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IMA/AIM data report: applications and limitations of Belgian prescription data

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IMA/AIM data report: applications and limitations of Belgian prescription data

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Abstract

The aim of this report is to offer an overview of the datasets on medical prescriptions in Belgium provided by the Belgian inter-mutual agency (InterMutualistisch Agentschap/Agence InterMutualiste – IMA/AIM). These extensive datasets consist of multiple layers: information of prescription numbers and costs is available for 13 medication classes, at four different geographical levels, by sex and age group, year by year from 2006 to 2014. Nonetheless, not all of the data is exploitable. Some medication classes may be too broad and/or may not be of real interest for research. There is a substantial number of missing information on the level of statistical sectors for many of the different medication classes. As a consequence, studies at such fine geographical levels will often be impracticable. Furthermore, the data has intrinsic limitations: the number of prescriptions within a certain medication class is not a straightforward proxy for the prevalence of the corresponding pathology, and interpretations in terms of morbidity must be made with caution. In this report we (1) discuss the indicators constructed to analyse prescription behaviour; (2) assess the data's main limitations and potential uses; and (3) formulate recommendations for analyses based on the IMA/AIM data.

Keywords

Prescription data, Belgium, public health, medication use

Introduction

The aim of this report is to present the Belgian prescription data delivered by the IMA/AIM within the framework of the GRESP-HEALTH project[1] (BRAIN-be, 2015–2019). It documents essential information on the data and provides a reference for future users.

After a short description of the data, we discuss the indicators constructed to analyse prescription behaviour. We then assess the data's main limitations and potential uses. We conclude with some recommendations for analyses based on the IMA/AIM data.

The IMA/AIM datasets contain a considerable volume of information: prescription numbers and costs within 13 medication classes for men and women by age group, between 2006 and 2014, at the level of districts (arrondissements), municipalities, sections and statistical sectors. For the sake of clarity, the illustrations and examples in this report are limited to three medication classes – 'cardiovascular general' (CVG), 'asthma and COPD' (AC) and 'depression and anxiety' (DA) – for age groups 0–84, 19–39 and 40–64.

IMA/AIM data

The datasets on medical prescriptions were provided by the inter-mutual agency (InterMutualistisch Agentschap/Agence InterMutualiste – IMA/AIM). The data was gathered by the seven mutual health insurance companies operating in Belgium, based on their members' refunds of medical services and prescription medications. Detailed information on data collection is available on the IMA/AIM website: https://aim-ima.be.

The composition of medication classes was conceived by both a specialized working group of the RIZIV/INAMI and members of the GRESP-HEALTH project. The different medication classes were compiled based on the Farmanet database. Originally, the RIZIV/INAMI working group had been working on these classes for the purpose of predicting future health costs.

The datasets made available for the GRESP-HEALTH project contain information on prescriptions within 13 medication classes[2]:

- *Affections cardiovascular general (CVG)*
- *Affections cardiovascular cardiac (CVC)*
- High blood pressure (HBP)
- Ischemic disorder (ID)
- *Diabetes type II (DII)*
- Dyslipidemia (DY)

[1] Belgian Science Policy Office (BELSPO), grant number: BR/143/A3/GRESP-HEALTH.

[2] Medication classes indicated in italics were compiled by the RIZIV/INAMI working group; the other ones were compiled by the GRESP-HEALTH team. Details on the content of each class (CNK codes) can be found in the online appendix 'Disease indicators.xlsx'.

- Thyroid disorder (TD)
- *Respiratory obstructive diseases: asthma/COPD (AC)*[3]
- Allergy (AL)
- *Autoimmune disorders (AD)*
- Depression, anxiety (DA)
- Autism (AU)
- *Parkinson (PA)*

For each of these medication classes, the datasets contain four types of information:

- number of patients for whom a refundable medication was prescribed in a given year (hereafter 'prescription-patients');
- costs paid by the patients in a year;
- costs paid by the health insurance company in a year;
- total costs.

These elements are available yearly from 2006 to 2014 for men and women separately, by age group, at the level of the districts, municipalities, sections and statistical sectors.

The numbers are based on the average of two moments of reference during the year: the 30th of June and the 31st of December (or the 1st of January the following year). In principle, it includes all registered individuals in Belgium, since registration in a mutual health insurance company is mandatory. Individuals not registered are not included in the database; this mainly concerns diplomats, some employees of international institutions and cross-border workers, as well as unregistered migrants.

Since January 2008, health insurance is mandatory for all self-employed individuals. The inclusion of the self-employed produced a visible rise in the numbers, which does not necessarily reflect a rise in the prevalence of medication use over the years. Therefore, it is more reliable to work with IMA/AIM data from the year 2009 on.

For privacy reasons, the data is broken down by age groups instead of single age years. In fact, in small spatial units, the number of patients receiving a specific medication can be very small, or equal to one. Therefore, in order to avoid individual identification issues, IMA/AIM provided data by age groups in four different options (Table 1). To note, data at the Belgian level was provided by single age years as well.

[3] Although asthma and COPD have different underlying causes, they are often treated with the same medications. In distinguishing between both asthma and COPD, we use the age cut-off of 40. In specific studies on these affections, we assume that individuals under the age of 40 using these medications were suffering from asthma, whereas those aged 40 and older were suffering from COPD. Even though there is no general agreement on the age cut-off, it is generally accepted that it lies between 40 and 50. Because age groups are predetermined in the data (see Table 1), the best solution was to choose 40 as the age cut-off.

Table 1. Four age group distributions in the IMA/AIM data

No age group	3 age groups	5 age groups	7 age groups
(1) all ages	(2) 0–18	(5) 0–5	(10) 0–5
	(3) 19–64	(6) 6–18	(11) 6–12
	(4) 65+	(7) 19–64	(12) 13–18
		(8) 65–84	(13) 19–39
		(9) 85+	(14) 40–64
			(15) 65–84
			(16) 85+

Indicators and interpretation

The main interest of the IMA/AIM data is that it allows the study of prescription behaviour in Belgium; that is, the spatial patterns of prescriptions of a given medication, as well as the relationship between prescriptions and health. To this end, the number of prescription-patients within a medication class is the most useful element in the data.

The number of prescription-patients in a geographical area is influenced by the age structure of this area. In order produce comparable measures of prescription behaviour, we use age-standardised indicators, such as those typically used in mortality and morbidity studies. We have worked with two indicators calculated in the same way as standard mortality rates (SMR) and adjusted standard mortality rates (ASMR).

- SMRs express the ratio between observed number of prescription-patients in a geographical area and the expected number in this area if its prescription behaviour were the same as that of the overall Belgian population, considering the age- and sex-specific structure of the area. Values higher than 100 indicate an excess of prescription-patients of a medication class in the geographical area, whereas values lower than 100 indicate that prescription behaviour is below the Belgian level.
- AMSRs are SMRs adjusted by the crude rate of prescriptions. The units are expressed as prescription-patients/100 individuals for each geographical area.

When these indicators are computed for a specific age group, the Belgian population within that age group is used as standard population.

