Review

A comprehensive review of epilepsy in the Arab world

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ABSTRACT

Purpose: We conducted a comprehensive review of the epidemiology of epilepsy in the Arab world.

Methods: Epidemiological literature about epilepsy from 22 countries of the Arab League was searched in French and English using several keywords (specific and wider) and combinations, individually for each country. The search was conducted on Google first and then on PubMed. The results are presented as counts, proportions, and medians along with 95% confidence intervals (CI). Unpaired t-test with unequal variance and regressions were performed, altogether and individually, for lifetime and active epilepsy prevalence as well as incidence.

Results: Google provided 21 prevalence, four camp and nine incidence estimates while PubMed provided ten such estimates; none of them was identified by Google. No epidemiological data about epilepsy was found from 10/22 countries. Excluding pediatric studies, 13 prevalence estimates from six countries were identified. Including pediatric studies, 21 estimates from nine countries were found. Median lifetime and active epilepsy prevalence were 7.5(1000) (95% CI 2.6–12.3, range 1.9–12.9) and 4.4(1000) (95% CI 2.1–9.3, range 2.1–9.3), respectively, excluding pediatric studies (1984–2014, N = 244081). Median incidence was 56.0/100,000 (n = 9, N = 122484, 95% CI 13.7–147.9, range 10.4–1190).

Conclusion: The fact that no epidemiological data about epilepsy is available in the public domain for almost one half of all Arab countries offers opportunities for future research. This thorough review of existing literature demonstrates a prevalence of epilepsy three times higher than previously reported for this region. The median incidence is similar to other regions of the world, e.g. North America. Google yielded additional valuable sources not indexed in PubMed and provided pertinent references more quickly.

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which may not be the most suitable tool for countries where English is not the native language, and where scientific capacity is underdeveloped in comparison to other more developed regions such as Europe or North America. Interestingly, they had also taken into account hospital-based studies, but despite this the median epilepsy prevalence proposed for this Arab region was merely 2.3/1000. In view of these shortcomings, we considered it necessary to conduct a more comprehensive review of both English and French literature, adapted to the regional particularities, in order to better elucidate the burden of epilepsy in this region.

2. Methods

2.1. Search strategy

We searched literature on epilepsy in the Arab world, published in both English and French. These were obtained via Google and PubMed, using specific keywords and their combinations: epilepsy, convulsive disorders, seizure disorder, Arab, epilepsy, crisis epileptique, crisis convulsive, Arabe, and the name of individual countries. The search was conducted principally on Google, followed by a similar search on PubMed. No restrictions were made pertaining to the year of publication. On Google, only the first five pages were taken into consideration while on PubMed, all the results were looked at (titles first, then abstracts, then full-text) for identifying suitable studies. Our target approach was to identify all formal and informal estimates of the prevalence and incidence of epilepsy by including studies that were population based, and had clearly defined methodological parameters. The bibliography of each of these articles was thoroughly looked into as well.

2.2. Definitions

The Arab world was defined as the 22 member states of the Arab League. According to the International League against Epilepsy (ILAE), active epilepsy is defined as “atleast one epileptic seizure in the last five years, irrespective of treatment”. Treatment gap is generally defined as “the difference between the number of people with active epilepsy and the number being appropriately treated.”

2.3. Statistical analyses

We performed statistical analysis by using Stata, 2009. t-Test (unpaired, unequal variance) was used to determine statistical significance of differences, if any, between groups or estimates. Regression results were derived for population size, age group, year of study, gross domestic product (GDP) in the year of survey, and treatment gap, together and individually. A scatter plot with error margins was plotted by using Microsoft Excel. The results were derived separately for lifetime and active epilepsy prevalence, and incidence of epilepsy. The results have been presented in terms of counts, proportions, and medians alongwith respective 95% confidence intervals (CI).

3. Results

Overall, no prevalence or incidence estimates on epilepsy were available from the following ten countries; namely Bahrain, Comoros, Djibouti, Jordan, Kuwait, Lebanon, Mauritania, Oman, Qatar, Yemen. We obtained 13 prevalence estimates (excluding pediatric studies) from six countries and if pediatric studies were included; it summed up to 21 prevalence estimates from nine countries. In addition, four estimates of the prevalence of epilepsy consultations (per 1000) were identified that were based on extremely large United Nations' refugee (Syria, Somalia) camp population. Further, nine incidence estimates were identified from three countries, namely Algeria, Egypt and Palestine. On PubMed, 1285 titles were looked at from 22 countries but only 10 studies (pertaining to Algeria, Egypt, Libya, Saudi Arabia, Sudan and Tunisia) were obtained. Each of these had already been identified during our primary search on Google.

