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Epidemiology of Stroke in the MENA Region: A Systematic Review

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Abstract

Introduction

Stroke is a major burden on the health system due to high fatality and major disability in survivors. Whilst Stroke incidence has declined in the developed world, it continues to increase in developing nations, including the MENA (Middle East and North Africa) region. This may reflect different risk factors and strategies to treat and manage patients prior to and after Stroke.

Methods

We have conducted a systematic review of the prevalence, incidence and mortality of Stroke in the 23 countries of MENA region following the PRISMA guidelines.

Results

8,874 published papers were retrieved through both PubMed and Embase. Of those, 38 studies were found to be eligible for inclusion in this review. Only thirteen countries in the MENA region had data points for the critical stroke parameters. Of these qualified studies, 14 were prospective, population-based studies. In the age-adjusted studies, incidence ranged widely between 16/100,000 in a prospective population-based in Iran to 162/100,000 in Libya. Age-adjusted prevalence was available only from Tunisia at 184/100,000. Mortality for all strokes from the eight countries reporting this measure found the 30-day-case fatality ranged from 9.3% in Qatar to 30% in Pakistan.Most stroke studies in the MENA region were small sized, hospital-based, lacked confidence intervals and did not provide prevalence and mortality figures.

Conclusion

National policymakers, public health and medical care stakeholders need more reliable epidemiologic studies on Stroke from the MENA region to plan more effective preventive and therapeutic strategies.

Keywords: Stroke; MENA ; Incidence; Prevalence; Mortality

Abbreviations

ICH: Intracerebral Hemorrhage; TIA: Transient Ischemic Attack; MENA: Middle East and North Africa; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses; MESH: Medical Subject Headings; Emtree: EMBASE Subject Headings.

Introduction

Stroke is a major burden on health systems due to high fatality rates and major disability in survivors [1]. Despite a decline in stroke incidence in the developed world, developing nations are witnessing a growing problem [2]. Indeed, over 80% of all stroke deaths in the world occur in developing countries. This includes the MENA (Middle East and North Africa) region, which includes heavily populated and lesser-developed countries as well as more developed countries with varied ethnic groups from South Asia and South-east Asia [3,4].

Studies have shown that different ethnic groups have different lifestyle, demographic, and/or socioeconomic factors and resultant epidemiological patterns and outcomes of stroke. The ability to deliver effective strategies to prevent and manage stroke can impact significantly on morbidity and mortality in stroke [5-7].

Since stroke prognosis, risk factor management and treatment strategies differ when stroke incidence, prevalence and mortality in populations are considered, we undertook a systematic review of studies on stroke in the MENA region.

Methods

Data sources and search strategy

We conducted a systematic review of the prevalence and incidence of Stroke in the 23 countries of MENA region (Sudan, Somalia, Djibouti, Pakistan, Afghanistan, Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Libya, Iran, Iraq, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, Palestine and Yemen) (Figure 1). The review was conducted following the PRISMA guidelines and the PRISMA checklist can be found in Supporting Information [8]. Our search criteria and methods can be delineated in Figures (2). Briefly, PubMed and EMBASE databases were used for this review. The databases were searched using text terms and MeSH/Emtree terms exploded to cover all sub-headings, encompassing 30 years between 1985 and 2016. We used a broad search criterion with no restrictions for language, or year of publication.

Study selection

The search results were imported to a reference manager, Endnote, and screened for duplicate papers. After exclusion of duplicates the titles and abstracts of the final set of distinctive papers was exported to Microsoft Excel. All the extracted articles were screened for relevance by four authors (HG, AM, SA and DD). The process of screening was conducted in two separate steps: First level of screening involved screening titles and abstracts of all papers to exclude all non-relevant articles; second level involved screening the full-text of all relevant or potentially relevant articles thus, excluding all non-eligible articles. Since the review extend over several years (2013-17) two pairs of reviewers were involved. In each case, after the both authors screened the articles, the excluded papers were reviewed by the opposite author. Thus, insuring that no eligible article is lost. Discrepancies were settled by the lead author (LJS). Any paper reporting the incidence or prevalence of stroke based on primary data were included in this review. For additional sources of data, the authors checked the reference lists of included articles and identified publications to supplement our searches. All forms of study designs except literature reviews, case reports, case series editorials, and letters to editors were included in the review. A publication is included in the review if it had a data point on either the prevalence of any type strokes, or the incidence of any type of stroke, or both.