The maps in Figure 1 illustrate the importance of using age-standardised indicators. The example is based on the number of female patients aged 0 to 84 whom were prescribed 'cardiovascular general' medication in 2012, at the municipality level. The first map (1a) depicts a non-standardised indicator, which is simply the proportion of cardiovascular patients in the municipal female population; the second map (1b) depicts the standardised indicator SMR for the same group. Without standardisation, the coastal municipalities appear to have a high incidence of cardiovascular prescriptions. However, this is not due to a different prescription behaviour or higher incidence of cardiovascular diseases, but simply to the fact that these municipalities have a much stronger presence of older persons, who are more prone to consume these medications. Likewise, the north of the Brussels Capital Region appears to have low prescription rates, whereas this can be attributed to the presence of a younger population. These 'false patterns' caused by age structure disappear in the second map (Figure 1b) using the standardised indicator. Moreover, the differences between Flanders and Wallonia become clearer, with a much higher prescription behaviour in the south of the country[4].

It is difficult to find a general name for these age-standardised indicators. On the one hand, they refer to a well-known standardisation technique for morbidity and mortality; on the other hand, we cannot create the illusion that we are describing morbidity data. When describing the results, it may be better to refer to 'age-standardised indicator of prescription-patients', or simply 'prescription-patient SMR'.

As described in the next session, the number of prescriptions contained in the IMA/AIM data only give an indication that a certain medication was prescribed and bought by an individual in the course of a year; however, it is impossible to know how much of this medication an individual actually bought and used. The information on costs in the IMA/AIM data could shed some light on medication consumption. Two indicators can be computed based on cost data[5]:

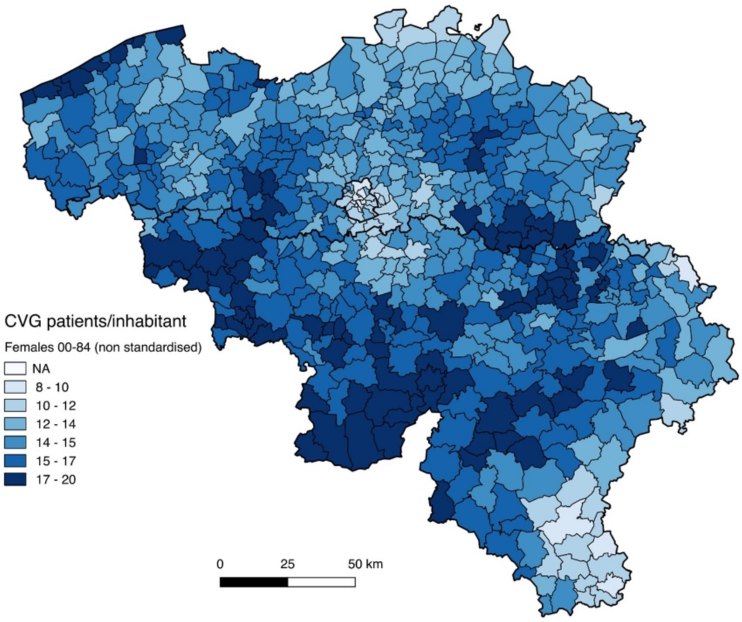
- the total cost expended on a medication class for a given age group and sex in a geographical area, divided by the area's population of that age group and sex: €/inhabitant;
- the total cost expended on a medication class for a given age group and sex in a geographical area divided by the number of patients of that age group and sex who had that medication prescribed: €/patient.

The costs are only based on the reimbursed medication sales corresponding to the 13 medication classes. Furthermore, they do not cover all additional costs related to non-reimbursed medication sales, treatment programmes, doctor visits, hospitalizations, etc., which might be substantial for some affections (e.g. ischemic disorders, asthma and cardiovascular diseases).

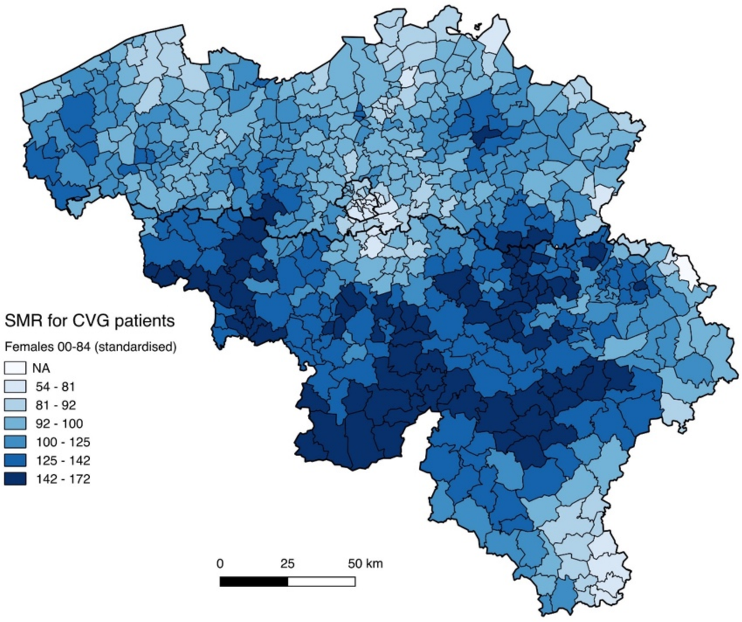
[4] To note, municipalities at the Luxembourg border appear to have low prevalence of cardiovascular medication prescription in both maps. However, the low prevalence is certainly due to the underestimation of medication consumption by cross-border workers in the IMA/AIM datasets (see section 3). Such particular patterns at border regions should be interpreted with caution.

[5] As mentioned in section 1, the database distinguishes the costs payed by the patient from those payed by the health insurance. However, we choose to work with total costs in order to avoid potential bias. In fact, patients who are entitle to a preferential tariff (*verhoogde tegemoetkoming/intervention majorée*) have lower patient costs and, in compensation, higher insurance costs. In this context, if poorer regions have more persons entitle to a preferential tariff, patient costs will be lower, while this would not reflect a lower prevalence of medication use. The opposite holds for richer areas. The total costs will remain the same in any case.

Figure 1. Municipal distribution of 'cardiovascular general' medication prescriptions for females aged 0 to 84: standardised and non-standardised indicators, 2012–2014



(a) Non-standardised: % cardiovascular prescription-patients in the female population



(b) Standardised indicator: prescription-patient SMR

Data sources IMA/AIM and National Register (Statistics Belgium)

Main limitations in the IMA/AIM data

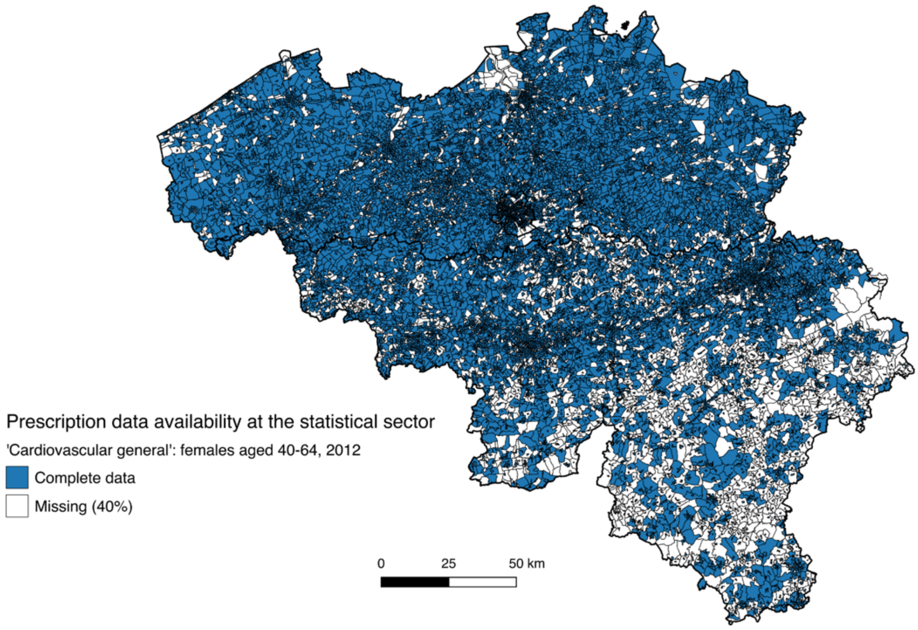
The IMA/AIM data has a series of limitations for the study of medication use and the prevalence of given medical conditions.

