



Institut National de Santé Publique, d'Épidémiologie Clinique et de Toxicologie

POLICY BRIEF

PUBLIC HEALTH & EPIDEMIOLOGY AXIS - STROKE

JULY 2020

Title: Stroke in Lebanon: A Roadmap for Evidence-Based Action**Authors:** Lahoud N*, Farah R*, El-Hajj M*, Abdo R*, Malaeb D*, Boutros C*, Sacre H, Salameh P.** authors with equal contribution***SUMMARY**

Given the lack of epidemiological information regarding a major public health problem, the Cerebrovascular Accident (CVA), also known as Stroke, we have evaluated the prevalence, risk factors, cost, and management of this disease in the Lebanese population. We also developed and validated two scores, one for screening and the other for diagnosing stroke. Based on our research, we suggested a list of practical recommendations for the prevention (primary, secondary, and tertiary) and care (transportation, emergencies, intensive care unit admission, treatment) of stroke in Lebanon.

POLICY IMPLICATIONS/MAIN RECOMMENDATIONS TO THE MINISTRY OF PUBLIC HEALTH

- Apply primary care prevention measures in the community, particularly for high risk groups
- Increase awareness of the general population about stroke prevention, early recognition, early intervention and management before hospitalization
- Monitor stroke incidence and risk factors through continuous surveillance; point prevalence repeated assessments can also be useful
- Disseminate the validated scores on stroke symptoms and stroke diagnosis, to apply in research and clinical practice settings
- Improve in-hospital stroke management through special training of dedicated healthcare professionals
- Ensure quality care through appropriate medical charts filling out, and appropriate application of international clinical guidelines
- Ensure adequate implementation of post-stroke recommendations.
- Develop a research policy related to stroke.
- Develop guidelines for the prevention and management of stroke, adapted to the Lebanese context.

SUMMARY OF THE RESEARCH FINDINGS**Primary Prevention of Stroke in Lebanon: Advice about Risk Factors**

- Age (≥ 65 years): The risk of stroke increases with age;
- High blood pressure: Maintain blood pressure below 120/80 mmHg;
- Heart diseases: Keep your heart healthy;
- Medication: Take prescribed medications (antihypertensive and anticoagulant for selected high-risk patients) as recommended by the physician;
- Tobacco (cigarette and waterpipe): Undergo pharmacotherapy and behavioral interventions to maximize smoking cessation;
- Diet: Eat a healthy diet; the Mediterranean Diet has been shown to reduce the risk.

Gaps in Knowledge About Stroke in the General Population

- There are significant gaps in the knowledge of stroke among the elderly population.
- Educational efforts are needed to improve stroke awareness, as better knowledge may improve both primary prevention and early recognition of stroke symptoms and appropriate action.

Prevalence of Stroke in Lebanon

- The prevalence of stroke in Lebanon is higher than that of Arab and other developing countries but lower than that of developed countries (could be due to a higher incidence, better access to healthcare, better diagnosis, or lower mortality).
- The prevalence in North Lebanon is lower than in other governorates (probably due to a higher case fatality rate, misdiagnosis, and the longer distance between patients and hospitals).
- Early mortality (in hospitals) is high (around 20%).
- Small vessel disease is more prevalent in Beirut (probably due to the high prevalence of hypertension, advanced age, or pollution level).
- Smoking is highly prevalent among other risk factors of stroke compared to other countries.

Recommendations for Dealing with Stroke Symptoms Between Onset and Hospitalization

- Developing policies and implementing health promotion to raise awareness of interpreting and appropriately dealing with stroke symptoms after onset.
- There is a clear need to raise awareness about stroke symptoms in the community and take immediate action towards case transportation to hospitals; health promotion activities should be targeting patients (particularly those with comorbidities) and caretakers.
- These recommendations should translate into increased use of emergency services to transport stroke cases (80-85% of patients are transported by families, and only 15-20% by these services).
- At the hospital, applying effective in-hospital management to ensure the prompt evaluation and treatment of patients with acute ischemic stroke and consider dual therapy during the treatment course (if thrombolysis/thrombectomy is not indicated or unavailable).
- Adhering to stroke management standardized protocols and procedures, leading to optimal patient outcomes.
- Optimizing case management after stroke onset should be a priority due to the proven effects on the collective economic burden of the health cost bill.

Stroke Diagnosis Based on Stroke Symptoms in Lebanon

Sensitizing the population for the early detection of stroke symptoms is highly recommended.

- Sudden and strange numbness or dead feeling in the face, arm, or leg
- Sudden and strange weakness in the face, arm, or leg such as having difficulties keeping left or right arm raised high or having a drooping appearance on one side of the face
- Sudden loss of coordination on one side of body
- Sudden trouble in walking
- Sudden loss in vision in one or both eyes
- Sudden confusion in understanding what people were saying
- Trouble expressing oneself verbally or in writing
- Sudden and severe headache with no known cause just before admission
- Sudden vomiting away from a GI infection
- Loss of consciousness

Stroke Diagnosis in Lebanese Hospitals Emergency Rooms

Initial evaluation:

- Age (≥ 65 years): Check if the patient is older than 65 years
- History of hypertension: Investigate if the patient has a history of hypertension
- History of dyslipidemia: Check if the patient has a history of dyslipidemia
- History of cigarette smoking: Check if the patient is a current or former cigarette smoker

Neurological examination (using a standardized stroke scale):

- Sudden and strange numbness or dead feeling in the face, arm, or leg
- Sudden trouble in walking
- Sudden loss in vision in one or both eyes

- Trouble expressing oneself verbally or in writing
- Sudden and severe headache with no known cause just before admission.