3.1. Prevalence (lifetime and active)

Excluding pediatric (Table 1) and camp population studies, the lifetime prevalence of epilepsy (1984–2014, N = 244081) was reported by 12 studies and the median lifetime prevalence of epilepsy was estimated to be 7.5/1000 (95% CI 2.6–12.3, range 1.9–12.9). After including pediatric studies, the median lifetime prevalence of epilepsy increased to 7.8 (n = 19, 95% CI 5.6–10.9, range 0.9–133.3), (Fig. 1).

Excluding pediatric (Table 1) and camp population studies, the prevalence of active epilepsy was reported by only four studies (Table 2) excluding children and camp studies, and the median prevalence of active epilepsy was estimated to be 4.4/1000 (95% CI 2.1–9.3, range 2.1–9.3). No active epilepsy estimates were available from pediatric studies. Uni- and multivariate regression of lifetime epilepsy for population size, age group, year of study and GDP was not significant (p > 0.05).

Among children, eight epilepsy prevalence estimates were identified (N = 28990, 1979–2013) from four countries, namely Egypt, Iraq, Morocco and Sudan. The median lifetime prevalence of epilepsy was estimated to be 8.1 (95% CI 0.96–50.7, range 0.9–133.3). Treatment gap varied from 20.0% in Sudan to 84.5% in Egypt. The frequency of generalized epilepsy varied from 62.0% to 93.8%, and that of partial epilepsy varied from 6.3% to 58.7%; these data were available from Egypt alone. Only two studies (from Egypt) [6,33] reported gender-specific prevalence of

Table 1

<table>
<thead>
<tr>
<th>Country</th>
<th>R/U</th>
<th>Year</th>
<th>N</th>
<th>P/1000</th>
<th>Additional comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt [24]</td>
<td>U</td>
<td>2012</td>
<td>12093</td>
<td>9.0</td>
<td>DTD among children; neurologist-diagnosis and EEG + Scan</td>
</tr>
<tr>
<td>Egypt [25]</td>
<td>U</td>
<td>2009</td>
<td>8750</td>
<td>7.2</td>
<td>Random sample of conventional schools, health insurance system, school doctor records, school health visitor records, filling of questionnaire by parents and parent's interview; neurologist-diagnosis and EEG</td>
</tr>
<tr>
<td>Egypt [25]</td>
<td>U</td>
<td>2009</td>
<td>120</td>
<td>133.3</td>
<td>Random sample of schools for mentally retarded; health insurance system, school doctor records, school health visitor records, filling of questionnaire by parents and parent's interview; neurologist-diagnosis and EEG</td>
</tr>
<tr>
<td>Egypt [35]</td>
<td>Both</td>
<td>2013</td>
<td>8027</td>
<td>7.3</td>
<td>DTD; neurologist-diagnosis; Psychiatrist, and EEG + Scan; children 0–14 years; Refer footnote</td>
</tr>
<tr>
<td>Iraq [26]</td>
<td>U</td>
<td>2005</td>
<td>–</td>
<td>1.0</td>
<td>–</td>
</tr>
<tr>
<td>Morocco [27]</td>
<td>U</td>
<td>1998</td>
<td>–</td>
<td>11.0</td>
<td>–</td>
</tr>
<tr>
<td>Sudan [19]</td>
<td>U</td>
<td>1979</td>
<td>–</td>
<td>0.9</td>
<td>Entire school population, hospital and private clinics</td>
</tr>
</tbody>
</table>

DTD, door-to-door; EEG, electroencephalogram; P, prevalence; R, rural; U, urban; N, population size; *government estimate.
epilepsy: 10.5–14.1 per 1000 among males and 7.4–10.6 per 1000 among females. None of the results was found to be significant (p > 0.05) upon regression for population size, year of study, GDP, and treatment gap.

3.2. Incidence of epilepsy

We identified nine estimates of epilepsy incidence from three countries (Table 3). It varied from 10.4/100,000 in Palestine to 190.0/100,000 in Algeria. The median incidence of epilepsy was estimated to be 56.0 (N = 122484, 95% CI 13.7–147.9). This indicates that 204,777 new cases of epilepsy are likely to be occurring every year in this region. None of the results was found to be significant (p > 0.05) upon regression for population size, year of study and GDP. However, incidence estimates were found to be statistically different from each other (Egypt studies only) with p = 0.0004.