A first problem is intrinsic to the data. The data only covers medications that are reimbursed by the health insurance (some prescription medications are not reimbursed at all). The number of prescriptions reported in the datasets only indicate that a certain refundable medication was prescribed and bought. Assuming that individuals actually used the medication, we still do not know if the medication was used only once (for an acute problem) or several times (for a chronic condition). Nor do we know if these individuals suffer from other diseases and use different types of medication for different treatments; i.e., there is no indication of multimorbidity. Furthermore, many prescriptions drugs also have off-label uses to treat different health conditions.

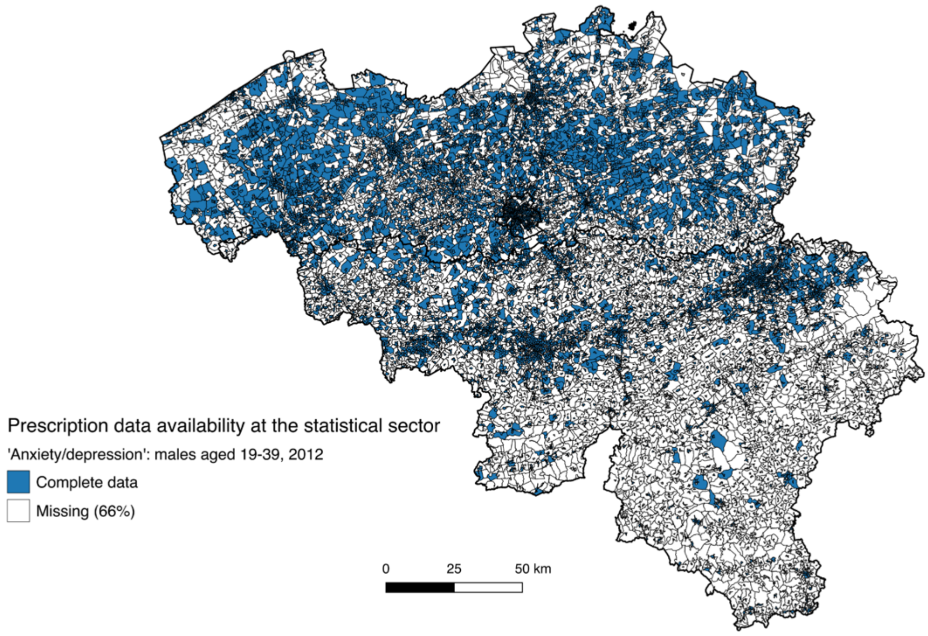
Second, there is a considerable amount of missing data at the level of statistical sector. For privacy reasons, cases with less than five observations were excluded from the datasets: this concerns many statistical sectors, all the more so if the information is broken down by age groups and medication classes. Furthermore, data collection may be subjected to technical problems in certain areas, especially in the allocation of individuals to small geographical units. If we take the example of ‘cardiovascular general’ prescriptions for females aged 40–64 in 2012, data are missing for 40% of statistical sectors. Data on anxiety/depression prescription for males aged 19–39 are missing in 66% of the cases. These two examples are illustrated by the maps below (Figure 2). Missing values are more frequent in Wallonia, especially in the south, where population density is lower. In cases such as anxiety/depression in the age group 19–39 (Figure 2b), missing values are so frequent that spatial analyses are not viable at the statistical sector level. In these cases, only densely populated areas – such as urban zones – may be suitable for analyses.

Third, medication consumption is likely to be underestimated among cross-border commuters residing in Belgium. Even though these commuters are registered in a Belgian health insurance company, they may choose to buy their medication and benefit from health insurance in their country of work. This seems to be particularly the case at the Luxembourg border, where prescription-patient SMRs of different medication classes are consistently lower compared to the rest of the country (see Figures 1b, 5b and 5a). For example, the prescription-patient SMR for cardiovascular medication among men in the Arlon district has the unreasonably low value of 58.5 for the period 2012–2014, against values above 80 for all other districts. Given this potential underestimation bias, data at border regions should be interpreted with caution.

Figure 2. Spatial distribution of missing data in the IMA datasets at the statistical sector level: two examples from 2012



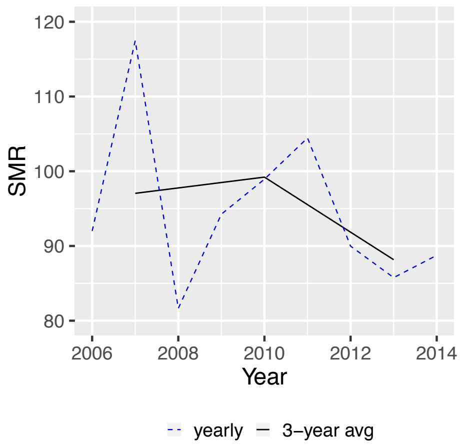
(a) Missing values in 'cardiovascular general' prescriptions for females aged 40–64



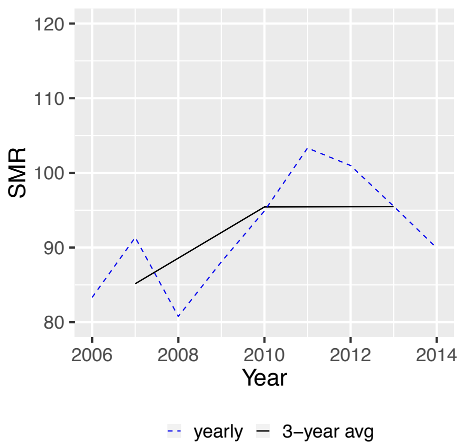
(b) Missing values in 'anxiety/depression' prescriptions for males aged 19–39

Data source IMA/AIM

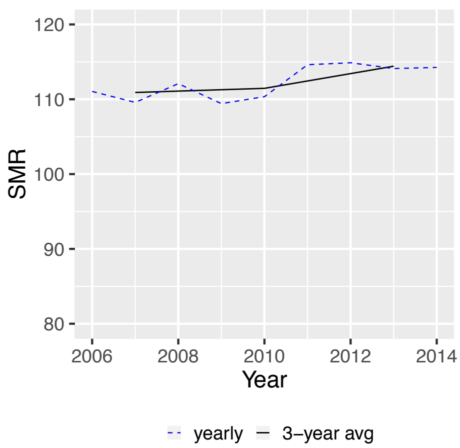
Figure 3. Fluctuations over time in a standardised indicator of anxiety/depression drugs prescription for males aged 19–39: yearly indicator and 3-year averages at three aggregation levels



(a) Statistical sector in central Eupen



(b) Municipality of Eupen



(c) District of Malmedy

Data sources IMA/AIM and National Register (Statistics Belgium)

Fourth, the presence of small numbers in the prescription data causes fluctuations over the years that do not reflect real trends in prescription behaviour. Statistical sectors are obviously more prone to such fluctuations compared to municipalities: numbers are so small that little changes from one year to the next may provoke large variations. In the calculation of indicators based on the IMA data, we exclude statistical sectors with less than 200 inhabitants in the year 2010 (as a reference year for all yearly indicators). Moreover, besides yearly indicators from 2006 to 2014, we also propose average values over three years (2006–2008, 2009–2011 and 2012–2014). Figure 3 illustrates the variations due to small numbers in anxiety/depression drug prescriptions for males aged 19–39. The graphs depict the age-standardised indicator of prescription-patients (SMR) over time at three different aggregation levels: a statistical sector of central Eupen (3a), the municipality of Eupen (3b), and its arrondissement of Malmedy (2c). At the statistical sector level, fluctuations are too wide from one year to the other: they most probably reflect small variations that have a large impact on the indicator. The 3-year averages offer a smoothed trend. At the municipality level, yearly fluctuation still seems erratic: the 3-year averages also seem an appropriate smoothing of the trend. At the district level, however, numbers seem to be sufficiently large to prevent random fluctuations over the years. Here, yearly series would be preferred, as 3-year averages are an unnecessary reduction of information detail.