Management of stroke in Lebanese Hospitals

Imaging techniques:

- MRI imaging should not be delayed. Time to imaging should be lowered by half.
- There are differences in the management of stroke between private and public hospitals, and between day arrival (day shift) and night arrival (night shift).

Filling out medical charts:

- Some medical records were missing the National Institutes of Health Stroke Scale (NIHSS), a widely used tool developed to assess the cognitive effects of stroke, providing a quantitative measure of stroke-related neurologic deficit.
- Documenting the NIHSS in patients' medical charts to assess stroke severity should be mandatory in all hospitals.

Use of fibrinolytic medications:

- The percentage of thrombolysis in hospitals is very low (around 1%) due to contra-indications, late arrival, and absence of stroke management protocol/units.
- Although it is a vital component in acute stroke management, the use of fibrinolytic medications was limited and sometimes absent, as the time from stroke onset to hospital admission was unknown
- Assess the time from stroke onset to hospital admission to evaluate patients who are candidates to the use of fibrinolytic medications.

Use of antihypertensive agents:

- Overall, acute blood pressure (BP) management was not consistent with international guidelines. Antihypertensive medications were administered at BP levels below the treatment threshold to justify their administration.
- Antihypertensive drugs were administered, although they did not meet the criteria for treatment; this mismanagement is probably due to the unclear policy regarding the use of these medications in the acute setting.
- Before prescribing antihypertensive medications, the threshold of BP should be assessed to avoid overtreatment.
- The choice of antihypertensive agents was not consistent with the guidelines. When antihypertensive treatment is deemed necessary, adherence to the list of medications set by the guidelines is vital.

Post-stroke management

- Physician adherence to secondary stroke prevention guidelines lacks in Lebanese hospitals.
- The inappropriate prescription of post-discharge medications contributes to an increased risk of secondary stroke.
- Improving adherence to post-discharge stroke management (medications in particular) would minimize the recurrence of stroke.
- Symptomatic individuals and those with a history of stroke or Transient Ischemic Attack (TIA), had reduced physical and mental health functions. Monitoring these functions and improving them when possible is warranted.
- Socioeconomic issues and awareness of patients or caregivers have an impact on early post-stroke rehabilitation, which is expensive and not always covered by third-party payers.

Local research and management guidelines

- Concerned authorities should develop a research policy related to stroke.
- They should also adapt guidelines for prevention and management to the Lebanese context.

ABSTRACTS OF MAJOR STUDIES ON STROKE IN LEBANON

1. **Farah R, Zeidan RK, Chahine MN, Asmar R, Chahine R, Salameh P, Hosseini H. Prevalence of stroke symptoms among stroke-free residents: first national data from Lebanon. *International Journal of Stroke*. 2015 Oct; 10:83-8.**

Background: Stroke symptoms are common among people without a history of stroke or transient ischemic attack. Reported stroke symptoms may represent stroke episodes that failed to reach the threshold for clinical diagnosis. Aims: This study aimed to assess in the Lebanese population the prevalence of self-reported stroke symptoms in a stroke- and transient ischemic attack-free population, and the association of these symptoms with major risk factors for stroke. Methods: We carried out a cross-sectional study using a multistage cluster sample across Lebanon. We interviewed residents aged 40 years and more. Stroke symptoms were assessed using the Questionnaire for Verifying Stroke-Free Status. Results: We included 1515 individuals (mean age was 57.2 ± 12.4 years, 783 women, 51.7%). Among 1460 participants stroke- and transient ischemic attack-free, 175 had experienced at least one stroke symptom (12.1%, 95% CI 9.9%–14.3%). Arterial hypertension (adjOR 4.37, 95% CI 2.68–7.12), history of heart disease (adjOR 3.34, 95% CI 2.00–5.56), current waterpipe smoking (adjOR 3.88, 95% CI 2.33–6.48), current and former cigarette smoking (adjOR 1.84, 95% CI 1.18–2.87 and adjOR 2.01, 95% CI 1.13–3.5, respectively), psychological distress (adjOR 1.04, 95% CI 1.02–1.05), the Mediterranean diet score (adjOR 0.87, 95% CI 0.76–0.99), and regular physical activity (adjOR 0.45, 95% CI 0.26–0.77) were independently associated with stroke symptoms. Conclusions: This is the first study conducted in the Middle East, assessing self-reported stroke symptoms among stroke-free residents. Our study showed that almost one in eight residents without a history of stroke or transient ischemic attack has had stroke symptoms. Major vascular risk factors are associated with these symptoms, thus allowing for prevention strategies.