Data extraction and data synthesis

Data from relevant articles was extracted primarily by four authors, HG, AM, SA and DD, for the following indicators: author, year of publication, year of study, country of study, study design, sampling technique, population, sample size, stroke incidence and stroke prevalence. Stroke parameter of incidence and prevalence were generally expressed as 100,000 population (persons) per year. We made no note of the mix of ethnicity or immigration status of the populations cited in our review. Though the articles were not search for mortality and risk factors, this information was extracted from relevant reports when available. Data was extracted from abstracts when the full text was unavailable. Author DD screened any studies in Arabic or French. The schematic of the study selection process was adapt-

Figure 1: Map of the MENA region involved in this systematic review of Stroke in the MENA region. Figure courtesy of Prof. Abu Raddad and author on this review.

PubMed: ("Stroke"[Mesh] OR "Ischemic attack, transient"[Mesh] OR "Hemorrhage"[Mesh] OR "Stroke"[Text] OR "TIA"[Text] OR "Hemorrhage"[Text]) AND ("Middle East"[Mesh] OR "Islam"[Mesh] OR "Arabs"[Mesh] OR "Arab World"[Mesh] OR "Africa, Northern"[Mesh] OR "Sudan"[Mesh] OR "Somalia"[Mesh] OR "Djibouti"[Mesh] OR "Pakistan"[Mesh] OR "Middle East"[Text] OR "Middle-East"[Text] OR "North Africa"[Text] OR "North-Africa"[Text] OR "EMRO"[Text] OR "Eastern Mediterranean"[Text] OR "Arab"[Text] OR "Arabs"[Text] OR "Arab World"[Text] OR "Islam"[Text] OR "Afghanistan"[Text] OR "Algeria"[Text] OR "Bahrain"[Text] OR "Djibouti"[Text] OR "Egypt"[Text] OR "Jordan"[Text] OR "Kuwait"[Text] OR "Lebanon"[Text] OR "Libya"[Text] OR "Iran"[Text] OR "Iraq"[Text] OR "Morocco"[Text] OR "Oman"[Text] OR "Pakistan"[Text] OR "Qatar"[Text] OR "Saudi Arabia"[Text] OR "Somalia"[Text] OR "Sudan"[Text] OR "Syria"[Text] OR "Tunisia"[Text] OR "United Arab Emirates"[Text] OR "Dubai"[Text] OR "Abu Dhabi"[Text] OR "Abu-Dhabi"[Text] OR "Sharjah"[Text] OR "West Bank"[Text] OR "Ghaza"[Text] OR "Palestine"[Text] OR "Yemen"[Text])

Embase: (exp cerebrovascular accident/ or cerebrovascular accident.mp. or exp bleeding/ or bleeding.mp. or exp transient ischemic attack/ or transient ischemic attack.mp. or subarachnoid hemorrhage.mp.) and (exp Middle East/ or exp North Africa/ or exp Arab/ or exp Afghanistan/ or exp Djibouti/ or exp Pakistan/ or exp Somalia/ or exp Sudan/ or Middle East.mp. or North Africa.mp. or EMRO.mp. or Eastern Mediterranean.mp. or Arab.mp. or Arabs.mp. or Arab World.mp. or Islam.mp. or Afghanistan.mp. or Algeria.mp. or Bahrain.mp. or Djibouti.mp. or Egypt.mp. or Jordan.mp. or Kuwait.mp. or Lebanon.mp. or Libya.mp. or Iran.mp. or Iraq.mp. or Morocco.mp. or Oman.mp. or Pakistan.mp. or Qatar.mp. or Saudi Arabia.mp. or Somalia.mp. or Sudan.mp. or Syria.mp. or Tunisia.mp. or United Arab Emirates.mp. or Dubai.mp. or Abu Dhabi.mp. or Sharjah.mp. or West Bank.mp. or Ghaza.mp. or Palestine.mp. or Yemen.mp.)

Figure 2: Search string text schema used in this systematic review.

ed from the PRISMA 2009 flow diagram [8].