Ultimately, the choice of the most appropriate spatial aggregation level and temporal smoothing technique will depend on the presence of small numbers in each specific medication class and age group, along with the specific purposes of a given study.

The fifth limitation relates to the population numbers used to calculate age-standardised indicators. Ideally, we would use the same data source for standardisation, that is, the population by age and sex registered in the IMA/AIM database. However, due to privacy reasons, IMA/AIM could only provide the population numbers by single age years at the national level, but not disaggregated by municipalities or statistical sectors. To be able to perform age-standardisation we obtained the population data from the National Register, provided by Statistics Belgium (Statbel). Combining these two different data sources when applying age-standardisation may lead to biased indicators, given their discrepancy in population registration procedures. First, IMA/AIM data are based on the average of two moments in the reference year (see section 1), whereas the National Register data as delivered by Statbel refer to the population status at a fixed time point for every year. Second, the population in the IMA/AIM data might differ since (1) individuals not covered by health insurance are not registered, and thus excluded from this database; and (2) individuals may be deceased but that still included in the IMA/AIM database.

In particular, there is a significant overrepresentation of older ages in the IMA/AIM data. The tables below present the differences in population numbers between the IMA/AIM data and the official Statbel data for males in 2006 and females in 2014. Table 2 shows age groups whereas Table 3 zooms in on the 90+ by single age years. Population numbers are slightly underestimated in age groups 19–39 and 40–64, and somewhat overestimated in age-group 65–84. But the most significant deviation concerns the population older than 85, overestimated by around 7 to 8% in the IMA/AIM data (Table 2). After 90 years old, the overestimation is even stronger (Table 3), surpassing the official population numbers by 15% and more. The well-pronounced overrepresentation of older ages in the IMA/AIM data is most probably due to the specificity of the mismatch in registration procedures (as described above) being enhanced by higher mortality rates at older age.

Table 2. Statbel vs. IMA population by age group

	Males, 2006			Females, 2014		
Age group	**Statbel**	**IMA**	**Relative difference (%)**	**Statbel**	**IMA**	**Relative difference (%)**
19–39	1,459,329	1,454,534	–0.16	1,487,336	1,466,557	–0.70
40–64	1,784,575	1,764,889	–0.55	1,888,639	1,865,427	–0.62
65–84	699,802	729,317	2.07	954,254	975,383	1.09
85+	54,581	65,271	8.92	198,581	226,599	6.59

Data sources IMA/AIM and National Register (Statistics Belgium)

Table 3. Statbel vs. IMA population by age (zoom 90+)

	Males, 2006			Females, 2014		
Age	**Statbel**	**IMA**	**Relative difference (%)**	**Statbel**	**IMA**	**Relative difference (%)**
90	3,010	3,714	10.47	17,087	19,667	7.02
91	2,849	3,618	11.89	14251	16,589	7.58
92	2,485	3,259	13.47	11,447	13,649	8.77
93	1,744	2,318	14.13	9,161	11,254	10.25
94	1,221	1,673	15.62	7,137	8,867	10.81
95	803	1,088	15.07	4,020	5,178	12.59
96	553	809	18.80	2,012	2,690	14.42
97	314	477	20.61	1,489	2,019	15.11
98	204	303	19.53	1,151	1,638	17.46
99	125	194	21.63	903	1,343	19.59
100+	151	268	27.92	1,738	2,827	23.86

Data sources IMA/AIM and National Register (Statistics Belgium)

The difference in population numbers causes a problem in the calculation of SMRs at older ages. There is an inflation of the number of *observed prescriptions* in the older age groups (based on IMA/AIM data) in respect to the *expected prescriptions* obtained from the (correct) population (Statbel data). The differences in population numbers yield biased SMRs. In fact, we have noticed for instance that SMRs for 'cardiovascular general' at the district level in the age group 85+ are higher than 100 for nearly all districts, which is illogical. Because of this bias, we choose to systematically exclude the persons above 85 years old when computing prescription-patient SMRs and ASMRs.

Apart from the older population, differences in population numbers at younger ages introduce small anomalies in prescription-patient SMRs and ASMRs. For example, the mean value of prescription-patient SMR in any context should logically be 100; however, this value is often between 98 and 102. These small noises in the indicators should not affect analyses based on SMRs and ASMRs nonetheless. The differences between IMA and Statbel populations are likely to be randomly distributed, and not concentrated in specific areas. Thus, the relative variation in prescription numbers among geographical units should still be consistent and yield accurate results.

Obviously, problems caused by the population mismatch are worse for statistical sectors, for which little variations in very small numbers can cause wide fluctuations.

Spatial distribution

One of the greatest interests of the IMA/AIM data is its richness of spatial detail. Here we use three examples to illustrate the potential and drawbacks of the data and indicators in the study the spatial distribution of prescription behaviour.

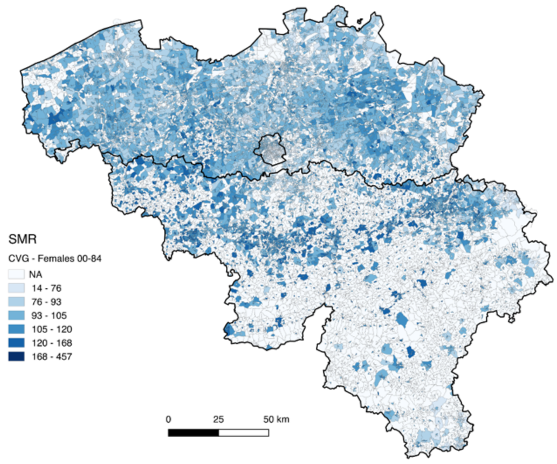
The examples are based on 3-year averages for 2012–2014. Note that the maps' scales are not the same, as it is difficult to compare the various measures (standardised rates, Euros per person…). Scales were obtained with natural breaks/Jenks method, which minimise intra-class variance and maximise between-class variance.

The first example shows the spatial distribution of prescription indicators of 'cardiovascular general' medication for females aged 0 to 84 at the level of statistical sectors (Figure 4). Data are missing for a considerable part of Wallonia, especially for prescription-patient SMRs (4a). Still, some interesting patterns emerge: we observe a stronger presence of cardiovascular prescription-patients along the old industrial belt in Wallonia, whereas their presence is relatively low in urban and suburban areas north of the linguistic border, especially Brussels, Antwerp, Ghent and Bruges. The two indicators of prescription costs (4b and 4c), in contrast, show no clear spatial pattern. If costs are any indication of consumption intensity, then cardiovascular medication seem to be consumed in an equal manner across the country.

