

COST OF DIAGNOSING AND TREATING COGNITIVE COMPLAINTS: ONE-YEAR COST-EVALUATION STUDY IN A PATIENT COHORT FROM A SLOVENIAN MEMORY CLINIC

STROŠKI DIAGNOSTICIRANJA IN ZDRAVLJENJA DEMENCE: 1-LETNA OCENA STROŠKOV OBRAVNAVE V SLOVENSKEM CENTRU ZA KOGNITIVNE MOTNJE

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ABSTRACT

Keywords:

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Introduction: Dementias present a global health challenge and give rise to significant economic costs. This study aims to evaluate the economic impact of one-year outpatient healthcare, nursing home, and formal and informal home help costs for all patients referred to the Centre for Cognitive Impairments at the Department of Neurology, Ljubljana University Medical Centre, Slovenia.

Methods: Data was acquired retrospectively from physicians' records and the costs for 2015 were calculated. Total costs were estimated by means of a bottom-up calculation of outpatient visits, diagnostic examinations and anti-dementia medication. In a subgroup of 120 patients with dementia, the Resource Utilization in Dementia questionnaire was used to estimate formal and informal care costs.

Results: A total of 720 patients visited the memory clinic in 2015. Diagnosis at first visit was subjective cognitive or mild cognitive impairment (SCI/ MCI) for 322 patients, dementia for 258 patients, and psychiatric or other disorders for 140 patients. The average annual cost per patient was EUR 578. It was highest for patients with dementia (EUR 751), EUR 550 for patients with SCI/MCI, and lowest for patients with psychiatric and other disorders (EUR 324). Monthly informal and social care costs were between EUR 1,037 and EUR 3,369, depending on the methodology used.

Conclusion: The cost of diagnosing a cognitive disorder depends on how extensive the diagnosis is. With an estimated prevalence of 34,137 persons with dementia in Slovenia, basic diagnostic investigations incur costs of approximately EUR 7 million. Direct medical costs represent a smaller portion of total dementia costs; this is because annual costs for formal and informal home help are estimated at EUR 265 million and nursing home placements at EUR 105 million.

IZVLEČEK

Ključne besede:

kognitivne motnje,
demenca,
ocena stroškov

Uvod: Demence so globalni zdravstveni izziv in strošek. Ovrednotili smo ekonomski vpliv enoletnih stroškov ambulantne obravnave, domske oskrbe ter formalne in neformalne pomoči na domu bolnikom, napotenih v Center za kognitivne motnje Nevrološke klinike Univerzitetnega kliničnega centra Ljubljana.

Metode: Podatki so bili pridobljeni za nazaj iz zdravniških izvidov bolnišničnega registra bolnikov. Skupne enoletne stroške v 2015 smo ocenili z izračunom stroškov ambulantnih obiskov, diagnostičnih pregledov in zdravlil za demenco. V podskupini 120 bolnikov z demenco smo uporabili Vprašalnik za oceno virov pri demenci za oceno formalnih in neformalnih stroškov.

Rezultati: V letu 2015 je Center za kognitivne motnje obiskalo 720 bolnikov. Diagnoza ob prvem obisku je bila subjektivna ali blaga kognitivna motnja pri 322 bolnikih, demenca pri 258 bolnikih in psihiatrične ali druge motnje pri 140 bolnikih. Povprečni letni stroški so znašali 578 EUR na bolnika, najvišji so bili pri bolnikih z demenco (751 EUR), pri bolnikih s subjektivno ali blago kognitivno motnjo so bili 550 EUR, najnižji pa so bili pri bolnikih s psihiatričnimi in drugimi motnjami (324 EUR). Mesečni neformalni stroški in stroški socialne oskrbe so bili med 1,073 EUR in 3,369 EUR, odvisno od uporabljene metodologije izračuna.

Zaključek: Stroški diagnosticiranja kognitivnih motenj so odvisni od obsežnosti diagnostičnega procesa. Ob ocenjeni prevalenci 34.137 oseb z demenco v Sloveniji bi za izvedbo osnovnih diagnostičnih preiskav odšteli približno 7 milijonov EUR. Neposredni zdravstveni stroški predstavljajo manjši del skupnih stroškov demence, saj ocena neformalnih in drugih formalnih stroškov znaša 265 milijonov EUR in 105 milijonov EUR za nastanitev v domsko varstvo.