Results

Search Summary

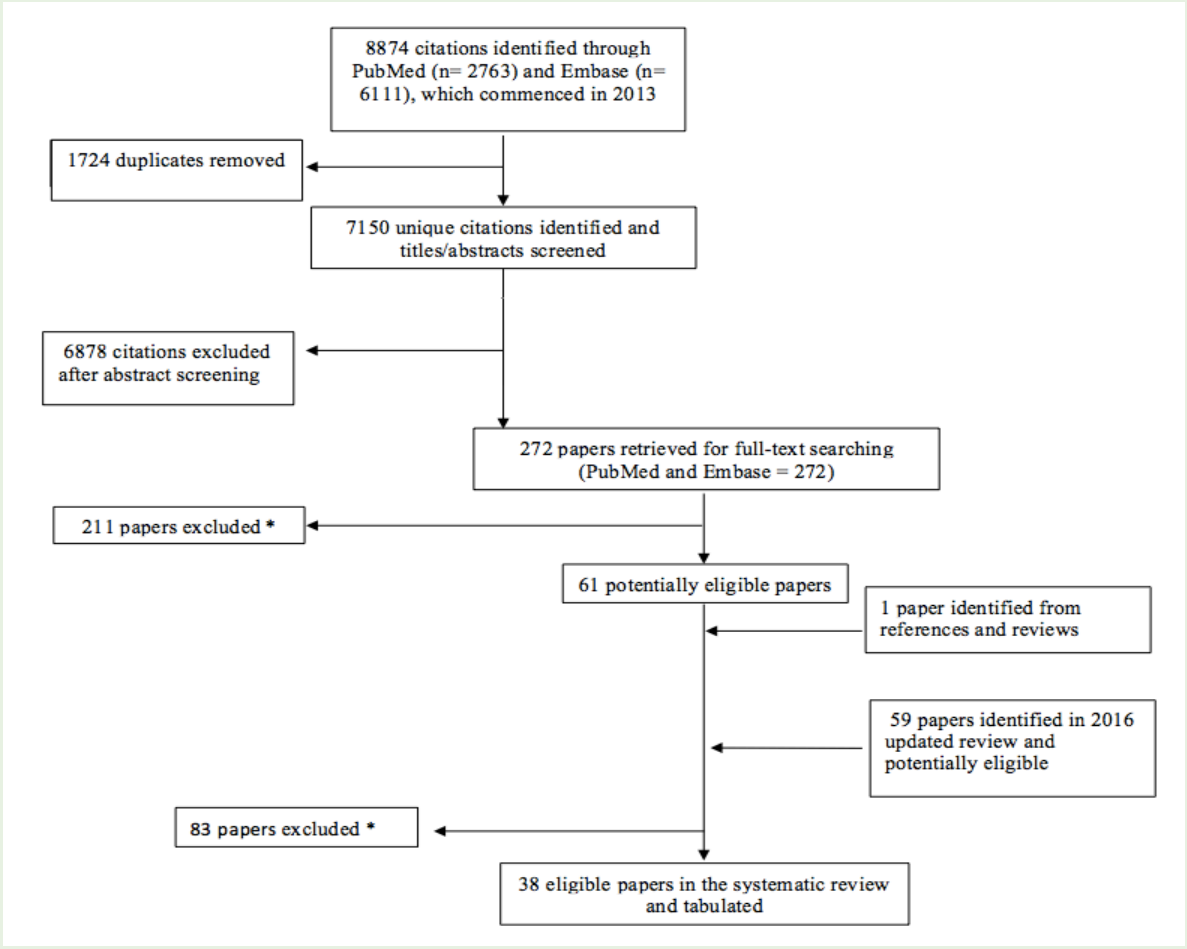
We retrieved 8,874 published papers through both PubMed and Embase databases as of January 25, 2014. We excluded 1,724 duplicate records from the retrieved set of papers. After screening the titles and abstracts of the 7,150 unique studies, the full-text of 211 potentially relevant papers were retrieved for screening. In December 2016, the databases were re-searched to included more current publications, yielding 60 additional possibly eligible papers. After exclusion of 138 studies following full text review, 38papers were found eligible for inclusion in this review (Figure 3).

Stroke Parameters Overview

Twenty-four data points were extracted on the incidence of stroke from the relevant records, and presented in Table (1). Of these studies, six were prospective hospital based incidence studies, and only three of those studies reported age-adjusted data on incidence of acute stroke. The crude incidence of stroke reporting both ischemic and hemorrhagic stroke ranged between 9/100,000 in a prospective population-based study from Iran to 640/100,000 in retrospective hospital-based study in Pakistan. In the age-adjusted studies incidence ranged between 16/100,000 in a prospective population-based study from Iran to 196/100,000 in a prospective population-based study in Libya.

