

1 **Abstract**

2 *Objectives*

3 There is paucity of studies on the relationship between personal wealth and healthcare costs
4 among persons with dementia, and earlier studies on other indicators of socioeconomic position
5 have assessed costs after dementia diagnosis only. We investigated how different indicators of
6 personal wealth (disposable income, supplementary income, assets subject to taxation, taxes and
7 tax-like payments and liabilities) are associated with healthcare costs in persons with Alzheimer's
8 Disease (AD) before and after AD diagnosis.

9 *Design*

10 Register-based nationwide cohort study of persons with AD.

11 *Setting and participants*

12 Cohort of 70,531 people who received a clinically verified AD diagnosis in Finland between 2005–
13 2011 and were community-dwelling at time of diagnosis.

14 *Methods*

15 Data on income indicators were obtained from Statistics Finland. Data on medication costs and
16 hospital care costs for 12-months period from five years before to two years after AD diagnosis
17 were obtained from national registers. Associations of wealth indicators with costs were
18 investigated with multivariate mixed-effect negative binomial regression.

19 *Results*

After adjustment for age, region, sex, marital status, comorbidities, expensive medications, use of psychotropic and antimentia medication and highest occupational class before AD, people with higher levels of personal wealth indicators were more likely to have higher total healthcare costs along the whole follow-up period. The incidence rate ratios (IRR) , 95%CI for highest quintile vs. lowest quintile were 1.17, 1.15–1.19 for disposable income, 1.10, 1.08–1.12 for taxable income, 1.18, 1.16–1.19 for supplementary income, 1.07, 1.06–1.09 for taxes, and 1.05, 1.04–1.07 for taxable wealth.

Conclusions and implications

Our observation on the association between income/wealth indicators and healthcare costs in a country with a strong public healthcare system call for more effective measures in targeting health inequalities in the aging population. Although the different indicators were not completely interchangeable, associations of different indicators were towards the same direction.

39 Introduction

40 Care for people with Alzheimer's disease (AD) and other dementias poses major societal
41 challenges given the growing demands of long-term healthcare and caregiver support.^{1, 2}
42 Although the impact of AD on healthcare costs and marked intra-individual variation in costs are
43 recognised, the determinants of this between-person variation are less well-known. Indicators of
44 socioeconomic position (SEP) such as education^{3,4,5} and occupational social class,⁴ beside other
45 demographic characteristics, comorbidities and AD severity,^{3,6,7} have been linked to healthcare
46 costs for people with AD. However, these factors are interrelated and associations are complex.
47 For example, low SEP is associated with more comorbidities,⁸ which, in turn, are associated with
48 higher healthcare costs.^{3,7} On the other hand, SEP can be measured with different indicators such
49 as education, occupational class, or income or wealth, which are not typically interchangeable^{9,10}.

50 The association between lower SEP (measured as educational level or occupation) and higher
51 healthcare costs among persons with AD has been demonstrated previously.^{3,4,5} However, there
52 is little evidence on whether personal income or wealth indicators are associated with healthcare
53 costs. Hojman et al demonstrated that higher household social level, based on education and
54 occupation, was associated with higher medical care costs among persons with dementia in Chile,
55 and the average annual household income per capita was higher for persons/households with
56 higher social level.⁴ However, that study did not assess the association between income and
57 costs.

58 Notable intra-individual variation in healthcare costs in people with AD over time has been
59 demonstrated previously in Finland.⁷ In a nationwide cohort of people with AD, 62.9% of the

study population belonged to the highest cost decile in at least one six-month time window in the period from five years before to two years after AD diagnosis.⁷ The earlier studies have not explored associations of SEP indicators at different timepoints,^{3,4} or evaluated the association of wealth and income indicators. Therefore, it is not known whether SEP as indicated by wealth or income associate with healthcare costs in persons with AD and whether the associations are similar before and after the diagnosis.

We investigated the association between different indicators of income and wealth and healthcare costs in people with AD in a nationwide representative population-based cohort in Finland during the period from five years before AD diagnosis until two years after diagnosis.

