Cost of Disorders of the Brain in Europe 2010

Gustavsson et al. *Cost of disorders of the brain in Europe 2010.*
Steering Committee

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Background
Previous report

Cost of the disorders of the brain in Europe 2005

- Report included 27 European countries and 12 diagnostic groups
- Cost was estimated at €386 billion in 2004
- Number of persons affected: 127 million European adults
Need for revision

EBC 2005 cost estimates

- Covered only 12 major disorders of the brain
- Lack of epidemiologic and/or economic data
EBC 2010 study

- Growth of evidence – possibility to include more disorders of the brain / extensions to previously studied disorders

- Addition of two European countries (Bulgaria & Romania)
Aim of study

To estimate:

1. The number of persons with defined disorders of the brain in Europe in 2010
2. The total cost per person per year related to each disease by specifying direct and indirect costs
3. The total cost per disorder and country
4. The total cost of brain disorders in all of Europe
Methods
Update on disorders included in 2005

Addiction

Anxiety disorders

Brain tumour

Dementia

Epilepsy

Migraine

Mood disorders

Multiple sclerosis

Parkinson’s disease

Psychotic disorders

Stroke

Traumatic Brain Injury

Extension of disorders included in 2005

Anxiety disorders: PTSD

Traumatic Brain Injury: Moderate and Severe cases, Prevalent cases

Stroke: Prevalent cases

Headache: Medication Oversuse, Tension Type, Other
Disorders of the brain added in the 2010 study

- Child/adolescent disorders
- Eating disorders
- Intellectual disability disorders
- Personality disorders
- Sleep disorders
- Somatoform disorders
Geographical scope

EU member countries (EU-27) plus Iceland, Norway, and Switzerland
Cost-of-illness methodology

- Societal perspective

- Cost is presented in 3 main categories:
  - Direct health care cost
  - Direct non-medical cost
  - Indirect cost
Cost-of-illness methodology

Bottom-up
Cost information collected for individual patients

Prevalence-based
Number of patients in a 12 month period

Total Cost
Annual cost per subject $\times$ Number of patients in a given year

European Cost-of-illness Model

**Input Data**

*For countries where data was available*

- Cost per subject with a disorder
- 12-month prevalence of the disorder

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Cost per subject with a disorder

Literature review (PubMed)

- Search strings - combination of disorder and cost terms, and relevant countries

- All hits with an English abstract were reviewed

- Articles with potentially useful information were retrieved as full texts
Cost per subject with a disorder

Literature review (PubMed)

**Inclusion criteria**

Data on costs / resource use – cost-of-illness studies

Relevant diagnosis

Data for any of the 30 relevant countries

Written in English, French, German, Italian or Spanish

Robust methodology

Published on January 1\(^{st}\) 2004 or later

Cost components included in the 2010 study

For most disorders:
direct healthcare, direct non-medical cost, and indirect cost

- Indirect cost only applicable to working population (18 – 65 years old) unless estimates were presented as an average of the total population with the disorder

- Direct cost was adjusted for the treated vs. untreated population where estimates referred to a subset of the total population
12-month prevalence for each disorder

Literature review (PubMed)
- Performed by disorder specific epidemiologic panels

Country-specific surveys
- Best-estimate provided by experts
European Cost-of-illness Model

COST PER PATIENT \times NUMBER OF PATIENTS = COST PER BRAIN DISORDER

PREVALENCE \times POPULATION

Cost per brain disorder per country

Cost of all brain disorders per country

Cost of all brain disorders in Europe

European Cost-of-illness Model

Cost per subject

- adjusted to € 2010 using the Consumer Price Index (Eurostat)
- converted to real € using nominal exchange rates (European Central Bank)
- adjusted for comparative price levels (PPP - Eurostat)

Population data retrieved from Eurostat
European Cost-of-illness Model

For countries with missing prevalence and/or cost data

- median prevalence ratio
- median cost per subject

*adjusted for income, healthcare expenditure and wage level differences across countries*
European Cost-of-illness Model