2. **El-Hajj M, Salameh P, Rachidi S, Hosseini H. The epidemiology of stroke in the Middle East. *European Stroke Journal*. 2016 Sep;1(3):180-98.**

Purpose: The purpose of this paper is to review and synthesize data from different countries in the Middle East on stroke and its potential risk factors. Method: A systematic review of all published stroke articles in the Middle East between 1980 and May 2015 was conducted. Findings: Sixty-four papers were included in the review. The incidence rate for all strokes ranged between 22.7 and 250 per 100,000 population per year. The prevalence rate for stroke ranged between 508 and 777 per 100,000 population. Among studies reporting gender differences, 75% reported a high male-to-female ratio among stroke patients. The mean age of stroke was within the sixth and the seventh decade. Ischemic stroke was the most reported type followed by intracerebral hemorrhage and subarachnoid hemorrhage. Hypertension was the most reported risk factor followed by diabetes. The overall case-fatality rate within one month was 12–32%. Discussion: During the last decades, there was an increase in stroke incidence and mortality rates in the Middle East. The Middle East faces low rates of self-awareness and control of non-communicable diseases and also lacks knowledge for stroke risk factors, awareness, causes, and symptoms. Conclusion: There is an urgent need to develop more efficient and accurate methods to measure stroke in the Middle East. There is also a significant call to increase public awareness and implement interventions on stroke and its risk factors and symptoms to help people understand the negative impact of stroke on quality of life and potentially prevent this disease.

3. **Lahoud N, Salameh P, Saleh N, Hosseini H. Prevalence of Lebanese stroke survivors: A comparative pilot study. *Journal of epidemiology and global health*. 2016 Sep 1;6(3):169-76.**

Stroke is a leading cause of morbidity and mortality worldwide and its late burden has mainly been attributable to developing countries. Lebanon is one of these countries where epidemiological studies on stroke burden are scarce but necessary. Thus, the present study was conducted to assess the prevalence of stroke survivors among Lebanese inhabitants. A cross-sectional survey was carried out using randomly selected landline phone numbers on all governorates to retrieve data on stroke survivors and their sociodemographic characteristics. Results were then standardized over the Lebanese and the World Health Organization (WHO) world populations. A total of 6963 Lebanese inhabitants were included in the study; among these were 56 stroke survivors. This led to an adjusted stroke prevalence of 0.50% [95% confidence interval (CI) = 0.33–0.66%] and a world-standardized prevalence of 0.60% (95% CI = 0.42–0.78%). A significantly higher stroke prevalence was found among older age groups and more socioeconomically

privileged areas. Overall, the study showed a relatively higher prevalence of stroke in this sample of Lebanese inhabitants when compared to other developing countries. However, larger community-based studies with a clinical assessment of stroke cases are needed to confirm our findings.

4. **Farah R, Zeidan RK, Chahine MN, Asmar R, Chahine R, Salameh P, Pathak A, Hosseini H. Predictors of uncontrolled blood pressure in treated hypertensive individuals: first population-based study in Lebanon. The Journal of Clinical Hypertension. 2016 Sep;18(9):871-7.**

Arterial hypertension is a leading risk factor for cardiovascular disease and stroke. This study aimed to assess the predictors of uncontrolled systolic and diastolic blood pressure (BP) in Lebanon among treated hypertensive individuals. The authors included 562 participants 40 years and older. The potential predictors included sociodemographic characteristics, self-reported health information, and medication adherence. Prevalence of uncontrolled systolic and diastolic BP reached 43.1% and 24.9%, respectively. Independent predictors of uncontrolled systolic BP were older age, male sex, and low and medium medication adherence level. Predictors of uncontrolled diastolic BP were younger age, obesity, and low medication adherence level. Married individuals and patients taking statins had better diastolic BP control. Uncontrolled BP is a major public health problem in Lebanon. The authors identified low adherence as a major modifiable risk factor for systolic and diastolic BP control and obesity as a major modifiable risk factor for diastolic BP control.

5. **Lahoud N, Abbas MH, Salameh P, Saleh N, Abes S, Hosseini H, Gebeily S. A retrospective analysis of 254 acute stroke cases admitted to two university hospitals in Beirut: classification and associated factors. Functional neurology. 2017 Jan;32(1):41.**

Lebanon is a developing country where the prevalence of stroke subtypes and their correlation with risk factors have not been studied, even though stroke management is an ongoing major national healthcare challenge. In a retrospective study conducted in two university hospitals, data were collected on all stroke cases admitted in 2012 and 2013. Ischemic strokes were then classified according to a modified TOAST classification. A total of 254 inpatients (mean age 68.41 years \pm 13.34, 55.1% males) was included in the study; of these, 15% had had a hemorrhagic stroke and was therefore excluded. Conversely to findings from studies in other Arab and Asian countries, where small vessel disease is the most frequent subtype, our study showed a predominance of large artery atherosclerosis (53.5%) which, in comparison with other subtypes, was found to be associated with dyslipidemia (OR= 3.82, 95% CI= [1.76–8.28]; $p=0.001$). Cardioembolic stroke and small vessel disease were found to be positively associated with aging and living in Beirut, respectively. Larger studies are needed to explain these findings.