79 **Methods**

80 *Study population*

81 The Medication use and AD (MEDALZ) cohort includes 70,719 persons who were diagnosed with
82 AD between 2005–2011 in Finland and were community-dwelling at time of diagnosis.¹¹ Data
83 were collected using Finnish personal identification numbers through linkage with the
84 Prescription Register (for purchased prescribed medications and medication costs), Special
85 Reimbursement Register (for comorbidities), Care Register for Healthcare (for comorbidities and
86 hospitalisations) and Statistics Finland (for socioeconomic data). The research team received
87 pseudonymised data from register maintainers, and study participants were not contacted.
88 Therefore, according to Finnish legislation, no approval from the ethics committee nor written
89 consent from cohort participants were needed. The MEDALZ study protocol was approved by the
90 register maintainers.

91 The follow-up study began five years before AD diagnosis and ended at the end of study period
92 (2 years after AD diagnosis; n = 47,859), end of data-linkage (December 31, 2012; n = 1,654),
93 death (n = 18,354) or permanent institutionalization (n = 2,852), whichever occurred first. Follow-
94 up duration ranged between 60 and 85 months. The choice of follow-up period was based on our
95 previous studies on the same population demonstrating an increase in healthcare costs in the 5-
96 year time window before the AD diagnosis ¹² and notable inter-individual variation in costs among
97 persons with AD in this time window ⁷.

98 *Exposures*

Information on disposable income (e.g. salaries, entrepreneurial income, property income, benefits in kind, with deduction of current transfers paid; 1995–2006), supplementary income (e.g. earnings-related and national pensions, social security benefits; 1995–2006), taxable income, or assets subject to taxation (e.g. real estate, enterprises, agriculture, forestry, shares; 1993–2005), taxable wealth (taxable income minus debts and deductions; 1991–2005) and taxes (all paid taxes combined; 1990–2006) were obtained from Statistics Finland. Exact definitions provided by Statistics Finland are given in Supplementary Table 1. The wealth and income indicators were adjusted for inflation using consumer price index and valued at 2011. The annualized indicators were stratified to quintiles.

Dependent variable

We investigated cumulative total healthcare costs (which include hospitalization and outpatient medication expenses) for the period from 5 years before AD diagnosis until 2 years after. The National Health Insurance scheme covers the majority (87%) of hospital care costs for patients in Finland, regardless of the received treatment. For medications, however, the proportion of covered costs varies.¹³ Therefore, the costs in our study refer to hospitalization and medication costs paid by society, including the costs reimbursed to patients. The follow-up was divided into 12-month periods. Cumulative costs were calculated for each period. Periods when the person was in a nursing home were not included in the analyses. Number of included persons per 12-month period varied between 57661 and 70470 (Supplementary Table 2).

Data on hospital stays were obtained from the national Care Register for Healthcare. Hospital costs were calculated based on length of inpatient stay and the level of the caring unit using the

Finnish health care system unit costs between 2006–2011.¹⁴ Unit cost estimates were specifically derived for research purposes and adjusted for regional price differences. Hospital care costs were calculated from the service provider's perspective, covering clinical and diagnostic costs, as well as medication costs during the hospital stay.

The Prescription Register contains data on reimbursed drugs dispensed from pharmacies. We utilized the total cost of medication claims and costs of all dispensing during the study period. All costs in Euros were then valued at 2011 price index public expenditure rate.¹⁵

Covariates

Detailed definitions of covariates are given in Supplementary Table 3. Comorbidities were chosen based on previous literature on determinants of costs between persons with and without AD¹⁶ and our previous study on hospital stays in different specialties of care for persons with AD.¹⁷

From the Special Reimbursement Register,¹⁸ we obtained data on diabetes, asthma or chronic obstructive pulmonary disease (COPD), and the following cardiovascular diseases: hypertension, coronary artery disease, familial hypercholesterolemia, heart failure and cardiac arrhythmias since 1972. From the national Care Register for Healthcare (since 1996), the following comorbidities were extracted: strokes, fractures, ischaemic heart diseases and mental and behavioural disorders excluding dementia. Active cancer was defined as cancer treatment with medication, surgery or radiation therapy,¹⁹ and defined during the follow-up time. In addition, the number of hospital days in each 12-month time period was calculated.