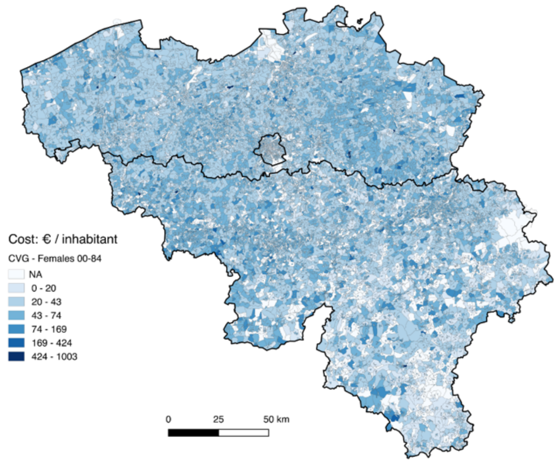
The second illustration (Figure 5) shows the age-standardised indicators (SMR) of Asthma/COPD prescriptions for males between 40 and 64 years old at two aggregation levels: statistical sectors (5a) and municipalities (5b). In this case, there are so many missing values at the statistical sector level that it becomes hard to examine the spatial distribution of SMRs at this scale. We do see a higher incidence of asthma/COPD patients stretching along the Walloon industrial belt (Mons–Charleroi–Namur–Huy–Liège) and in East-Flanders (around Sint-Niklaas and Dendermonde) but, apart from that, we cannot say much about the other parts of the country. At the municipal level, in turn, we have a complete picture. We still observe the patterns of overrepresentation in the Walloon industrial belt and in East-Flanders. But now other patterns become clear: the general contrast between Flanders and Wallonia, with a much higher incidence of asthma/COPD prescription-patients in the south; the low incidence in the affluent areas of Brussels (south–east) and at the Luxembourg border (around Arlon), and a zone of strong incidence at the French border around Chimay. This example shows that, in some cases, it is impractical to use the IMA/AIM data at a very fine aggregation level. There is inevitably some loss in precision when we go from statistical sectors to municipalities, but in cases such as this one, the loss is balanced out by the gain in complete information.

The third example depicts prescription-patient SMRs and costs indicators of anxiety/depression prescriptions for females aged 19 to 39 at the municipality level (Figure 6). The spatial distribution of SMRs (6a) resembles that of asthma/COPD (Figure 5b): there is a clear regional divide with a stronger incidence of anxiety/depression patients in Wallonia compared to Flanders; a lower incidence in the south of Brussels and around Arlon; and a zone in East-Flanders that stands out as having more prescription-patients than the rest of Flanders. However, the costs indicators (6b and 6c) tell a somewhat different story. In the case of costs by patient (6c), the contrast between Flanders and Wallonia is reversed: the average expenses by patient in anxiety/depression drugs is clearly higher in Brussels and Flanders. This could indicate that, whereas there are less anxiety/depression patients in the north of the country, these patients use medications more intensively. In any case, this example shows that cost indicators may be useful to balance the conclusions drawn from age-standardised indicators of prescription-patients (SMR and ASMR).

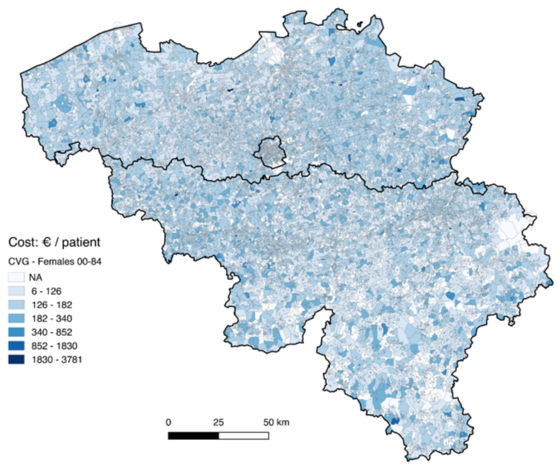
Figure 4. 'Cardiovascular general' medication prescriptions for females aged 0–84 at the level of statistical sectors, 2012–2014



(a) SMR



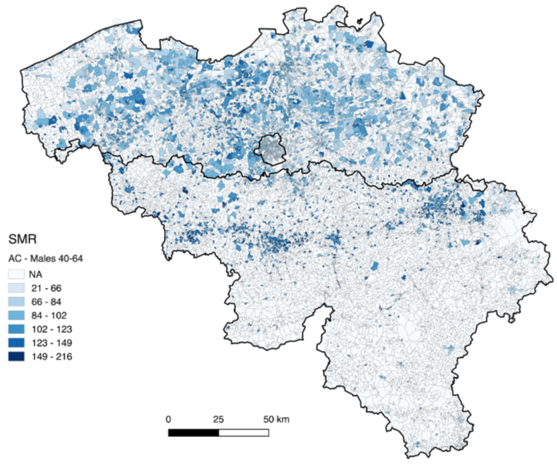
(b) Cost by inhabitant



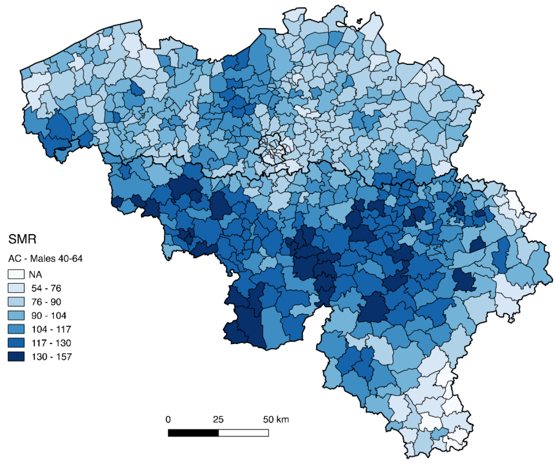
(c) Cost by patient

Data sources IMA/AIM and National Register (Statistics Belgium)

Figure 5. 'Asthma/COPD' medication prescriptions for males aged 40–64 at the level of statistical sectors and municipalities, 2012–2014.



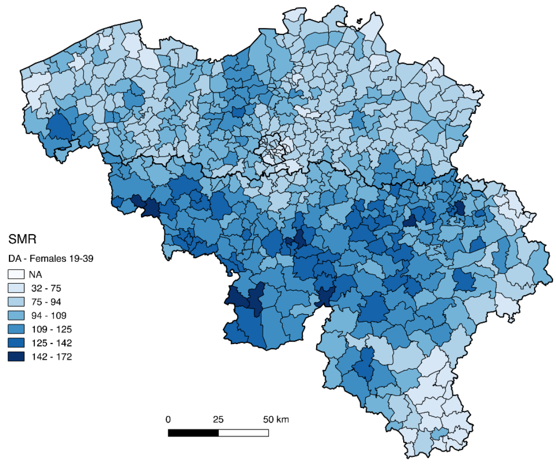
(a) SMR at the statistical sector level



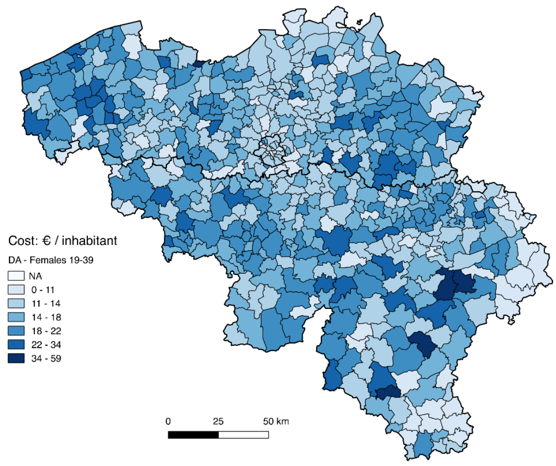
(b) SMR at the municipality level

Data sources IMA/AIM and National Register (Statistics Belgium)