Data on the prevalence of stroke was extracted from the 38 relevant studies and we found only seven data points for this parameter. Age-adjusted prevalence was available only from Tunisia at 184/100,000.

Mortality data points were reported in eight of the relevant studies. Of the eight countries reporting mortality data, the 30-day-case fatality ranged between 9.3% in Qatar to 30% for Pakistan. The studies that reported only ischemic stroke subtypes had much lower mortality rate, ranging from 7% to 24%



*Reasons for exclusion:

- Full-text did not include data on relevant indicators (n= 253)
- Article is an editorial/commentary/letter to editor (n=4)
- Full-text could not be retrieved and abstract does not have data on relevant outcomes (n=15)
- Same dataset as another included relevant publication (n=5)
- Paper presents contradictory/unclear numbers that could not be verified (n=0)

Figure 3: PRISMA flow diagram of search conducted in systematic review of Stroke in the MENA region.

in Iran. Conversely, series reporting only hemorrhagic stroke (ICH) had the highest mortality as in a Jordanian report of 42% mortality for spontaneous ICH.

Risk factors were systematically studied and identified in all 13 countries reporting stroke incidence, prevalence or mortality. In 26 of the relevant countries, hypertension was the leading risk factor identified followed closely by diabetes and rheumatic valvular disease. Considering all studies, over two-thirds of individuals presenting with ischemic or hemorrhagic stroke were hypertensive.

The following is our synthesis stroke incidence, prevalence and mortality from each of the MENA region countries from which relevant epidemiologic stroke data was extracted (Table 1).

Review of Stroke Incidence, Prevalence and Mortality by Country

Bahrain: A retrospective hospital based study in 2000 by Al-Jishet al. at the Salmaniya Medical Complex, Bahrain, reports a crude stroke incidence of 57/100,000. The incidence is higher in males as compared to females in all age groups. Hypertension, dyslipidemia, diabetes mellitus, ischemic heart disease and smoking were commonly identified risk factors [9]. In a retrospective study of 872,288 individuals in 2015, Al Bannaet al. reported a crude stroke incidence of 60/100,000, with diabetes, hypertension and dyslipidemia being the most common risk factors for stroke [10].

Egypt: A prospective, population based study conducted in Assiut Governorate, Egypt by Khedr et al., in 2013 reported a crude stroke prevalence of 963/100,000 and an age-adjusted stroke prevalence of 699.2/100,000. The male to female ratio

Table 1: Studies reporting Stroke incidence or prevalence in the MENA region

Citation	Year of Data Collection	Study Design	Population	Sample Size	Stroke Incidence (per 100,000 pop./yr.)	Stroke Prevalence (per 100,000 pop./yr)	Stroke Mortality
Bahrain (n=2)							
A. A. Al-Jish, et al., 2000 [9]	1995	Retrospective	Hospital-based	144	57/100,000	NA	NA
M. Al Banna, et al., 2015 [10]	2011	Retrospective	Hospital based	872288	60/100,000 crude	NA	NA
Egypt (n=6)							
E. M. Khedr, et al., 2013 [11]	2010	Prospective	Popultion based Assuit	5920	–	963/100,000	NA
E. M. Khedr, et al., 2014 [15]	2011-2013	Retrospective	Population based - Qena	8027	137/100.000 crude	797/100000	NA
H. N. El-Tallawy, et al., 2013 [13]	2009-2012	Prospective	Popultion based	19848	181/100,000	655/100,000	NA
W. M. A. Farghaly, et al., 2013 [14]	2005-2008	Prospective	Popultion based	62583	250/100000	560/100,000	NA
H. N. El Tallawy, et al., 2010 [15]	2005-2009	Prospective	Popultion based	62583	250/100,000	NA	NA
H. N. El Tallawy, et al., 2015 [16]	2006-2012	Retrospective	Population based	447	-	7.2/1000	NA
Jordan (n=1)							
Y. G. Bahou, et al., 2009 [17]	2002-2007	Retrospective	Hospital-based - Amman	1498	15.8/100,000	NA	All strokes = 42.0%
Iran (n=11)							
M. Azarpazhooh, et al., 2013 [18]	2007-2008	Prospective	Popultion based	92974	16/100,000 crude 13/100,000 (CL: 9-17) age-adjusted	-	NA
M. R. Azarpazhooh, et al., 2010 [19]	2006-2006	Prospective	Population based	450229	139/100000 crude	NA	NA