Sum of all brain disorders per country

Cost of all brain disorders per country

Cost of all brain disorders in Europe

European Cost-of-illness Model

Total cost of disorders of the brain in Europe 2010

Cost of all brain disorders per country

Cost per brain disorder per country

Cost of all brain disorders in Europe 2010
Validation of results

- Comparison with EBC 2005

- External data
  - Administrative databases
  - Other European reviews
  - Studies from the United States (for some disorders)
Epidemiology
Epidemiology

Aggregated 12-month prevalence rates

- age-group-specific prevalence: calibrated age-specific diagnostic prevalence to reflect the total population of all ages

- adjusting for comorbidity: assumptions based on theoretical and restricted empirical grounds to avoid double counting
### Mental disorders – 12 month prevalence

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Prevalence per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental retardation</td>
<td>1 000</td>
</tr>
<tr>
<td>Opiate dependence</td>
<td>400</td>
</tr>
<tr>
<td>OCD</td>
<td>700</td>
</tr>
<tr>
<td>Eating disorders</td>
<td>900</td>
</tr>
<tr>
<td>Cannabis dependence</td>
<td>1 000</td>
</tr>
<tr>
<td>Psychotic disorders</td>
<td>1 200</td>
</tr>
<tr>
<td>Personality disorders</td>
<td>1 300</td>
</tr>
<tr>
<td>PTSD</td>
<td>2 000</td>
</tr>
<tr>
<td>Conduct disorder</td>
<td>3 000</td>
</tr>
<tr>
<td>Alcohol dependence</td>
<td>3 400</td>
</tr>
<tr>
<td>Somatoform disorder</td>
<td>4 900</td>
</tr>
<tr>
<td>ADHD</td>
<td>5 000</td>
</tr>
<tr>
<td>Bipolar depression</td>
<td>900</td>
</tr>
<tr>
<td>Unipolar depression</td>
<td>6 900</td>
</tr>
<tr>
<td>Anxiety disorders</td>
<td>14 000</td>
</tr>
</tbody>
</table>

*Best Estimate by Expert*
Results
Number of diagnoses

- EBC 2005 – 127 million
- EBC 2010 – 380 million
  - 12 previously studied disorders including extensions: 299 million
  - New disorders of the brain: 81 million
Number of diagnoses – difference with EBC 2005

- Increase in underlying population
  - Population under 18 and over 65 was included
  - Per country increase of population
  - New countries were added

- Disorder extensions and new disorders
  - Additional sub-groups for disorders studied previously
  - Results for 7 new disorders
Number of diagnoses – difference with EBC 2005

New evidence for the prevalence of some disorders

- **Addiction**
  - higher prevalence for alcohol addiction but lower for cannabis addiction

- **Brain tumors**
  - higher prevalence due to inclusion of benign brain tumors

- **Migrainous headaches**
  - new evidence in the literature suggesting higher prevalence compared to 2005

- **Multiple Sclerosis**
  - change in diagnostic criteria resulted in earlier detection of the disease and therefore to higher prevalence
### Number of diagnoses with disorders of the brain in Europe, in Million

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Diagnosis (Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain tumor</td>
<td>0.2</td>
</tr>
<tr>
<td>Neuromuscular disorders</td>
<td>0.3</td>
</tr>
<tr>
<td>Multiple Sclerosis</td>
<td>0.5</td>
</tr>
<tr>
<td>Parkinson's disease</td>
<td>1.2</td>
</tr>
<tr>
<td>Eating disorders</td>
<td>1.5</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>2.6</td>
</tr>
<tr>
<td>Traumatic Brain Injury</td>
<td>3.7</td>
</tr>
<tr>
<td>Mental Retardation</td>
<td>4.2</td>
</tr>
<tr>
<td>Personality disorders</td>
<td>4.3</td>
</tr>
<tr>
<td>Psychotic disorders</td>
<td>5.0</td>
</tr>
<tr>
<td>Child/Adolescent disorders</td>
<td>5.9</td>
</tr>
<tr>
<td>Dementia</td>
<td>6.3</td>
</tr>
<tr>
<td>Stroke</td>
<td>8.2</td>
</tr>
<tr>
<td>Addiction</td>
<td>15.5</td>
</tr>
<tr>
<td>Somatoform disorder</td>
<td>20.4</td>
</tr>
<tr>
<td>Mood disorders</td>
<td>33.3</td>
</tr>
<tr>
<td>Sleep disorders</td>
<td>44.9</td>
</tr>
<tr>
<td>Anxiety disorders</td>
<td>69.1</td>
</tr>
<tr>
<td>Headache</td>
<td>152.8</td>
</tr>
</tbody>
</table>