Each comorbidity was categorized as “never”, “before the follow-up only” and “before and during the follow-up” for descriptive analyses, based on the similarity of association of categories that included comorbidities diagnosed during the follow-up.

Information on dispensed medications was obtained from the Prescription Register since 1995. Tumor necrosis factor alpha (TNF- α) inhibitors, pregabalin, bisphosphonate, erythropoietin and antimentia medication were chosen due to their high price in the study period,⁷ in addition to psychotropic medication (antipsychotics, antidepressants, benzodiazepines) which may indicate the presence of neuropsychiatric symptoms.

Medication data were categorized into “no” and “yes”, except for psychotropics which were categorized as “Never”, “Before the follow-up”, “During the follow-up” and “Before and during the follow-up”. For the mixed-effect model, diagnoses and medication were coded to categories “before the follow-up” and “during follow-up”.

Based on Statistics Finland classification, the highest occupational social class before AD was categorized into: Managerial/Professional, Office, Farming/Forestry, Sales/Industrial/Cleaning and Other.⁷

Statistical analysis

The correlation between different income and wealth indicators was evaluated with Spearman correlation coefficient and agreement of exposure quintile classification was evaluated by calculating the proportion of persons belonging to the same quintile of the compared indicators. The Spearman’s rho between continuous indicators ranged between 0.19 and 0.98 (Supplementary Table 4), with strongest pairwise correlations observed between disposable

income and supplementary income, taxable income or taxes (0.80-0.88) and taxable income and taxes (0.98). However, as there still was some discrepancy in the quintile classification also for these indicators with highest correlation (e.g. proportion of persons classified to the same quintile of taxes and taxable income was 83%), we included all five indicators in the analyses to assess whether similar results are observed with different indicators.

To investigate the association between covariates and hospital stays and healthcare costs, quintiles for hospital days and total costs were derived for the entire follow-up time, time before AD diagnosis and after AD diagnosis. Univariable associations between covariates and these quintiles were investigated with χ^2 tests and ANOVA. The same methods were used to evaluate associations between covariates and exposures. The categorised healthcare costs were used only for deriving the descriptive statistics.

Multivariate mixed-effect negative binomial regression was used for investigating associations between exposure quintiles and annualised healthcare costs as a continuous variable. The data were formatted into a panel format, with up to seven 12-month periods per individual (Supplementary Figure 1). Because the number of observations varied in between the assessment periods due to variation in institutionalisation status and exposure data availability, this approach maximises the use of information because even if the person is excluded from one time window due to, e.g., missing exposure data, they can still be included in the consecutive assessment periods. We used negative binomial regression as there was no evidence for overdispersion of zeros, and the variance exceeded the mean in all timepoints for total costs (Supplementary Table 5).

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182 Income/wealth indicator information from the year preceding the dependent variable was used
183 in the main analyses. The proportion of persons with available exposure data per 12-month
184 period varied, with highest availability in the earliest period (range from 79.3% for taxable wealth
185 to 99.6% for supplementary and disposable income) and lowest availability in the last period (no
186 data for taxable wealth, other indicators available for 25.8-25.9% of eligible persons,
187 Supplementary Table 3). In addition, we conducted sensitivity analyses in which the missing
188 exposure data were imputed with exposure from the latest available year (imputed exposure
189 data available for >99% of eligible persons in each period, except for taxable wealth, availability
190 79.3%-99.5%, Supplementary Table 3).

191 In the main analyses we fitted four hierarchical models: Model 1 adjusted for year of AD
192 diagnosis, age (years), university hospital district, and gender (men, women) Model 2 included
193 factors in Model 1 and marital status and comorbidities (diabetes, cardiovascular diseases,
194 asthma/COPD, mental and behavioural disorders, any fracture, ischemic heart disease, stroke,
195 acute cancer treatment), Model 3 included covariates of Model 2 plus expensive medications
196 (biologicals, pregabalin, bisphosphonates, erythropoietin), psychotropic drugs (antidepressants,
197 antipsychotics, benzodiazepines), antidementia medication (acetylcholinesterase inhibitors,
198 memantine), and highest occupational social class before AD. Model 4 included the number of
199 hospital days in the same time window the total costs were calculated in addition to covariates
200 of Model 3. Convergence was achieved for all models. Stata 17.2 MP was used for statistical
201 analyses.