M. Tohidi, et al., 2013 [20]	1999-2001	Prospective	Hospital-based Tehran	2620	326/100,000	NA	NA
A. Ahangar, et al., 2005 [21]	2001-2003	Prospective	Hospital based Babol	550,00	52/100,000 crude	NA	All strokes = 19.2%
N. Fahimfar, et al., 2012 [22]	1999-2009	Prospective	Popula-tion-based	2378	M450/100,00(CL: 330-600) & W 25/100,000(CL: 170-360)	-	NA
N. Sarrafzadegan, et al., 2011 [23]	2001	Longitudinal	Popula-tion-based Isfahan	24379	230/100,000	NA	NA
S. Zabihyan, et al., 2011 [24]	2008-2009	Retrospective	Hospital-based	143	1.3/100,000 (SAH only)	NA	NA
A. Delbari, et al., 2011 [25]	2006-2008	Prospective	Hospital-based	953	338/100,000 (Age > 45yrs.)	NA	IS = 15.3%
M. D. Firoozabadi et al., 2013 [26]	2002-2008	Prospective	Hospital-based	1219	48.6-103.4/100,000, yr. 1-6	NA	IS = 13.0% ICH = 23.0%
K. Ghandehari, et al., 2006 [27]	2001-2005	Prospective	Hospital-based	1392	43.2/100,000	NA	IS = 7.3%
S.Oveisgharan, et al., 2017 [28]	2000-2003	Prospective	Hospital based	4361	73.4/100000 crude	NA	NA
Kuwait (n=2)							
A. Ashkanani, et al., 2013 [29]	2008	Retrospective	Hospital-based	151	27.6/100,000	NA	NA
N. Abdul-Ghaffar, et al., 1997 [30]	1989-1993	Prospective	Hospital-based	241	27.9/100,000 (CL:27.5-27,6) crude 92.2/100,000 (CL: 69.6-114.) age-ad-justed	NA	All strokes = 10.0%
Lebanon (n=2)							
R. Farah, et al., 2015 [31]	2014	Prospective	Population based	15155	NA	3630/100,000	NA
N. Lahoud, et al., 2015 [32]	2012	Retrospective	Population based	6963	NA	500/100,000 age- adjusted prevalence	NA
Libya (n=2)							
S. El Zunni, et al., 1995 [33]	1991-1993	Retrospective	Hospital-based	921	48/100,000 crude 162/100,000 age-adjusted	NA	NA

P.P. Ashok, et al., 1986 [34]	1984-1986	Prospective	Population based	518745	63/100000 crude	NA	NA
Pakistan (n=3)							
A. K. Kamal, et al., 2009 [35]	2008-2009	Prospective	Popultion based - BialColony, Karachi	545	NA	19000/100,000 (CL: 18.4-25.5)	NA
T. H. Jafar, et al., 2006 [36]	2001-2002	Prospective	Population -based	500	NA	4800/100,000	NA
E. A. Vohra, et al., 2000 [37]	1982-1990	Retrospective	Hospital-based	12454	6/100,000	NA	All strokes = 30%
Palestine (n=1)							
W. M. Sweileh, et al., 2008 [38]	2006-2007	Prospective	Hospital-based	186	51.4/100,000 (CL: 44-58.8)	62.7/100,000 (CL: 51.1-74.4)	All strokes = 21%
Qatar (n=3)							
A. Hamad, et al., 2001 [39]	1997-1997	Prospective	Hospital-based-Doha	217	41/100,000 (CL: 30.2 – 52.4), 123.7/100,000 (CL: 103.0-144.3) age-adjusted	NA	NA
Abdulbari Bener, et al., 2006 [40]	1999-2003	Prospective	Hospital-based	377	11.8/100,000	NA	NA
F. Ibrahim, et al., 2015 [41]	1990-2015	Retrospective	Population based	1491	51.88/100,000	NA	All strokes = 9.3%
Saudi Arabia (n=3)							
A. E. Ayoola, et al., 2003 [42]	1997-1998	Retrospective	Hospital-based-Gizan	241	15.1/100,000	NA	NA
S. Al Rajeh, 1998[43]	1989-1993	Prospective	Popula-tion-based-Eastern prov-inces	488	29.8/100,000 (CL: 25.2-34.4), 38.5/100,000 age-adjusted	NA	Al Strokes = 15%
S. Al Rajeh, 1993 [44]	1982-1992	Retrospective	Hospital-based-Riyadh	500	43.8/100,000	186/100,000	NA
Syria (n=1)							
W. Maziak, 2007 [45]	2004	Prospective	Popula-tion-based-Aleppo	2038	NA	1008/100,000	NA