Number of diagnoses – Austria

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson’s disease
- Neuromuscular...
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent.
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Number of diagnoses – Belgium

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson's disease
- Neuromuscular disorders
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent disorders
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Number of diagnoses – Czech Republic

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson's disease
- Neuromuscular disorders
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent disorders
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Number of diagnoses – Denmark

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson’s disease
- Neuromuscular disorders
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent disorders
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Number of diagnoses – Finland

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson’s disease
- Neuromuscular disorders
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent disorders
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Number of diagnoses – Germany

Number of diagnoses (in thousands)

- Headache: 25,000
- Anxiety disorders: 10,000
- Traumatic brain injury, Stroke, Somatoform disorder, Sleep disorders, Psychotic disorders, Personality disorders, Parkinson’s disease, Neuromuscular disorders, Multiple sclerosis, Mood disorders, Mental retardation, Headache, Epilepsy, Eating disorders, Dementia, Child/Adolescent disorders, Brain tumour, Anxiety disorders, Addiction

Number of diagnoses – Greece

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson’s disease
- Neuromuscular disorders
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent disorders
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Number of diagnoses – Iceland

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson’s disease
- Neuromuscular disorders
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent disorders
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Number of diagnoses – Italy

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson’s disease
- Neuromuscular disorders
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent disorders
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Number of diagnoses – Latvia

Traumatic brain injury
Stroke
Somatoform disorder
Sleep disorders
Psychotic disorders
Personality disorders
Parkinson’s disease
Neuromuscular disorders
Multiple sclerosis
Mood disorders
Mental retardation
Headache
Epilepsy
Eating disorders
Dementia
Child/Adolescent disorders
Brain tumour
Anxiety disorders
Addiction

Number of diagnoses (in thousands)
Number of diagnoses – Lithuania

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson’s disease
- Neuromuscular disorders
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent disorders
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Number of diagnoses – Netherlands

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson’s disease
- Neuromuscular disorders
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent disorders
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Number of diagnoses – Norway

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson’s disease
- Neuromuscular disorders
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent disorders
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Number of diagnoses – Slovakia

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson’s disease
- Neuromuscular disorders
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent disorders
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Number of diagnoses – Sweden

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson’s disease
- Neuromuscular disorders
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent disorders
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Number of diagnoses – UK

- Traumatic brain injury
- Stroke
- Somatoform disorder
- Sleep disorders
- Psychotic disorders
- Personality disorders
- Parkinson's disease
- Neuromuscular disorders
- Multiple sclerosis
- Mood disorders
- Mental retardation
- Headache
- Epilepsy
- Eating disorders
- Dementia
- Child/Adolescent disorders
- Brain tumour
- Anxiety disorders
- Addiction

Number of diagnoses (in thousands)
Cost per patient, average for disorders (€ PPP)
12 previously reviewed disorders

- EBC 2005 – € 3 040
- EBC 2010 – € 2 670

Difference:

- Lower cost per patient estimates: alcohol addiction, brain tumor, epilepsy, migraine, mood disorders, psychotic disorders, and traumatic brain injury
- Higher cost per patient estimates: dementia
- Exclusion of cost components (e.g. indirect cost due to mortality for brain tumor)
Cost per patient, average for disorders (€ PPP)

*Extension to 12 previously reviewed disorders*

- PTSD - € 1 082

- Headache:
  - Medication overuse headache - € 2 291
  - Other headaches - € 57
  - Tension type headache - € 64

- Psychotic disorders (indirect costs) - € 12 991

- Stroke (prevalent cases) – € 5 368

- Traumatic Brain Injury
  - Moderate and severe prevalent cases – € 9 020
  - Indirect costs of incident cases - € 4 156
Cost per patient, average for disorders (€ PPP)

