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The Risk Factors in Patients Hospitalized for a First Episode of Stroke in France

Camille Léandre (IRDES, AP-HP), Laure Com-Ruelle (IRDES)

The frequency of strokes in France and the significant consequences in terms of the fatality rate and disability linked to sequelae have made them a true public health concern. In order to improve the treatment of patients, the 2010–2014 Stroke National Action Plan (Plan d'actions national AVC) recommends, in particular, the development of stroke prevention strategies by deploying preventive measures and screening initiatives for checking risk factors that are causes of stroke. Although the risk factors have been clearly identified by clinicians and calculated in certain sample studies, what is the state of play at the national and regional levels? The National Health Data System (Système national des données de santé or SNDS) offers the possibility to analyse the total stroke population in France through medical information and hospital healthcare and ambulatory care consumption data that are integrated into the database. A series of French cohorts were extracted from the database, including the victims of a first episode of stroke that occurred in 2010–2019 (ultimately); they included the medical care during the 24 preceding and subsequent 24 months.

In order to identify and quantify the stroke risk factors, a method was developed and tested on the 2012 adult cohort. Hence, the prevalences of risk factors associated with pathologies were estimated to be 51% for high blood pressure, 37% for dyslipidaemia, 20% for diabetes, 16% for atrial fibrillation and 20% for depression. They fell within the national and international clinical ranges and provided new useful information in terms of stroke prevention and the effective treatment of patients. However, it was not possible to use the National Health Data System (SNDS) to identify risk factors associated with lifestyles and individual behaviour such as obesity, smoking and alcoholism, highlighting the need for further studies that include clinical data.

Strokes are a major public health concern in France due to the sheer number of cases, which are unevenly distributed in France, and the significant related effects both in terms of the fatality rate and disability linked to sequelae and the economic effects (Com-Ruelle et al., 2018). The 2010–2014 Stroke National Action Plan

(Plan d'actions national AVC) describes the national and regional stroke treatment strategy. In order to improve the treatment of patients, the Plan recommends, in particular, the development of stroke prevention strategies by deploying preventive measures and screening initiatives for checking cardiovascular and neurovascular risk factors.

The aim of this study was to identify the known individual stroke risk factors associated with illnesses or lifestyles amongst the adult victims of a first episode of established stroke^{1*}, that is to say a full stroke, through the National Health

¹ The terms marked by an asterisk are defined in the "Definitions" inset on page 2

Data System (SNDS). Several risk factors were identified in the literature:

More than 90% of the stroke cases in the world are attributable to a set of individual clinical risk factors or are associated with individual behaviour (O'Donnell et al., 2016). In a descending order of the seriousness of risks associated with the onset of a stroke, the authors observed: cardiac diseases, high blood pressure, psychosocial factors, alcohol consumption, elevated levels of apolipoprotein B (associated with "bad" cholesterol, it represents an increased cardiovascular risk), tobacco consumption, a high waist-to-hip ratio, diabetes, low levels of physical activity and a poor diet.

A study analysing the impact of stroke risk factors in terms of Disability Adjusted Life Years (DALYs*) or "disease burden" produced similar results (Feigin et al., 2016). More than 90% of the "disease burden" was attributable to external

individual factors, such as factors associated with individual behaviour (tobacco consumption, poor diet and low levels of physical activity) and metabolic factors (high blood pressure, a high body mass index, hyperglycaemia, hypercholesterolemia, etc.). Environmental factors—in particular, air pollution (Feigin et al., 2016; Scheers et al., 2015) and the working environment—can also predispose individuals to the onset of a stroke.

The victims of a first episode of full stroke who were hospitalized for a short period in France: a cohort whose characteristics were similar to those in the literature

The aim behind the creation of cohorts of victims of a first episode of stroke in the IRDES study, based on data from the National Health Data System (SNDS), in the context of the 2010–2014

Stroke National Action Plan (Plan d'actions national AVC), was to monitor the patients' healthcare pathways over time in order to develop and improve preventive measures to reduce the incidence and recurrence of stroke.

The 2012 cohort was comprised of 98,853 adult victims of a first episode of full stroke in 2012 who were hospitalized for a short period (Medicine, Surgery and Obstetrics, or MSO) [see "Sources" inset]. The male-to-female ratio was close to 1 and the incidence of stroke increased with age (see Graph 1). 67% of the cohort was comprised of victims of a first episode of an ischemic stroke*, 7% of victims of a first episode of an unspecified stroke, which is closer to an ischemic stroke, 21% of victims of a first episode of haemorrhagic stroke* and 5% of victims of a subarachnoid haemorrhage (SAH)*.