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1 INTRODUCTION

One third of the total disease burden is caused by mental and neurological disorders (1). In Europe, the costs for dementia are staggeringly high at EUR 105.2 billion (2). In Slovenia, the purchasing power parity (PPP) figure for the total cost of dementia in 2010 was estimated at EUR 214.9 million, while the costs of mood disorders (EUR 329.3 million PPP) and anxiety disorders (EUR 289.4 million PPP) were even higher (3). However, these estimates are based on extrapolations and imputations from the European Brain Council study (2). With no reliable national epidemiological and health economic data, the financial costs of dementia in Slovenia may be over- or underestimated (3). There is considerable potential for medical costs to increase, particularly with advanced imaging and biomarker analyses of cerebrospinal fluid (CSF) in the coming years, with reductions in the diagnosis and treatment gap of cognitive disorders. However, underdiagnosis and undertreatment are proven to be cost-ineffective approaches (4), and diagnostic work-up and treatment will not necessarily increase overall expenditure (as a result of the earlier introduction of more appropriate management) (5). Establishing cost-effective management is challenging, and depends on the practices and organisation of the health system in different countries.

Since 2009, patients with cognitive complaints have been able to be referred to the Centre for Cognitive Impairments at the Department of Neurology, Ljubljana University Medical Centre, Slovenia. With a lack of country-specific, comprehensive data on the size, burden and cost of cognitive disorders, we aimed to evaluate the economic impact of the costs of one-year outpatient healthcare, nursing home, and formal and informal home help for all referred patients.

2 METHODS

The one-year direct medical costs of outpatients who attended the Centre for Cognitive Impairments at the Department of Neurology, Ljubljana University Medical Centre, Slovenia (6) were evaluated for 2015. Data on demographics, comorbidities, medication, referrals or completed diagnostic procedures and the number of medical visits was acquired retrospectively from physicians' records from the hospital's patient registry in March and April 2016.

At first visit, a detailed history is taken from all patients, who also undergo a general neurological examination, a cognitive assessment (Mini-Mental State Examination [MMSE] and/or a Montreal cognitive assessment [MoCA] and/or neuropsychological evaluation), and screening for mood disorders using the Beck Depression Inventory

(BDI). They are referred for extensive laboratory testing (basic blood tests, thyroid function, vitamin B12 and folic acid) and a structural brain scan (either computerised tomography [CT] or magnetic resonance imaging [MRI]). Basic blood tests consist of differential blood count, electrolytes, proteins, cholesterol and triglycerides, kidney and liver function tests, and sedimentation rate. Additional examinations are indicated on a case-by-case basis.

The total costs were estimated using a bottom-up calculation of the unit costs of examination, diagnostic procedures and medication. The costs of medical visits and procedures (lumbar puncture [LP]), laboratory tests, electroencephalography (EEG), and structural (CT or MRI) and functional brain imaging tests (fluorodeoxyglucose positron emission tomography [FDG-PET], dopamine transporter scan [DaT scan]) were obtained from institutional and government sources. For the unit costs, we regarded Ljubljana University Medical Centre to be the main source of examinations and procedures, and used its price list for 2015. The costs of LP include the procedure itself, CSF analysis and the stay in a day hospital. In 2015 billing for LP with CSF analysis became less costly (EUR 734.84-2,264.54) and the average price (EUR 1,499.69) was taken into account. The Ljubljana University Medical Centre price list for 2021 was used to calculate the diagnostic packages.

Details of the prescription of anti-dementia medication were obtained from the hospital records. There is a record of patients who were prescribed medication at any time during their follow-up at the cognitive outpatient clinic; however, data on dispensation from pharmacies and the actual consumption of medication was not available. Some patients switched from one anti-dementia medication to another. If two different cholinesterase inhibitors (ChEIs) were prescribed to the patient, only one was considered in the final cost calculation. However, if a patient was receiving both ChEI and memantine, we regarded the patient as receiving them simultaneously. For anti-dementia medication, we used the average prices from 2015. For patients receiving ChEIs, the approximate price was calculated according to the proportion of patients receiving rivastigmine, galantamine and donepezil.