Seven new disorders

- Child/adolescent disorders - € 3 595
- Eating disorders - € 559
- Mental retardation - € 10 334
- Neuromuscular disorders - € 30,052
- Personality disorders - € 6 328
- Sleep disorders - € 790
- Somatoform disorder - € 1 037
Cost per patient (€ PPP 2010)

- Neuromuscular disorders: 30,052
- Multiple sclerosis: 26,974
- Brain tumor: 21,590
- Psychotic disorders: 18,796
- Parkinson's disease: 16,584
- Sleep disorders: 11,517
- Anxiety disorders: 10,334
- Mood disorders: 8,809
- Epilepsy: 6,328
- Personality disorders: 5,221
- Child/Adolescent disorders: 4,227
- Addiction: 3,595
- Somatoform disorder: 3,406
- Traumatic Brain Injury: 2,854
- Stroke: 2,770
- Mental Retardation: 2,534
- Parkinson's disease: 2,159
- Dementia: 2,077
- Mood disorders: 2,037
- Personality disorders: 1,840
- Eating disorders: 1,077
- Somatoform disorder: 1,037
- Headache: 285

Cost per patient (€ PPP 2010) – Neurologic disorders

- Headaches: €285
- Sleep disorders: €790
- Epilepsy: €5221
- Stroke: €7775
- Traumatic brain injury: €8809
- Parkinson's disease: €11153
- Dementia: €16584
- Brain tumor: €21590
- Multiple sclerosis: €26974
- Neuromuscular disorders: €30052
Cost per patient (€ PPP 2010) – Mental disorders

- Eating disorders: €559
- Somatoform disorder: €1,037
- Anxiety disorders: €1,077
- Mood disorders: €3,406
- Child/Adolescent disorders: €3,595
- Addiction: €4,227
- Personality disorders: €6,328
- Mental retardation: €10,334
- Psychotic disorders: €18,796
Direct healthcare cost per patient (€ PPP 2010)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Cost (€ PPP 2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>59</td>
</tr>
<tr>
<td>Eating disorders</td>
<td>400</td>
</tr>
<tr>
<td>Child/Adolescent disorders</td>
<td>439</td>
</tr>
<tr>
<td>Sleep disorders</td>
<td>441</td>
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<tr>
<td>Somatoform disorder</td>
<td>468</td>
</tr>
<tr>
<td>Anxiety disorders</td>
<td>670</td>
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<tr>
<td>Personality disorders</td>
<td>773</td>
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<tr>
<td>Mood disorders</td>
<td>781</td>
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<tr>
<td>Addiction</td>
<td>1782</td>
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<tr>
<td>Epilepsy</td>
<td>2461</td>
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<td>Dementia</td>
<td>2673</td>
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<tr>
<td>Traumatic Brain Injury</td>
<td>2697</td>
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<tr>
<td>Stroke</td>
<td>5141</td>
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<tr>
<td>Parkinsons disease</td>
<td>5626</td>
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<tr>
<td>Psychotic disorders</td>
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<td>Mental Retardation</td>
<td>6970</td>
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<tr>
<td>Neuromuscular disorders</td>
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<tr>
<td>Multiple sclerosis</td>
<td>9811</td>
</tr>
<tr>
<td>Brain tumor</td>
<td>13387</td>
</tr>
</tbody>
</table>
Direct healthcare cost per patient (€ PPP 2010) – Neurologic disorders

- Headaches: 59
- Sleep disorders: 441
- Epilepsy: 2461
- Dementia: 2673
- Traumatic brain injury: 2697
- Stroke: 5141
- Parkinson’s disease: 5626
- Neuromuscular disorders: 7133
- Multiple sclerosis: 9811
- Brain tumor: 13387