Their characteristics did not differ much from the data in French and international literature (Bejot et al., 2008; Bejot et al., 2016; de Peretti et al., 2017; Lecoffre et al., 2017; Roussot et al., 2015; O'Donnell et al., 2016; Ovbiagele et al., 2011; and Tuppin et al., 2013), particularly with regard to age and gender distribution. In this literature, the victims of a first episode of an ischemic stroke represent 55 to 90% of the cases, the victims of a first episode of haemorrhagic stroke 14.5 to 35% of the cases, and the victims of a subarachnoid haemorrhage (SAH) less than 5% of the cases.

DEFINITIONS

DALYs (Disability-Adjusted Life Years): an indicator developed by the World Health Organisation (WHO), it aims to assess the burden of disease or risk factor burden. One DALY corresponds to one lost year of healthy life.

Risk factor: in this study, this notion corresponds to a pathology, a behaviour, or an individual's specific lifestyle habit, which are known to be partly responsible for the onset of stroke, and which are searched for in stroke victims.

Strokes: strokes include a range of pathologies that affect venous or arterial cerebral circulation. They are characterised by the sudden onset of a focal neurologic deficit and constitute a medical emergency. The neurologic deficit can affect the motor functions, neurosensory functions (vision, speech, and hearing), or feeling. The loss of function corresponds to an anatomical lesion in a specific area of the brain. In most of the cases, the onset of the symptoms is sudden and without warning symptoms. Nevertheless, more insidious forms may exist, which are important to diagnose and treat. The semiology of stroke depends on the aetiology and the vascular area of the brain involved. Although there are a few cases of venous stroke, in most cases they affect arterial cerebral circulation:

- **Ischemic strokes** comprising **cerebral infarctions**. They result from two different mechanisms: (1) **embolization, which causes arterial occlusion**; (2) **hemodynamic mechanisms with a reduction in cerebral perfusion without embolic occlusion, secondary to a fall in blood pressure**.
- **Or haemorrhagic strokes**, comprising intracranial or parenchymal haemorrhages.

In this study, the notion of full stroke is defined as any individual who has been the victim of an ischemic, haemorrhagic, or unspecified stroke (due to absence of additional examinations). The victims of a transient ischemic attack (TIA) were not included.

Hospital stay of inclusion: identification in the French National Hospital Database (PMSI) of the first stay at the time of admission in Medicine, Surgery, and Obstetrics (MSO) with a primary diagnosis of full stroke, in the absence of hospitalization for full stroke or TIA from D-1 to M-24.

First episode: identification in the French National Hospital Database (PMSI) of all the hospital stays contiguous with hospitalization and which included a primary diagnosis of full stroke. The first episode ended with discharge from MSO or with a stay in which the primary diagnosis was different from that of full stroke.

Waist-to-hip ratio: the ratio of the circumference of the waist to that of the hips.

CONTEXT

This study is part of the IRDES research programme devoted to the healthcare received by stroke victims (PaSoV-AVC) (Com-Ruelle et al., 2018). It was conducted in the context of an internship in medicine, with a specialty in public health and social medicine, completed at IRDES in 2016–2017. It was the subject of Camille Léandre's (Université Paris-Est Créteil) thesis for the doctor of medicine State Diploma, defended on 11 October 2017. It received technical support from Nelly Le Guen, Damien Bricard, Clément Nestrigue and Charlène Le Neindre.