6. **Abdo R, Hosseini H, Salameh P, Abboud H. Coût direct hospitalier des AVC au Liban. Revue Neurologique. 2017 Mar 1;173:S100.**

Introduction : Les accidents vasculaires cérébraux (AVC) constituent un véritable problème de santé publique au Liban avec une charge importante tant sur le plan médical que social et économique. Objectifs : L'objectif de cette étude était d'évaluer le coût direct hospitalier des AVC dans les régions de Beyrouth et Mont Liban, Liban. Patients et méthodes : Il s'agissait d'une étude transversale prospective qui s'est déroulée sur une période d'un an (août 2015 à août 2016). Les patients âgés de plus de 18 ans, hospitalisés pour AVC étaient inclus dans l'étude. Les données concernant les différents postes de consommation ont été collectées, de même les données démographiques, socio-économiques et cliniques des malades. L'unité du coût était le Dollars Américain (USD). Le coût direct médical, le coût par vie sauvée et par année de vie sauvée ont été calculés. Résultats : Deux cent trois patients [57 % hommes] étaient inclus dans cette étude. L'âge moyen était de 68,8 \pm 12,9 ans. La durée moyenne d'hospitalisation était de 11,5 \pm 13,8 jours. Le coût moyen était de 1364 pour l'AIT (n = 15), 3613 pour l'AVC ischémique (n = 144), 9880 pour l'AVC ischémique avec transformation hémorragique (n = 14), 12 318 pour l'AVC hémorragique (n = 14), et 21 679 USD pour l'hémorragie sous arachnoïdienne (n = 16). Le coût par vie sauvée et par année de vie sauvée était 6226 et 6485 USD respectivement. Discussion : Les meilleurs prédicateurs du coût élevé étaient une hémorragie méningée, un NIHSS élevé à l'admission et la durée du séjour (en unité de soins normales et intensifs). Une meilleure prise en charge en phase aiguë, des examens complémentaires diagnostiques devraient réduire le coût des AVC. Conclusion : C'est la première étude qui a permis d'avoir une idée sur ce que dépense le patient, l'état et les compagnies d'assurance à la phase aiguë d'un AVC au Liban.

7. **El-Hajj M, Salameh P, Rachidi S, Al-Hajje A, Lahoud N, Hassan H. Stroke risk factors: a hospital-based case-control study in Lebanon. JR Soc Med Open. 2017; 8(6):1-0.**
Objective: There is scarcity of reliable information on stroke in Lebanon. We aim to determine the potential risk factors for stroke in the Lebanese population. Design: A retrospective case-control study was conducted between January 1st, 2012 and December 31st, 2014 at two different tertiary hospitals in Lebanon. Data were collected through a designed data collection sheet. A multiple logistic regression determined stroke risk factors. The strength of association between the dependent variable and independent variables was expressed in odds ratio (OR) through 95% confidence interval. Setting: Lebanon
Participants: Lebanese hospitalized patients. Main outcome measures: Stroke risk factors. Results: Overall, 202 stroke cases and 530 stroke-free controls were included. The mean age of stroke was 68+/-13 years. Age, smoking and a history of hypertension, cardiac arrhythmia, coronary heart disease/myocardial infarction, deep venous thrombosis/pulmonary embolism, and migraine were significantly associated with high risk of stroke. Grade 3 blood pressure had the highest OR (44.112; 95% CI, 16.144–120.528). Conclusions: The results of this study confirm the significant contribution of certain well-identified risk factors with stroke. Modifying, treating and controlling major stroke risk factors through medications or lifestyle change would result in having a second change in the Lebanese population. Therefore, we recommend implementing preventive strategies on those pathologies to reduce the risk of total stroke in Lebanon.
8. **Salameh P, Zeidan RK, Hallit S, Farah R, Chahine M, Asmar R, Hosseini H. Cardiovascular Diseases and Long-Term Self-Reported Exposure to Pollution: RESULTS OF A NATIONAL EPIDEMIOLOGICAL STUDY IN LEBANON. Journal of cardiopulmonary rehabilitation and prevention. 2018 Nov.**
Background: Cardiovascular diseases (CVDs) are linked to high mortality and morbidity, particularly in developing countries. Some studies have linked indoor and outdoor pollution to CVD, but results are inconsistent. Our objective was to assess this association in Lebanon, a Middle Eastern country. Methods: A national cross-sectional study was conducted across Lebanon. CVD prevalence, which included prevalent ischemic heart and cerebrovascular diseases, was assessed. Moreover, in addition to self-reported items of pollution exposure, we assessed potential predictors of CVD, including sociodemographic characteristics, self-reported health information, and biological measurements. Results: We assessed the dose-effect relationship of pollution items in relation with CVD. Self-reported indoor and outdoor pollution exposures were associated with CVD, with or without taking biological values into account. Moreover, we found a dose-effect relationship of exposure with risk of disease (44% increase in risk of CVD for every additional pollution exposure item), after adjustment for socio-demographic and biological characteristics. Conclusion: Although additional studies would be necessary to confirm these findings, interventions should start to sensitize the population about the effect of pollution on chronic diseases and the work of reducing pollution and improving air quality should be implemented to decrease the disease burden on the population and health system.
9. **Salameh P, Chahine M, Hallit S, Farah R, Zeidan RK, Asmar R, Hosseiny H. Hypertension prevalence and living conditions related to air pollution: Results of a national epidemiological study in Lebanon. Environmental Science and Pollution Research. 2018 Apr 1;25(12):11716-28.**
Hypertension is a risk factor of several diseases, linked to high mortality and morbidity, particularly in developing countries. Some studies have linked indoor and outdoor pollution exposure items to hypertension, but results were inconsistent. Our objective was to assess the association of living conditions related to air pollution to hypertension in Lebanon, a Middle Eastern country. A national cross-sectional study was conducted all over Lebanon. Blood pressure and its related medications were assessed to be able to classify participants as hypertensive or not. Moreover, in addition to living conditions related to air pollution exposure, we assessed potential predictors of hypertension, including sociodemographic characteristics, self-reported health information and biological measurements. Furthermore, we assessed dose-effect relationship of air pollution items in relation with hypertension. Living conditions related to indoor and outdoor air pollution exposures were associated with hypertension, with or without taking biological values into account. Moreover, we found a dose-effect relationship of exposure with risk of disease (15% increase in risk of disease for every additional pollution exposure item), after adjustment for sociodemographics and biological characteristics (Ora = 1.15 [1.03–1.28]). Although additional studies would be necessary to confirm these findings, interventions should start to sensitize the population about

the effect of air pollution on chronic diseases. The work on reducing pollution and improving air quality should be implemented to decrease the disease burden on the population and health system.