According to hospital records, some examinations (e.g. CT, MRI) were often indicated, but might have been performed at another centre. If there was a lack of feedback information about whether these examinations were performed, we did not include them in the analyses. Although DaT scans and EEG can be used to diagnose dementia with Lewy bodies, we were unable to ascertain whether they had been performed for other indications. The performance of CT, MRI, FDG-PET, DaT scans and EEG is given for 2015 (Table 2) and the whole observation period (2006-2016, Table 1).

Details of informal costs (non-professional caregivers' time spent on care and supervision) and formal help hours were acquired using the Resource Utilization in Dementia (RUD) questionnaire (7). The main caregivers of dementia patients were identified, and 120 RUDs were completed via telephone interviews in 2016. The control group comprised 92 caregivers of patients with no memory complaints that visited primary care physicians in the same city (Ljubljana).

The main caregiver estimated the proportion of the time they spent on giving care. Activities of daily living (ADLs) consisted of basic and instrumental activities (e.g. personal hygiene, ambulating, managing finances, medication). Supervision was defined as time needed to prevent potential hazardous events. Since supervision time was inflated (a lot of caregivers reported monitoring 24 hours a day), it was adjusted by subtracting the caregiver's sleeping time and time spent on ADLs. The unit costs for formal home help are based on the median price of home help organised by municipalities in the public sector (EUR 16.67 per hour) (8). Different approaches to the quantification and costing of informal care were applied in the sensitivity analysis. Informal care costs were calculated as opportunity costs and as replacement costs. Opportunity costs refer to the loss of benefit as a consequence of engaging in an activity, offering a lower return in benefit (e.g. care for a person with dementia). It was calculated using median hourly earnings for Slovenia in 2014 (EUR 7.32 per hour) (9). A replacement cost is a cost required to replace any existing asset (e.g. care by a caregiver). It was calculated by using the median price of home help as described above (8). Other social care costs (e.g. transportation, food delivery, day care) were collected by RUD. However, since there was a high proportion of missing values for frequency of implementation, they were unsuitable for further analysis. The help associated with dementia was calculated by subtracting the average help required for persons of a similar age without dementia. The average daily cost of a public nursing home placement for a person who needs partial or complete help as a result of dementia was EUR 28.71 in 2015 (10).

2.1 Statistical analysis

Categorical variables are presented as the number of cases, and percentages and continuous variables as median (\pm interquartile range - IQR). To calculate intergroup differences, ANOVA, the Mann-Whitney U-test or the Kruskal-Wallis test and Chi-square or Fisher's exact tests were used for continuous and categorical variables respectively. Tests were 2-tailed with a p value <0.05 considered significant.

Since data on informal and formal home help hours were skewed and not normally distributed, a generalised linear model with a gamma distribution and log link was applied for monthly hours and costs. Models were adjusted for age and sex.

The IBM Statistical Package for Social Sciences (IBM SPSS) for Windows, Sciences software version 22 (IBM Corporation, Armonk, NY, USA) was used.

3 RESULTS

A total of 720 patients were referred to the Centre for Cognitive Impairments in 2015. Diagnosis at first visit was subjective cognitive impairment (SCI) or mild cognitive impairment (MCI) for 322 patients, dementia for 258 patients, and psychiatric or other disorders for 140 patients.

In the SCI and MCI group, 53 (16.5%) had SCI and 269 (83.5%) had MCI. Out of the 258 patients with dementia, 103 (39.9%) had unspecified or other dementia, 85 (32.9%) had Alzheimer's disease dementia (AD), 34 (13.2%) had mixed dementia, 18 (7%) had dementia with Lewy bodies or Parkinson's disease dementia, 12 (4.7%) had vascular dementia, and 6 (4.7%) had frontotemporal dementia. The remaining 140 patients had depressive or anxiety disorder (68 [48.6%], other psychiatric diagnoses (e.g. adjustment disorders, 18 [12.9%]) and other diagnoses (e.g. Parkinson's disease, amyotrophic lateral sclerosis, 54 [38.6%]). Patients with dementia were older, had lower MMSE, and were more likely to be retired than patients from the SCI/MCI group and patients with psychiatric or other disorders (Table 1). Only 11 (2.3%) patients from all three groups were nursing home residents.