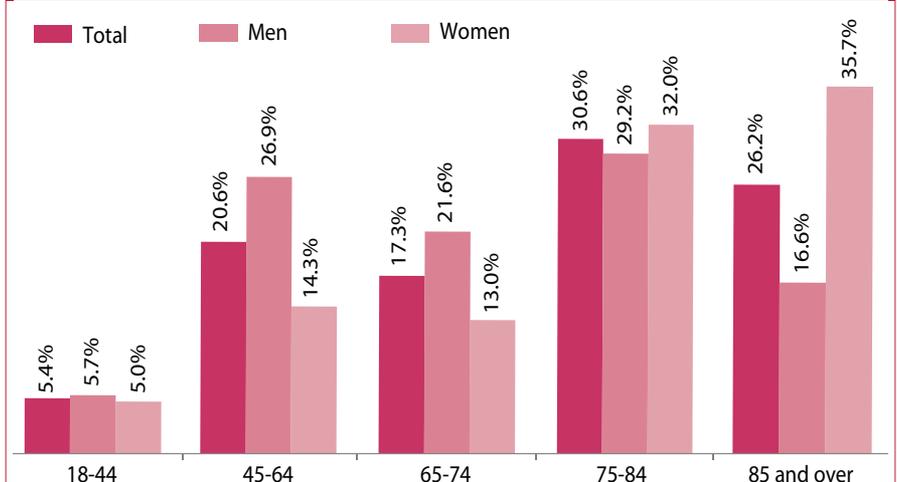
G1

More than half of the patients had at least two pathologies that are known stroke risk factors, high blood pressure being the most common pathology

The data available in the National Health Data System (SNDS) made it possible to identify the patients whose pathologies were recorded and treated, that is to say pathologies whose healthcare costs had been reimbursed by the French National Health Insurance Fund (*Assurance maladie obligatoire*). The identification of the risk factors was carried out in the twenty-four-month period available for the cohort prior to the onset of stroke. It was mainly based on the French National Health Insurance Fund's medical algorithms adapted to our purpose. It used the data relating to the diagnosis of pathologies and specific procedures present in the French National Hospital Database (*Programme de médicalisation du système d'information hospitalières*, PMSI) and/or in the French Health System's inter-scheme consumption data (DCIR) or, alternatively, the medication consumption data (see the "Method" and "Algorithms" insets).

Hence, in the 2012 adult cohort of victims of a first episode of stroke, more

Distribution of adult victims of a first episode of full stroke in 2012, according to age and gender



Sources: The National Health Data system (SNDS) (the French National Hospital Database (PMSI) and the Inter-scheme consumption data (DCIR)). Data analysed by IRDES. Cohort of adult victims of a first episode of full stroke in 2012. [Download the data](#)

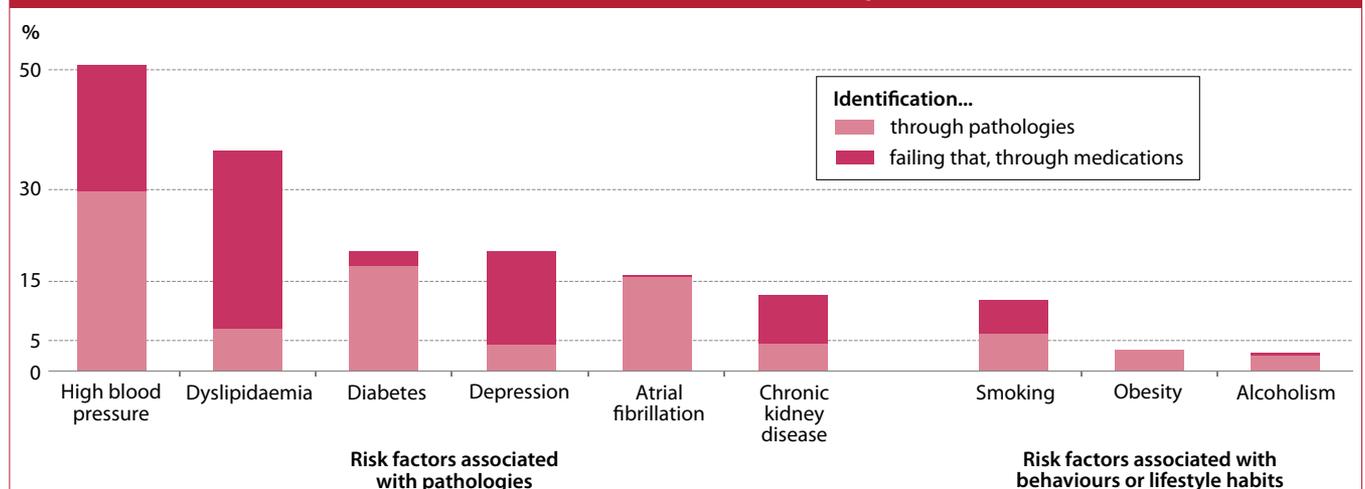
than half (52%) had at least two risk factors for stroke; 51% had been treated for high blood pressure, 37% for dyslipidaemia, 20% for diabetes, 16% for atrial fibrillation (proxy for a history of heart disease), 20% for depression (proxy for psychosocial stress), 13% for moderate to severe chronic kidney disease (MSCKD) and 0,8% for terminal chronic kidney disease (TCKD).