4. Discussion

We conducted a comprehensive review of epilepsy in the Arab world to provide regional estimate of the prevalence and incidence

<table>
<thead>
<tr>
<th>Country</th>
<th>R/U</th>
<th>Year</th>
<th>Age</th>
<th>N</th>
<th>P-L</th>
<th>P-A</th>
<th>Additional comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria [28]</td>
<td>Both</td>
<td>2012</td>
<td>All ages</td>
<td>8046</td>
<td>8.3</td>
<td>–</td>
<td>Randomly selected primary care clinics of five regions; neurologist-diagnosis and EEG + Scan</td>
</tr>
<tr>
<td>Algeria [29]</td>
<td>–</td>
<td>2002</td>
<td>–</td>
<td>–</td>
<td>1.9</td>
<td>–</td>
<td>MOH survey</td>
</tr>
<tr>
<td>Algeria [30]</td>
<td>U</td>
<td>2011</td>
<td>&gt; 2 months</td>
<td>3002</td>
<td>12</td>
<td>–</td>
<td>Random sample of private and public practitioners and pediatricians of 5 regions; neurologist-diagnosis</td>
</tr>
<tr>
<td>Egypt [31]</td>
<td>Both</td>
<td>2010</td>
<td>All ages</td>
<td>6498</td>
<td>12.6</td>
<td>9.3</td>
<td>DTD; neurologist-diagnosis and EEG + Scan</td>
</tr>
<tr>
<td>Egypt [32]</td>
<td>U</td>
<td>2012</td>
<td>All ages</td>
<td>33283</td>
<td>5.5</td>
<td>–</td>
<td>DTD for multiple neurological disorders; neurologist-diagnosis</td>
</tr>
<tr>
<td>Egypt [33]</td>
<td>–</td>
<td>2008</td>
<td>All ages</td>
<td>62583</td>
<td>6.7</td>
<td>4.9</td>
<td>DTD; neurologist-diagnosis and EEG + Scan</td>
</tr>
<tr>
<td>Egypt [34]</td>
<td>Both</td>
<td>2008</td>
<td>All ages</td>
<td>62583</td>
<td>2.1</td>
<td>–</td>
<td>DTD for uncontrolled epilepsy; neurologist-diagnosis and EEG + Scan</td>
</tr>
<tr>
<td>Egypt [35]</td>
<td>Both</td>
<td>2013</td>
<td>All ages</td>
<td>8027</td>
<td>12.4</td>
<td>2.1</td>
<td>DTD; neurologist-diagnosis; Psychiatrist, and EEG + Scan</td>
</tr>
<tr>
<td>Libya [17]</td>
<td>U</td>
<td>1984</td>
<td>Adults &gt; 15</td>
<td>–</td>
<td>2.3</td>
<td>–</td>
<td>Polyclinics, EEG labs, university hospitals; DTD; neurologist-diagnosis; and EEG + Scan</td>
</tr>
<tr>
<td>Saudi [36]</td>
<td>U</td>
<td>1995</td>
<td>All ages</td>
<td>1485</td>
<td>10.2</td>
<td>–</td>
<td>DTD for multiple neurological disorders; DTD; neurologist-diagnosis</td>
</tr>
<tr>
<td>Saudi [37]</td>
<td>U</td>
<td>1989</td>
<td>All ages</td>
<td>23700</td>
<td>6.5</td>
<td>–</td>
<td>DTD of restricted area; DTD; neurologist-diagnosis; and EEG + Scan</td>
</tr>
<tr>
<td>Tunisia [38]</td>
<td>–</td>
<td>1985</td>
<td>All ages</td>
<td>34874</td>
<td>4.0</td>
<td>–</td>
<td>Refer footnote</td>
</tr>
<tr>
<td>UAE [39]*</td>
<td>Both</td>
<td>2014</td>
<td>All ages</td>
<td>12.9</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
</tbody>
</table>

DTD, door-to-door; EEG, electroencephalogram; *Unofficial estimate; MOH, Ministry of Health; N, population size; P-A, prevalence active/1000; P-L, prevalence lifetime/1000; R, Rural; U, urban.
of epilepsy in the Arab world region. Owing to the robustness of our methodology, we were able to incorporate a higher number of studies into our analysis, than what has been hitherto done [5], and therefore come up with figures that are more reflective of the true burden of epilepsy in this region. Our use of a varied combination of keywords, no restriction on the year of publication, consideration of French literature and the use of a more general search engine like Google, inclusion of sources such as thesis, reports and conference abstracts among others which cannot be retrieved from PubMed, were some necessary qualities for this difference.

Largely, epilepsy has not been systematically evaluated and reported in this region as is the case with some of the other regions as well, particularly Asia [1]. As mentioned earlier, ten out of 22 countries do not have any fundamental data on epilepsy as of yet, reflecting the possibility of lower importance given to epilepsy in such scientifically-silent countries. The general paucity of this precious fundamental data rules out the possibility of local evidence-based public health interventions or the establishment of formal health programs dedicated to epilepsy by engaging key local stakeholders as has been done in Cambodia and Laos, for example [7,8]. At the same time, this also accentuates the role of international parent organizations like the ILAE and the World Health Organization in the betterment of this scenario.