Table 2 shows the performance and costs of examinations and procedures. The average annual cost per patient was EUR 578. It was highest for patients with dementia (EUR 751) and lowest for patients with psychiatric and other disorders (EUR 324). The costs of MMSE (EUR 13.34), MoCA (EUR 26.67), and BDI (EUR 11.74) are only charged when performed on hospitalised patients. However, if those performed on an outpatient basis are included, this would give rise to additional costs of EUR 6,430, EUR 9,335 and EUR 1,843 respectively (these results are not presented in the table).

The informal and social care costs for patients with dementia and the control group without dementia are shown in Tables 3 and 4. Patients with dementia needed more help with basic and instrumental ADLs and more supervision than patients without dementia. The monthly total care costs for one patient with dementia were, on average, EUR 381 higher than for a person of similar age without dementia in the base cost option. However, the sensitivity analysis (Table 4) highlights how crucial the assumptions for informal care are. With the most costly

option, the difference is EUR 1,474 per month, with total costs being around three times higher than they are with the base option. The cost of diagnosing a cognitive disorder depends on how extensive the diagnosis is (Table 5).

The observation periods for all patients ranged from 0-10 years. In this period, 27% patients with SCI/MCI and 11% patients with psychiatric or other disorders progressed to dementia (Figure 1). In the majority (94%) of patients with dementia, there was no change in diagnosis during the follow-up.

Table 1. Demographics, comorbidities, cognitive status and medication of patients at the Centre for Cognitive Impairments.

	All patients (n=720)	SCI and MCI (n=322)	Dementias (n=258)	Psychiatric disorders and other dg. (n=140)	p-value
Age, mean (SD)	73 (13)	72 (10)	80 (8)	61 (15)	<0.001*
Women, n (%)	427 (59.3)	189 (58.7)	149 (57.8)	89 (63.6)	0.506
Employed	47 (6.5)	19 (5.9)	3 (1.2)	25 (17.9)	<0.001
Residency					
living alone	114 (23.4)	58 (27.5)	46 (22.2)	10 (14.3)	
with a partner or caregiver	363 (74.4)	148 (70.1)	156 (75.4)	59 (84.3)	0.199***
nursing home/institution	11 (2.3)	5 (2.4)	5 (2.4)	1 (1.4)	
MMSE, median (IQR)	27 (4)	28 (4)	22 (6)	28 (5)	<0.001**
MMSE 0-10	7 (1.5)	0	7 (3.1)	0	0.024***
MMSE 11-20	98 (20.3)	11 (5.0)	81 (36.3)	6 (14.6)	<0.001
MMSE 21-30	377 (78.2)	207 (95.0)	135 (60.5)	35 (85.4)	<0.001
MoCA, median (IQR)	22 (7)	24 (6)	18 (6)	25 (4)	<0.001**
Antidementives	348 (48.3)	91 (28.3)	237 (91.9)	20 (14.3)	<0.001
Memantine	100 (13.9)	19 (5.9)	77 (29.8)	4 (2.9)	<0.001
ChEIs	293 (40.7)	77 (23.9)	200 (77.5)	16 (11.4)	<0.001
Rivastigmine	181 (25.1)	36 (11.2)	136 (52.7)	9 (6.4)	<0.001
Galantamine	45 (6.3)	12 (3.7)	30 (11.6)	3 (2.1)	<0.001
Donepezil	95 (13.2)	36 (11.2)	52 (20.2)	7 (5.0)	<0.001
Antidepressants	372 (51.7)	152 (47.2)	131 (50.8)	89 (63.6)	0.005
First visit in 2015	374 (51.9)	181 (56.2)	109 (42.2)	84 (60.0)	0.001
Total number of imaging/ neurophysiological examinations (CT, MRI, FDG-PET, DaT scan, EEG)	723 (100)	317 (43.8)	282 (39.0)	124 (17.2)	/