10. **Salameh P, Farah R, Hallit S, Zeidan RK, Chahine MN, Asmar R, Hosseini H. Self-reported history of stroke and long-term living conditions near air pollution sources: results of a national epidemiological study in Lebanon. Environmental monitoring and assessment. 2018 Mar 1;190(3):153.**

Stroke is a disease related to high mortality and morbidity, particularly in developing countries. Some studies have linked self-reported indoor and outdoor pollution to stroke and mini-stroke, while some others showed no association. Our objective was to assess this association in Lebanon, a Middle Eastern developing country. A national cross-sectional study was conducted all over Lebanon. In addition to self-reported items of pollution exposure, we assessed potential predictors of stroke and mini-stroke, including sociodemographic characteristics, self-reported health information, and biological measurements. Moreover, we assessed dose-effect relationship of pollution items in relation with stroke. Self-reported indoor pollution exposure was associated with stroke and mini-stroke, with or without taking biological values into account. Moreover, we found a dose-effect relationship of exposure with risk of disease, but this effect did not reach statistical significance after adjustment for socio-demographics and biological characteristics. No association was found for any outdoor pollution item. Although additional studies would be necessary to confirm these findings, sensitizing the population about the effect of pollution on chronic diseases, working on reducing pollution, and improving air quality should be implemented to decrease the burden of the disease on the population and health system.

11. **El-Hajj M, Salameh P, Rachidi S, Al-Hajje A, Hosseini H. Development of a diagnosis score for stroke in the Lebanese population. Clinical Epidemiology and Global Health. 2018 Feb 2.**

Underdiagnosing a stroke at emergency may have devastating consequences on patients. We aim to develop a diagnosis score for stroke at emergency among the Lebanese population by using stroke risk factors and symptoms. A hospital-based case-control study was conducted for the score generation. Data were collected through a designed data collection sheet at two Lebanese tertiary hospitals between January 1st, 2012 and December 31st, 2014. A logistic regression determined the association of stroke risk factors and symptoms, and the rounded coefficients generated the Diagnosis Score for Stroke (DS-Stroke). Another case-control study was conducted for the score validation. Data were collected through a standardized questionnaire at five different Lebanese tertiary hospitals between January 1st, 2015 and December 31st, 2016. DS-Stroke was validated by comparing it to hospitals final diagnosis. DS-Stroke was constructed with good properties, comprising 7 items. The area under the curve was high at 0.980 (0.969–0.990; $p < .001$). A score <4 points indicated a high negative predictive value of stroke of 97.3%. A score ≥ 4 points indicated a positive predictive value of stroke of 91.3%. In the validation study, DS-Stroke had an area under the curve of 0.964 (95% CI, 0.951–0.978; $p < .001$), 93.2% sensitivity, 91.9% specificity, and 84.1% positive predictive value and 96.7% negative predictive value. In conclusion, the DS-Stroke is a useful tool for emergency physicians, non-specialists and front-line clinicians. It is a good diagnosis tool for use to diagnose stroke at emergency, call for further emergency testing if necessary and speed up treatment.

12. **Lahoud N, Salameh P, Hosseini H, Saleh N, Rizk E, Hallit S, Abbas MH, Gebeily S. Care and Discharge Outcome of Acute Stroke in Lebanon: A Hospital-Based Study. The Journal of nervous and mental disease. 2018 Aug 1;206(8):637-43.**

The present study was conducted to assess stroke care and outcomes in two Lebanese hospitals. Patients admitted in 2012 and 2013 were retrospectively selected. Data were extracted from medical records for time to hospital arrival, stroke severity, management, and discharge outcomes. A Cox regression analysis was then conducted to predict time to in-hospital death. A total of 201 patients were included (mean age = 69.2 years), among whom 50% arrived within a delay of 3.75 hours. Half underwent brain imaging in the first hour, and nine patients received an acute intervention. Forty-four patients died at the hospital; 142 were discharged home, among whom 98 patients were dependent in their daily activities. Stroke severity on admission and time from onset to arrival were found to be significantly associated to the time to in-hospital death (adjusted hazard ratio [HRa] = 1.13 and HRa = 0.98 respectively; $p < 0.05$). The study sheds light on high case fatality and dependency rates at discharge among stroke patients in Lebanese hospitals.