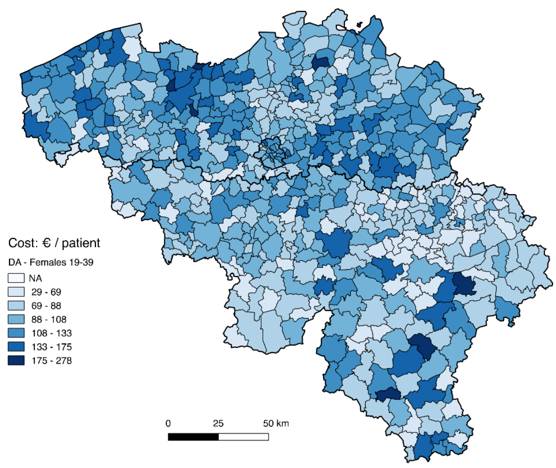
Figure 6. ‘Anxiety/depression’ medication prescriptions for females aged 19–39 at the municipality level, 2012–2014



(a) SMR



(b) Cost by inhabitant



(c) Cost by patient

Data sources IMA/AIM and National Register (Statistics Belgium)

Correlation with mortality

If prescription behaviour of a given medication reflects the incidence of the correspondent morbidity in any way, one can expect to find some correlation between prescription-patient incidence and mortality.

In order to test this hypothesis, we looked into the associations between prescription behaviour and cause-specific mortality for two health affections: cardiovascular diseases and asthma/COPD. These health affections are suitable for the test for several reasons. Cardiovascular problems and asthma/COPD are treated with definite medications classes, which are less likely to overlap with other diseases. The link between these diseases and cause of death is also more straightforward compared to other affections such as anxiety/depression or diabetes. Furthermore, there is a good correspondence between the medication classes and the mortality causes following the ICD-10 codes. Finally, the number of both prescriptions and deaths related to cardiovascular diseases and asthma/COPD is large enough to produce accurate results.

We computed correlations between the age-standardised indicator of prescription-patients (prescription-patient SMRs) and cause-specific mortality rates (mortality SMRs) at the district level for Belgium, Flanders, and Wallonia. Mortality rates are made available by Sciensano on the SPMA-Belgium website (https://spma.wiv-isp.be). We used deaths of men and women of all ages caused by cardiovascular diseases defined by three different criteria (ICD-10 codes I00–I99, I10–170, and I10–I59), as well as deaths caused by asthma/COPD (ICD-10 codes J40–J47).

Table 4 shows the correlations between standard mortality rates of cardiovascular causes (resp. asthma/COPD) and the age-standardised indicator of prescription-patients using 'cardiovascular general' medication (resp. asthma/COPD medication) for men and women of all ages in 2012–2014. As mentioned above, correlations were computed at the level of the 43 Belgian districts (22 in Flanders, 20 in Wallonia, and one corresponding to the Brussels Capital Region). The use of districts, rather than finer geographical units, ensures a sufficient number of observations to produce stable results. Correlations at lower levels – such as municipalities – are expected to be weaker, but to go in the same direction.

Taking Belgium as a whole, correlation coefficients fluctuate between 0.3 and 0.5. It is important to note that medication prescription is not expected to match mortality directly. In fact, several factors must be taken into consideration. There is a time lag between medication consumption and death; in fact, some individuals might take a medication for several years before dying from the associated disease. Within this time lag, there are competing risks: cardiovascular or asthma/COPD patients may die from any other reason during their treatment. What is more, effective medication should be negatively correlated to death: in extending patients' lifespan, these are more likely to die from other causes. This is likely to be the case, for example, of antihypertensive drugs (comprised in the cardiovascular class): their consumption against high blood pressure is so widespread among men and women above 60 that they might have a negative impact on the correlation between prescription behaviour and deaths. On the other hand, medication classes from the IMA/AIM data include medication with important side effects and controversial effectiveness (such as Statins in the cardiovascular class). Bearing these considerations in mind, we can consider that medication prescriptions and deaths are strongly correlated in the Belgian districts, especially in the case of asthma/COPD for men and cardiovascular diseases for both men and women (r≈0.5).

Table 4. Correlations between prescription SMRs and mortality SMRs at the district level, 2012–2014

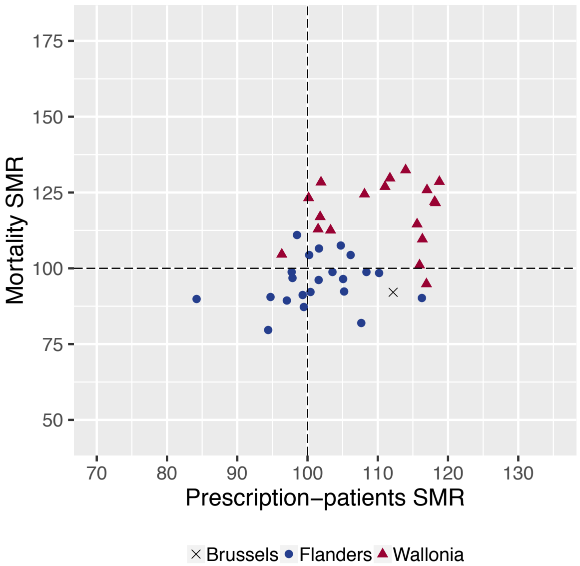
		Cardiovascular			Asthma/COPD
		I00–I99	**I10–I70**	**I10–I59**	**J40–J47**
Belgium	Male	0.454	0.463	0.431	0.509
	Female	0.502	0.477	0.472	0.332
Flanders	Male	0.173	0.178	0.165	0.137
	Female	0.416	0.440	0.518	0.184
Wallonia	Male	0.458	0.484	0.426	0.547
	Female	0.504	0.471	0.342	0.011

Data sources IMA/AIM, National Register (Statistics Belgium) and SPMA-Belgium (Sciensano)