Unless stated otherwise, the data is represented as number of cases (n) and percentage proportion (%). Unless stated otherwise, the p-values were obtained by chi-square. Employment status and residency were recorded only at the first examination. *ANOVA, **Kruskal-Wallis test, ***Fisher's exact test

ChEIs - cholinesterase inhibitors, CT - computerised tomography, DaT scan - dopamine transporter scan, EEG - electroencephalography, FDG-PET - fluorodeoxyglucose positron emission tomography, IQR - interquartile range, MCI - mild cognitive impairment, MMSE - mini-mental state examination, MoCA - Montreal cognitive assessment, MRI - magnetic resonance imaging, SCI - subjective cognitive impairment, SD - standard deviation

Table 2. Costs of diagnostic procedures and treatment performed in 2015.

	Unit costs (EUR) 2015	All patients (n=720)		SCI and MCI (n=321)		Dementias (n=259)		Psychiatric and other dg. (n=140)	
		No of ptn	Costs (EUR)	No of ptn	Costs (EUR)	No of ptn	Costs (EUR)	No of ptn	Costs (EUR)
First visit	17.3	374	6,470	181	3,131	109	1,886	84	1,453
Follow-up visits	8.65	514	4,446	214	1,851	198	1,713	102	882
Basic blood panel	34.46	374	12,888	181	6,237	109	3,756	84	2,895
Vitamin B12, folic acid, homocysteine	41.53	374	15,532	181	7,517	109	4,527	84	3,489
Thyroid function (TSH, T4, T3)	20.14	374	7,532	181	3,645	109	2,195	84	1,692
MRI	250.72	108	27,078	61	15,294	28	7,020	19	4,764
CT	88.97	28	2,491	7	623	16	1,424	5	445
LP	1,499.69	61	91,481	37	55,489	20	29,994	4	5,999
Neuropsychological examination	230.01	94	21,621	65	14,951	17	3,910	12	2,760
FDG-PET	928.67	32	29,717	20	18,573	8	7,429	4	3,715
DaT scan	1,235.31	13	16,059	3	3,706	4	4,941	6	7,412
EEG	49.33	49	2,417	21	1,036	15	740	13	641
Dg. - cost per group (EUR)		237,733		132,053		69,535		36,146	
Dg. - cost per person (EUR)		330		412		268		258	
Anti-dementia treatment/month ChEI	40.8	293	143,453	77	37,699	200	97,920	16	7,834
Memantine	29.3	100	35,160	19	6,680	77	27,073	4	1,406
Med. - cost per group (EUR)		178,613		44,380		124,993		9,240	
Med. - cost per person (EUR)		248		138		483		66	
All - cost per group (EUR)		416,346		176,433		194,528		45,386	
All - cost per person (EUR)		578		550		751		324	

Costs are reported in euros.

EUR - euro, BDI - Beck Depression Inventory, ChEIs - cholinesterase inhibitors, CT - computerised tomography, dg - diagnoses, FDG-PET - fluorodeoxyglucose positron emission tomography, LP - lumbar puncture with dementia biomarkers cerebrospinal fluid analysis, MCI - mild cognitive impairment, Med. - medications, MMSE - mini-mental state examination, MoCA - Montreal cognitive assessment, No - number, SCI - subjective cognitive impairment

Table 3. Informal and social care monthly costs in patients with and without dementia.

	Patients with dementia (n=120)	Patients without dementia (n=92)	p-value
Age, median (IQR)	81 (10)	81 (9)	0.580
Women, n (%)	73 (60.8)	63 (68.5)	0.250a
Number of caregivers, median (IQR)	2 (4)	2 (4)	0.840
Type of help and costs			Difference
Informal care: ADLs (hours/month)	118	77	41
Informal care: opportunity cost (EUR/month (95% CI))	EUR 894 (725-1103)	EUR 561 (445-707)	EUR 333
Home help (hours/month)	3.1	3.6	-0.5
Home help costs (EUR/month; (95% CI))*	EUR 53 (21-85)	EUR 60 (23-98)	-EUR 7
Nursing home placement, n (%)	17 (14.2%)	3 (3.3%)	
Nursing home cost (EUR/month (95% CI))*	EUR 114 (69-158)	EUR 15 (-37-66)	EUR 99
Total costs: opportunity cost (95% CI)**	EUR 1,037 (897-1177)	EUR 656 (500-812)	EUR 381

Unless stated otherwise, variables are reported as estimated marginal means. P-values were obtained the Mann-Whitney U-test, a Chi-square test

Total costs are the costs of informal care (ADLs), home help and nursing home placement.