With respect to most of the risk factors that were considered, the study's results were similar to the prevalence data in

French and international literature (see Graph 2) [Bejot et al., 2008; Bejot et al., 2010; de Peretti et al., 2017; Lecoffre et al., 2017; Pistoia et al., 2016; Roussel et al., 2015; O'Donnell et al., 2016; and Tuppin et al., 2013]. In this literature, the prevalence of high blood pressure was found in 55 to 60% of the stroke victims, dyslipidaemia in 25 to 50%, diabetes in 15 to 21%, atrial fibrillation in 14 to 20% and depression in 16 to 21%. With regard to chronic kidney disease (CKD), TCKD prevalences of between 0.6 and 0.8% were only found in France.

G2

Risk factors identified in the cohort of adult victims of a first episode of full stroke in 2012



Reading: More than 50% of patients have high blood pressure, 30% are identified by pathologies (hospital stays, long-term diseases (ALD) and, failing that, 20% are identified by their ambulatory drug consumption.

Sources: The National Health Data system (SNDS) (the French National Hospital Database (PMSI) and the Inter-scheme consumption data (DCIR)). Data analysed by IRDES. Cohort of adult victims of a first episode of full stroke in 2012. [Download the data](#)

Algorithms to identify stroke risk factors: diabetes, high blood pressure, and chronic kidney disease, as examples

Diabete

Individuals who, during the consecutive 24-month period preceding the first episode of stroke in 2012, received:

- Specific hospital treatment for diabetes and/or were registered on the Long-term diseases scheme (Dispositif des Affections de longue durée, or ALD) for diabetes. Hence, the patients identified through the identification of pathologies¹:
- Were hospitalized for:
 - Diabetes (insulin-dependent diabetes mellitus; non-insulin-dependent diabetes mellitus; malnutrition-related diabetes mellitus; other specified diabetes mellitus; and unspecified diabetes mellitus);
 - And/or diabetes complications (diabetic mononeuropathy; diabetic polyneuropathy; myasthenic syndromes in endocrine diseases; autonomic neuropathy in endocrine and metabolic diseases; diabetic cataract; diabetic

retinopathy; peripheral angiopathy in diseases classified elsewhere; ulcer of lower limb, not elsewhere classified; diabetic arthropathy; neuropathic arthropathy; and glomerular disorders in diabetes mellitus);

And/or were registered on the Long-term diseases scheme (ALD) for diabetes (insulin-dependent diabetes mellitus; non-insulin-dependent diabetes mellitus; malnutrition-related diabetes mellitus; other specified diabetes mellitus; unspecified diabetes mellitus).

- Failing the above, specific medication for diabetes (oral anti-diabetic medicine, insulin), with dispensing of medication on at least 3 occasions in an ambulatory healthcare structure on different dates. Hence, the patients were identified through the identification of medications.

¹ ICD-10 codes identified: E10, E11, E12, E13, E14, G59.0, G63.2, G73.0, G99.0, H28.0, H36.0, I79.2, L97, M14.2, M14.6, and N08.3.

High blood pressure

Individuals who, during the consecutive 24-month period preceding the first episode of stroke in 2012, received:

- Specific hospital treatment for high blood pressure and/or were registered on the Long-term diseases scheme (ALD) for high blood pressure. Hence, the patients identified through the identification of pathologies²:
- Were hospitalized for:
 - Essential (primary) hypertension;
 - And/or hypertension complications (vascular dementia, background retinopathy and retinal vascular changes, hypertensive heart disease, hypertensive renal diseases, hypertensive heart disease and hypertensive renal disease, and hypertensive encephalopathy).
 And/or were registered on the Long-term diseases scheme (ALD) for essential high blood pressure.
- Failing the above, specific medication for high blood pressure (a combination of anti-hyperten-

sive drugs in dual therapy), with dispensing of medication on at least 3 occasions in an ambulatory healthcare structure on different dates. Hence, the patients were identified through the identification of medications.