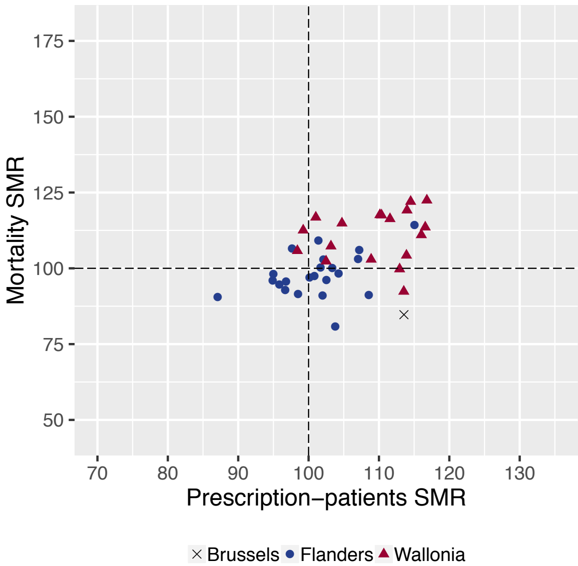
The associations between prescription behaviour and mortality are less consistent at the regional level. When Flanders and Wallonia are taken separately, the correlation for asthma/COPD among women (r≈0.33) decreases substantially (r≈0.14 in Flanders and r≈0.01 in Wallonia). This suggests that the correlation observed for Belgium mostly captures the disparities between the two regions. The regional divide is clear in Figure 8b. No Flemish district combines high mortality with high prescription behaviour for asthma/COPD among women; in Wallonia, both prescription behaviour and mortality are high compared to the national level. Among men, correlations for cardiovascular affections and asthma/COPD are very low in Flanders (r~1.7 and r~1.4 respectively), whereas they remain high in Wallonia (r~0.46 and r~0.55). In the case of cardiovascular affections, the low correlation in Flemish districts can be explained by their homogeneity in terms of mortality levels and prescription behaviour (Figure 7a). As for asthma/COPD, low correlations can be ascribed to the erratic association between prescription behaviour and mortality among Flemish districts (Figure 8a). In contrast, associations are clearer in Wallonia in both cases, which probably reflect the territorial disparities inside this region (between the districts situated in the old industrial belt and the more prosperous ones). Overall, the small number of districts may also affect the observed differences in correlation values as we take the two regions separately.

All things considered, these tests suggest that the prescription-patient SMRs calculated with the IMA/AIM data give an indication of the prevalence of the associated morbidity in districts, at least in the case of cardiovascular affections and asthma/COPD.

Figure 7. Prescription-patient SMRs and mortality SMRs at the district level: Cardiovascular affections (ICD-10 I00–I99), 2012–2014



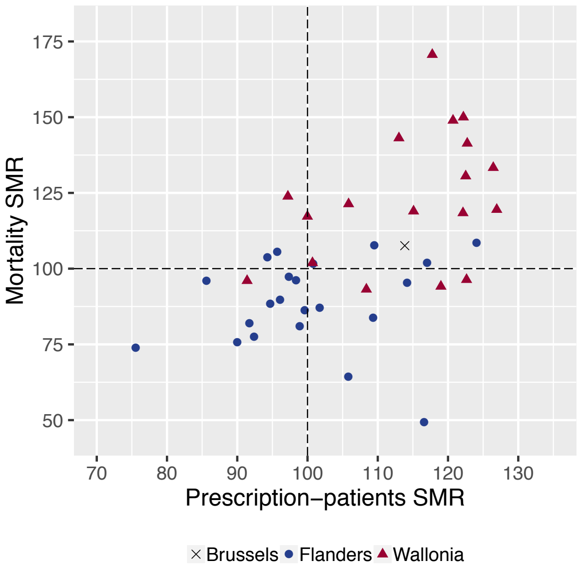
(a) Males (r=0. 454)



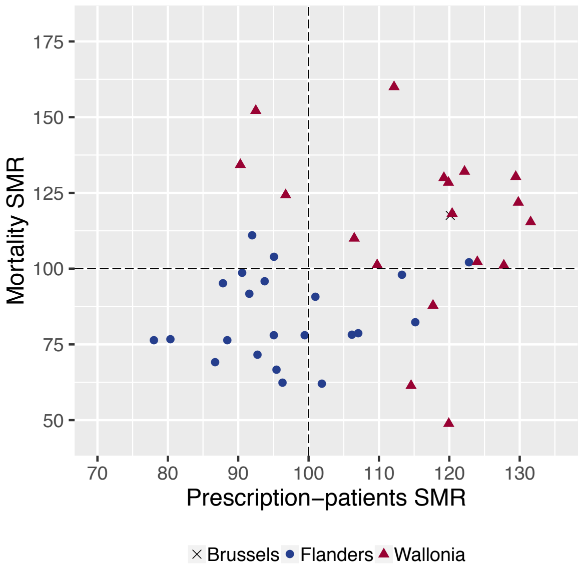
(b) Females (r=0. 502)

Data sources IMA/AIM, National Register (Statistics Belgium) and SPMA-Belgium (Sciensano)

Figure 8. Prescription-patient SMRs and mortality SMRs at the district level: Asthma/COPD (ICD-10 J40–J47), 2012–2014



(a) Males (r=0.509)



(b) Females (r=0.332)

Data sources IMA/AIM, National Register (Statistics Belgium) and SPMA-Belgium (Sciensano)

Correlation with socio-economic indicators

It is also relevant to explore the correlations between prescription data and living conditions. It is likely that the incidence of prescription-patients and medication consumption is associated with socio-economic and environmental factors. In fact, the maps showing the spatial distribution of prescription behaviour, presented in section 4, mimic well-known spatial differences in socio-economic conditions. To further explore the associations between prescription behaviour and living conditions, we computed correlations between prescription-patient indicators in 2006–2008 and socio-economic indicators from the Census 2001 at the municipality level, for the three examples discussed above: 'cardiovascular general' prescriptions for females aged 0–84 (Table 5), 'asthma/COPD' prescriptions for males aged 40–64 (Table 6) and 'anxiety/depression' prescriptions for females aged 19–39 (Table 7).

Before turning to socio-economic indicators, it is interesting to observe the associations among the three prescription indicators. Logically, the two costs indicators are highly correlated. The age-standardised indicator of prescription-patients (SMR) is strongly correlated with the costs by inhabitant; but surprisingly it is not correlated with the costs by patient. In other words, incidence of prescriptions and intensity of medication consumption do not go hand in hand. This is an indication that the data on costs is relevant and can complement the analyses of prescription incidence/behaviour.

The associations between prescription- and socio-economic indicators are very similar in the three examples. Prescription-patient SMRs are associated with unemployment, with housing conditions, and to a certain extent with education levels. Thus, as expected, municipalities with lower living conditions have higher incidence of prescription-patients with cardiovascular diseases, asthma/COPD and anxiety/depression. The presence of foreigners from low-income countries is not associated with prescription behaviour (to note, this is also valid at the level of statistical sectors). The shares of manual workers and of adults with primary education are also uncorrelated with prescription behaviour.

When we consider correlations in Flanders and Wallonia separately, some regional differences appear. For example, the association between unemployment and prescription-patient incidence only holds in Wallonia, not in Flanders. In the case of asthma/COPD, the association with of low-quality housing does not hold in Flanders. Many of such regional particularities can be observed on the tables.

Finally, in contrast with SMRs, the indicator of costs per patient has low correlations with socioeconomic indicators, in all cases. Unlike the prevalence of prescriptions, the intensity of medication consumption in a municipality does not seem to be related to its socio-economic conditions. This is an interesting point to be investigated further, among many others.

