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The socioeconomic burden of migraine in Belgium

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List of Abbreviations

CVD	Cardiovascular diseases
DALY	Disability-adjusted life year
DM	Diabetes mellitus
FCA	Friction cost approach
GBD	Global burden of disease
GDP	Gross domestic product
GVA	Gross value added
HCA	Human capital approach
IHME	Institute for Health Metrics and Evaluation
IO	Input-output
NACE Rev. 2	Second revision of the Statistical Classification of Economic Activities in the European Community
OECD	Organization for Economic Cooperation and Development
SOB	Socioeconomic burden
USES	Unpaid substitution economic sector
YLD	Years lived with disability
YLL	Years of life lost

Summary

Background

Migraine is a highly prevalent neurovascular disorder that disproportionately affects younger women, with prevalence rates reaching 43.5% among women aged 20–29. According to the Global Burden of Disease study, migraine ranks as the second-highest disease-related cause of disability worldwide. While direct healthcare costs are well-documented (€1,495–€8,344 per patient annually in OECD countries), broader productivity-related costs remain understudied.

Objective

This study quantifies the socioeconomic burden (SOB) of migraine in Belgium, capturing productivity losses in both paid and unpaid work through disability-adjusted life years (DALYs) and gross value added (GVA). The analysis includes direct, indirect, and induced economic effects using input-output modelling, and compares migraine's burden with cardiovascular disease (CVD) and diabetes mellitus (DM).

Results

From 2011 to 2024, the cumulative socioeconomic burden of migraine in Belgium totaled €96 billion at current prices (€85 billion inflation-adjusted). Annual losses ranged from €5.83 billion (2011) to €8.10 billion (2024). The burden consistently represented 1.54–1.31% of Belgium's GDP throughout the decade, averaging 1.5% annually. Paid work productivity losses accounted for €77.91 billion over the 14 years, while unpaid work losses totaled €18.36 billion. In 2024, migraine-related productivity losses were equivalent to 1.50 additional working days per person in the general population aged 15 and older. Migraine imposed a substantially higher economic burden than both CVD and DM across the entire study period. In 2024, the wider economic impact of migraine paid work productivity losses accounted for 1.06% of GDP, compared to 0.37-0.38% for DM and 0.26–0.37% for CVD. Among seven European countries studied, Belgium ranked fifth in cumulative burden (€72 billion). As a percentage of GDP (1.47%), Belgium's burden was higher than France (1.39%) and the Netherlands (1.20%), and comparable to Germany (1.54%).

Conclusions

Migraine imposes a considerable and persistent burden on Belgium's economy, predominantly affecting individuals during their peak working years. The condition generates significant spillover effects across economic sectors through indirect and induced productivity losses. Given that migraine affects working-age populations in an ageing society, reducing its burden could enhance overall economic output, ease fiscal pressures on public budgets, and support individuals in fulfilling essential unpaid roles such as caregiving. Policymakers should consider migraine prevention and treatment as strategic investments with broad societal returns.

1 Introduction

Migraine is a neurovascular disorder that is defined by recurring moderate to severe headaches (Goadsby, 2007). Additionally, migraine is highly prevalent. A global prevalence of 14% was estimated for 2019, corresponding to approximately 1.1 billion individuals affected worldwide (Amiri *et al.*, 2022). The combined severity and frequency of these headaches and the high prevalence results in a high disease burden. According to the Global Burden of Disease (GBD) study, this disease represents the second-highest disease-related cause of disability (years lived with disability, YLD), after lower back pain (IHME, 2025).

The high disease burden of migraine is associated with high costs to the healthcare system. In Belgium, a study found that in 26% of the migraine patients, there is the suspicion of medication overuse, and 13% visited an emergency department within a year (Lourens *et al.*, 2023). It is therefore unsurprising that migraine is associated with high direct costs, which include healthcare cost such as medication, hospital, and physician visits. A systematic review of 13 articles by Eltrafi *et al.* (2023) shows that in OECD countries, the annual estimated direct cost per patient ranges from €1,495.20 to €8,344.30. Due to the high prevalence, the aggregated cost to the healthcare system is high.

Beyond the costs of migraine to the healthcare system, the severity and frequency of the headaches also result in productivity losses due to absenteeism. A study among 336 employees with migraine in Flanders and the Brussels-Capital Region indicated that, on average, 2.3 days are lost per migraine patient per year (Moens *et al.*, 2007). This number should be taken as a lower-bound estimate due to reporting bias and given that this study was conducted with a convenience sample of relatively healthy individuals. Still, a total of 1,650,000 sick leave days can be observed each year when these results are extrapolated, based on the prevalence of migraine in Belgium (Moens *et al.*, 2007). Other studies, not conducted in Belgium, have shown that particularly these productivity losses due to migraine-induced absenteeism result in high societal costs (García-Azorín *et al.*, 2024). Beyond absenteeism, migraine also results in presenteeism (Landy *et al.*, 2011), which causes additional productivity losses (Seddik *et al.*, 2020).

Despite these high broader societal costs, Eltrafi et al. (2023) found that most studies focus on direct costs to the healthcare system and that the broader productivity-related costs of migraine to society remain understudied. To research these broader costs in Belgium, a socioeconomic burden (SOB) of disease study can be conducted. The SOB of disease describes how disease impairs labor supply by reducing the ability of individuals to use their human capital. This goes beyond standard cost of illness studies, because it accounts for not only the direct effect of disease which are typically covered under the calculation of “indirect costs”, but also indirect and induced effects. These indirect and induced effects occur due to the reduction in demand that is associated with reduced productivity. A detailed explanation of these effects can be found in the appendix. Additionally, cost of illness studies typically do not include the productivity losses associated with a reduction in unpaid work productivity. In SOB of disease studies, these costs are acknowledged as well.

The aim of this report is therefore to describe the SOB of migraine in Belgium. More specifically, the study will:

- Describe the prevalence, burden, and SOB of migraine
- Compare the SOB of migraine with cardiovascular disease and diabetes mellitus

2 Methods

2.1 Analysis

The analysis of the socioeconomic burden (SOB) of migraine links disease burden to productivity losses and is conducted in three main steps. In step (A), the burden of migraine is quantified using disability-adjusted life years (DALYs). In step (B), this burden is converted into productivity losses, expressed as lost working time, whereby one DALY lost is interpreted as one year without productive capacity. In step (C), the resulting loss of working time is monetized using gross value added (GVA). An overview of these three steps is provided below, while the detailed calculation formulas are presented in the Annex.

In step (A), disease burden is measured using DALYs, which integrate information on both mortality and morbidity. The mortality-related component of disease burden is captured by years of life lost (YLL), representing the number of years an individual would have lived had death from a specific disease not occurred. For example, if an individual dies at age 30 due to a cardiovascular event and would otherwise have been expected to live to age 80, this corresponds to 50 YLL. Morbidity-related disease burden is expressed as years lived with disability (YLD), reflecting the loss of healthy life due to living with a condition. For instance, a person with migraine is assigned a disability weight of 0.4, implying that 80 years lived with migraine are equivalent to 48 years in full health (80 multiplied by one minus the disability weight), meaning that 32 healthy life years are lost due to disability. Together, YLL and YLD provide a common metric that allows disease burden to be aggregated. The sum of YLL and YLD constitutes the DALY.

In step (B), disease burden is translated into productivity losses by assuming that each DALY lost corresponds to one non-productive year. However, the relationship between productivity losses and YLL differs from that for YLD. For YLL, two methodological approaches are applied: the human capital approach (HCA) and the friction cost approach (FCA). Under the HCA, the death of an individual is assumed to result in a permanent loss of productivity that cannot be replaced. Under the FCA, it is assumed that organizations adjust to the loss of a worker after one year through mechanisms such as recruitment or organizational and technological changes; accordingly, mortality is assumed to lead to a productivity loss of one year. While both approaches yield identical results for migraine, they lead to different estimates for diabetes and cardiovascular disease (CVD), where mortality plays a larger role. For YLD-related DALYs, it is similarly assumed that each lost DALY represents one non-productive year. By way of illustration, one healthy individual without migraine is assumed to be as productive as 2.5 individuals with migraine within a given year (the inverse of the disability weight). YLD is assumed to capture productivity losses arising from both presenteeism and absenteeism.

In step (C), lost productive working time is valued using GVA. Traditionally, productivity losses are monetized using wages; however, due to market imperfections, wages do not fully reflect workers' actual productivity. GVA provides a more accurate measure of economic contribution, as it represents the value created by an industry after subtracting the value of intermediate inputs used in production. Consequently, GVA reflects the net economic value added by a given sector. In SOB analyses, disease-related reductions in the productivity of employed individuals are estimated using GVA per capita. As such, the monetary valuation of disease burden captures the economic impact of reduced working capacity among productive individuals in the economy.

In addition, to assess the impact of disease burden on productivity in terms of paid work, multipliers derived from input–output models are applied to estimate not only direct effects, but also indirect and induced spillover effects. Direct effects represent the immediate economic impact of reduced paid work resulting from ill health. Indirect effects capture losses in intermediate consumption of goods and services that arise from reduced GVA attributable to disease, reflecting productivity losses in other sectors due to lower demand from the affected primary sector. Induced effects account for reductions in household consumption resulting from lower income generated both directly and indirectly. Together, indirect and induced effects represent spillover effects. Total productivity losses from paid work are calculated as the sum of direct, indirect, and induced costs.

In addition to paid work, the socioeconomic burden associated with unpaid work is also estimated. Unpaid work does not generate market-valued outputs, requiring its productive value to be estimated indirectly. Importantly, unpaid work differs from paid work in the nature of the activities involved, such as meal preparation, caring for household members, and household maintenance. Accordingly, the value of unpaid work is assumed to differ from that of paid work. Unpaid work is therefore valued by identifying market-based economic activities that most closely correspond to the relevant unpaid tasks. Further details on this valuation approach are provided in the Annex.
Finally, to place the SOB of migraine in a broader context, the SOB of CVDs and diabetes is also estimated using the same methodological framework described above.

2.2 Data

The Institute for Health Metrics and Evaluation (IHME) uses a range of datasets to inform the analysis (Stovner *et al.*, 2018). Estimates of disease burden, including prevalence, YLDs, YLLs, and mortality, are obtained from the GBD database for migraine, CVD, and diabetes mellitus (IHME, 2025). Data are retrieved from the latest available database (GBD 2023) and stratified by country, sex, age group, and year. Age categories are defined in five-year bands from ages 15 to 94, with a final open-ended group covering individuals aged 95 and older.

Migraine prevalence data specifically are estimated with population-based epidemiological data using DisMod-MR 2.1, a Bayesian meta-regression tool (Stovner *et al.*, 2018). Migraine cases are defined according to the International Classification of Headache Disorders (ICHD) criteria, with prevalence representing individuals who experienced at least one migraine episode in the preceding 12 months (Stovner *et al.*, 2018). Disease burden is expressed as Years Lived with Disability (YLDs), calculated by multiplying prevalence by the proportion of time spent in the symptomatic state and the disability weight for migraine (Stovner *et al.*, 2018). Since migraine is not associated with mortality, YLDs are equivalent to Disability-Adjusted Life Years (DALYs) (Stovner *et al.*, 2018).