Tunisia (n=1)							
N.A. Romdhane, 1993 [46]	1985	Prospective	Population-based- Kelibia	35370	NA	120/100,000 crude, 184/100,000 age-adjusted	NA

in the region was reported to be approximately 1.7:1 and hypertension and diabetes were the most common risk factors for strok [11]. Another prospective, population based study in Al Kharga district, New valley, Egypt by El Tallawy et al., in 2010 reported a prevalence of 560/100,000 in the population >18 years and an incidence of 250/100,000 [12]. Another prospective population-based study conducted by El Tallawy et al., in Al Quseir city reported a prevalence of 655/100,000 and an incidence 181/100,000, with a higher prevalence in males and with increasing age [13]. Moreover, a retrospective study in 2014 by Khedr et al., reported an incidence of 137/100,000 and a prevalence of 797/100,000 for stroke, in Qena [12-15]. The most recent study by El Tallawy et al., in 2015, reported a stroke incidence of 7.2/100,00 with the most common risk factors being hypertension, hyperlipidemia and diabetes [16].

Iran: Iran stands out in the MENA region with the most prolific research on the incidence of stroke with four population-based and seven hospital-based studies. However, there are no data on the prevalence of stroke in Iran. Azarpazhooh et al., has published two population-based studies; the most recent one was a prospective study on the incidence of stroke in Hajj pilgrims, yielding an age-adjusted incidence of 7/100,000 [17-19]. The second study is a large population based study of 450,229 people from Mashhad, and reported a crude age-adjusted incidence of 13/100,000 [18]. In 2011, Sarrafzadegan et al., undertook a population-based study in Isfahan and reported an incidence of 230/100,000 [20-23]. Fahimfar et al., undertook a population-based study in 2378 participants and reported an incidence of 450/100,000 in males and 250/100,000 in females [22]. In a prospective hospital based study from 2005, Ahangar et al., reported a crude stroke incidence of 52/100,000 with a stroke mortality of 19.2% [21]. In a hospital based retrospective study, Zabihyan reported an incidence of 1.3/100,000 for sub-arachnoid haemorrhage [24]. In 2013, Tohidi et al., reported an incidence of 326/100,000, in a small prospective hospital-based study of 2620 subjects [20]. A hospital-based prospective study by Ghandebari et al., in 2006 reported a stroke incidence of 43.17/100,000 and a mortality of 7.3% for ischemic stroke in Khorasan and noted that rheumatic valvular disease was the most common cause of ischemic stroke in young adults [25-27]. In 2013, Firoozabadi et al., reported an annual incidence of stroke ranging from 48.6-103.4/100,000 with an overall in-hospital mortality of 17.1% and a mortality of 13% and 23% for ischemic stroke and intracranial haemorrhage, respectively. The most common risk factors for stroke were hypertension, cardiac diseases, history of stroke, diabetes, dyslipidemia and smoking [26]. Furthermore, Delbari et al., undertook a cross sectional hospital based study in the Qom region with a sample size of 460, and reported an annual incidence of 53/100,000, with a mortality of 15.3% for ischemic stroke [25]. The most recent study is by Oveisgharan et al., from 2016 and is a prospective hospital-based study which reported a crude stroke incidence of 73.4/100,000 [28].

Jordan: There is only one hospital based retrospective study from Amman by Bahou et al., undertaken in 2009 and reported a haemorrhagic stroke incidence of 15.8/100,000 with an all stroke mortality of 42% [17].

Kuwait: A prospective, hospital-based study from Adan Hospital has reported a crude stroke incidence of 27.6/100,000, with an age-adjusted stroke incidence of 145.6/100,000 and a 30-day case fatality of 10%. Hypertension, diabetes, heart disease, smoking and hypercholesterolemia were the most common risk factors for stroke [29,30]. In 2013, a hospital-based retrospective study by Ashkanani et al., reported a stroke incidence of 27.6/100,000.