202 *Data Availability Statement*

203 Analysis protocols, scripts and supporting results are available from the corresponding author on
 204 request. The restrictions posed by the Social Insurance Institution of Finland, and Finnish
 205 legislation do not allow open data sharing by researchers.

206 *Standard Protocol Approvals, Registrations, and Patient Consents*

207 According to the Finnish legislation, no ethics committee approval or patient consents were
 208 required, as pseudonymised register-based data was used, and the participants were not
 209 contacted.

210 **RESULTS**

211 *Participant characteristics*

212 Characteristics of people with AD according to quintiles of combined hospital and medication
 213 costs for the full follow-up period (5 years before to 2 years after AD diagnosis) are shown in
 214 Table 1. Age, expensive medication use and all comorbidities except coronary artery disease
 215 before follow-up and any fracture before follow-up were associated with higher total costs.
 216 Disposable income, taxable income, debts and taxes paid were inversely associated with higher
 217 costs, while supplementary income was positively associated.

218 Before AD diagnosis, taxable income and taxes paid were higher among persons with higher
 219 costs, whereas their supplementary income was lower. However, the associations between
 220 characteristics and high total costs before and after AD diagnosis were otherwise similar to those

observed during the full follow-up period (data not shown). Similar associations were observed between characteristics and quintiles of cumulative hospital days (Supplementary Table 6).

Characteristics of people with AD by disposable income quintiles during the full follow-up period are presented in Table 2. All comorbidities except coronary artery disease and fractures before follow-up were less common among those with highest disposable income. The use of pregabalin, bisphosphonates, erythropoietin and antimentia medication were less common among persons with highest disposable income. Characteristics of people with AD according to disposable income quintiles before and after AD diagnosis were similar to those during total follow-up period.

Associations of income with total healthcare costs

During the entire follow-up, higher supplementary income and disposable income were associated with higher healthcare costs in Model 1 (adjusted for the year of AD diagnosis, age, university hospital district and gender). Taxable wealth and taxable income were not associated with higher costs while those in the highest quintile of taxes had higher costs compared to those in the lowest quintile (Figure 1 and Supplementary Table 7).

After additional adjustment for marital status and comorbidities, expensive medications, psychotropic drugs, antimentia medication and occupational social class (models 2-3), all five income and wealth indicators were associated with higher costs. The strongest associations were observed for supplementary and disposable income (Figure 1, Supplementary Table 7). The same associations were observed after additional adjustment for hospital days.

The associations of different income and wealth indicators with total costs during the different time periods are illustrated in Figure 2. In general, associations during the overall follow-up period were more similar to those observed before AD diagnosis than those observed after AD diagnosis. Higher levels of taxable wealth, paid taxes and taxable income associated with lower healthcare costs after AD in the Model adjusted for the year of AD diagnosis, age, university hospital district and gender. However, this association was no longer observed in the fully adjusted model, although the 95% CIs was suggestive of an inverse association. The associations between higher levels of disposable and supplementary income and higher healthcare costs were observed also after AD diagnosis also after adjusting for marital status and comorbidities, expensive medications, psychotropic drugs, antimentia medication and occupational social class. The associations remained similar after additional adjustment for hospital days, except for the association between higher supplementary income and higher costs after AD diagnosis, which was strengthened after additional adjustment hospital days.

Similar results were observed with imputed exposure data for the entire follow-up time as well as time until and after the AD diagnosis (Supplementary Tables 8-10). Complete parameter estimates for the fully adjusted models during the entire follow-up are included as Supplementary material.

Discussion

Our nationwide longitudinal study of people who were community-dwelling at the time of their AD diagnosis shows that there are associations between income/wealth indicators and

healthcare costs, and that these associations differ between indicators and are not necessarily consistent over time. Although the different indicators were not completely interchangeable, associations of different indicators were towards the same direction.