<table>
<thead>
<tr>
<th>Condition</th>
<th>Cost (€ PPP 2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>0</td>
</tr>
<tr>
<td>Sleep disorders</td>
<td>0</td>
</tr>
<tr>
<td>Somatoform disorder</td>
<td>0</td>
</tr>
<tr>
<td>Psychotic disorders</td>
<td>0</td>
</tr>
<tr>
<td>Brain tumor</td>
<td>0</td>
</tr>
<tr>
<td>Anxiety disorders</td>
<td>2</td>
</tr>
<tr>
<td>Eating disorders</td>
<td>48</td>
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<tr>
<td>Mood disorders</td>
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<tr>
<td>Personality disorders</td>
<td>625</td>
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<tr>
<td>Epilepsy</td>
<td>625</td>
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<tr>
<td>Addiction</td>
<td>873</td>
</tr>
<tr>
<td>Traumatic Brain Injury</td>
<td>893</td>
</tr>
<tr>
<td>Stroke</td>
<td>2035</td>
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<tr>
<td>Child/Adolescent disorders</td>
<td>3156</td>
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<tr>
<td>Mental Retardation</td>
<td>3364</td>
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<tr>
<td>Parkinsons disease</td>
<td>4417</td>
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<tr>
<td>Neuromuscular disorders</td>
<td>5641</td>
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<tr>
<td>Multiple sclerosis</td>
<td>8438</td>
</tr>
<tr>
<td>Dementia</td>
<td>13911</td>
</tr>
</tbody>
</table>
Direct non-medical cost per patient (€ PPP 2010) – Neurologic disorders

- Brain tumor: 0
- Headaches: 0
- Sleep disorders: 0
- Epilepsy: 625
- Traumatic brain injury: 893
- Stroke: 2035
- Parkinson's disease: 4417
- Neuromuscular disorders: 5641
- Multiple sclerosis: 8438
- Dementia: 13911
Direct non-medical cost per patient (€ PPP 2010) – Mental disorders

- Psychotic disorders: 0
- Somatoform disorder: 0
- Anxiety disorders: 2
- Eating disorders: 48
- Mood disorders: 464
- Personality disorders: 625
- Addiction: 873
- Child/Adolescent disorders: 3156
- Mental retardation: 3364
Indirect cost per patient (€ PPP 2010)

- Neuromuscular disorders: 17,278
- Psychotic disorders: 12,991
- Multiple sclerosis: 8,725
- Psychotic disorders: 12,991
- Traumatic Brain Injury: 5,219
- Brain tumor: 8,203
- Multiple sclerosis: 8,725
- Personality disorders: 4,929
- Mood disorders: 2,161
- Epilepsy: 2,136
- Sleep disorders: 348
- Personality disorders: 1,109
- Headache: 226
- Eating disorders: 111
- Dementia: 0
- Mental Retardation: 0
- Child/Adolescent disorders: 0

Indirect cost per patient (€ PPP 2010) – Neurologic disorders

- Dementia: 0
- Headaches: 226
- Sleep disorders: 348
- Stroke: 599
- Parkinson's disease: 1109
- Epilepsy: 2136
- Traumatic brain injury: 5219
- Brain tumor: 8203
- Multiple sclerosis: 8725
- Neuromuscular disorders: 17,278
Indirect cost per patient (€ PPP 2010) – Mental disorders

- Child/Adolescent disorders: 0
- Mental retardation: 0
- Eating disorders: 111
- Anxiety disorders: 405
- Somatoform disorder: 570
- Addiction: 1572
- Mood disorders: 2161
- Personality disorders: 4929
- Psychotic disorders: 12991
Total cost (€ PPP)

- EBC 2005 – € 386 billion
- EBC 2010 – € 798 billion
  - 12 previously studied disorders (including extensions): € 641 billion
  - 7 new disorders: € 157 billion
Total cost (€ PPP) – difference with EBC 2005

- Differences in the number of persons
- Differences in the cost per person
Total cost per disorder (million € PPP 2010)

- Mood disorders: 113,405
- Dementia: 105,163
- Psychotic disorders: 93,927
- Anxiety disorders: 74,380
- Addiction: 65,684
- Stroke: 64,053
- Sleep disorders: 35,425
- Mental Retardation: 43,301
- Headache: 43,154
- Traumatic Brain Injury: 33,013
- Personality disorders: 27,345
- Child/Adolescent disorders: 21,326
- Somatoform disorder: 21,169
- Multiple sclerosis: 14,559
- Parkinsons disease: 13,933
- Epilepsy: 13,800
- Neuromuscular disorders: 7,726
- Brain tumor: 5,174
- Eating disorders: 1,827
Total cost per disorder (million € PPP 2010) – Neurologic disorders