Lebanon: In 2015, a population-based prospective study by Farah et al., reported a surprisingly high prevalence of 3630/100,000, with hypertension, history of heart disease and smoking as risk factors [31]. In support of this a retrospective population based study by Lahoud et al., in the same year also reported an age-adjusted prevalence of 500/100,000 [32].

Libya: A retrospective, hospital-based study from Benghazi has reported a crude stroke incidence rate of 48/100,000 and an age-adjusted stroke incidence rate of 162/100,000 and 133/100,000 for males and females >45 years of age, respectively. Hypertension, smoking, diabetes and cardiac lesions were identified as risk factors. In younger patient's aged 15-45 years the annual incidence rate of stroke was 14/100,000 with hypertension, diabetes and heart disease being identified as important risk factors [33]. In a 1986, prospective population based study from Benghazi, Radakrishnan et al., reported a crude stroke incidence of 63/100,000 with a crude incidence rate of 39.3/100,00 and 40.3/100,000, respectively and age adjusted rates of 47.7/100,000 and 46.1/100,000, for men and women, respectively. Hypertension was the most common risk factor and was present in 45% of patients, followed by diabetes mellitus and rheumatic valvular disease, with at least one risk factor pres-

ent in 78% of patients [34].

Pakistan: A prospective population-based study of 545 subjects in Karachi an exceptionally high incidence of stroke of 19,000/100,000 was reported [35]. In contrast an earlier prospective population based study by Jafar with a sample size of 500 reported an incidence rate of 4800/100,000 in Karachi [36]. Vohra et al., undertook a retrospective hospital based study in 12454 subjects and reported a stroke incidence of 640/100,000, with an overall stroke morbidity of 30%. Hypertension, cardiac disease, diabetes, history of previous stroke and smoking were the most common risk factors for stroke in this study [37].

Palestine: A prospective hospital-based by Sweileh et al., in 2008 with a population size of 186 was conducted between the years 2006-2007 and the study reported a crude incidence of 51.4/100,000 (CL: 44-58.8). The age-adjusted incidence was calculated to be 89.8/100,00 age adjusted. Mortality was 21% in all stroke types. Hypertension, diabetes mellitus and renal dysfunction were the most common risk factor in the patients [38].

Qatar: In a study of prospective and retrospective outcomes undertaken in 1999-2003, Bener et al., reported an incidence of 11.7/100,000. There was a strong association with hypertension and diabetes with 60% of the stroke patients having had a previous acute myocardial infarction and 46.4% had diabetes mellitus [39,40]. In a prospective hospital-based study from 1997, Hamad et al., reported a somewhat higher incidence of 47/100,000 with an overall stroke mortality of 16% [39]. Ibrahim in 2015, undertook a retrospective population based study and reported a stroke incidence of 51.8/100,000 and a 30-day stroke mortality of 9.3% [41].

Saudi Arabia: A retrospective hospital based study in King Fahad National Guard Hospital reported a crude stroke incidence rate of 43.8/100,000 and hypertension, diabetes mellitus, and heart disease were common risk factors, smoking was identified as a less common risk factor in this population [42-44]. Another hospital-based retrospective study from Gizan was undertaken by Ayoola et al., and reported a stroke incidence of 15.1/100,000 [42]. In 1998, a population-based study from the Eastern provinces by Al Rajeh et al., reported a stroke incidence of 29.8/100,000 and an age-adjusted incidence of 38.5/100,000; with a stroke mortality of 15%. Hypertension, diabetes, heart disease, smoking and a previous stroke were the most significant risk factors for stroke [43].

Syria: In a prospective population based study in Aleppo, the prevalence of stroke in adults aged 18 to 65 years old was 1000/100,000 and hypertension, obesity and smoking were identified as the most common risk factors [45].

Tunisia: A prospective population-based study by Romdhane et al., in 1993 in Kelibia, Tunisia reported a crude prevalence of 120/100,000, and an age-adjusted prevalence of 184/100,000 [46].

Discussion

Stroke is a major global health problem, particularly in the MENA region due to an aging population and multi-ethnic expatriate population with disparate availability and delivery of health care [2,47]. To gain an overview of the scope of the problem and deficiencies of studies in the MENA region, we have completed a systematic review specifically assessing the availability of epidemiologic data on stroke incidence, prevalence and mortality. Our review has focused on the MENA region where there is a predominance of developing countries apart from four gulf nations (Bahrain, Kuwait, Qatar and Saudi Arabia).