Information on paid and unpaid working time for Belgium is sourced from the United Nations Department of Economic and Social Affairs (UN Statistics Division, 2024a), which aggregates findings from national time-use surveys conducted at different points in time. For each country, data from the most recent available survey are used. Priority is given to match age group of the GBD data and the national time-use surveys. For Belgium, data for the “15 years and over” population were used.

Unpaid work is defined as the average number of hours per day devoted to unpaid domestic and care activities. These averages are calculated over the entire week, thereby accounting for differences between weekdays and weekends. Total working time comprises both paid and unpaid work and is similarly reported as average daily hours over a full week, including weekend days.

WifOR’s methodological framework extends beyond conventional economic evaluation approaches by integrating productivity loss assessment with value chain analysis based on Input–Output (IO) modeling and health economic principles. The approach evaluates how investments in health contribute to economic development through improvements in population health. Earlier applications and methodological iterations have been validated across a wide range of projects, peer-reviewed journal articles, conference presentations, and books (e.g. Ostwald *et al.,* 2023); a comprehensive list can be provided upon request.

On the basis of IO matrices, the analysis quantifies direct economic effects and estimates spillover impacts in related sectors as well as induced effects along value chains (Bess and Ambargis, 2011; Scholz *et al.*, 2025). The analysis first estimates the direct economic gains that would occur if the affected population were healthier and able to remain in employment, thereby directly increasing GVA. It then estimates indirect effects arising from higher intermediate demand for goods and services from upstream suppliers, driven by the additional GVA generated. Finally, induced effects are captured by accounting for increased consumption resulting from income generated through both direct and indirect channels. Spillover effects are defined as the combined impact of indirect and induced effects.

Demographic and macroeconomic data for Belgium are sourced from the World Bank (World Bank, 2025). Demographic inputs include the population aged 16–64 and 65 years and older. Economic indicators include the labour force participation rate, gross value added, unemployment rate, employment-to-population ratio, and GDP. Results are presented in current Euros. To account for inflation, additional GVA figures expressed in constant 2015 Euros are used. All monetary values are subsequently converted into euros using nominal exchange rates from the European Central Bank data portal (European Central Bank, 2025a).

3 Results

3.1 Prevalence, health burden, and socioeconomic burden of migraine

Migraine prevalence in Belgium varies depending on whether it is expressed as rates (per 100,000 population) or as absolute numbers of affected individuals. Prevalence rates reflect the likelihood of migraine occurrence within each age group, while absolute numbers are determined by the prevalence rate and the size of the corresponding age-group population. Figure 1 presents migraine prevalence in 2024 using both measures.

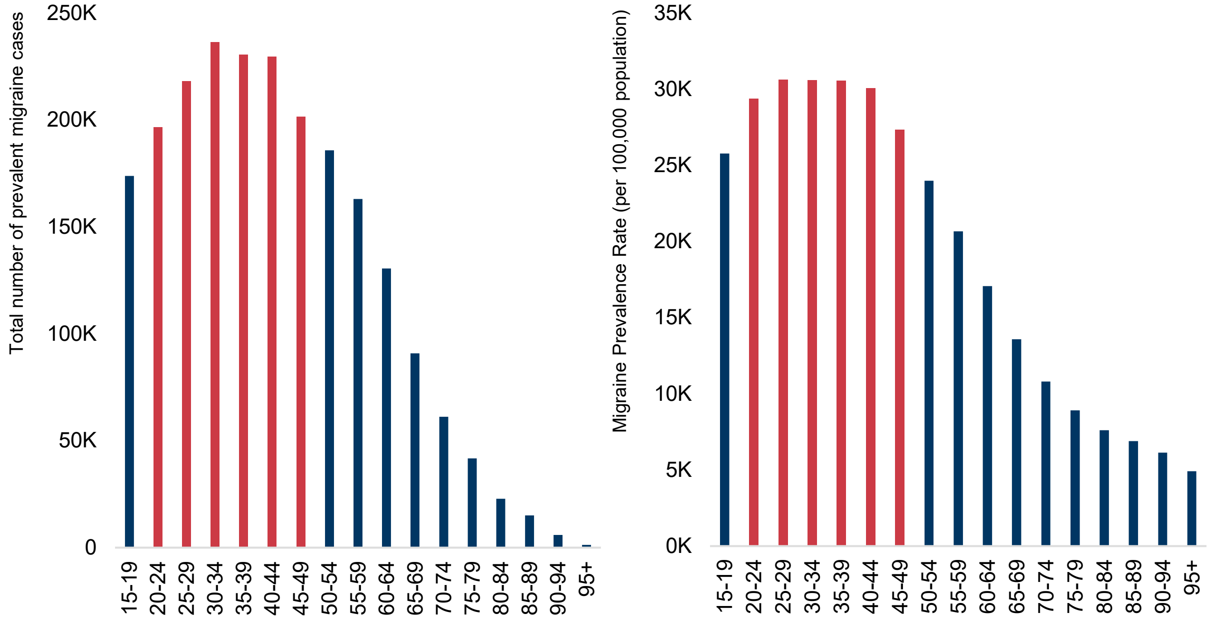

Figure 1. ***Prevalence of Migraine in Belgium: Absolute Numbers (Left) and distribution by age group per 100,000 (Right) in 2024***

Source: IHME (2025)

When examining absolute numbers and prevalence rates, the younger age groups (20–50) exhibited the highest migraine prevalence in Belgium in 2024. Prevalence rates by age group are highest in the age group 20-24 (~30K per 100K) and for the absolute cases, peak at ~240K in the 30-39 age group. However, the sharper decline in absolute numbers compared to rates after age 60 reflects Belgium's demographic structure rather than a proportional decrease in migraineurs - the rate data shows a meaningful per-capita burden persisting into the 70s.

As migraine carries no associated mortality, its health burden is fully captured by Years Lived with Disability (YLDs). Figure 2 presents the distribution of migraine-related YLDs per age group in Belgium for 2024.

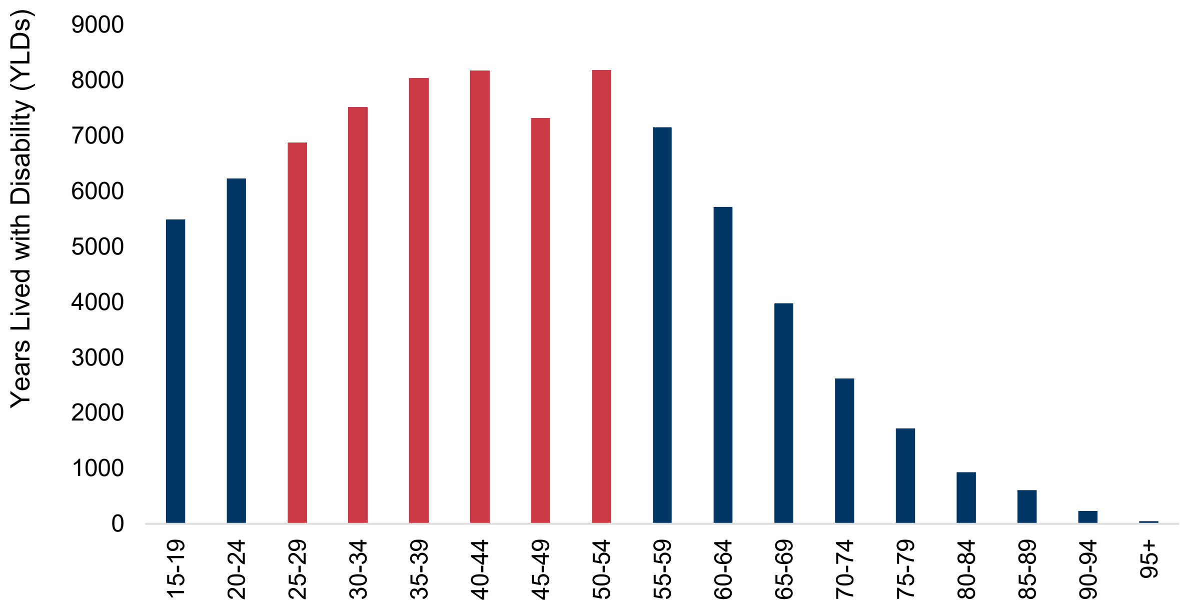

Figure 2. ***Years Lived with Disability (YLDs) Due to Migraine in Belgium in 2024***

Source: IHME (2025)

The data reveal that in Belgium, the highest disease burden occurs in individuals between 25 and 50 years of age, corresponding to the core working-age population. Beyond age 50, the burden gradually declines, reflecting both lower prevalence rates and smaller population sizes in older age groups. This concentration of disease burden in working-age individuals highlights the potential for substantial productivity and economic consequences.

The SOB of migraine represents a substantial impact on the economy. To place this burden in macroeconomic context and enable comparisons across countries and over time, Figure 3 presents the SOB from 2011 to 2024 as a percentage of Belgium's GDP.

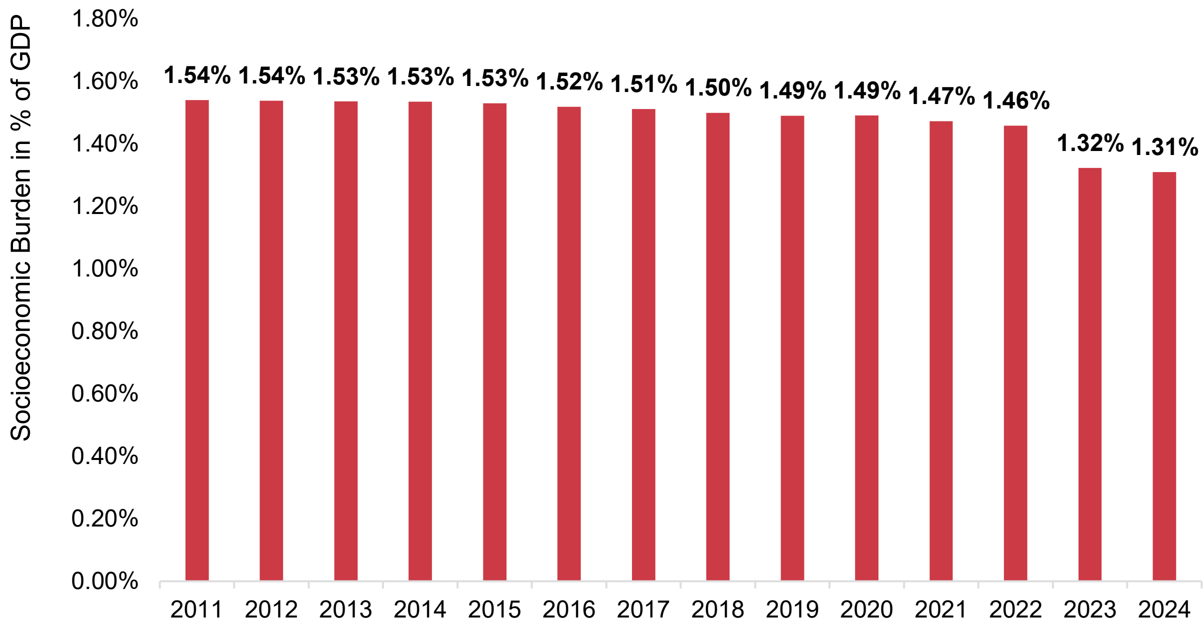

Figure 3. ***Overall Socioeconomic Burden of Migraine as a Percentage of Belgium's GDP, 2011–2024***

Source: WifOR elaboration

Within this comparative framework, during the period between 2011-24, the total socioeconomic burden expressed as a percentage of GDP remained consistently high, ranging from 1.54% to 1.31% in Belgium, averaging 1.5% of the GDP annually.

