed patients had markedly higher costs than non-depressed individuals at every level of Chronic Disease Score.

### Table 3

<table>
<thead>
<tr>
<th>Cost categories</th>
<th>Group, mean (s.d.)</th>
<th>Mann/Whitney-U-test</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outpatient</td>
<td>385 (388)</td>
<td>573 (2,085)</td>
<td>Z=−1.380</td>
</tr>
<tr>
<td>Non-physician</td>
<td>186 (354)</td>
<td>167 (385)</td>
<td>Z=−1.075</td>
</tr>
<tr>
<td>Medical supply</td>
<td>225 (696)</td>
<td>216 (969)</td>
<td>Z=−2.205</td>
</tr>
<tr>
<td>Inpatient care</td>
<td>2,087 (5,714)</td>
<td>1,291 (3,692)</td>
<td>Z=−0.107</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>1,410 (1,359)</td>
<td>1,017 (2,048)</td>
<td>Z=−3.705</td>
</tr>
<tr>
<td>Non-medical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home care</td>
<td>790 (2,042)</td>
<td>292 (1,232)</td>
<td>Z=−3.279</td>
</tr>
<tr>
<td>Assisted living</td>
<td>48 (189)</td>
<td>32 (175)</td>
<td>Z=−1.417</td>
</tr>
<tr>
<td>Transportation</td>
<td>110 (273)</td>
<td>60 (180)</td>
<td>Z=−1.132</td>
</tr>
<tr>
<td>Total direct</td>
<td>5,241 (6,670)</td>
<td>3,648 (5,854)</td>
<td>Z=−2.806</td>
</tr>
</tbody>
</table>
3.4. Multivariate analyses

The linear regression model (see Table 4) revealed that three variables were significantly associated with health care costs: the Geriatric Depression Score, the Chronic Disease Score and a middle education level (reference group: low education). A one-point increase in GDS was associated with a €336 increase in health care costs. With each change of the CDS by one point, the annual health care costs increase by €456. With a change in education level from low to middle, the annual health care costs increase by €1819.

4. Discussion

For a German primary care sample aged 75 years and over, we found that the annual direct costs for depressed individuals (€5241) were 30% higher than for those without symptoms (€3648). The association between depression and direct costs remained significant after adjustment for age, gender, education and chronic medical illness.

A few studies conducted in the USA, also examined costs of depression in old age samples in primary care (Callahan et al., 1994; Unützer et al., 1997; Luber et al., 2001; Katon et al., 2003). These studies used the bottom-up approach and estimated costs of depression starting with the individual patient and using databases of health care providers which allowed the investigation of large samples. We also used the bottom-up approach, but collected data retrospectively by applying cost diaries in face-to-face interviews with the patients. This strategy has the advantage of allowing comprehensive collection of the data for resource consumption of each patient. Furthermore, individual data such as out-of-pocket expenses or costs of social services can also be collected. However, recall bias cannot be excluded completely in face-to-face examination with elderly patients. We tried to minimize the bias applying different time periods for cost components due to recommendations of Johnston et al. (1999).

Fig. 4 shows the comparison of our results with those from the American studies. To allow comparison between studies, direct costs were inflated to the year 2003 and converted into US-Dollars using purchasing power parities. Independent of the methodical characteristics and the substantial cost differences between studies, the direct costs of depressed individuals exceeded the direct costs of those without depression by about one-third in all studies, except for one study published by Luber et al. (2001). For case-finding of depressed patients Luber et al. (2001) relied on

---

Table 4

| Coefficient (95% CI) | Standard errors \( b \) | Z | \( p > |z| \) |
|----------------------|--------------------------|---|-----------------|
| Age (years) \(-55.74 (-185.78 to 61.70)\) | 62.64 | \(-0.89\) | 0.374 |
| Gender \(408.21 (-552.98 to 1,322.71)\) | 472.80 | 0.86 | 0.388 |
| CDS \(455.92 (266.64 to 634.66)\) | 92.92 | 4.91 | 0.000 |
| Education \(\text{ref} = \text{low}\) |
| Middle \(1,819.37 (379.03 to 3594.02)\) | 829.69 | 2.19 | 0.028 |
| High \(1,662.58 (291.74 to 3736.67)\) | 858.31 | 1.94 | 0.053 |
| MMSE \(-1.33 (-487.26 to 480.00)\) | 247.15 | \(-0.01\) | 0.996 |
| GDS \(336.44 (101.25 to 636.75)\) | 134.81 | 2.50 | 0.013 |
| Constant \(228.46 (-961.67 to 1,347.14)\) | 583.76 | 0.39 | 0.696 |
| \( R^2 \) | 0.082 |
| \( N \) | 451 |