It is well-established that people with AD have higher healthcare costs compared to people without AD,⁵ and several determinants of higher costs (e.g., age, comorbidities and AD severity) have been identified.⁶ SEP indicators such as income and education are also associated with AD costs,⁴ besides being proxies for cognitive reserve and function in older populations,²⁰ since lower SEP is associated with higher severity of functional impairment and neuropsychiatric symptoms.⁴ Additionally, low SEP is generally associated with poorer access to healthcare.²¹ However, income/wealth disparities are expected to be less marked in Finland because of its universal healthcare system and long history of income redistribution policies.²² Finland, along with England and the Netherlands, is considered the most dementia-friendly country based on care and treatment availability and affordability.²³ Nevertheless, our findings suggest that income/wealth disparities are still associated with cumulative healthcare costs among people with AD.

We found that higher taxable income, disposable income, supplementary income, taxable wealth and paid taxes were associated with higher healthcare costs *before* AD diagnosis. Inequality in admission is likely to be low given Finland's public healthcare system, so these associations might be influenced by higher educational attainment and better health awareness among affected persons with higher income, or their family members. Higher education and health awareness might have driven their decisions to seek more healthcare services and examinations, as well as to seek assessment once early symptoms appear. On the other hand,

the influence of early-life income levels on educational opportunities and lifestyle choices also predicts AD risk, severity and mortality as previously observed in the United States:²⁴ early-life low income had a substantial impact on higher AD mortality in later years.

Higher taxable income, taxes and taxable wealth in our study were associated with lower healthcare costs *after* AD diagnosis, but these associations were no longer evident after adjusting for marital status and comorbidities. The inverse association is not unexpected as a number of health inequalities, including longer life expectancy and better self-rated health among people with higher SEP have been reported in Finland.²⁵ Differences in comorbidities across income/wealth groups may partially explain these findings, as there was a higher prevalence of comorbidities in the lower quintiles of wealth in our study.

An earlier study reported an association between higher household social level based on education and occupation, and higher medical care costs in persons with dementia in Chile, hypothesizing different purchasing power as one explanation for their results.⁴ Interestingly, in our study the findings after AD dementia diagnosis were not similar to those by Hojman et al, while the results from the entire follow-up including also time before AD were more in line with these previous results.

Using nationwide registers enabled us to capture community-dwellers with clinically verified AD diagnosis and to explore associations between different wealth indicators and healthcare use and costs. Because of the public healthcare system, risk of selection bias is low. This is a considerable strength compared to studies limited to a specific insurance scheme or specific study cohort. The registers also allowed us to evaluate the accumulation of hospitalization and

medication costs over time without loss to follow-up. Thus, for a very large sample, we were able to examine longitudinal associations for the seven-year observation period, including time both before and after AD diagnosis. Given previously demonstrated intra-individual variation in costs over time, this is a strength of our study.

We acknowledge that we were not able to assess social care, outpatient or caregiving costs or the costs to caregiver. However, hospitalization costs have previously been shown to be the main driver of healthcare costs in persons with AD, and outpatient services account for only 10% of hospital care costs.²⁶ The income and wealth data were available until 2005 and 2006, while the dependent variables were measured between 2000-2012. Therefore, there is variation in the elapsed time between individuals diagnosed in different years. AD severity is associated with higher costs,^{5,27} but unfortunately we had no data on severity in this study, nor on disease progression. However, due to the strict reimbursement criteria, we know that all study participants had mild or moderate AD on the date of diagnosis. Finally, since our study was restricted to people who were community-dwelling at the time of AD diagnosis, we cannot generalize the results to people living in congregate settings or to persons with other cognitive disorders. The generalizability of our results to countries with different healthcare systems may also be limited. However, the limitations are unlikely to impact our main finding that income/wealth indicators are associated with healthcare costs in a country with a strong public healthcare system.

Conclusions and implications

326 Our findings show large inter-individual variations in costs and hospital days linked to individuals'
327 own wealth, suggesting that lower personal income or wealth may further add to the economic
328 impact of AD, already in prediagnostic phase. The findings pinpoint the importance of more
329 effective measures in targeting health inequalities in the aging population.