Figure 4 presents the total socioeconomic burden of migraine in Belgium from 2011 to 2024, expressed in both current and inflation-adjusted prices. This distinction enables the assessment of nominal trends alongside real economic changes over time

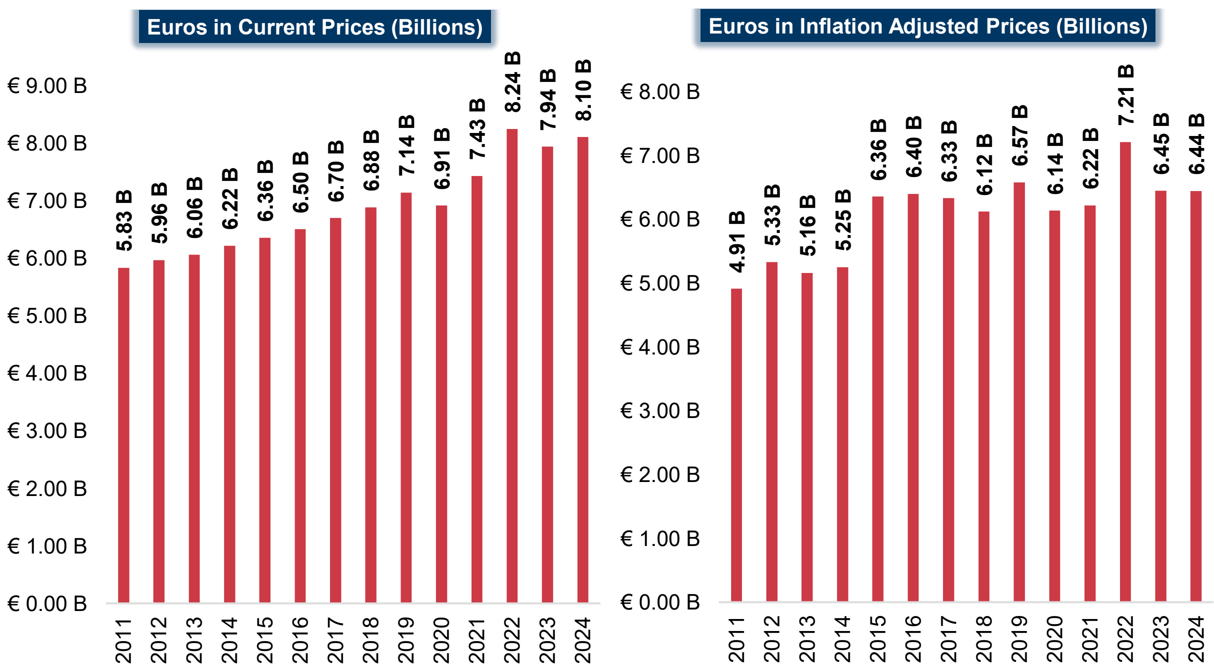

Figure 4. ***Total Socioeconomic Burden of Migraine, 2011–2024: Current Prices (Left) and Inflation-Adjusted Prices (Right)***

Source: WifOR elaboration

Across this period, migraine imposed a substantial and persistent economic burden, driven primarily by productivity losses in both paid and unpaid work. At current prices, annual losses increased from €5.83 billion in 2011 to €8.10 billion in 2024, yielding a cumulative burden of €96 billion. When adjusted for inflation, annual losses rose from €4.91 billion to €6.44 billion, totaling €85 billion over the same period. These findings indicate that the economic impact of migraine has grown in absolute terms, reflecting the combined influence of demographic and economic factors.

Figure 5 depicts the distribution of these losses between paid and unpaid work over 14 years at current prices.

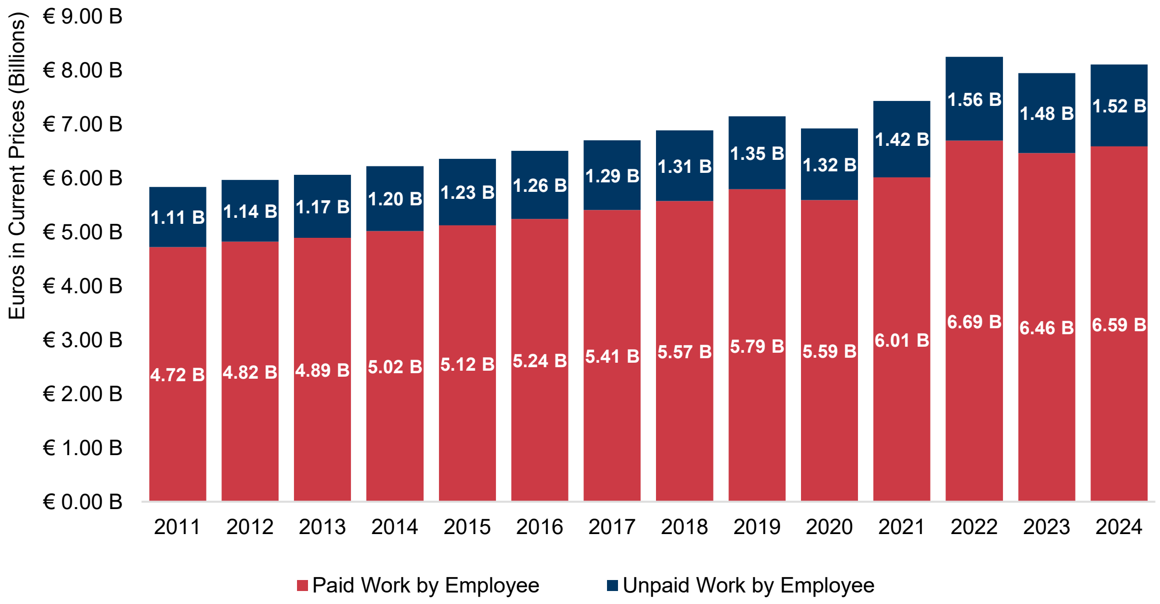

Figure 5. ***Overall Socioeconomic Burden of Migraine: Paid and Unpaid Productivity Losses, 2011–2024 (Current Prices)***

Source: WifOR elaboration

This analysis reveals that the majority of the productivity losses stem from paid work activities. Losses from paid work ranged from €4.72 billion in 2011 to €6.59 billion in 2024, totaling €77.91 billion over the 14 years. In contrast, losses from unpaid work ranged from €1.11 billion in 2011 to €1.52 billion in 2024, totaling €18.36 billion over the same period.

To further contextualize those results, the additional working days required per individual aged 15 years or older to recover productivity losses from migraine were calculated.

The analysis revealed that in 2024, each individual in this age group in Belgium would need to work an additional 1.50 days to compensate for the productivity losses incurred that year.

3.2 The socioeconomic burden of migraine compared with diabetes and cardiovascular diseases

A comparative analysis of productivity losses attributable to migraine versus those associated with diabetes and cardiovascular disease provides an additional contextual perspective. Figure 6 illustrates temporal trends for these three conditions from 2011 to 2024, utilizing the Friction Cost Approach (FCA), which assumes labor market substitution in cases of premature mortality, or in other words, that the productivity of an employee can be replaced in one year.

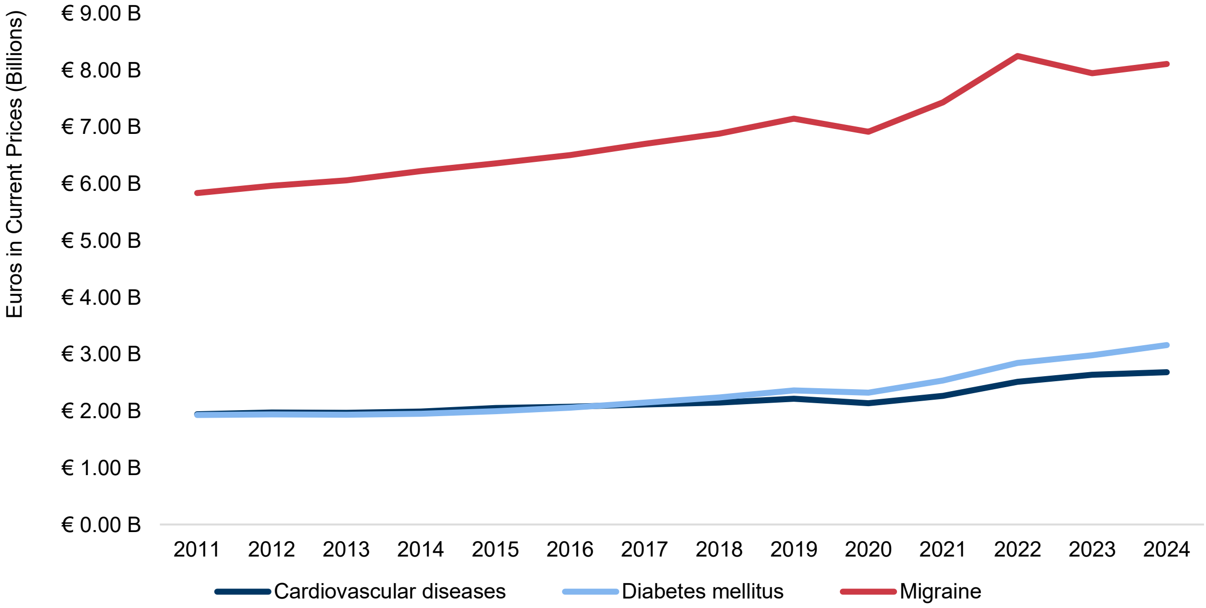

Figure 6. ***Time Trends in Socioeconomic Burden: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Friction Cost Approach, Assuming Substitution), 2011-2024***

Source: WifOR elaboration

The data demonstrate that across the entire 14-year period, migraine imposed a substantially higher economic burden than both cardiovascular disease and diabetes mellitus in Belgium.

Consistent with the analytical approach applied to migraine burden in general, inter-disease comparisons were made, expressing the socioeconomic burden relative to the country's GDP. Figure 7 presents results utilizing the Friction Cost Approach (FCA), a conservative method that assumes an individual's productivity can be replaced by another worker, and the Human Capital Approach (HCA), which assumes no labour market substitution and thus accounts for complete productivity loss in the event of premature death.