\( a \) Bias-corrected confidence intervals.
\( b \) Bootstrap standard errors with 3,000 replications.
physician diagnosis including only recognised depressed cases. All other studies considered both recognised and unrecognised cases identified by study diagnosis. The low excess costs for recognised depressed cases of 7% of direct costs (Luber et al., 2001) in comparison to a compound of recognised and unrecognised depressed cases resulting in excess costs by about one third of direct costs (Callahan et al., 1994; Unützer et al., 1997; Katon et al., 2003) indicated that unrecognised depression caused higher direct costs than recognised depression.

A German cost-of-illness study of depression in the whole adulthood (Salize et al., 2004) reported for a small sample of elderly depressed primary and specialized care patients of 65 years and older (n=27) mean annual treatment costs of 2130 US$ for depressive disorders according to ICD-10. As expected, these mean annual treatment costs for recognized clinical depressed cases were higher as our calculated excess direct costs for recognised and unrecognised clinical and subclinical depressed cases (1664 US$).

Regarding cost components, depressed individuals caused significantly higher costs for pharmaceuticals, medical supply/dentures, and home care. Depressed patients utilised more pharmaceuticals and medical supply/dentures, and they were more provided with benefits from long-term care insurance as non-depressed patients, even after controlling for severity of medical illness. This is in line with studies showing that patients with depression in old age often have significantly more non-specific medical complaints such as pain or headache (Luber et al., 2001; Waxman et al., 1985) and tended to amplify such medical symptoms (Katon et al., 2003). This increase in medical symptoms in elderly patients with depression may have led to more medical investigations and prescriptions aimed at reducing these symptoms.

Mental health care was not often used by depressed individuals. Treatment with antidepressants only occurred for 21% of depressed patients. This indicated that more unrecognised than recognised depressed cases were contained in the sample and facilitated the findings that depression in old age in primary care is often underdiagnosed (Callahan, 2001).

Certain limitations caused by methodical characteristics must be considered in interpreting the results. 93% of the German elderly population regularly visits their General Practitioner (Linden et al., 1996). Although sampling in the primary care sector seems reasonable, cost estimates reported are seen as rather conservative estimates. There are two reasons: firstly, via exclusion criteria nursing home residents and patients with dementia disorders, known to have higher depression rates and supposedly higher health care costs, were not considered. Secondly, only 39.8% (n=451) of the randomly selected sample (n=1,133) were finally evaluated with the health economic interview, so that there is a possibility of response bias may cause underestimation of direct costs, since depressed – especially more severely depressed – older adults are known to be more likely to refuse research invitations (Thompson et al., 1994).

Another issue is the case definition used. Since depressive disorders vary from a continuum from very mild forms to very severe disturbances, prevalence is heavily influenced by the case definition. Especially in the
elderly, major depression according to the modern classificatory systems was found to be rather low — 1.8% (Beckman et al., 1999). In our sample only nine individuals (2.0%) fulfilled the criteria of a major depression according to DSM-IV. In contrast, in various studies a larger number of individuals suffering relevant depressive symptoms ranging from 8 to 28% could be identified by screening scales (Riedel-Heller et al., 2006). This phenomenon is widely recognized, and psychiatric epidemiology has not yet successfully dealt with the gap between occurrence of clinical relevant symptoms and diagnostic cases according to modern classificatory systems — especially in old age. Therefore we decided, in line with other studies, to base our case definition on the GDS, known to be valid and reliable with adequate psychometric properties (Sheikh and Yesavage, 1986; Gauggel and Bircker, 1999; Montorio and Izal, 1996).

Depression in old age is frequent and it is associated with adverse outcomes. Although we found that depression in old age is associated with increased service utilisation and enhanced health care costs, it is still uncertain which shares of health care costs were caused by recognised and unrecognised depression at a time. In the future it would be interesting to find out how recognition and adequate treatment of unrecognised depression in old age will affect the excess costs of depressed elderly individuals. Anyhow, early detection and adequate treatment of depression in old age lead to an increase in quality of life for the sufferer and their families.

Acknowledgment

The study is part of the German Research Network on Dementia and was funded by the German Federal Ministry for Education and Research (grant 01GI0420 and 01ZZ0106) and by the formel.1-04/NBL-3 Program.

References


German Hospital Federation (Eds.), 2006. Bestandsaufnahme zur Krankenhausplanung und Investitionsfinanzierung in den Bundesländern. (www.dkgev.de).