- Brain tumor: 5174
- Neuromuscular disorders: 7727
- Epilepsy: 13800
- Multiple sclerosis: 14559
- Parkinson's disease: 13933
- Traumatic brain injury: 33013
- Sleep disorders: 35425
- Headaches: 43514
- Stroke: 64053
- Dementia: 105163

Total cost per disorder (million € PPP 2010) – Mental disorders

- Eating disorders: 827
- Somatoform disorder: 21,169
- Child/Adolescent disorders: 21,326
- Personality disorders: 27,345
- Mental retardation: 43,301
- Addiction: 65,684
- Anxiety disorders: 74,380
- Psychotic disorders: 93,927
- Mood disorders: 113,405

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Cost (€ PPP 2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety disorders</td>
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<tr>
<td>Neuromuscular disorders</td>
<td>1834</td>
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<tr>
<td>Child/Adolescent disorders</td>
<td>2601</td>
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<tr>
<td>Brain tumor</td>
<td>3208</td>
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<tr>
<td>Personality disorders</td>
<td>3342</td>
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<tr>
<td>Multiple sclerosis</td>
<td>5295</td>
</tr>
<tr>
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<td>Parkinsons disease</td>
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<td>Traumatic Brain Injury</td>
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<td>Dementia</td>
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<tr>
<td>Sleep disorders</td>
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<td>Mood disorders</td>
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<tr>
<td>Addiction</td>
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<tr>
<td>Mental Retardation</td>
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<tr>
<td>Stroke</td>
<td>42352</td>
</tr>
<tr>
<td>Anxiety disorders</td>
<td>46267</td>
</tr>
</tbody>
</table>
Direct healthcare cost per disorder (million € PPP 2010) – Neurologic disorders

- Neuromuscular disorders: 1,834
- Brain tumor: 3,208
- Multiple sclerosis: 5,295
- Epilepsy: 6,503
- Parkinson’s disease: 7,029
- Headaches: 9,039
- Traumatic brain injury: 10,106
- Dementia: 16,949
- Sleep disorders: 19,796
- Stroke: 42,352
Direct healthcare cost per disorder (million € PPP 2010) – Mental disorders

- Eating disorders: 593
- Child/Adolescent disorders: 2601
- Personality disorders: 3342
- Somatoform disorder: 9547
- Mood disorders: 26016
- Addiction: 27685
- Psychotic disorders: 29007
- Mental retardation: 29204
- Anxiety disorders: 46267
Direct non-medical cost per disorder (million € PPP 2010)

- Brain tumor: 0
- Somatoform disorder: 0
- Sleep disorders: 0
- Headache: 0
- Psychotic disorders: 0
- Eating disorders: 70
- Anxiety disorders: 144
- Neuromuscular disorders: 1450
- Epilepsy: 1653
- Personality disorders: 2701
- Traumatic Brain Injury: 3348
- Multiple sclerosis: 4554
- Parkinsons disease: 5519
- Addiction: 13569
- Mental Retardation: 14097
- Mood disorders: 15437
- Stroke: 16769
- Child/Adolescent disorders: 18724
- Dementia: 88214

Direct non-medical cost per disorder (million € PPP 2010) – Neurologic disorders

- Sleep disorders: 0
- Headaches: 0
- Brain tumor: 0
- Neuromuscular disorders: 1450
- Epilepsy: 1653
- Traumatic brain injury: 3348
- Multiple sclerosis: 4554
- Parkinson’s disease: 5519
- Stroke: 16769
- Dementia: 88214

Direct non-medical cost per disorder (million € PPP 2010) – Mental disorders

- Somatoform disorder: 0
- Psychotic disorders: 0
- Eating disorders: 70
- Anxiety disorders: 144
- Personality disorders: 2701
- Addiction: 13569
- Mental retardation: 14097
- Mood disorders: 15437
- Child/Adolescent disorders: 18724
Indirect cost per disorder (million € PPP 2010) – Neurologic disorders