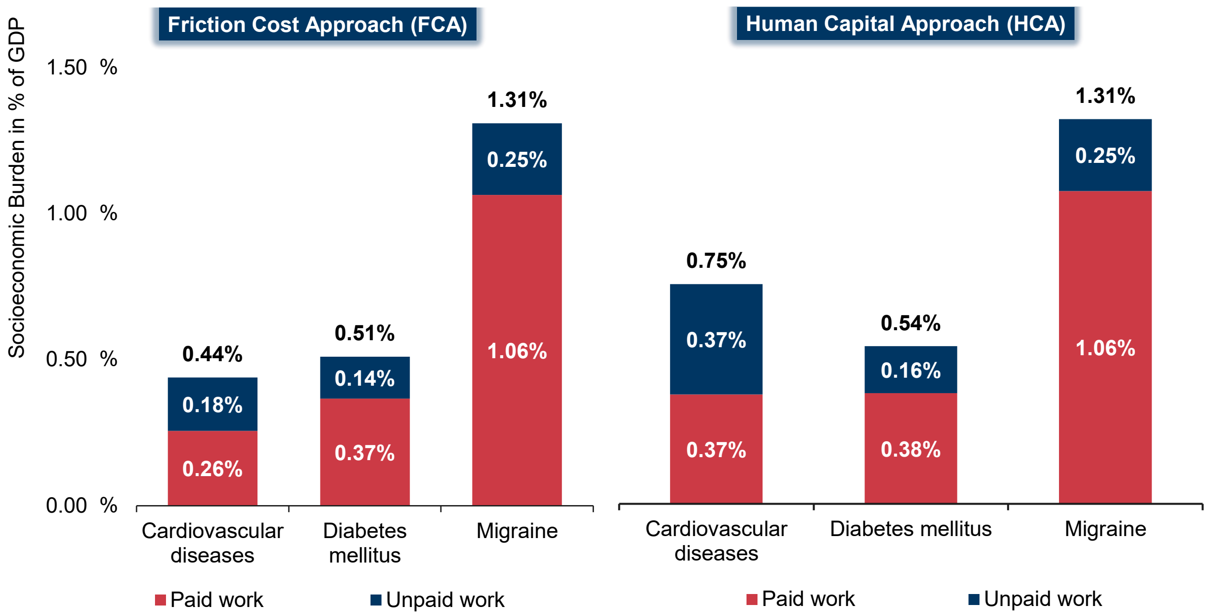

Figure 7.*Overall Socioeconomic Burden of Migraine in % of the GDP: Paid and Unpaid Productivity Losses, 2024 (FCA: Assuming Substitution – left side; HCA: Assuming no Substitution – right side)*

Source: WifOR elaboration

This proportional analysis further confirms that in Belgium, migraine imposes a higher economic burden relative to GDP than both CVD and DM. In the FCA scenario, the majority of productivity losses across all disease areas stem from paid work activities. For CVD, paid and unpaid productivity losses were relatively similar (0.26% and 0.18% of GDP, respectively). In contrast, DM and migraine exhibited substantially higher paid work productivity losses (0.37% for DM and 1.06% for migraine). Nevertheless, unpaid work contributed a notable proportion to the socioeconomic burden for both DM and migraine (0.14% and 0.25%, respectively). In the HCA scenario, instead, where premature death is more impactful on diseases like CVD and DM, CVD still kept similar paid and unpaid productivity losses (0.37% of GDP for both) but a way higher level of SOB in % of the GDP (0.75%). The SOB in % of the GDP of DM remained almost unchanged, rising from 0.51% to 0.54%, while Migraine kept accounting for the highest economic burden in Belgium.

To further elucidate the primary sources of paid work productivity losses, Figure 8 illustrates the spillover effects across migraine, diabetes mellitus, and cardiovascular disease in Belgium in 2024. These estimates, expressed as a percentage of GDP, were calculated using both the FCA and HCA approaches.

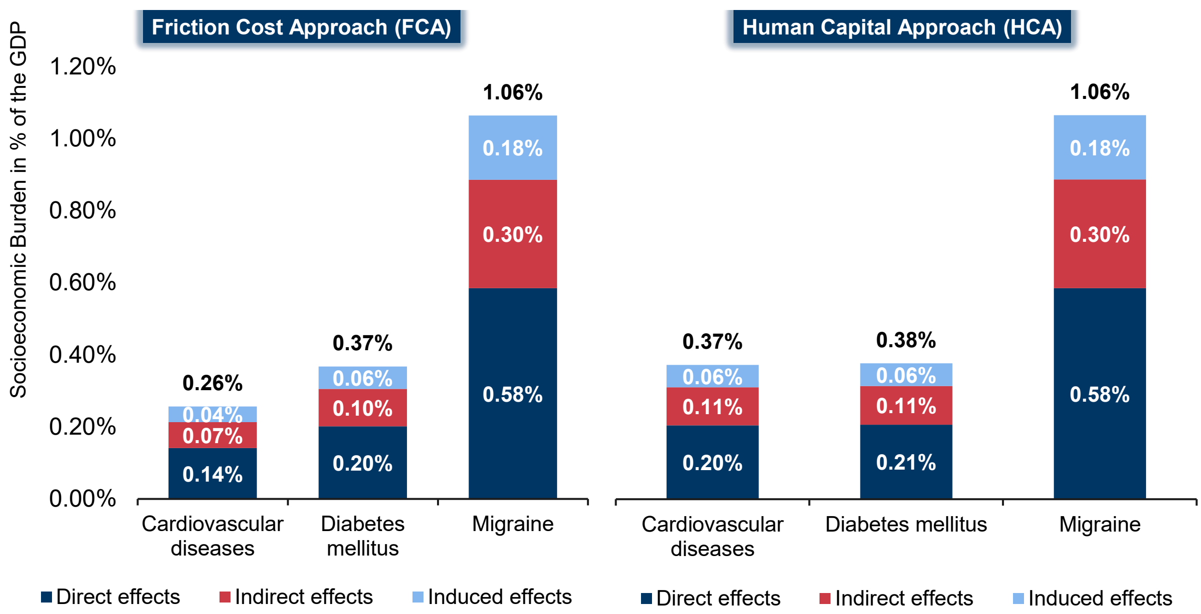

Figure 8. ***Total Socioeconomic Burden from Paid Work Activities, 2024 (Human Capital Approach, Assuming No Substitution): Spillover Effects Across Disease Areas***

Source: WifOR elaboration

Regardless of the approach employed, the majority of paid work productivity losses across all disease areas derived from direct effects, with migraine accounting for 0.58% of GDP, DM for 0.20–0.21%, and CVD for 0.14–0.20%. Indirect effects ranked second, with migraine accounting for 0.30%, DM for 0.10-0.11%, and CVD for 0.07–0.11% of Belgium's GDP. Lastly, induced effects contributed to a lesser extent to paid work productivity losses, with migraine at 0.18%, DM at 0.06%, and CVD at 0.04–0.06% of GDP.

3.3 Comparison with other European countries

A similar study has been published by WifOR (Lovera and Ubels, 2025), showing the impact of Migraine in six European countries: Germany, France, Spain, the Netherlands, Portugal, and the Czech Republic.

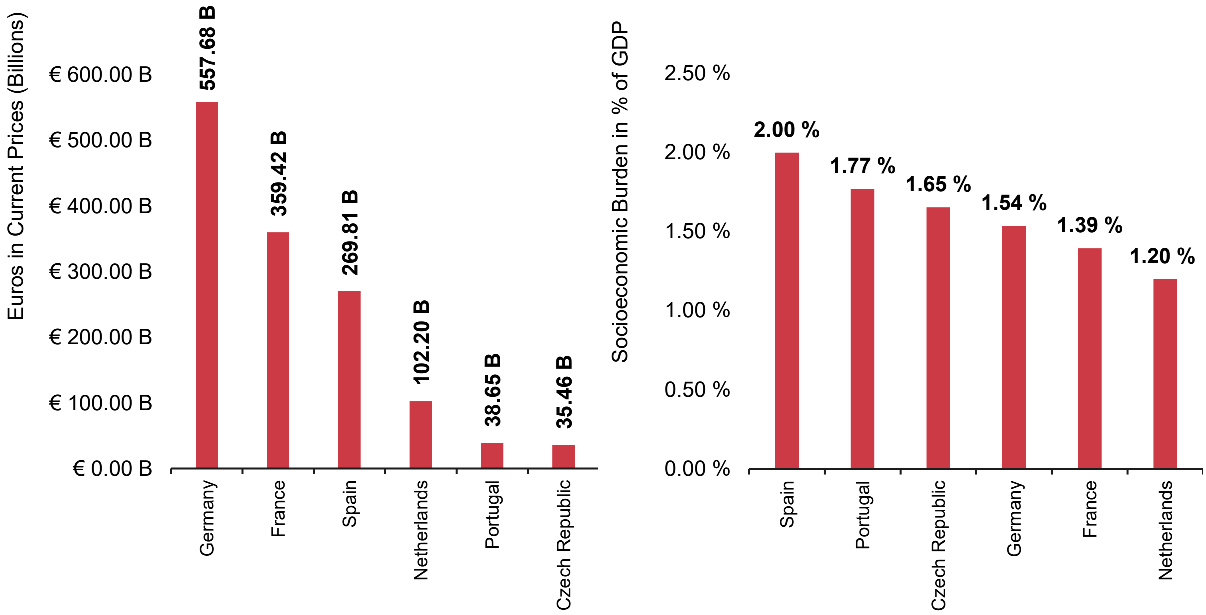

Figure 9. ***Total socioeconomic burden of migraine in current price between 2011-2021 (left) and as a percentage of the country's GDP in 2021 (right)***

Source: WifOR elaboration

Analysis of data from 2011 to 2021, encompassing productivity losses from both paid and unpaid work, reveals that these losses ranged from €557 billion in Germany to €35 billion in the Czech Republic, when current prices were considered. Within this context, Belgium, with €72 billion lost over the same period, ranks between the Netherlands and Portugal as the fifth country with the highest overall socioeconomic burden of migraine.
When examining losses in 2021 as a percentage of GDP, values ranged from 1.20% to 2.00% across the countries of interest. Spain exhibited the highest proportional burden at 2.00% of GDP, followed by Portugal (1.77%), the Czech Republic (1.65%), Germany (1.54%), France (1.39%), and the Netherlands (1.20%). Within this framework, Belgium (1.47%) demonstrated a socioeconomic burden higher than France and the Netherlands and comparable to Germany. It is important to note that this analysis used GBD 2023 data for Belgium, while the European report used GBD 2021 data. Therefore, some differences in socioeconomic burden between Belgium and other European countries could be attributed to methodological differences between the datasets rather than actual differences in disease burden. However, these methodological differences are likely minimal. When comparing the two datasets for Belgium, the socioeconomic burden as a percentage of GDP was 1.50% in 2021 and 1.47% in 2023—a difference of only 0.03 percentage points.

4 Discussion

The SOB imposed by migraine represents a substantial economic impact in Belgium. Over the 14-year period from 2011 to 2024, this cumulative burden ranged from €5.83 billion to €8.10 billion in 2024, totaling €96 billion in current prices, and from €4.91 billion to €6.44 billion, totaling €85 billion in inflation-adjusted prices. When this socioeconomic burden is expressed relative to Belgium's GDP, the data indicate that migraine represents a structurally significant economic burden relative to the country's overall economic capacity. Throughout 2011–2024, migraine's socioeconomic burden ranged from 1.54% to 1.31% of Belgium's GDP, remaining broadly stable and underscoring its persistent societal impact. The productivity-related socioeconomic burden of migraine increased in absolute terms from €7.73B to €8.10B (2021–2024) but declined as a proportion of GDP (1.46% to 1.31%) because overall economic output expanded more rapidly than migraine-related losses, particularly during the post-pandemic economic recovery and elevated inflation.

A comparative analysis of the SOB of migraine relative to diabetes mellitus and cardiovascular diseases provides further contextual perspective on these findings. The data demonstrate that across the entire 14-year period, migraine imposed a substantially higher economic burden than both cardiovascular disease and diabetes mellitus in Belgium. This finding reflects the fact that migraine primarily affects individuals during their prime working years, resulting in sustained productivity losses over long periods of time despite its lack of associated mortality.