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Table 1. Characteristics of people with AD according to total (hospital and medication) costs quintiles during total follow-up time (5 years before AD diagnosis – 2 years after AD diagnosis)						
Variable	1st quintile (N=14114)	2nd quintile (N=14100)	3rd quintile (N=14107)	4th quintile (N=14107)	5th quintile (N=14106)	P
Age (median,95%CI)	78.0 (72.9-82.5)	80.2 (75.5-84.1)	81.3 (77.0-85.1)	82.0 (77.8-85.9)	82.1 (77.6-85.9)	<0.001
Gender (N,%)						0.040
<i>Women</i>	9238 (65.45)	9159 (64.96)	9063 (64.24)	9300 (65.92)	9227 (65.41)	
<i>Men</i>	4876 (34.55)	4941 (35.04)	5044 (35.76)	4807 (34.08)	4879 (34.59)	
Cardiovascular diseases (N,%) before/during the follow-up	5434 (38.50)	7092 (50.30)	7863 (55.74)	8184 (58.01)	8338 (59.11)	<0.001
Coronary artery disease (N,%)						<0.001
Before follow-up only	1201 (8.51)	1315 (9.33)	1040 (7.37)	916 (6.49)	744 (5.27)	
During the follow-up	778 (5.51)	2515 (17.84)	3927 (27.84)	4896 (34.71)	5571 (39.49)	
Stroke (N,%)						<0.001
Before follow-up only	402 (2.85)	554 (3.93)	592 (4.20)	586 (4.15)	620 (4.40)	
During the follow-up	252 (1.79)	877 (6.22)	1450 (10.28)	2067 (14.65)	2454 (17.40)	
Diabetes (N,%) before/during the follow-up	1392 (9.86)	1874 (13.29)	2245 (15.91)	2413 (17.10)	2674 (18.96)	<0.001
Asthma/ Chronic obstructive pulmonary disease (N,%) before/during the follow-up	873 (6.19)	1189 (8.43)	1280 (9.07)	1486 (10.53)	1612 (11.43)	<0.001
Active cancer treatment (N,%) during the follow-up	27 (0.19)	50 (0.35)	74 (0.52)	86 (0.61)	100 (0.71)	<0.001

Any fracture (N,%)						<0.001
Before follow-up only	752 (5.33)	852 (6.04)	831 (5.89)	755 (5.35)	660 (4.68)	
During the follow-up	997 (7.06)	1863 (13.21)	3038 (21.54)	4342 (30.78)	5571 (39.49)	
Mental/behavioral disorder (excluding dementia) (N,%)						<0.001
Before follow-up only	638 (4.52)	686 (4.87)	704 (4.99)	793 (5.62)	790 (5.60)	
During the follow-up	189 (1.34)	703 (4.99)	1247 (8.84)	2021 (14.33)	3545 (25.13)	
Psychotropic medication (N,%)						<0.001
Before follow-up only	743 (5.26)	673 (4.77)	580 (4.11)	467 (3.31)	353 (2.50)	
During the follow-up	4212 (29.84)	4430 (31.42)	4616 (32.72)	4993 (35.39)	5059 (35.86)	
Before & during follow-up	3760 (26.64)	4734 (33.57)	5354 (37.95)	5972 (42.33)	6889 (48.84)	
Expensive medication (N,%) during the follow-up	1282 (9.08)	1759 (12.48)	2228 (15.79)	2841 (20.14)	3279 (23.25)	<0.001
Disposable income (median, IQR)	9783 (7786-13417)	9304 (7588-12268)	9218 (7629-11793)	9154 (7606-11593)	9313 (7790-11773)	<0.001
Supplementary income (median, IQR)	9224 (6708-13252)	9455 (7151-13180)	9573 (7352-13097)	9672 (7465-13097)	9940 (7676-13368)	<0.001
Taxable property (median, IQR)	11801 (8126-17808)	10468 (7493-15697)	10052 (7352-14824)	9829 (7196-14458)	9989 (7408-14454)	<0.001
Assets subject to taxation (median, IQR)	18095 (8491-31912)	17144 (7804-30209)	16774 (7599-29715)	16591 (7069-29107)	16722 (7673-28918)	<0.001
Debts (median, IQR)	824 (0-5792)	457 (0-4627)	297 (0-3892)	190 (0-3474)	300 (0-3714)	<0.001
Taxes paid (median, IQR)	2717 (1141-5088)	2148 (902-4402)	1957 (831-4111)	1828 (751-3956)	1886 (832-3977)	<0.001