- Dementia: 0 million €
- Parkinson's disease: 1386 million €
- Brain tumor: 1966 million €
- Neuromuscular disorders: 4442 million €
- Multiple sclerosis: 4709 million €
- Stroke: 4932 million €
- Epilepsy: 5644 million €
- Sleep disorders: 15630 million €
- Traumatic brain injury: 19560 million €
- Headaches: 34475 million €
Indirect cost per disorder (million € PPP 2010) – Mental disorders

- Mental retardation: 0
- Child/Adolescent disorders: 0
- Eating disorders: 164
- Somatoform disorder: 11622
- Personality disorders: 21301
- Addiction: 24430
- Anxiety disorders: 27969
- Psychotic disorders: 64920
- Mood disorders: 71952
Proportions of three types of costs as a share of the total cost

A. Total disorders of the brain

- Indirect costs: 40%
- Direct healthcare costs: 37%
- Direct non-medical costs: 23%

B. Neurological disorders

- Indirect costs: 26%
- Direct healthcare costs: 34%
- Direct non-medical costs: 40%

C. Mental disorders

- Indirect costs: 48%
- Direct healthcare costs: 39%
- Direct non-medical costs: 13%

Direct healthcare cost per country (million € PPP 2010)
Direct non-medical cost per country (million € PPP 2010)
Indirect cost per country (million € PPP 2010)

Total cost per capita (€ PPP 2010)

Cost in € PPP 2010

- Bulgaria
- Romania
- Lithuania
- Latvia
- Slovakia
- Estonia
- Poland
- Hungary
- Czech Republic
- Malta
- Cyprus
- Slovenia
- Portugal
- Greece
- Italy
- Finland
- France
- Spain
- Belgium
- Ireland
- Denmark
- Netherlands
- Iceland
- Germany
- Switzerland
- Sweden
- Austria
- Norway
- United Kingdom
- Luxembourg
Direct healthcare cost per capita (€ PPP 2010)

Cost in € PPP 2010
Direct non-medical cost per capita (€ PPP 2010)

<table>
<thead>
<tr>
<th>Country</th>
<th>Cost in € PPP 2010</th>
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<tbody>
<tr>
<td>Bulgaria</td>
<td>100</td>
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<tr>
<td>Romania</td>
<td>200</td>
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<tr>
<td>Lithuania</td>
<td>300</td>
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<tr>
<td>Poland</td>
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<tr>
<td>Slovakia</td>
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<tr>
<td>Latvia</td>
<td>600</td>
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<tr>
<td>Malta</td>
<td>700</td>
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<td>Hungary</td>
<td>800</td>
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<td>Estonia</td>
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<td>Cyprus</td>
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<td>Spain</td>
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<td>Sweden</td>
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<td>United Kingdom</td>
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<tr>
<td>Luxembourg</td>
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</tbody>
</table>

Indirect cost per capita (€ PPP 2010)

Cost in € PPP 2010

- Bulgaria
- Lithuania
- Romania
- Latvia
- Slovakia
- Estonia
- Czech Republic
- Poland
- Hungary
- Slovenia
- Portugal
- Malta
- Italy
- Greece
- France
- Spain
- Cyprus
- Finland
- Sweden
- Belgium
- Switzerland
- Ireland
- Netherlands
- Denmark
- Norway
- Germany
- Austria
- Iceland
- Luxembourg
- United Kingdom

Validation – Healthcare cost of Epilepsy

European review by Koutsopoulos et al. 2001

- Healthcare expenditure between 1.5 – 14 billion
- EBC 2010 € 6.5 billion
  - EBC 2010 estimate is in the middle range
Validation – Healthcare cost of Stroke

European review by Evers et al. 2004

- Healthcare expenditure € 38 billion
- EBC 2010: € 42 billion
Validation – Total cost of dementia in Europe

Cost of dementia in Europe by Wimo et al. 2010

- €160 billion in 2008
- EBC 2010 estimate: 105.1 billion
  - Higher prevalence and cost estimates in the Wimo et al. 2010 analysis

Validation – Cost per patient with dementia

ICTUS study - Gustavsson et al. 2010

- € 8 000 per patient
- EBC 2010 study: € 16 584 per patient

- Cost per patient from the ICTUS study based on a milder sample of patients
  - For a more severe sub-group: €13 000 - € 20 000
Validation – Cost of MS in Europe