ADLs - activities of daily living (basic and instrumental), EUR - euro, IQR - interquartile range, CI - confidence interval

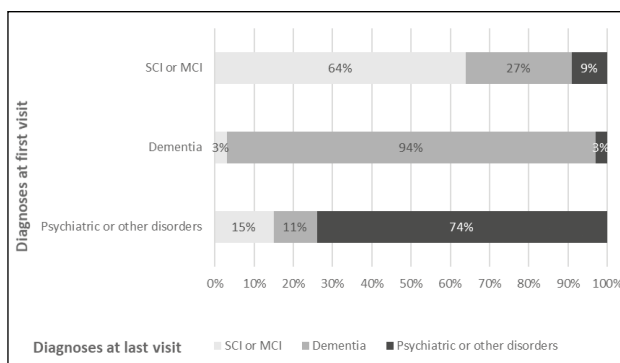
*Owing to the many zero values, a general linear model was applied here.

**Due to regression analyses, the total costs are not identical to the sums of the components.

Table 4. Sensitivity analysis of informal and social care costs in patients with and without dementia.

	Patients with dementia (n=120)	Patients without dementia (n=92)	Difference
ADLs (hours/month)	118	77	41
Replacement costs	EUR 2,028 (1,728-2,327)	EUR 1,312 (978-1,646)	EUR 716
ADLs and supervision (hours/month)	188	102	86
Opportunity costs	EUR 1,392 (1,169-1,617)	EUR 790 (560-1,019)	EUR 602
Replacement costs	EUR 3,173 (2,663-3,63)	EUR 1,798 (1,275-2,322)	EUR 1,375
Home help costs (EUR/month)	EUR 53 (21-85)	EUR 60 (23-98)	/
Nursing home costs (EUR/month)	EUR 114 (69-158)	EUR 15 (-37-66)	EUR 99
Total costs with informal care ADL replacement costs (EUR/month)	EUR 2,174 (1,873-2,475)	EUR 1,392 (1,056-1,723)	EUR 782
Total costs with informal care ADL and supervision opportunity costs (EUR/month)	EUR 1,495 (1,265-1,726)	EUR 872 (635-1,108)	EUR 623
Total costs with informal care ADL and supervision replacement costs (EUR/month)	EUR 3,369 (2,856-3,880)	EUR 1,895 (1,370-2,420)	EUR 1474

A general linear model was used and the variables are reported as estimated marginal means with 95% confidence intervals. EUR - euro. Total costs are costs of informal care (ADLs or ADL and supervision time), home help and nursing home placement.

**Figure 1.** Changes in diagnostic groups from first to last visit.

4 DISCUSSION

The total cost of diagnosing and treating patients in one year at a specialist centre for cognitive disorders was almost EUR 420,000 per year, with an average of EUR 578 per patient per year. The higher costs associated with patients with SCI and MCI (EUR 550) and dementia (EUR 751) compared to psychiatric and other diagnoses (EUR 324) is probably due to the use of more extensive diagnostic methods in patients with SCI and MCI (EUR 412) and to anti-dementia medication in patients with dementia (EUR 483). Informal and social care monthly costs were between EUR 1,037 and EUR 3,369, depending on the methodology used.

A comparison with the costs in other countries is complicated by the fact that the time frames of the study are different, different diagnostic groups are included (only AD, dementias, MCIs, patients with cognitive complaints), direct/indirect costs and medical/social

Table 5. Different diagnostic pathways and their costs when a cognitive disorder is suspected.