- The patient could receive different combinations of dual therapy;
- Seven combinations of dual therapy were looked for: diuretics and beta-blockers, diuretics and calcic inhibitors, diuretics and converting enzyme inhibitors (CEI) or angiotensin II antagonists (AA2), beta-blockers and calcic inhibitors, beta-blockers and CEI or AA2, calcic inhibitors and CEI or AA2 and a combination of two different therapeutic classes;
- In the event of large packages of medicine, the patient could receive at least one large package and a small package, or two large packages.

² ICD-10 codes identified: I10, F01, H35.0, I11, I12, I13, I67.4.

Chronic kidney disease (CKD)

Individuals who, during the consecutive 24-month period preceding the first episode of stroke in 2012, received:

Identification of patients suffering from terminal chronic kidney disease (TCKD):

- Specific hospital treatment for TCKD or were registered on the Long-term diseases scheme (ALD) for TCKD. Hence, the patients identified through the identification of pathologies 2:
 - Were hospitalized for:
 - A kidney transplant;
 - And/or monitoring of a kidney transplant;
 - And/or kidney dialysis;
 And/or were registered on the Long-term diseases scheme (ALD) for TCKD.
 - And/or underwent at least 3 CCAM (French Medical Classification for Medical Procedures) kidney dialysis procedures in an ambulatory healthcare structure.
- As well as: specific medication for TCKD (treatment with immunosuppressants for individuals who were undergoing monitoring of a kidney

transplant), with dispensing of medication on at least 3 occasions in an ambulatory structure on different dates.

Failing the above: Identification of patients suffering from moderate CKD (MCKD) or severe CKD (SCKD):

- Were hospitalized for CKD, And/or were registered on the Long-term diseases scheme (ALD) for CKD.
- Failing the above: treatment for CKD:
 - Defined as the combination of a treatment designed to limit progression of CKD (CEI, AA2) and a treatment for complications associated with CKD (iron deficiency anaemia, folic acid deficiency anaemia, anaemia secondary to CKD, treatment of renal sodium and water retention, treatment of phosphor-calcic disorders, or treatment of fluid and electrolyte disorders);
 - With dispensing of medication on at least 3 occasions in an ambulatory healthcare structure on different dates.

Risk factors associated with patients' individual behaviour were difficult to detect

The analysis of the risk factors associated with lifestyles and individual behaviour (obesity, tobacco consumption and alcoholism), exclusively based on data from the National Health Data System (SNDS), revealed an underestimation of their prevalence because the elements needed to identify them were scarce and were most often based on the severity of the pathologies and the resulting complications, or on major procedures carried out in patients who did not consult a doctor for such a reason or at least not early. Hence, only 4% of the victims of a first episode of stroke suffered from obesity that was detectable via the National Health Data system (SNDS), 12% smoked and 3% suffered from alcoholism.

In contrast with results based on pathologies, these results were well below those mentioned in the international and French literature which use additional data (Bejot et al., 2008; Bejot et al., 2010; de Peretti et al., 2017; Lecoffre et al., 2017; Pistoia et al., 2016; Roussot et al., 2015; O'Donnell et al., 2016; and Tuppin et al., 2013). In this literature, the prevalence of obesity is between 35 and 43%, that of tobacco consumption between 13 and 37% and that of alcoholism between 15 and 18%.

The advantages and limitations of using the National Health Data System (SNDS) to identify stroke risk factors

The prevalences of risk factors in this study therefore differed to a greater or lesser extent from the prevalences obtained in health surveys and epidemiological studies conducted amongst the general population or amongst stroke victims. Indeed, the indicators in the literature may have been developed using a different method from that used in

this study and are based on data sources other than the medico-administrative databases. The epidemiological studies, with a population-based survey, for example, make it possible to collect data that is not always available in the medico-administrative databases.

The secondary data matching from surveys and studies with data in the French National Health Insurance's medico-administrative databases highlighted the difference between the prevalence of disease or health behaviour, on the one hand, and healthcare consumption, on the other. The declared or identified diagnosed illnesses are not systematically treated with reimbursable medications and they do not always have an unequivocal indication.

The databases used and the construction of risk factors identification algorithms only identified patients with a known pathology that had been treated (see "Method" inset). 'Treatment of disease' means that the patients were reimbursed by the French National Health Insurance Fund (*Assurance maladie obligatoire*), benefitted from 100% cover for the treatment of a long-term disease (*Affection de longue durée*, ALD) or received hospital treatment for the illness. Furthermore, the algorithms did not identify the patients whose risk factors were known but whose treatment costs were not reimbursed by the French National Health Insurance Fund (such as treatment with hygiene and dietary measures). The reli-

ability of the algorithms also depends on good coding quality. With regard to the identification of the medications, it was carried out under the assumption of compliance with good professional practice guidelines and marketing authorisations (AMM) for the prescription of medications in ambulatory healthcare.