13. **Salhab HA, Salameh P, Hajj H, Hosseini H. Stroke in the Arab World: A bibliometric analysis of research activity (2002–2016). *eNeurologicalSci*. 2018 Nov 22.**
Background: The Arab world has an increasing prevalence of strokes, a leading cause of death in this part of the world. Aims: The aim of this article is to quantify the stroke research activity in the Arab countries over the past 15 years taking into consideration the population, GDP, and DALY of each country. Methods: A PubMed search was conducted to find stroke research articles published from the Arab countries between 2002 and 2016 (inclusive). Medical subject headings related to strokes and author origin/affiliation were used for this purpose. Results: The Arab world only produced 0.51% of all the stroke-related publications on PubMed even though the stroke-related DALY percentage in this region was greater than 2.88% during the period we studied. In general, the number of publications increased in the last few years. Somalia came first regarding the percentage of stroke to non-stroke publications released. Lebanon had the highest number of publications per GDP (in US Billion Dollars), Qatar had the highest number of publications per million persons (PPMP), while Saudi Arabia had the highest number of publications per 1% of stroke DALY. In addition, a strong positive correlation was found between the number of stroke publications and GDP; however, the correlation between the number of stroke publication and either population size or DALY was a weak positive one. Conclusions: A general increase in publications is noticed, but stroke research activity in the Arab world is still poor compared to other parts of the world.
14. **El-Hajj M, Salameh P, Rachidi S, Al-Hajje A, Hosseini H. Development of a risk of stroke score in the Lebanese population. *Clinical Epidemiology and Global Health*. 2018 Feb 23.**
Background/Aims: As in all developing countries, there could be a large number of stroke cases that can be prevented provided that individuals at risk are recognized. We aim to develop a score for screening individuals at risk of stroke in the Lebanese population. Methods: A hospital-based case-control study was conducted for the score generation. Data were collected through a designed data collection sheet at two Lebanese tertiary hospitals between January 1st, 2012 and December 31st, 2014. A logistic regression determined the association of stroke risk factors with stroke, and the rounded coefficients generated the Risk of Stroke Score (ROSS). Another case-control study was conducted for the score validation. Data were collected through a standardized questionnaire at five different Lebanese tertiary hospitals between January 1st, 2015 and December 31st, 2016. ROSS was validated by comparing it to hospitals final diagnosis. Results: ROSS was constructed with good properties, comprising 10 items. The area under the curve was high at 0.869 (0.838–0.899; $p < 0.001$). A score < 2 points indicated a 94.4% high negative predictive value of stroke. A score > 10 points had more than 85.4% positive predictive value of stroke. In the validation study, ROSS had an area under the curve of 0.826 (0.790–0.863; $p < 0.05$), 88.7% negative prediction value and 96.2% positive prediction value. Conclusion: It is highly recommended to use the ROSS, particularly in the primary care setting, as a good assessment tool to predict stroke among high-risk people and encourage them to get involved in intervention programs to prevent this disease.
15. **Abdo RR, Abboud HM, Salameh PG, Jomaa NA, Rizk RG, Hosseini HH. Direct Medical Cost of Hospitalization for Acute Stroke in Lebanon: A Prospective Incidence-Based Multicenter Cost-of-Illness Study. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing*. 2018 Aug;55: 0046958018792975.**
Stroke is a major social and health problem posing heavy burden on national economies. We provided detailed financial data on the direct in-hospital cost of acute stroke care in Lebanon and evaluated its drivers. This was an observational, quantitative, prospective, multicenter, incidence-based, bottom-up cost-of-illness study. Medical and billing records of stroke patients admitted to 8 hospitals in Beirut over 1 year were analyzed. Direct medical costs were calculated, and cost drivers were assessed using a multivariable linear regression analysis. In total, 203 stroke patients were included (male: 58%; mean age: 68.8 ± 12.9 years). The direct in-hospital cost for all cases was US\$1 413 069 for 2626 days (US\$538 per in-hospital day). The average in-hospital cost per stroke patient was US\$6961 \pm 15 663. Hemorrhagic strokes were the most costly, transient ischemic attack being the least costly. Cost drivers were hospital length of stay, intensive care unit length of stay, type of stroke, stroke severity, modified Rankin Scale, third party payer, surgery, and infectious complications. Direct medical cost of acute stroke care represents high financial burden to Lebanese health system. Development of targeted public health policies and

primary prevention activities need to take priority to minimize stroke admission in future and to contain this cost.