Regardless of the assumption employed, migraine was causing more productivity losses than CVD and DM for paid work activities. In 2024, migraine accounted for 1.06% of Belgium's GDP, compared with 0.37-0.38% for DM and 0.26%-0.37% for CVD. In the context of paid work, migraine not only reduces direct productivity but also leads to considerable indirect and induced productivity losses. These spillover effects highlight that the economic consequences of migraine extend beyond affected individuals and propagate across economic sectors through reduced demand and consumption. Consequently, preventing or reducing the burden of migraine could have far-reaching positive effects across the economy.

Beyond paid work, migraine also contributes to productivity losses in unpaid work. Similarly, migraine was causing more productivity losses than CVD and DM, for unpaid work activities. In 2024, Migraine accounted for 0.25% of Belgium´s GDP, compared with 0.14-0.16% for DM and 0.18-0.37% for CVD. Although unpaid activities are typically not monetized, they generate goods and services essential to society. Given that migraine predominantly affects individuals of working age, it is particularly important in an ageing society to reduce the burden of this condition and support affected individuals in fulfilling unpaid roles, such as caregiving, that might otherwise remain unmet. Without such intervention, the social systems are further pressured to address this gap between unpaid labor supply and demand.

When comparing those results with other European countries, the cumulative burden of Belgium ranked, between the Netherlands and Portugal, as the fifth country with the highest overall socioeconomic burden of Migraine among the seven European countries. When examining those losses in 2021 as a percentage of the GDP, Belgium demonstrated a socioeconomic burden higher than France and the Netherlands and comparable to Germany. These findings suggest that while Belgium does not bear the highest absolute burden, its economic impact relative to GDP is substantial. This indicates that migraine represents a meaningful constraint on economic productivity relative to the size of Belgium's economy. This positioning warrants attention from policymakers, as Belgium's burden approaches that of larger economies such as Germany despite its considerably smaller population and economic output.

Studies show that workplace interventions can reduce the burden of migraine and improve functioning in affected employees (Begasse de Dhaem *et al.*, 2021). Key modifiable factors include fostering autonomy, social support, and job satisfaction, while minimizing environmental triggers such as bright light, noise, odors, and poor air quality, and ensuring adequate restroom access. Additionally, managing quantitative demands (e.g., workload, work hours, schedule flexibility) and emotional demands (e.g., stressful work atmosphere) is important. Furthermore, targeted interventions, such as workplace migraine education programs, not only improves employee wellbeing but can also increase productivity by 29-36% (Begasse de Dhaem *et al.*, 2021). These findings suggest that investments in migraine prevention, diagnosis, and management may generate economic benefits alongside health improvements.

Several methodological limitations should be acknowledged. The economic and demographic parameters applied in this study- such as multipliers for direct, indirect, and induced effects - are derived from aggregated databases that lack detailed information on occupational or sector-specific distributions of disease prevalence. For example, individuals with migraines, typically younger and female, are likely concentrated in different industries than those with cardiovascular disease, who are often older and male. Future analyses should explore how these demographic and occupational patterns influence the broader economic ripple effects of various diseases across industrial sectors.

Moreover, this study does not incorporate the economic consequences of informal caregiving associated with migraine, diabetes mellitus, or cardiovascular disease. Informal caregiving refers to unpaid care provided by relatives, friends, or community members to individuals with chronic illnesses, disabilities, or age-related health conditions. Such care frequently falls on women and can lead to reduced working hours, career disruptions, or withdrawal from the labor force, resulting in substantial but often overlooked economic costs. Understanding how disease burden interacts with caregiving responsibilities and labor market participation represents a critical direction for future research.

With respect to the GBD framework, it is important to note its dependence on country-reported data. While advanced statistical adjustments mitigate some inconsistencies, residual reporting biases may remain, potentially influencing the reliability of cross-country comparisons.

In conclusion, migraines impose a considerable burden on both paid and unpaid productivity in Belgium. This disease predominantly affects individuals during their peak working years. As a result, migraines represent not only a public health challenge but also a macroeconomic issue, affecting labor supply, economic output, and societal functioning. Reducing the burden of migraine could therefore generate substantial economic and societal benefits alongside improvements in health outcomes.

Bibliography

Amiri, P. *et al.* (2022) “Migraine: A Review on Its History, Global Epidemiology, Risk Factors, and Comorbidities,” *Frontiers in Neurology*, 12, p. 800605. Available at: https://doi.org/10.3389/fneur.2021.800605.

Begasse de Dhaem, O. *et al.* (2021) “Identification of work accommodations and interventions associated with work productivity in adults with migraine: A scoping review,” *Cephalalgia*, 41(6), pp. 760–773. Available at: https://doi.org/10.1177/0333102420977852.

Bess, R. and Ambargis, Z.O. (2011) *Input-Output Models for Impact Analysis: Suggestions for Practitioners Using RIMS II Multipliers*. Bureau of Economic Analysis. Available at: https://www.bea.gov/system/files/papers/WP2012-3.pdf.

Brouwer, W.B.F. and Koopmanschap, M.A. (2005) “The friction-cost method,” *PharmacoEconomics*, 23(2), pp. 105–111. Available at: https://doi.org/10.2165/00019053-200523020-00002.

Eltrafi, A. *et al.* (2023) “Economic burden of chronic migraine in OECD countries: a systematic review,” *Health Economics Review*, 13(1), p. 43. Available at: https://doi.org/10.1186/s13561-023-00459-2.

Eora Global MRIO (2024). Available at: https://worldmrio.com/ (Accessed: November 20, 2024).

European Central Bank (2025a) *Currency converter*, *European Central Bank | Eurosystem*. Available at: https://data.ecb.europa.eu/currency-converter.

European Central Bank (2025b) *US dollar/Euro, Annual*, *European Central Bank | Eurosystem*. Available at: https://data.ecb.europa.eu/data/datasets/EXR/EXR.A.USD.EUR.SP00.A (Accessed: May 27, 2025).

Eurostat (2008) *NACE Rev. 2 – Statistical classification of economic activities in the European Community*. Publications Office.

García-Azorín, D. *et al.* (2024) “Societal and economic burden of migraine in Spain: results from the 2020 National Health and Wellness Survey,” *The Journal of Headache and Pain*, 25(1), p. 38. Available at: https://doi.org/10.1186/s10194-024-01740-3.

Goadsby, P.J. (2007) “Recent advances in understanding migraine mechanisms, molecules and therapeutics,” *Trends in Molecular Medicine*, 13(1), pp. 39–44. Available at: https://doi.org/10.1016/j.molmed.2006.11.005.

Hall, R.E. and Jones, C.I. (1999) “Why do Some Countries Produce So Much More Output Per Worker than Others?*,” *The Quarterly Journal of Economics*, 114(1), pp. 83–116. Available at: https://doi.org/10.1162/003355399555954.

IHME (2025) *Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2023 (GBD 2023)*. Seattle, United States: Institute for Health Metrics and Evaluation (IHME).

Landy, S.H. *et al.* (2011) “Assessing the Impact of Migraine Onset on Work Productivity,” *Journal of Occupational and Environmental Medicine*, 53(1), p. 74. Available at: https://doi.org/10.1097/JOM.0b013e31812006365.

Leontief, W. (1986) *Input-output Economics*. Oxford University Press.

Lourens, S. *et al.* (2023) “Burden of migraine in patients attending Belgian headache specialists: real-world evidence from the BECOME study,” *Acta Neurologica Belgica*, 123(4), pp. 1495–1503. Available at: https://doi.org/10.1007/s13760-023-02280-4.

Lovera, D. and Ubels, J. (2025) *The socioeconomic burden of migraine The case of 6 European Countries*. Darmstadt, p. 41. Available at: https://www.wifor.com/en/download/the-socioeconomic-burden-of-migraine-the-case-of-6-european-countries/?wpdmdl=358249&refresh=693c3b62230441765555042.

Moens, G. *et al.* (2007) “The prevalence and characteristics of migraine among the Belgian working population,” *Acta neurologica Belgica*, 107(3), pp. 84–90.

OECD (2023) *Pensions at a Glance 2023: OECD and G20 Indicators*. OECD (OECD Pensions at a Glance). Available at: https://doi.org/10.1787/678055dd-en.

Ostwald, D.A. *et al.* (2023) “The societal impact of Inclisiran in England: Evidence from a population health approach,” *Value in Health: The Journal of the International Society for Pharmacoeconomics and Outcomes Research*, 26(9), pp. 1353–1362. Available at: https://doi.org/10.1016/j.jval.2023.05.002.

Scholz, R. *et al.* (2025) *Impact measurement using WifOR’s sustainability footprint method*.

Seddik, A.H. *et al.* (2020) “The socioeconomic burden of migraine: An evaluation of productivity losses due to migraine headaches based on a population study in Germany,” *Cephalalgia*, 40(14), pp. 1551–1560. Available at: https://doi.org/10.1177/0333102420944842.

Stovner, L.J. *et al.* (2018) “Global, regional, and national burden of migraine and tension-type headache, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016,” *The Lancet Neurology*, 17(11), pp. 954–976. Available at: https://doi.org/10.1016/S1474-4422(18)30322-3.

Targoutzidis, A. (2018) “Some adjustments to the human capital and the friction cost methods,” *The European Journal of Health Economics*, 19(9), pp. 1225–1228. Available at: https://doi.org/10.1007/s10198-018-0969-z.

UN Statistics Division (2017) *International classification of activities for time use statistics 2016 (ICATUS 2016)*. UN Statistics Division.

UN Statistics Division (2024a) “Minimum Set of Gender Indicators.” Available at: https://gender-data-hub-2-undesa.hub.arcgis.com/pages/indicators (Accessed: November 18, 2024).

UN Statistics Division (2024b) *Minimum Set of Gender Indicators*. Available at: https://gender-data-hub-2-undesa.hub.arcgis.com/pages/indicators (Accessed: November 18, 2024).

World Bank (2025) *World Development Indicators | DataBank*. Available at: https://databank.worldbank.org/source/world-development-indicators# (Accessed: February 4, 2025).

World Input-Output Database (2016) *University of Groningen*. Available at: https://www.rug.nl/ggdc/valuechain/wiod/ (Accessed: November 20, 2024).