With respect to illnesses, the individuals identified in this study nevertheless constituted a population prone to these credible risk factors, even though the under-diagnosis and inadequate treatment of pathologies is a reality, and there is even a possibility of over-diagnosis and over-treatment.

With respect to behaviours that pose "a health risk", the differences with the literature are due to the fact that the indicators used were different. The medico-administrative databases do not contain any data from qualitative studies or from clinical and additional examinations. There were few tracers for these health risk behaviours and they targeted, for example, amongst obese individuals, only those treated for morbid obesity (there was notably no body mass index (BMI) measurement); amongst the smokers, only those who had given up smoking or, by approximation, individuals suffering from chronic obstructive pulmonary disease (COPD); and amongst individuals with harmful alcohol consumption, only those treated for alcohol addiction.

The National Health Data System (SNDS) thus offers the distinct advantage of data relating to the total population, in the framework of a precise and pragmatic definition of a first episode of stroke, making it possible to make estimates of the prevalence of stroke risk factors on the national level and regional comparisons. Although the stroke records and the clinical studies offer a greater wealth of additional clinical information, the size and specificity of the populations studied do not always make it possible to make projections on the national level or regional comparisons. The use of medico-administrative data may be used for epidemiological purposes with, in addition, several advantages: rapid database availability, the possibility of observation several years prior to the onset of stroke, the low cost of the study, and the routine use of the indicators created. The spatial and temporal monitoring of the indicators created is a veritable tool for adapting preventive measures for the population, in institutions and amongst health professionals.

The complementarity of the sources and studies and perspectives

Taking the points discussed above into account and in order to validate and complement our current results, complementary studies should be considered within our data: the matching of the

METHOD

Algorithms to identify stroke risk factors

They were generally constructed on the following way:

Identification of pathologies: identification of individuals who, during the consecutive 24-month period preceding the first episode of stroke in 2012 (D-1 to M-24), were hospitalized in a healthcare establishment in Medicine, Surgery, and Obstetrics (MSO) with ICD-10 codes specific to a risk factor identified in a significant primary diagnosis, a related diagnosis, or an accompanying diagnosis, and/or were registered as having a long-term disease (ALD), identified by an ICD-10 code specific to that risk factor. Consequently, these pathologies were identified, on the one hand, in the French National Hospital Database (PMSI), and, on the other hand, in the medico-administrative data from the French Health System's inter-scheme consumption data (DCIR). For certain algorithms (obesity, chronic kidney disease, and atrial fibrillation), the identification of pathologies was also made through the identification of certain Homogeneous patient groups (GHM) and certain procedures in the French Medical Classification for Medical Procedures (CCAM) carried out in a hospital, in outpatient treatment or in a freelance healthcare structure.

Failing the above, **identification of medications:** identification of individuals who, during the consecutive 24-month period preceding the first episode of stroke in 2012 (D-1 to M-24), received at least 1 to 3 treatments specifically designed for the identified risk factor in an ambulatory healthcare structure on different dates. Consequently, these medications were identified in the French Health System's inter-scheme consumption data (DCIR).

The identification of medications specifically designed to treat a risk factor was based on the following common method:

- The selection of specific Anatomical, therapeutic and chemical (ATC) classifications.
- The selection of medications with prescription information specific to the risk factor (marketing authorisation).
- The inclusion of medications marketed from D-1 to M-24.
- The exclusion of medications stored in hospitals and/or exclusive of homogeneous groups of stays (Groupes homogènes de séjours, GHS).
- The final selection of the 13-digit identification codes (*Codes identifiants de présentation* (CIP)).

available medico-administrative databases with clinical and epidemiological data would make it possible, on the one hand, to validate risk factor identification algorithms developed in the context of this study, and, on the other hand, to enhance the study with elements that are unobservable in the current results, such as medical, environmental, and socio-economic factors, and access to healthcare, particularly in the pre-hospital phase (before MSO).