2009 review by Kobelt G. and F. Kasteng

- EU 27 + 3: € 14.9 billion
- EBC 2010 study: € 14.6 billion

Methodological differences in estimating the total number of patients with MS in Europe

- 470,000 persons above the age of 19 in the review vs. 440,000 above the age of 18 in the EBC 2010
Validation – US evidence

- Overall, higher healthcare cost estimates in the US studies than in Germany
- US health care cost 17.3% of GNP and 10.4% in Germany
- Variability between disorders
Comparison to European estimates of other major groups of disorders

Cardiovascular disease: €192 billion in 2008
(21% indirect cost, 79% direct cost)

- Cost per capita per year: € 391
  - from € 60 for Bulgaria to € 600 for Germany

- Cost of productivity losses due to illness: € 13.9 billion

- Cost of informal care: € 42 billion
Comparison to European estimates of other major groups of disorders

Cancer: total costs between € 150 and 250 billion in 2010

- Direct healthcare costs: € 79 billion in 2010
Comparison to European estimates of other major groups of disorders

Diabetes (direct healthcare costs): €20 – 83 billion in 2010

- Hospitalization: 55%
- Drug therapy: 27%
  - Antidiabetic drugs and insulin: 7% of total direct healthcare costs
- Ambulatory care: 18%
Comparison to European estimates of other major groups of disorders

Rheumatoid Arthritis:

Cost per patient with RA: € 12 900

- Direct cost per patient (excluding biologics): € 5 512
  - Biologics: €1 028
  - Informal care: € 2 012
  - Indirect cost: € 4 289

Total cost of RA in Europe: € 25.1 billion in 2008
Comparison to European estimates of other major groups of disorders

Chronic Obstructive Pulmonary disease: Total cost € 39 billion in 2006

- Indirect cost (including the cost due to premature mortality): 60% of total cost

- Direct cost: 54% hospitalization cost, 6% unscheduled visits, 16% COPD medication, 5% medical investigations, 3% oxygen
Discussion
Main findings

- The EBC 2005 cost estimate remains quite stable if correcting for inflation and the increase in the population

- Important elements that were lacking in the 2005 study were added:
  - new sub-diagnoses
  - cost components (indirect costs)

- Cost of extensions – € 164 billion
Main findings

- The cost of disorders of the brain amounts overall to €798 billion in Europe in 2010

- Less prevalent disorders are still missing due to lack of data

“True” estimate of the cost of disorders of the brain is probably considerably higher
Over- and Underestimations

Reasons for overestimation

- Comorbidities – overlap between the disorders of the brain

Reasons for underestimation

- Unable to include certain elements, such as:
  - indirect costs of certain disorders (e.g. insomnia)
  - more than a limited age group for certain disorders (e.g. cost of adult autism)
  - a large number of less prevalent diseases have not been included at all
- Estimates for cannabis dependence were not included
Policy implications – European research

- Not sufficient funding for the disorders of the brain despite their huge burden

- From a societal perspective: the return on investment in brain research far exceeds the return from any other branches of research

- FP7: Specific mention of brain research but uncertain if % of funds increase from FP6 to FP7

**FP8: must address clinical and basic brain research**
Policy implications – European health care

- Further increase of the burden due to the increasing trend in life expectancy in Europe
- A coordinated policy covering all disorders of the brain is needed

**Increased focus on prevention should be of high priority**
Policy implications – European health educators

- Normally at most 2 of 24 months or 8% of clinical education at medical schools is allocated to psychiatry and neurology. Cost is 33%

- Even less teaching in brain disorders in other health educations

- Treatment for brain disorders have drastically improved

**Increased curricula and teaching efforts are needed**
Policy implications – European pharmaceutical industry

- Pharmaceutical industry is moving out of Europe
- Investments in drugs for brain disorders have been disappointing
- Drug development for brain disorders is being abandoned despite huge need
- Unnecessary regulatory barriers to drugs for brain disorders

**Political action to halt this exit is needed**

- simplify procedures for approval/reimbursement
- reduce bureaucracy
- prolong patents for drugs