Diagnostic packages	Costs (EUR) for 2021
Exam + lab + CT	207
Exam + lab + MRI	365
Exam + lab + MRI + NP	622
Exam + lab + MRI + LP	2,922
Exam + lab + MRI + FDG-PET	1,296
Exam + lab + MRI + LP + FDG-PET	1,553
Exam + lab + MRI + NP + LP	3,179
Exam + lab + MRI + NP + FDG-PET	3,853
Exam + lab + MRI + NP + LP + FDG-PET	4,110

Exam: detailed history, general neurological examination, screening cognitive examination

Lab: basic and extended laboratory tests

CT - computerised tomography, FDG-PET - fluorodeoxyglucose positron emission tomography, LP - lumbar puncture with dementia biomarkers cerebrospinal fluid analysis, MRI - magnetic resonance imaging, NP - neuropsychology

costs are included, and there are differences in healthcare systems, etc. The annual cost of dementia in Europe ranged from EUR 755 in Ireland to EUR 5,888 in Finland (11). On average, the annual cost of diagnosing a patient with a cognitive complaint at our centre was EUR 330, which is much lower compared to Sweden, where the costs of referring and diagnosing dementia in specialist centres are much higher (EUR 1,298 nationally (12)). In two other Central European countries, direct medical costs were estimated at EUR 177 per month in Hungary (13) and EUR 243 per month in the Czech Republic (14). Both figures are

still higher than our annual estimate. However, together with the costs of treating and caring for a person with dementia, dementia costs were between EUR 13,195 and EUR 41,179, depending on the methodology used, which is similar to the Spanish figure of EUR 17,109 per year (15).

The lower costs of diagnosing dementia in our study could be due to the lack of reporting of medical investigations in medical notes, the performance of examinations at a later time (later than 2015), the lower utilisation of diagnostic tests or the skewed nature of the data, if there is a high proportion of patients who have not given rise to any costs (16). We only included the costs of visits to physicians (neurologists, psychiatrists) from our memory clinic. Our data did not include hospitalisations, visits to primary care doctors or to emergency and other specialists, unlike in the Hungarian (13) and Czech studies (14). The costs of individual investigations in Slovenia were comparable to the costs in some other countries (12, 15)), with the exception of higher LP costs, which are performed in a day hospital and not on an outpatient basis. Depending on the extensiveness of the diagnostic process, the costs of diagnosing dementia in 2021 would be much higher (EUR 207-4,110), and is comparable to the hypothetical EUR 1,842 per year in another study from the Czech Republic (17), including two visits to a neurologist, two blood tests, LP and the cost of medication per year. Although cognitive and mood tests (MMSE, MoCA, BDI) are time-consuming, they are not charged for when performed in an outpatient setting.

It is estimated that 34,137 persons were living with dementia in Slovenia in 2018. Performing only basic investigations (clinical examination, laboratory and CT imaging) would give rise to costs of approximately EUR 7 million. The increase in dementia costs that we are already observing are mainly a result of an increase in the number of affected/referred patients (4). Owing to the increase in the number of people aged over 65, we can expect this number to double by 2050 (18).

Even though new diagnostic methods and other outpatient-based examinations are expensive, the placement of patients with dementia in specialised facilities is a greater contributor to the total economic cost. In high-income countries (including Slovenia (19)), direct outpatient medical costs represent only a minority (19%) of overall expenditure on dementia management, while direct social sector costs and informal care costs (43.1% and 37.9% respectively) account for the the majority of the expenditure (20). Our estimation of informal care costs depended on the methodology of quantification and the costing of informal care used, as highlighted in the sensitivity analysis. The proportion of institutionalised patients in our study was low. However, 5% of people aged over 65 in 2011 (21,000) were in an institutional care setting (21). With an estimated 40-50% of all nursing home residents suffering from dementia (i.e. approximately

10,000 residents) (22) and annual nursing care costs of EUR 10,479 per person, this amounts to an annual expenditure of EUR 105 million on the institutionalisation of dementia patients. With the remaining patients with dementia residing at home, the costs (informal care and home help) would amount to approximately EUR 265 million per year. EUR 94 million of that figure is estimated as being the result of dementia and not other comorbidities. In our sample, patients with dementia received less formal home help. This might be due to the selection of the control group, since we included those who required a visit to their primary physician and who might have had more comorbidities or been chosen in an acute phase of their illness.