Annex

4.1 Additional results

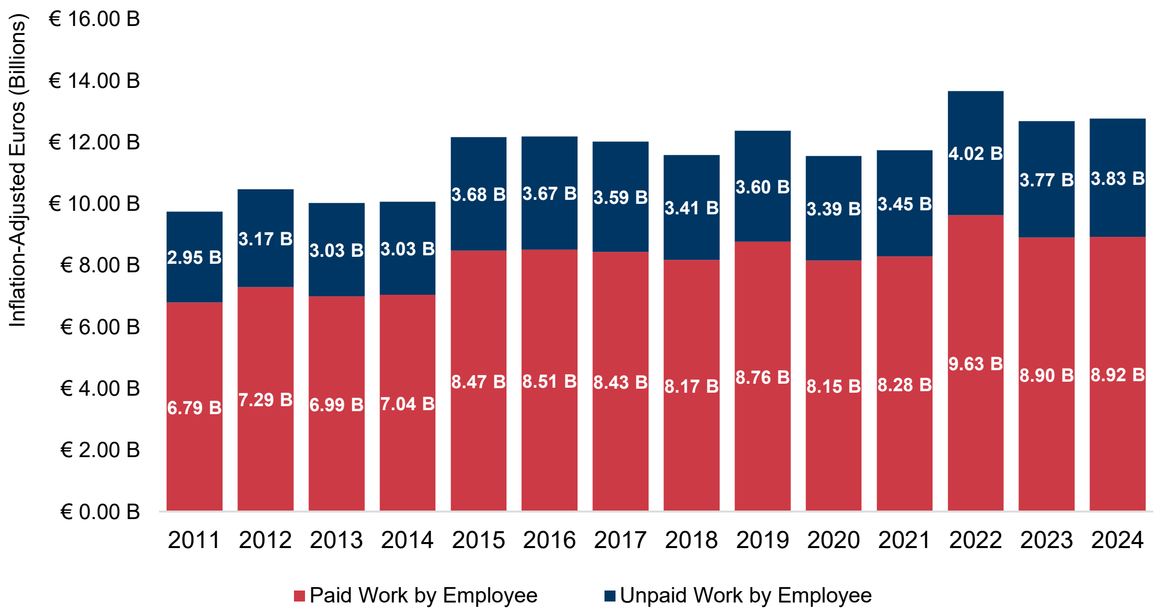

Figure 10. Overall Socioeconomic Burden of Migraine: Paid and Unpaid Productivity Losses, 2011–2024 (Inflation-Adjusted Prices)

Source: WifOR elaboration

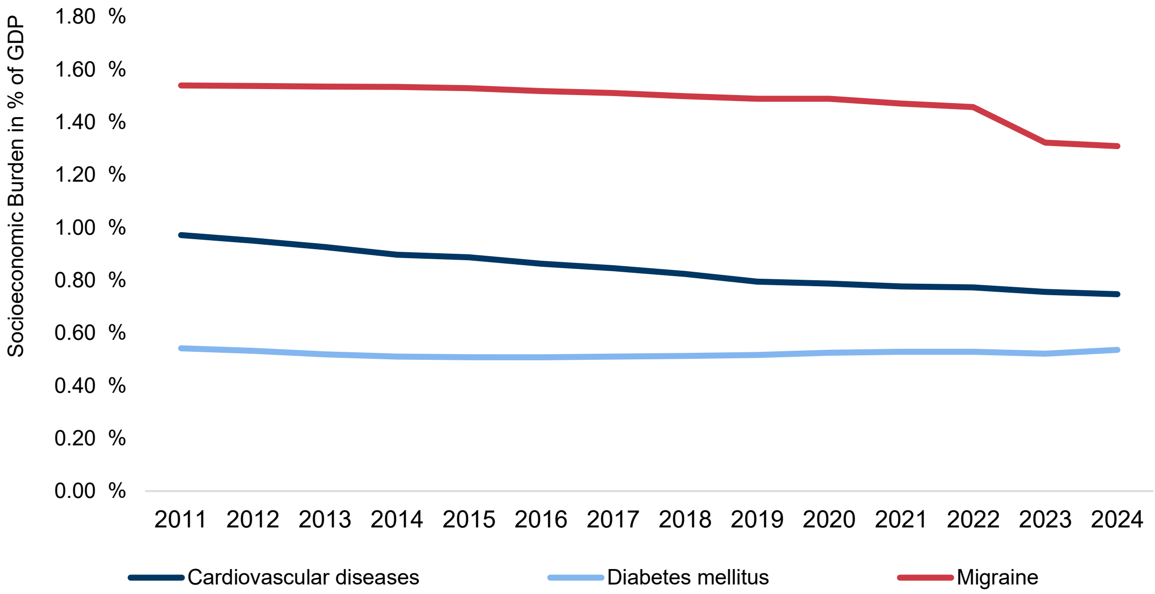

Figure 11. Time Trends in Socioeconomic Burden: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Human Capital Approach, Assuming No Substitution)*, 2011-2024*

Source: WifOR elaboration

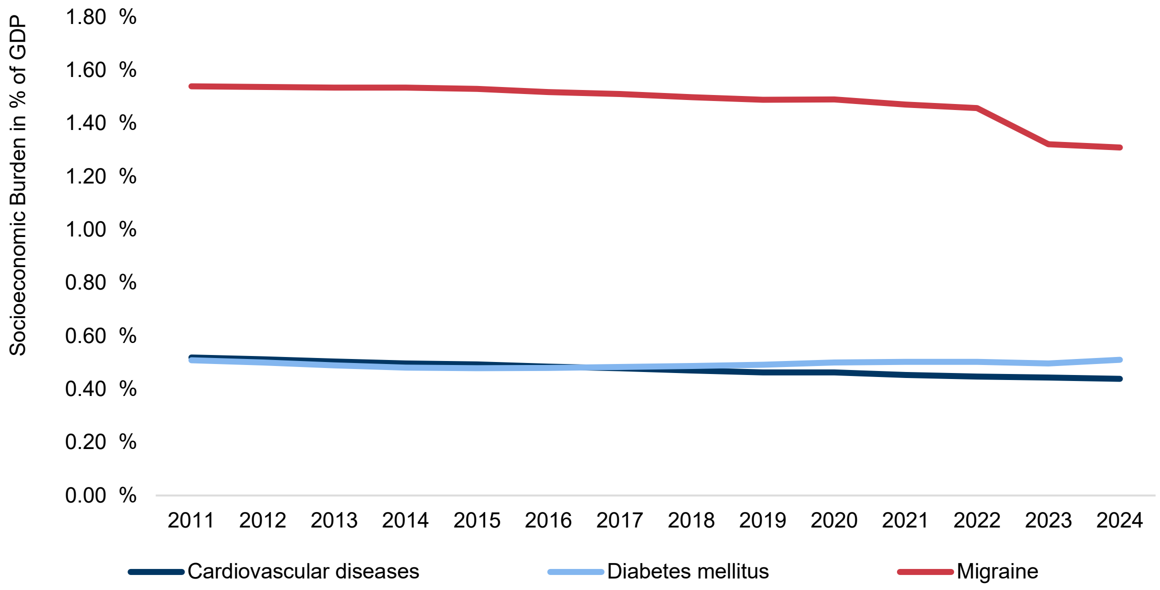

Figure 12.Time Trends in Socioeconomic Burden: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Friction Cost Approach, Assuming Substitution*), 2011-2024*

Source: WifOR elaboration

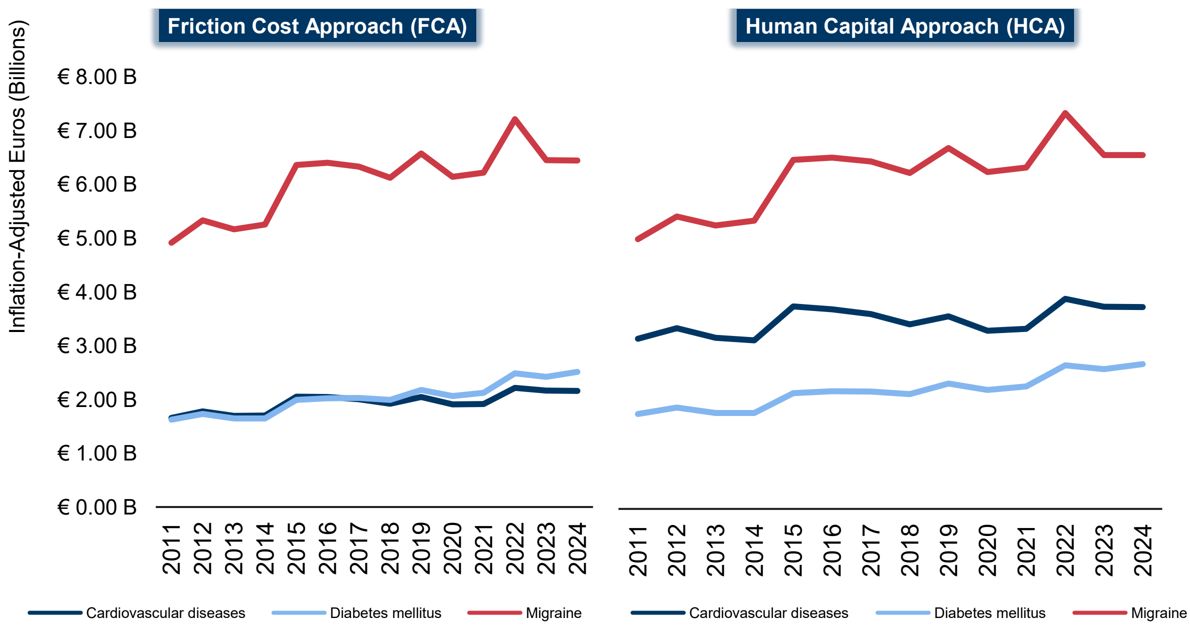

Figure 13. Time Trends in Socioeconomic Burden: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Inflation-Adjusted Prices, Friction Cost Approach (left), Human Capital Approach (right)*), 2011-2024*

Source: WifOR elaboration

4.2 Methodology

This section will provide a more detailed overview of the methodology that is used in this report. Table 1 presents time use data for Belgium sourced from the UN database, describing paid and unpaid working hours, while Table 2, provided at the end of this annex, offers an overview of the indicators employed, their identification approach, and the terminology adopted throughout this manuscript.

4.2.1 Overview of key assumption

For the analysis that is reported in this study, various methodological assumptions had to be made due to data availability and to facilitate the conduct of this study. The first key assumption is related to the use of YLD to estimate productivity losses. Here, it should be noted that DALY equals the loss of one year in full health. The loss of one year in full health is translated into a loss of one year of average working capability for both paid and unpaid work activities. With respect to YLDs, this means that any DALYs lost due to YLDs are assumed to result into a loss of one year of average working capability.

The second key assumption is that YLLs and YLDs are having the same effect on productivity. With respect to YLLs, it is possible that particularly in light of the FCA there are differences between countries in the speed to which workers can be replaced. Similarly, also with respect to YLDs, it is possible that there are national differences in how disease affects the productivity of workers, due to difference in presenteeism and absenteeism patterns.

The third key assumption is that the prevalence as reported by the IHME is a good reflection of the national disease prevalence estimates. Of course, on a national level, many methodologies exist to estimate the prevalence of disease. This could mean that there are deviations between national estimates and estimates by the IHME. We opted to use the IHME due to the benefits of using a uniform methodology to estimate prevalence in various countries, which directly results in the possibility to make cross country comparisons of the socioeconomic burden of disease.

4.2.2 Inputs regarding burden of disease

Data from the GBD study was used to evaluate the SOB of migraine, cardiovascular diseases, and diabetes. Specifically, the analysis utilized disease burden data, in terms of mortality and YLD, categorized by 5-year age groups (ranging from 15 to 95+ years), gender (combined), and country. This data covered the period from 2011 to 2024.

4.2.3 Economic inputs

The comprehensive assessment of the economic effects of disease in terms of direct and spillover effects is based on Input-Output (IO) modelling (Conway, 2022). The essential underlying principle of IO models is that the economy consists of interconnected economic sectors. This means that an increase in production in one sector leads to an increased demand in (intermediate) inputs, the production of which results in additional productivity in other sectors.