Table 2. Characteristics of people with AD according to disposable income quintiles during total follow-up period						
Variable	1 st quintile (N=14126)	2 nd quintile (N=14126)	3 rd quintile (N=14126)	4 th quintile (N=14126)	5 th quintile (N=14126)	P
Gender (N,%)						
Women	11366 (80.46)	10181 (72.07)	9633 (68.19)	8447 (59.80)	6434 (45.55)	
Men	2760 (19.54)	3945 (27.93)	4493 (31.81)	5679 (40.20)	7692 (54.45)	
CO-MORBIDITIES						
Cardiovascular diseases (N,%) before/during the follow-up	7726 (54.69)	7641 (54.09)	7604 (53.83)	7482 (52.97)	6537 (46.28)	<0.001
Coronary artery disease (N,%)						
Before follow-up only	921 (6.52)	1064 (7.53)	1095 (7.75)	1080 (7.65)	1063 (7.53)	
During the follow-up	3915 (27.71)	3672 (25.99)	3668 (25.97)	3563 (25.22)	2909 (20.59)	
Stroke (N,%)						
Before follow-up only	475 (3.36)	534 (3.78)	580 (4.11)	635 (4.50)	540 (3.82)	
During the follow-up	1459 (10.33)	1402 (9.92)	1407 (9.96)	1467 (10.39)	1375 (9.73)	
Diabetes (N,%) before/during the follow-up	2168 (15.35)	2297 (16.26)	2177 (15.41)	2209 (15.64)	1763 (12.48)	<0.001
Asthma/ Chronic obstructive pulmonary disease (N,%) before/during the follow-up	1205 (8.53)	1325 (9.38)	1393 (9.86)	1429 (10.12)	1094 (7.74)	<0.001
Active cancer treatment (N,%) during the follow-up	73 (0.52)	67 (0.47)	57 (0.40)	73 (0.52)	68 (0.48)	0.77

Any fracture (N,%)						<0.001
Before follow-up only	671 (4.75)	754 (5.34)	785 (5.56)	843 (5.97)	813 (5.76)	
During the follow-up	3276 (23.19)	3233 (22.89)	3233 (22.89)	3259 (23.07)	2851 (20.18)	
Mental/behavioral disorder (excluding dementia) (N,%)						<0.001
Before follow-up only	735 (5.20)	747 (5.29)	798 (5.65)	786 (5.56)	568 (4.02)	
During the follow-up	1411 (9.99)	1529 (10.82)	1673 (11.84)	1674 (11.85)	1436 (10.17)	
Psychotropic medication (N,%)						<0.001
Before follow-up only	568 (4.02)	585 (4.14)	561 (3.97)	529 (3.74)	581 (4.11)	
During the follow-up	4800 (33.98)	4840 (34.26)	4642 (32.86)	4501 (31.86)	4544 (32.17)	
Before & during follow-up	4919 (34.82)	5163 (36.55)	5602 (39.66)	5608 (39.70)	5497 (38.91)	
Expensive medication (N,%) during the follow-up	2383 (16.87)	2307 (16.33)	2351 (16.64)	2334 (16.52)	2025 (14.34)	<0.001

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419 FIGURE LEGENDS

420 Figure 1 Incidence rate ratios (IRR) for the association of income variable quintiles with total
421 costs among patients with AD during total follow-up period.

422 Figure 2 Incidence rate ratios (IRR) for the association of income variable quintiles with total
423 costs in different periods of the follow-up (the entire follow-up, before AD diagnosis and after
424 AD diagnosis) after adjustment for age, gender, year of AD diagnosis and university hospital
425 district