The total average annual cost of dementia in Slovenia between 2015 and 2017 was estimated at EUR 11.4 million (23), which is much lower than in this study. However, outpatient clinic calculations did not cover the costs of a diagnostic process, but included first visits to neurological and psychiatric outpatient services, which accounted for only ~0.4% (EUR 37,587 in 2015). Lower informal care costs might be due to the different methodology or to different estimates of the time spent on care. The cost of anti-dementia medication accounted for ~47.1% (EUR 5.5 million in 2015) of total dementia costs (23). Before 2019, general practitioners were not allowed to prescribe anti-dementia medication. Since then, everyday practice (and, consequently, the medical costs) might have changed. Nevertheless, even before 2019 there was no co-payment required for anti-dementia medication, so the use of these medications might have been greater than in neighbouring Croatia (for example) (24).

The accuracy of progression from MCI to dementia and determination of dementia type might be increased with additional investigations; however, if those increase, the benefit to the patient remains unknown. From a health-economics perspective, CSF biomarkers (for example) might be cost-effective, but the impact on stigmatisation, false positive/negative results and patient worry should also be taken into account (25). While the majority (94%) of patients with dementia retained their diagnosis during the follow-up, almost one-third (27%) of SCI/MCI patients progressed to dementia. This underscores the importance of monitoring and patient follow-up.

Since we only evaluated patients who visited the Centre for Cognitive Impairments at Ljubljana University Medical Centre, we used its price list as the main source for calculating the unit costs. Lumbar punctures, laboratory examinations, neuropsychological evaluations, EEG, DaT scans and FDG-PET were all performed at the university hospital. For CT and MRI, patients received referrals and could undergo those procedures elsewhere. For the latter, while one may question whether the price list is

representative for other service providers across Slovenia, we chose to use an approximation and used one source only. Given the relatively small size of Slovenia and the fact that Ljubljana is positioned in the centre of the country, the Centre for Cognitive Impairments could potentially cover the entire country. Nevertheless, patients with cognitive complaints are also diagnosed and treated by their general practitioner, a general neurologist or a psychiatrist. In 2015 the Centre was the only referral point for cognitive disorders in the whole country at which complete diagnostic work-up was possible. Our cost estimate therefore reflects the true direct medical expenses, while stepwise diagnostic pathways allow predictions to be made for patient management at different levels of healthcare.

The utilisation of anti-dementia medication was taken from the hospital records. Information on the actual dispensation of medication from pharmacies and the defined daily doses are outside the scope of this study. The cost estimates for informal and formal home help must be approached with care. The evaluation and inclusion of other costs (hospitalisations, other social costs such as transportation, food delivery, etc.) are crucial for future studies. Although only a small proportion (2.4%) of patients with dementia were nursing home residents, a substantial proportion of the data on where patients resided was missing. Our sample is therefore probably not representative of the general dementia population in Slovenia.

Despite its limitations, the study adds important insights into diagnostic procedures and total costs for patients with cognitive complaints. Staggering informal care times should encourage the development of community-based dementia care and support to family caregivers. Since the prevalence of patients affected with dementia is rising, the reshaping of the organisation of dementia care by national decision-makers is imminent.

5 CONCLUSION

The total cost of diagnosing and treating patients in one year in a specialist centre for cognitive disorders was EUR 578 per patient per year: EUR 751 per patient with dementia, EUR 550 per patient with SCI or MCI, and EUR 324 per patient with psychiatric and other diagnoses. The cost of diagnosing a cognitive disorder depends how extensive the investigation is, and can range from EUR 207 to EUR 4,110. With an estimated prevalence of 34,137 persons with dementia in Slovenia, the performance of basic diagnostic investigations (clinical examination, laboratory investigations and CT imaging) would give rise to costs of approximately EUR 7 million per year, nursing home placement to costs of EUR 105 million per year, and informal care and home help to costs of EUR 265 million per year.

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CONFLICTS OF INTEREST

The authors declare that no conflicts of interest exist.

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ETHICAL APPROVAL

The study was approved by the National Medical Ethics Committee (no 01-20-76/2017/39). The ethics committee waived the requirement for written consent.

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