To calculate these effects, we utilized an established algorithm from WifOR, which used WIOD (*World Input-Output Database*, 2016) and EORA (*Eora Global MRIO*, 2024) databases. Essentially, for each country, a specific Leontief inverse of the IO matrix is calculated (Leontief, 1986). This represents how change in a unit of output in one sector results in changes in output of all the other industrial sectors of a country. Through the introduction of quotes of each sector that represent the gross value added and the employment needed for a unit of output in each sector, we estimate the indirect effect of how adjacent sectors affect each other's creation of value and the contribution of employment. Additionally, through incorporating household consumption in the Leontief inverse, we account for how changes in productivity of a sector result in changes in demand by households, which leads to an estimation of the induced effects of changes in the productivity of a country.

The analysis is conducted per country, which means that any international effects are not accounted for. Industrial sectors are defined according to the NACE Rev.2 classification (Eurostat, 2008).

For each country, the following multipliers from IO analysis are derived and used to calculate direct, indirect, and induced effects.

- Direct multiplier per revenue increase (hereafter DirMult.Rev): this multiplier reflects the increase in GVA by each sector, for every additional 1 million USD in revenue (i.e. gross output, total value of sales, production value).
- Indirect multiplier per revenue increase (hereafter IndirMult.Rev): this multiplier reflects the effect of an increase in 1 million USD sector revenue on GVA.
- Induced multiplier per revenue increase (hereafter InducMult.Rev): this multiplier reflects the effect increased expenditures due to increases in directly or indirectly generated income due to an increase in 1 million USD sector revenue on GVA.
- GVA per economic sector (million USD) (hereafter GVA.PSector): this is an estimation of GVA generated per economic sector, that is based on the IO matrices of a country.
- Employees per economic sector (million of people) (hereafter EMP.PSector): an estimation of the number of employees per economic sector, based on IO matrices of a country.

4.2.4 GVA effects from paid work

Understanding how disease burden impacts individual productivity requires estimating the GVA generated per person. In the case of paid work, this is further narrowed down as the GVA generated by an employed person. The World Bank defines an employed person as "persons of working age who, during a short reference period, were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period (i.e., who worked in a job for at least one hour) or not at work due to temporary absence from a job, or to working-time arrangements" (World Bank, 2024a).

In order to study the impact of disease on the GVA of paid work, three different effects are assessed:

- Direct effects: these effects reflect the immediate impact of a decrease in paid work due to disease.
- Indirect effects: these effects reflect the decrease in GVA due to a decrease in intermediate consumption.
- Induced effects: these effects reflect the decrease in GVA due to a decrease in expenditures by households.

The three multipliers introduced in the previous section (DirMult.Rev, InderMult. Rev and InducMult.Rev) are needed to evaluate these three different effects from paid work (direct, indirect and induced effects), as well as the estimation for the GVA per economic sector (GVA.PSector).

Direct effects:

To estimate direct effects, a monetization of the average GVA per employee is calculated. For each country (c) and year (t), this is estimated by dividing the total GVA of a country (GVA.2015Pr) by the number of employed individuals in a population aged 15 years or older (Employees.15m), with the following equation:

$$DirectEffect.PerEmployee_{c,t} = GVA.2015Pr.PerEmployee_{c,t} = \frac{GVA.2015Pr_{c,t}}{Employees.15m_{c,t}}$$

Indirect effects:

To estimate indirect effects, we account for the interconnections between economic sectors. The indirect effect of disease therefore assesses the losses in productivity that are a consequence of a loss of demand for intermediate goods and services. Here, we again estimate indirect effects in terms of GVA per person. To do so, the input IndirMult.Rev (indirect multiplier per revenue increase) is transformed into IndirMult.GVA (indirect multiplier per GVA increase), by making use of the input DirMult.Rev (direct multiplier per revenue increase). For this, the following formula is used for each country (c) and economic sector (s):

$$IndirMult.GVA_{c,s} = \frac{IndirMult.Rev_{c,s} - DirMult.Rev_{c,s}}{DirMult.Rev_{c,s}}$$

To comprehensively capture the indirect multiplicative effects across all sectors, we applied the indirect total economy-wide average multiplier (TAv.MultIndir.GVA) for each country (c). This multiplier is calculated by dividing the total indirect GVA effects across the economy (i.e., the sum of indirect effects by economic sector, or GVA.Psector*IndirMult.GVA) by the total GVA. The latter is obtained from the sum of GVA generated by each economic sector (GVA.Psector), based on IO analysis.

$$TAv.MultIndir.GVA_c = sum_{s=1}^{S}(GVA.Psector_{c,s} * IndirMult.GVA_{c,s})/sum_{s=1}^{S}(GVA.PSector_{c,s})$$

Since only cross-sectional data, not time series data, is available for multipliers and GVA per sector, we assume that both the multipliers and the sectoral GVA distribution remain constant over time. As a result, we applied the average indirect GVA multiplier (TAv.MultIndir.GVA) to the direct effects derived from the time series data provided by the World Bank (DirectEffect). The indirect effects were then calculated by multiplying the average indirect GVA multiplier with the direct GVA effects in the economy.

$$IndirectEffect_{c,t} = DirectEffect.PerEmployee_{c,t} * TAv.MultIndir.GVA_c$$

Induced effects:

Direct and indirect effects occur across multiple sectors, generating induced effects throughout different parts of the value chain. Therefore, we need to estimate the induced effect multiplier per additional dollar of GVA (InducMult.GVA), rather than per additional dollar of sector revenue increase. This is obtained from dividing the induced effect multiplier per revenue increase (InducMult.Rev) by the direct multiplier per revenue increase (DirMult.Rev):

$$InducMult.GVA_{c,s} = \frac{InducMult.Rev_{c,s}}{DirMult.Rev_{c,s}}$$

To comprehensively capture the multiplicative effects across all sectors, we applied the induced total economy-wide average multiplier (TAv.MultInduc.GVA) for each country (c). Similarly as before, this multiplier is calculated by dividing the total induced GVA effects the economy (GVA.Psector*InducMult.GVA) by the total GVA.

$$TAvMultInduc.GVA_c = sum_{s=1}^{S}\left(GVA.Psector_{c,s} * InducMult.GVA_{c,s}\right)/sum_{s=1}^{S}(GVA.PSector)$$

As in the case of the indirect effects, we assume that these multipliers and the GVA distribution per sector remain constant over time. As a result, the induced effects are calculated by multiplying the average induced GVA multiplier (TVaMultInduc.GVA) with the direct GVA effects in the economy (DirectEffect):

$$InducedEffect_{c,t} = DirectEffect_{c,t} * TAvMultInduc.GVA_c$$

Total paid work effects:

The average effect of disease on reducing paid work (PaidW.PerEmployee) is then equal to the sum of the three calculated effects (DirectEffect, IndirectEffect and InducedEffect).

$$PaidW.PerEmployee_{c,t} = DirectEffect_{c,t} + IndirectEffect_{c,t} + InducedEffect_{c,t}$$

4.2.5 GVA effects from unpaid work

Given the nature of unpaid work, an indirect estimation of its productivity in monetary terms is necessary. To do so, several issues must be considered. First, it is important to account for the differences in productivity between countries. These differences are the result of different factors, such as the level of investment in the human or physical capital, or institutional and governmental policies (Hall and Jones, 1999). Second, due to the nature of unpaid work (e.g. preparation of meals, household upkeep, care taking of family), it is likely that there is a difference in the value of the productivity of unpaid work as compared to paid productivity in other sectors. To address this difference, we use data from a sector that is similar to unpaid work. To illustrate this, we assume that the value of household upkeep by an unpaid worker is similar to the productivity of hired household help.

To account for the differences between countries, the general approach is to start our estimation of the value of unpaid work of a certain country by calculating the relationship between time spent on paid and unpaid work for the different countries. Then, we initially assumed the same level of productivity in terms of GVA for both paid and unpaid work. After "anchoring" the value of unpaid work to the GVA of paid work of a country, we adjust the value of unpaid work with information about the value of productivity in terms of GVA of a sector that produces similar output as paid work. Following the second revision of the Statistical Classification of Economic Activities in the European Community (NACE Rev. 2), we assume that the sector with output most similar to unpaid work is "Sector T", which reflect the output of "households as employers; undifferentiated goods- and services-producing activities of households for own use" (Eurostat, 2008). For simplicity, we call this sector Unpaid Substitution Economic Sector (USES) from here onwards.

In more detail, we used a combination of time-use survey data, data from the IO analysis and data from the World Bank. With time-use survey data, we calculate the ratio of time spent on unpaid work per hour to time spent on paid work per individual.

As already explained in the method section, this data presents time use across different specific categories, such as time used on having meals, commuting, or work. These categories were reclassified to paid and unpaid work according to the International Classification of Activities for Time Use Statistics 2016 (UN Statistics Division, 2017). Consequently, the time spent on work was used as an indicator for paid work, and time spent on housework, taking care of family, educating children, shopping or errands as indicators for time spent on unpaid work. This resulted in the following parameter inputs:

Country	Gender	Paid work hours	Unpaid work hours	Reference
Belgium	Both	6	6.42	(UN Statistics Division, 2024b)

Table 1. Paid and unpaid working hours - UN Statistics Division

These inputs were used to calculate work time ratios, with the following formulas:

$$WorkTimeRatio_{c,t} = UnpaidHours_c / PaidHours_{c,t}$$

Where UnpaidHours is the number of unpaid hours worked, PaidHours is the number of hours spent on paid work by country (c) and year (t).

Then, per employee, an estimation is made regarding the value of their unpaid work in terms of GVA. This is done with the following formula:

$$UnpaidWork.PerEmployee_{c,t} = (GVA.2015Pr_{c,t} * WorkTimeRatio_{c,t})/Employees.15m_{c,t}$$

With GVA.2015Pr being the GVA of a country in 2015 USD, WorkTimeRatio the ratio calculated in equation 9, and Employees.15m the number of paid workers 15 years and older, by country (c), and year (t). This value essentially represents the value of unpaid work activities in terms of the average GVA produced in a country. However, as mentioned, this value needs further adjustment to more closely resemble the real value of unpaid work. This adjustment is explained in the next steps.

With data from the IO analysis, an estimation is made about the proportion of GVA that is contributed by USES relative to the output of all economic sectors. Assuming that this proportion remains stable over time, the annual GVA figures from the World Bank are multiplied by this proportion, to estimate the yearly contribution of USES to GVA over time. Following this, we calculate the proportion of individuals working in USES relative to all employees in all sectors and use this proportion to calculate the annual number of workers in USES over time. Then, we estimate the productivity per employee working in USES per year (GVA.2015Pr.PerEmployee.USES) by dividing the estimated contribution to GVA per year by the estimated number of employees working in USES. These steps are summarized in the following equation:

$$GVA.2015Pr.PerEmployee.USES_{c,t} = \left(\frac{GVA.PSector.USES_{c,USES}}{sum_{s=1}^{S}(GVA.PSector_{c,s})}\right) * GVA.2015Pr_{c,t} / \left(\frac{EMP.PSector.USES_{c,USES}}{sum_{s=1}^{S}(EMP.PSector_{c,s})}\right) * Employees.15m_{c,t}$$

Where GVA.PSector.USES corresponds to the GVA in the USES sector, EMP.PSector.USES to the number of people employed in the USES sector by country (c). It should be noted that there are deviations in both the GVA and number of employees between the World Bank and IO analysis, due to differences in the exact way that these numbers are estimated.