The review for the region was published in 2010, but was derived from data collected between 1983 and 2007 and was only from seven countries. After age-standardization it revealed a wide range of stroke incidence ranging from 38.5/100,000 in Saudi Arabia to 123.7/100,000, in Qatar [3]. This supports the contention of Feigin et al. (2009), which suggests that stroke incidence rates in the MENA region are lower than other parts of the world [48]. Benamer (2014) concluded that the incidence of both age adjusted and unadjusted incidence of stroke was lower in the MENA region compared to developed countries and attributed it to the fact that many of the studies were either hospital based or were population based and suffered from sampling errors [49]. Indeed, none of the studies from the seven Arab countries in the Middle East (ME) he cited, fulfilled the strict criteria of an ideal epidemiological study proposed by Sudlow and Warlow (1996) and utilized by Feigin (2004) [7]. In fact, no Arab countries were included in the systematic review of worldwide stroke incidence from 1970-2008 by Feigin and co-workers (2009) [48].

A great deal of weight is being given to the Global and Regional Burden of Stroke (1990-2013) which has revealed divergent data on some stroke mortality and disability between developed (high-income) and developing (low-and middle-income) countries [1]. It suggests that certain regions of the world have a disproportionate increased burden of stroke. Our review has focused on the MENA region where there is a predominance of developing countries. No relevant stroke research papers were found from low-income MENA countries. With exception of four high-income, Gulf nations (Bahrain, Kuwait, Qatar and Saudi Arabia), relevant papers were from nine middle income MENA countries. All papers would be considered developing countries. Indeed, studies including longitudinal data on stroke incidence show increasing trends for this parameter [23,41]. Unfortunately, no comparative mortality or disability data was included in these papers. Nevertheless, these observations sup-

port the contention of there is a divergence between developed and developing countries regarding stroke incidence trends over the past four decades with reduction in developed countries and increase in developing countries [48].

As observed by prior epidemiologic researchers, MENA region reports prior to 2014 found a predominance of small samplings from predominantly hospital-based studies for the region providing the basis for estimates of stroke incidence and the outstandingly low figures for several of the middle eastern gulf countries, particularly Qatar and Kuwait [2]. Our qualitative analysis of the crude incidence and age-adjusted prevalence in population-based reports between 1995 and 2016, including the Gulf region, has also found figures lower than most developed countries (America and Western Europe). This arose from low numbers of stroke research publications fulfilling our search criteria. Stroke incidence was biased by small sample sizes, predominant hospital-based studies and lax epidemiological methodology with mainly observational statistics lacking Confidence Intervals. Stroke prevalence data was found for seven MENA countries with only one age-adjusted, population-based report from 1985 meeting inclusion criteria [46].

In a recent review by El-Hajj and colleagues, 64 papers from nine Middle Eastern countries were reviewed and analyzed them for their epidemiologic value including the parameters shared with our study, including incidence, prevalence and case fatality [50]. They noted the same difficulties in their attempt to synthesize very heterogeneous studies. As we have remarked, the studies found were marked by relative lack of community or population-based acquisition; small sample size; lack of age-adjustment and prospective design.

In relation to risk factors for stroke, hypertension was the most prevalent risk factor, followed by diabetes, dyslipidemia and cardiac diseases. This simply reflects the huge increase in obesity and associated cardiometabolic risk factors in the MENA region [51]. Additionally, recent data from 1491 stroke patients in the Qatar Stroke registry show that 50% of stroke patients are aged less than 50 years [41].

There is an obvious need for nationwide coordinated efforts from government and community to prevent and treat stroke through research and implementation of modern stroke care planning and registries. Fundamentally, stroke research should include well-designed epidemiologic studies of the true incidence, prevalence and case fatality for each of the MENA countries including those of low income. Considering the urgent need, this could very well take the form of enrollment in the WHO STEP wise approach to stroke surveillance [52]. This, together with community stroke education and stroke risk factor management, seems a rational approach to an alarming health problem.

Conclusion

High quality stroke research in the MENA region must become a national priority and appropriate infrastructure provided. As a first step, national policymakers, public health and medical care stakeholders need more reliable epidemiologic studies upon which to gauge the effectiveness of therapeutic and preventive measures targeting the growing burden of stroke in this region of the world.

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