16. **Abdo R, Abboud S, Hosseiny H, Salameh P. Mortality and predictors of death post stroke: Data from a multicenter prospective cohort of Lebanese stroke patients. Journal of Stroke and Cerebrovascular Diseases, 2018. 28(4):859–868. doi: 10.1016/j.jstrokecerebrovasdis.2018.11.033.**
Background: Despite efforts to reduce stroke mortality rates, the disease remains a leading cause of death in Lebanon highlighting the importance of understanding risk factors and subsequent mortality. We examined mortality rates during the first year after acute stroke and the major short-term (1-month) and long-term (1-year) mortality predictors. Methods: Data were collected prospectively on hospitalized stroke patients from eight hospitals in Beirut during a 1-year period. Patients were followed up for 1-year or until death. Mortality rates were assessed at 1-month and at 1-year post stroke and predictors of death were evaluated using Cox proportional hazard model. Results: A total of 203 stroke patients were included. Survival data were completed for over 97% of patients. Cumulative mortality rates were 13.3% at 1-month and 21.2% at 1-year. Predictors of short-term and long-term mortality in univariate analysis were low socioeconomic status, intensive care unit admission, decreased level of consciousness, stroke severity and presence of complications. Marital status also predicted short-term mortality, while age >64 years and surgery need were also long-term mortality predictors. In multivariate analysis, stroke severity and presence of complications were predictors of death at 1-month and at 1-year. Low socioeconomic status, dependency in daily living activities, and the presence of co-morbidities were additional predictors of 1-year mortality. Conclusion: Approximately one over five of patients did not survive 1-year after stroke. There is a need for aggressive intervention to improve stroke knowledge, warning and prevention which may reduce this high stroke mortality rate in Lebanon.
17. **Salameh P, Zeidan RK, Hallit S, et al. Cardiovascular Diseases and Long-term Self-Reported Exposure to Pollution: RESULTS OF A NATIONAL EPIDEMIOLOGICAL STUDY IN LEBANON. J Cardiopulm Rehabil Prev. 2019;39(1):43–49. doi:10.1097/HCR.0000000000000378.**
Background: Cardiovascular diseases (CVDs) are linked to high mortality and morbidity, particularly in developing countries. Some studies have linked indoor and outdoor pollution to CVD, but results are inconsistent. Our objective was to assess this association in Lebanon, a Middle Eastern country. Methods: A national cross-sectional study was conducted across Lebanon. CVD prevalence, which included prevalent ischemic heart and cerebrovascular diseases, was assessed. Moreover, in addition to self-reported items of pollution exposure, we assessed potential predictors of CVD, including sociodemographic characteristics, self-reported health information, and biological measurements. Results: We assessed the dose-effect relationship of pollution items in relation with CVD. Self-reported indoor and outdoor pollution exposures were associated with CVD, with or without taking biological values into account. Moreover, we found a dose-effect relationship of exposure with risk of disease (44% increase in risk of CVD for every additional pollution exposure item), after adjustment for sociodemographic and biological characteristics. Conclusion: Although additional studies would be necessary to confirm these findings, interventions should start to sensitize the population about the effect of pollution on chronic diseases and the work of reducing pollution and improving air quality should be implemented to decrease the disease burden on the population and health system.
18. **El-Hajj M, Salameh P, Rachidi S, Al-Hajje A, Hosseini H. Cigarette and Waterpipe Smoking are Associated with the Risk of Stroke in Lebanon. J Epidemiol Glob Health. 2019;9(1):62–70. doi:10.2991/jegh.k.181231.002.**
Cigarette and waterpipe (shisha and hookah) smoking are main public health concerns in Lebanon. We aim to assess the relationship between smoking and stroke, mainly waterpipe smoking, to better apply preventive and therapeutic interventions. A case-control study was conducted at five tertiary private and governmental hospitals in Lebanon between January 1st, 2015 and December 31st, 2016, using a standardized questionnaire. A stepwise ascending logistic regression was conducted. Odds ratio through 95% confidence interval (CI) expressed the degree of association among variables. In total, 650 patients were involved in the study with 205 stroke cases and 445 stroke-free normal individuals considered as controls. The risk of stroke was found to increase significantly among current cigarette smokers; total stroke Odds ratio (OR) = 2.79 (95% CI, 1.72-4.54), ischemic stroke OR = 2.59 (95% CI, 1.46-4.59), and hemorrhagic stroke OR = 4.25 (95% CI, 1.33-13.59). The risk of total and ischemic stroke was also found

to increase significantly among current waterpipe smokers; OR 4.99 (95% CI, 2.07-11.99) and 6.25 (95% CI, 2.26-17.39), respectively. Moreover, waterpipe smoking was observed to have a stronger association with stroke in current cigarette smokers than non-smokers. Waterpipe smoking was found to be associated with stroke in this study. Moreover, this association is stronger among cigarette smokers, demonstrating a quantitative interaction between waterpipe and cigarette smoking.