Table 5. Correlations between IMA/AIM prescription indicators and SES indicators from the Census 2011: 'Cardiovascular general' prescriptions for females aged 0–84 at the municipality level (2006–2008)

	Belgium		
	SMR	**Cost/inhabitant**	**Cost/patient**
Cost/inhabitant	0.762	-	-
Cost/patient	0.303	0.738	-
% foreigners (low-income countries)	–0.113	–0.275	–0.243
% unemployed	0.569	0.389	0.139
% manual workers	–0.056	0.029	0.137
% primary education (25–64)	0.186	0.222	0.188
% high education (25–64)	–0.379	–0.449	–0.358
% high-comfort dwellings	–0.437	–0.433	–0.137
% low-comfort dwellings	0.530	0.419	0.194
	Flanders		
	SMR	**Cost/inhabitant**	**Cost/patient**
Cost/inhabitant	0.762	-	-
Cost/patient	0.375	0.772	-
% foreigners (low-income countries)	–0.147	–0.235	–0.201
% unemployed	0.172	0.122	0.091
% manual workers	0.378	0.194	0.215
% primary education (25–64)	0.401	0.253	0.168
% high education (25–64)	–0.434	–0.374	–0.320
% high-comfort dwellings	–0.435	–0.370	–0.075
% low-comfort dwellings	0.372	0.414	0.182
	Wallonia		
	SMR	**Cost/inhabitant**	**Cost/patient**
Cost/inhabitant	0.721	-	-
Cost/patient	0.143	0.685	-
% foreigners (low-income countries)	–0.136	–0.130	–0.151
% unemployed	0.559	0.617	0.243
% manual workers	0.051	0.050	0.156
% primary education (25–64)	0.136	0.359	0.327
% high education (25–64)	–0.409	–0.540	–0.398
% high-comfort dwellings	–0.614	–0.647	–0.269
% low-comfort dwellings	0.460	0.533	0.308

Data sources: IMA/AIM, National Register and Census 2001 (Statistics Belgium)

Table 6. Correlations between IMA/AIM prescription indicators and SES indicators from the Census 2011: 'Asthma/COPD' prescriptions for males aged 40–64 at the municipality level (2006–2008)

	Belgium		
	SMR	**Cost/inhabitant**	**Cost/patient**
Cost/inhabitant	0.771	-	-
Cost/patient	0.036	0.646	-
% foreigners (low-income countries)	–0.024	–0.075	–0.088
% unemployed	0.596	0.466	0.009
% manual workers	–0.099	–0.009	0.133
% primary education (25–64)	0.226	0.248	0.127
% high education (25–64)	–0.321	–0.354	–0.198
% high-comfort dwellings	–0.493	–0.450	–0.141
% low-comfort dwellings	0.443	0.335	0.047
	Flanders		
	SMR	**Cost/inhabitant**	**Cost/patient**
Cost/inhabitant	0.722	-	-
Cost/patient	0.069	0.727	-
% foreigners (low-income countries)	0.025	–0.043	–0.119
% unemployed	0.154	0.185	0.066
% manual workers	0.222	0.191	0.097
% primary education (25–64)	0.387	0.296	0.077
% high education (25–64)	–0.300	–0.311	–0.193
% high-comfort dwellings	–0.409	–0.301	–0.075
% low-comfort dwellings	0.100	0.009	0.036
	Wallonia		
	SMR	**Cost/inhabitant**	**Cost/patient**
Cost/inhabitant	0.752	-	-
Cost/patient	0.102	0.714	-
% foreigners (low-income countries)	–0.009	–0.067	–0.087
% unemployed	0.648	0.564	0.152
% manual workers	–0.007	0.037	0.085
% primary education (25–64)	0.205	0.269	0.177
% high education (25–64)	–0.377	–0.397	–0.204
% high-comfort dwellings	–0.659	–0.613	–0.228
% low-comfort dwellings	0.438	0.454	0.230

Data sources: IMA/AIM, National Register and Census 2001 (Statistics Belgium)

Table 7. Correlations between IMA/AIM prescription indicators and SES indicators from the Census 2011: 'Anxiety/depression' prescriptions for females aged 19–39 at the municipality level (2006–2008)

		Belgium	
	SMR	**Cost/inhabitant**	**Cost/patient**
Cost/inhabitant	0.558	-	-
Cost/patient	–0.134	0.719	-
% foreigners (low-income countries)	–0.072	–0.025	0.052
% unemployed	0.587	0.301	–0.079
% manual workers	–0.107	–0.108	–0.079
% primary education (25–64)	0.119	0.038	–0.070
% high education (25–64)	–0.308	–0.125	0.127
% high-comfort dwellings	–0.452	–0.280	0.000
% low-comfort dwellings	0.497	0.277	–0.021
		Flanders	
	SMR	**Cost/inhabitant**	**Cost/patient**
Cost/inhabitant	0.471	-	-
Cost/patient	–0.152	0.783	-
% foreigners (low-income countries)	–0.041	–0.051	–0.018
% unemployed	0.113	0.076	–0.020
% manual workers	0.291	0.025	–0.189
% primary education (25–64)	0.324	0.122	–0.102
% high education (25–64)	–0.369	–0.103	0.160
% high-comfort dwellings	–0.450	–0.300	–0.046
% low-comfort dwellings	0.405	0.199	0.048
		Wallonia	
	SMR	**Cost/inhabitant**	**Cost/patient**
Cost/inhabitant	0.508	-	-
Cost/patient	–0.023	0.828	-
% foreigners (low-income countries)	–0.040	0.001	0.071
% unemployed	0.592	0.242	–0.042
% manual workers	0.040	–0.002	–0.048
% primary education (25–64)	0.090	0.009	–0.049
% high education (25–64)	–0.347	–0.141	0.056
% high-comfort dwellings	–0.624	–0.284	0.035
% low-comfort dwellings	0.350	0.181	0.023

Data sources: IMA/AIM, National Register and Census 2001 (Statistics Belgium)

Final remarks

This report offers an overview of the IMA/AIM prescription data, its potential uses and its limitations.

The data provided by the IMA/AIM is extremely rich. It contains multiple layers: information on prescription numbers and costs is available for 13 medication classes, at four different geographical levels, by sex and age group, year by year from 2006 to 2014. Not all of the data is exploitable nonetheless. Some medication classes may be too broad and/or may not have real interest for research. There is a large number of missing information on statistical sectors for many of the different medication classes; as a consequence, studies at such fine geographical levels will often be impracticable. Furthermore, the data has intrinsic limitations: the number of prescriptions within a certain medication class is not a straightforward proxy for the prevalence of the corresponding pathology, and interpretations in terms of morbidity must be made with caution.

We proposed two types of indicators based on the raw data:

- age-standardised indicators of prescription-patients (SMR and ASMR), which express the prevalence of patients of a certain pathology over a year within a geographical area;
- indicators based on the costs expended in a medication class over a year – cost per inhabitant and cost per patient –; the latter, in particular, gives an indication of how much of a given medication is actually bought/consumed.

The age-standardised indicators of prevalence will certainly be the most useful and meaningful in the majority of studies, whereas the costs indicators may be used to complement and to temper the analyses.

These indicators may be affected by small numbers. Especially at lowest geographical level, indicators values are often volatile over the years because small changes provoke wide fluctuations. The use of larger geographical units and/or 3-year averages can smooth these fluctuations and resolve part of the problem. The choice of the most appropriate geographical level and temporal smoothing will depend on each specific study.

We examined three examples in this report: 'cardiovascular general' prescriptions for females aged 0–84, 'asthma/COPD' prescriptions for males aged 40–64 and 'anxiety/depression' prescriptions for females aged 19–39. Our purpose was not to produce a detailed analysis of prescription behaviour, but to illustrate the potential uses of the data and evaluate its interests and drawbacks. In particular, these examples offer a glimpse of the great potential of IMA/AIM data for the detection of spatial patterns of prescription behaviour in Belgium. Furthermore, we showed for cardiovascular affections and asthma/COPD that the age-standardised indicators of prescription-patients are highly associated with the corresponding cause-specific mortality at the district level, and therefore, that these indicators do reflect the prevalence of the morbidity in question.

In conclusion, despite its limitations, the IMA/AIM data is a very rich source of information and can be useful in many analyses related to health in Belgium.

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