With the estimated GVA per person for employees in the USES sector, a ratio is calculated which represents the productive value of an employee working in this sector relative to the productive value of an employee in the general population (GVA.Unpaid.AdjRatio). This ratio is calculated by dividing the per person GVA added of an employee in the USES sector by the general per person GVA of an employed individual, with the following formula:

$$GVA.Unpaid.AdjRatio_{c,t} = GVA.2015PR.PerEmployee.USES_{c,t} / \ GVA.2015Pr.PerEmployee_{c,t}$$

This ratio is then finally used to adjust the value of unpaid work calculated earlier (UnpaidWork.PerEmployee), using the following formula:

$$UnpaidWork.Adj.PerEmployee_{c,g,t} = UnpaidWork.PerEmployee_{c,g,t} * GVA.Unpaid.AdjRatio_c$$

4.2.6 Health outcome metrics and the SOB of disease

For the SOB of disease analysis, we assume on a general level that individuals contribute to society in terms of paid and unpaid work throughout the year, and that years lost due to morbidity or mortality lead to losses in productivity. To calculate these lost years, we use the Disability Adjusted Life Year (DALY) concept by the GBD of disease study (IHME, 2025). DALYs are calculated on the basis of Years Lived with Disability (YLDs) and Years of Life Lost (YLL). These metrics have been developed to make it possible to compare morbidity and mortality across diseases.

In order to evaluate the impact of disease in terms of YLD and YLL on productivity, we need to establish the maximum age that individual can stay productive. In other words, the maximum productive age needs to be established. For paid work, the effective retirement age was considered to be the most appropriate measure. The effective retirement age represents the average age at which individuals cease employment, in contrast to the official retirement age established by government policy. The latest OECD report, "Pensions at a Glance 2023", provides effective retirement age data divided by sex for Belgium (OECD, 2023).

For unpaid work instead, we assume that people remain productive until the age of 85. Combined, the value of both paid and unpaid work is comprehensively assessed.

To evaluate the effect of morbidity on productivity, we use YLDs. YLDs represent the burden of disease on those living with a disease. This burden is reflected as the “health” that is lost living with disease. Through the way that this health loss is estimated, this burden reflects years lost. To illustrate, if a disease results in a burden of 0.5, then two years of living with this disease is equal to living 1 year in complete health, or in other words, over a period of 2 years, someone living with a disease with a burden of 0.5 “loses” 1 year of life. In relation to productivity, we assume that these losses reflect lost time in productivity due to absenteeism and presenteeism. To monetize this loss in productivity (MVal.YLD.UnpaidW.PerEmployee and MVal.YLD.PaidW.PerEmployee), the country- and year-specific YLD of a disease (YLD) is multiplied with the country- and year average paid and unpaid work productivity (UnpaidWork.Adj.PerEmployee and PaidW.PerEmployee).

For unpaid work, the following formula is used:

$$MVal.YLD.UnpaidW.PerEmployee_{c,t} = UnpaidWork.Adj.PerEmployee_{c,t} * YLD_{c,g,t}$$

Where (c) represents the country and (t) represents the year.

For paid work, we use the following formula, which also account for the proportion of individuals who is employed with the variable EmplToPop.15m.T.Per:

$$MVal.YLD.PaidW.PerEmployee_{c,t} = PaidW.PerEmployee_{c.t} * EmplToPop.15m.T.Per_{c,t} * YLD_{c,t}$$

Where again (c) represents country, and (t) represents year.

The total monetary value of the lost productivity due to the morbidity of a disease for a specific country and year (MVal.YLD.PerEmployee) is then calculated by the sum of productivity losses in paid and unpaid work with the following formula, by (t) year and (c) country:

$$MVal.YLD.PerEmployee_{c,t} = MVal.YLD.UnpaidW.PerEmployee_{c,t} + MVal.YLD.PaidW.PerEmployee_{c,t}$$

To evaluate the effect of mortality on productivity, we calculate an adapted version of YLL. Where in the original GBD study YLL represents the life years lost in relation to life expectancy, we are interested in productive YLL lost, thus related at productive life expectancy. To calculate our adapted YLL, we use mortality estimated from the GBD study by age group, country, and year. To monetize the productivity losses related to YLL lost, we use two approaches: the FCA and the HCA.

For the FCA, we assume that the productivity of an individual can be replaced by another individual. To illustrate, if a company loses an employee through disease, then the company might hire a substitute, or might innovate, or conduct further adaptation to the production process to substitute the loss of an employee. This, of course, takes time. In this report, we therefore assume that the loss in productivity due to mortality is one year, or in other words, we assume that per deceased person, one year of productive work is lost.

Productive years of life lost are therefore the sum of all the deaths by country (c), year (t), and age group (a) as follows:

$$YLLFCA_{c,t} = sum_{a=1}^{A}(Deaths_{c,t,a})$$

Where the oldest age group for unpaid work is 80 to 84, the oldest age group for paid work depends on the effective retirement age of different countries as previously mentioned. In our analysis, we used a report from the OECD (OECD, 2023), in which the following effective retirement for Belgium was 61. The monetized loss of these years is calculated with the following formula for unpaid work:

$$MVal.YLLFCA.UnpaidW.PerEmployee_{c,t} = UnpaidWork.Adj.PerEmployee_{c,t} * YLLFCA_{c,t}$$

Where UnpaidWork.Adj.PerEmployee refers to the earlier estimated monetary value of one year of an individual's unpaid productivity for a specific (c) country, and (t) year. For paid work, the following formula is used:

$$MVal.YLLFCA.PaidW.PerEmployee_{c,t} = PaidW.PerEmployee_{c,t} * EmplToPop.15m.T.Per_{c,t*}YLLFCA_{c,g,t}$$

Where PaidW.PerEmployee refers to the earlier estimated monetary value of the individual's productivity of paid work, and EmplToPop.15m.T.Per refers to the proportion of employed people by (c) country, and (t) year. The total loss in productivity due to mortality in terms of FCA is then calculated by summing the loss in productivity of paid and unpaid work with the following formula, by (c) country, and (t) year:

$$MVal.YLLFCA.PerEmployee_{c,g,t} = MVal.YLLFCA.UnpaidW.PerEmployee_{c,t} + MVal.YLLFCA.PaidW.PerEmployee_{c,t}$$

For the HCA, it is assumed that an individual's death during her or his productive years results in a loss of productivity that cannot be replaced. Here, it is important to recall that productive years are defined according to effective retirement age for paid work and 84 years for unpaid work. Given that we have mortality data by age groups, we conduct the following steps to calculate the years of productive life that are lost:

- From the GBD study, the smallest range available for age groups are selected, which is mortality by 5-years (e.g. mortality in the age group of 15 to 19 years old, mortality in the age group of 20 to 24 years old etc.).
- On average, we assume that the average age of death within an age group is the midpoint of that age group. To illustrate, in the age group 20 to 24, we assume that the average of death is 22.5.
- To calculate the productive years of life lost for an age group, we then subtract the maximum productive age of paid and unpaid work from the average mentioned in the last step. For example, for the age group of 20 to 24, we subtract as follows: 84-22.5 = 61.5 productive years of unpaid work lost if an individual dies within this age group.
- To calculate the full number of years of life lost due to the number of deaths, we multiply the number of deaths per age group with the age specific value of productive years lost (e.g. number of deaths in age group 20-24 multiplied by 61.5 for unpaid work). For paid and unpaid work, these are referred to as YLLpaid and YLLunpaid.
- To value future productivity losses to the respective year that an individual dies, a discount rate of 3.5% is applied.

These steps above can be summarized by the following formulas:

$$MVal.YLLHCA.UnpaidW.PerEmployee_{c,g,t} = sum_{a=1}^{A}\left[sum_{i=1}^{YLLunpaid}\left[Deaths_{a,c,t} * UnpaidWork.Adj.PerEmployee_{c,t} * \frac{1}{(1+DiscRate)^{i}}\right]\right]$$

Where a = age group, i= each year of productive life lost (i= 1…YLLunpaid or YLLpaid), c= country, t = to the evaluated year, and DiscRate = 3.5%.

The monetary value of SOB of disease due to mortality calculated with the HCA is the sum of paid and unpaid productivity losses, which is calculated with the following formula:

$$MVal.YLLHCA.PerEmployee_{c,g,t} = MVal.YLLHCA.UnpaidW.PerEmployee_{c,t} + MVal.YLLHCA.PaidW.PerEmployee_{c,t}$$

It should be noted that there are extensive debates in health economic literature whether the FCA or HCA should be used, see for example (Brouwer and Koopmanschap, 2005) and Targoutzidis (2018). In this report, we refrain from making a judgement in this debate but do consider the FCA the conservative approach for estimating productivity losses. We therefore mainly report FCA based estimates throughout this study.

The complete SOB of disease, due to both mortality and morbidity, is then the sum of the productivity losses calculated with YLD and productivity losses calculated with life years lost (according to the HCA and the FCA). For this, the following formula is used, by (c) country, and (t) year:

$$MVal.Total.PerEmployee_{c,t} = MVal.YLD.Total.PerEmployee_{c,t} + MVal.YLL.Total.PerEmployee_{c,t}$$

Name in formulas	Name in data source	Reference
Disease parameters		
YLD*	YLD	(IHME, 2025)
Deaths	Mortality	(IHME, 2025)
Economic parameters		
GVA.2015Pr	GVA 2015 US$†	(World Bank, 2025)
GVA.CurrPr	GVA current US$	(World Bank, 2025)
GDP.2015Pr	GDP 2015 US$	(World Bank, 2025)
GDP.CurrPr	GDP current US$	(World Bank, 2025)
EXR.A.USD.EUR.SP00.A	Exchange rates Euro/US dollar 2011-2021	European Central Bank (2025b)
IndirMult.Rev	Not applicable, not public	WifOR's input/output model
InducMult.Rev	Not applicable, not public	WifOR's input/output model
GVA.PSector.USES	Not applicable, not public	WifOR's input/output model
GVA.PSector	Not applicable, not public	WifOR's input/output model
EMP.PSector.USES	Not applicable, not public	WifOR's input/output model
EMP.PSector	Not applicable, not public	WifOR's input/output model
Effective retirement age	Retirement Age Men/Women	OECD (2023)
Time use		
UnpaidHours	Total time spent on unpaid domestic and care work	(UN Statistics Division, 2024b)
PaidHours	See explanation in the annex	(UN Statistics Division, 2024b)
Demographic		
Pop.1564.T	Population ages 15-64, total	(World Bank, 2025)
Pop.60m.T	Population ages 65 and above, total	(World Bank, 2025)
EmplToPop.15m.T.Per	Employment to population ratio, 15+, total (%) (modeled ILO estimate)	(World Bank, 2025)

*Table 2. Variables and data sources. *YLD: years lived with disability, †GVA: gross value added*

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WifOR is an independent economic research institute, founded in 2009 as a spin-off from the Technical University of Darmstadt. As experts in macroeconomic analysis, our research focuses on the areas of labor markets, health, and sustainability. Through our studies, WifOR's mission is to enable data-based solutions to challenges on the labor market, set global standards in sustainability measurement, and illuminate worldwide the value of health investments. WifOR has over 75 employees located in Germany, Greece, Latin America, and the USA.

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