19. **Malaeb D, Cherri S, Hallit S, Saade S, Hosseini H, Salameh P. Assessment of post discharge medication prescription among Lebanese patients with cerebral infarction: Results of a cross-sectional study. Clin Neurol Neurosurg. 2020; 191: 105674. doi:10.1016/j.clineuro.2020.105674.**
Objectives: The study objective was to investigate the degree of physician adherence with the international guidelines for post-stroke discharge medications among Lebanese hospitals. Patient and methods: This retrospective observational study was conducted in three Lebanese hospitals between January 2016 and December 2017. Results: Out of 200 patients with stroke, 64.7 % were males. The difference of systolic blood pressure from baseline, 2 h, and after 24 h showed significant decrease by mean value 25.18 ± 33.45 ($P < 0.001$), and 6.44 ± 22.11 ($P = 0.019$) respectively. Also diastolic blood pressure showed significant decrease between baseline and after 24 h by a mean value 12.17 ± 13.63 (P value <0.001). Concerning post discharge medications adherence, antithrombotic drugs showed the highest percentage (73 %) followed by antihypertensive and lipid lowering agents by comparable results (47.5 % and 40.7 % respectively). The physician adherence for the three medications together showed (30.4 %). Conclusion: Secondary prevention for critical diseases such as stroke appears to be inadequate in the study area.
20. **Khalil H. and Lahoud N. Knowledge of Stroke Warning Signs, Risk Factors, and Response to Stroke among Lebanese Older Adults in Beirut. Journal of Stroke and Cerebrovascular Diseases accepted January 28, 2020. doi:10.1016/j.jstrokecerebrovasdis.2020.104716.**
Background: Stroke is the second leading cause of death and the third leading cause of disability worldwide. In Lebanon, recent studies have shown that stroke prevalence may be higher compared to other developing countries. Stroke outcome is known to be affected by the level of stroke awareness in the community. While older people are particularly vulnerable to stroke, research suggests that they have poor awareness of stroke symptoms and risk factors. The aim of this study to assess the level of stroke awareness in the Lebanese population whose ages are 50 and above and conduct a subgroup analysis of stroke concern. Methods: A cross sectional community based survey was conducted at 20 pharmacies in Beirut through face to face interviews utilizing a structured questionnaire composed of open and closed ended questions. Questions assessed general knowledge of stroke, symptoms, risk factors, and intended behavior in case of stroke suspicion. Results: In total, 390 participants agreed to complete the questionnaire. Of the participants, 266 (68.2%) were able to spontaneously recall at least one stroke symptom, most frequently headache, hemiparesis, and dizziness. Knowledge of both numbness/weakness and speech difficulties was recalled by only 15.6%. The majority of participants (85.4%), spontaneously recalled at least one risk factor, most frequently hypertension, smoking and stress. More than half of the sampled population (57.69%) would call emergency services in case of stroke suspicion. Knowing a stroke patient and educational level were predictors for recall of more symptoms and risk factors for stroke. Activation of emergency medical services was positively associated with identification of more stroke symptoms but inversely associated with having diabetes.
21. **Kamal H., Salhab D., Messi R. and Lahoud N. entitled: Evaluation of stroke pre-hospital management in Lebanon from symptoms onset to hospital arrival and impact on patients' status at discharge: A Pilot Study (launched in 2019 and still ongoing). Results to be published in 2021.**
Background: Stroke is a public health problem that has considerable effects on the quality of life of stroke patients and on the health system as a whole. Managing stroke cases following symptoms onset is critical and engages the patients and their parents or caregivers, EMS, and hospitals. The quality of managing stroke cases in both, the pre-hospital and the in-hospital phases is critically relevant to patients' prognosis. Objectives: This study explores the patterns of stroke management in the pre-hospital phase and the early phase of hospitalization. It also assesses the influence of the latter on stroke prognosis at discharge alongside other parameters such as the perceived awareness and attitudes towards stroke symptoms. Methods and materials: The study was carried out in 11 hospitals located in Beirut and Bekaa' governorates of Lebanon. Following a prospective observational design, data were collected on patients admitted for stroke like symptoms between April and July 2019. Time from symptoms onset to emergency call time

(OCT) and to hospital arrival (ODT) were recorded as well as door to imaging time (DIT). The modified Rankin scale (mRS) was used to assess patients' prognosis at discharge. Data were analyzed using SPSS version 21.0. Bivariate and multivariable analyses were conducted to assess factors associated with ODT, stroke prognosis, and length of stay (LOS). Results: The study sample had a mean age of 70 years and 40% were illiterate. The majority of the respondents were hypertensive (71.4%) and were not aware of stroke symptoms (72.5%), 85% of all the respondents arrived early to the hospital (≤ 3 hours) and 67% had late imaging (> 20 min). Investigating the factors that affected pre-hospital management, ODT was associated with the distance ($p = 0.029$), the first action taken after symptoms onset ($p = 0.016$), and having diabetes Mellitus ($p = 0.013$). LOS was associated with a dual anti-coagulant therapy protocol ($p = 0.013$), having an early DIT < 20 min ($p = 0.023$) and an abnormal level of Creatinine ($p = 0.028$). The mRs at discharge was associated with the OCT ($p = 0.046$) and the mRs at arrival ($p = 0.049$). Conclusion: The study findings make it imperative to recommend policy and practice health promotion efforts to raise the awareness about interpreting and properly dealing with stroke symptoms after onset. Such recommendations should be reflected in a higher utilization of the EMS in the transportation of stroke cases (80-85% of patients are transported by their families and only 15-20% by the EMS services).

22. **Bou Ali I, Farah R, Zeidan RK, et al. Stroke symptoms impact on mental and physical health: A Lebanese population based study [published online ahead of print, 2020 Jul 8]. Rev Neurol (Paris). 2020; S0035-3787(20)30601-9. doi:10.1016/j.neurol.2020.03.026.**

Background/objective: Stroke symptoms in the absence of diagnosed stroke are common worldwide and associated with stroke risk factors and great impact on the physical and mental health functioning. The aim of this study was to assess, at the national level, the association of stroke symptoms with mental and physical health. Methods: Quality of life was assessed using physical and mental component summary scores (PCS and MCS) of the Short Form 12v2 Health Survey in the Lebanese population. We assessed the differences in the mean PCS and MCS scores among asymptomatic individuals with no stroke/transient ischemic attack (TIA) history ($n = 1167$), symptomatic individuals with no stroke/TIA history ($n = 125$) and those with stroke/TIA history ($n = 46$). Psychometric properties of the Lebanese version of the SF- 12v2 were evaluated using principal component analysis. Results: Symptomatic individuals had an average PCS scores of 2.31 (95%CI: 0.75-3.88) points lower and those with stroke/TIA history had 3.26 (95%CI: 1.01-5.51) points lower when compared with asymptomatic individuals with no stroke/TIA history. Similarly, MCS scores for symptomatic individuals were 2.58 (95%CI: 1.02-4.13) points lower and those with stroke/TIA history had 3.28 (95%CI: 1.06-5.50) points lower than asymptomatic individuals. Conclusion: Physical and mental health functioning declined among symptomatic individuals and those with stroke/TIA history. Thus, frequent monitoring for the early detection of stroke symptoms may be recommended.