The possible identification of stroke risk factors associated with pathologies in this personal data source should make it possible, for example, to target at-risk populations in order to offer them primary preventive measures, before stroke onset, and assess the effectiveness and efficiency of the measures. A spatial study would make it possible to compare prevalences of identified stroke risk factors and refine local preventive measures. The comparison of the prevalences of risk factors observed prior to and after stroke onset, and the evolution of the difference over the years (via the analysis of successive cohorts) would also provide information on the impact of stroke on the downstream treatment for risk factors, and on the development of professional practices in terms of secondary prevention. A series of studies

could focus on the implementation of predictive studies regarding the onset of stroke. Lastly, the integration of the medical causes of death would make it possible to link—or not link—eventual outpatient deaths to stroke and analyse the role played by each of the risk factors in a stroke-related death.

* * *

This research is the first original study in France involving the construction of stroke risk factor identification algorithms—based on medico-administrative databases that combined hospital and ambulatory healthcare data—, conducted over such an extensive period of time. In the National Health Data System (SNDS), the use of the inter-scheme consumption data (DCIR) supplemented and enriched the hospital information from the French National Hospital Database (PMSI), providing new and useful information in terms of stroke prevention and the effective treatment of patients. Indeed, the algorithms for identifying known stroke risk factors developed in this study already constituted—despite their limits—tools that can be implemented by both healthcare professionals and the regulators, who can contribute to the adaptation of preventive measures for the population and

an improvement in professional practices, with the aim of increasing treatment efficiency.

Although they cannot provide comprehensive results on certain data, the clinical studies—together with qualitative and sociological studies—are of course indispensable for shedding light on the elements that are unobservable in this study. Nevertheless, it would be interesting to conduct additional studies on the medico-administrative databases used in this study to complete the observations. An analysis of the temporal evolution of the number of patients identified by the algorithms for identifying developed cardiovascular and neurovascular risk factors would make it possible to refine the initial results. The aim would be to observe the evolution of the treatment for risk factors over the course of the 2010–2014 Stroke National Action Plan (Plan d'actions national AVC) and beyond. Prior to a first episode of stroke, the treatment consists of primary prevention. After a first episode of stroke, the treatment consists of secondary prevention to avoid stroke recurrence. The effects of the Stroke Plan's medium-term measures could thus be assessed, particularly with regard to stroke recurrence and death. ♦

SOURCES

Constitution of the cohort of victims of a first episode of stroke in 2012

The patients were identified in the French National Hospital Database (PMSI) for Medicine, Surgery, and Obstetrics (MSO) for the year 2012, based on the primary diagnosis. The primary diagnoses were sought in anonymised data (*Résumé standardisé anonymisé*, RSA) through the following codes from the tenth revision of the International Classification of Diseases (ICD-10): I60 (subarachnoid haemorrhage), I61 (intracerebral haemorrhage), I62 (other non-traumatic intracranial haemorrhage), I63 (cerebral infarction), I64 (Stroke, not specified as haemorrhage or infarction), and

G45 (transient cerebral ischemic attacks (TIA) and related syndroms). The patients thus identified were included in the sample on the day of their first admission in MSO for stroke or TIA in the year, on condition that they had not been hospitalized for a full ischemic stroke (I63), a haemorrhagic stroke (I60, I61, I62), an unspecified stroke (I64), or a transient ischemic attack (TIA) [G45] during the preceding consecutive 24-month period (D-1 to M-24).

Administrative data and medical consumption data relating to the two years preceding their hospitalization (D-1 to M-24) and the following two

years (D+1 to M+24) was extracted from individual-level data linking, combining information from the French compulsory health insurance system's inter-scheme consumption data (DCIR) with information from the four fields of the French National Hospital Database (MSO, home care (HC), follow-up and rehabilitation care (FRC) services, and psychiatric care (PC)), for each patient identified. The scope included mainland France and the overseas regions and départements (DROM), as well as the three main French compulsory Health insurance schemes (the French Statutory Health Insurance

Fund (Régime général-RG), the NHI Fund for Agricultural Workers and Farmers (*Mutualité sociale agricole*, MSA), the French NHI Fund for Self-Employed (the Régime social des indépendants, or RSI)), the National Military Social Security Fund (*Caisse nationale militaire de sécurité sociale*, or CNMSS)), and the sub-schemes (Sections locales mutualistes, or SLM).

Only patients aged 18 or over who were victims of a first episode of full stroke (I60 to I64) were retained for this study; victims of a TIA (G45) were excluded.

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