Nine countries however were found to have some fundamental prevalence data on epilepsy representing 41.0% (45.5% if both prevalence and incidence data combined) of this region. This situation is better than other regions, namely Asia [1]. There are some Arab world countries, particularly Syria [4] and Somalia [9] that have experienced a considerable displacement of their population to refugee camps in their own or in other countries. These camps, belonging to the United Nations, are extremely large, with that of Somalia being the largest in the world [9]. Reports based on these populations could have been an additional source of valuable epilepsy data for these two countries. However, according to source reports, it is the frequency of consultations for epilepsy that has been reported from these camps, instead of the number of incident or prevalent cases of epilepsy or the population denominator.

As elsewhere [10,11] more emphasis has been placed on the lifetime epilepsy as compared to active epilepsy. This approach fails to accurately elucidate the burden of disease in need of active intervention. Based on available data (including children studies), we determined that only 56.4% of the total epilepsy case load in this region comprises of patients with active disease and therefore in true need of treatment. This is less than some countries where approximately 93% of those with lifetime epilepsy have active seizures [7]. Similarly, in Latin America (currently unpublished, D Bhalla), 64.0% of the total epilepsy case load requires active intervention. These differences are important in understanding the truer disease burden that is unique to each country or the region, and the true need of resources.

Our estimate of the median prevalence turned out to be much higher at 7.5/1000, in comparison to 2.3/1000 [5] that had been previously reported for this region. This difference can be accounted for by the robustness of the methodology we had adopted. This difference also compels us to reflect upon the various risk factors for epilepsy that are unique to this region. Consanguinity is extensively prevalent in Arab countries, some of which show the highest rates in the world with marriage among first cousins comprising >60% of all unions [3]. In Algeria, where prevalence of epilepsy is 8.3/1000, the rate of inbreeding is also high, i.e. close to 40% [12]. Some Arab countries like Qatar, Yemen and UAE are showing an increase in consanguinity rates [3], and these countries turned out to have high prevalence of epilepsy in our analysis as well (Table 1). Others like Palestine are experiencing a decline in consanguinity, and have at the same time shown comparatively lower prevalence and incidence figures [13], (Tables 1 and 2). Although prohibited by the religion, substance abuse has reached alarming proportions in some of these Arab world countries, particularly Egypt and Saudi Arabia, where prevalence of epilepsy is also high (Tables 1 and 2) [14]. Likewise, given the fact that the religion prohibits swine breeding and consumption of pork, neurocysticercosis has traditionally been considered to be non-existent in this region. However, literature suggests that the prevalence of neurocysticercosis in the Arab world has been increasing over the past few years [15]. A lot of these countries host migrant population from South East Asia where neurocysticercosis is a common occurrence, a fact that may explain the above finding. Interestingly, the pattern of disease expression of neurocysticercosis in the Arab region is similar to that observed in patients from South East Asia [16]. Besides these reasons, it was also observed that most studies had some methodological issues; such as using different recruitment schemes, ages, etc. (Tables 1–3) [17–20].

Similarly, incidence (per 100,000) varied considerably across countries and median incidence was estimated to be 56.0 (95% CI 13.7–147.9). Besides methodological issues [1], it is likely that the above factors play a major role in determining the incidence of epilepsy in this region. Moreover, when compared, the estimates of epilepsy incidence (Egypt studies only) were statistically different from one another (p = 0.0004), suggesting the presence of different within-country determinants and risk factors [21–23].

Regarding limitations in our work, our primary search was conducted on Google, and was verified by a similar search on PubMed. Although we may still have missed out on identifying some studies, our multi-language, Google-inclusive approach did ensure that our review had far more number of studies and estimates as compared to the previous regional reviews. Another limitation may arise from the variations in the definition of epilepsy across studies. We did not devise our own definition, nor did we judge which version of the definition was more appropriate, and by and large respected the interpretation of individual authors.

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Table 3

<table>
<thead>
<tr>
<th>Country</th>
<th>R/U</th>
<th>Year</th>
<th>Age</th>
<th>N</th>
<th>I</th>
<th>Additional comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria 1 [29]</td>
<td>–</td>
<td>2006</td>
<td>All</td>
<td>–</td>
<td>190</td>
<td>MOH survey</td>
</tr>
<tr>
<td>Egypt 1 [33]</td>
<td>Both</td>
<td>2008</td>
<td>All</td>
<td>62583</td>
<td>43.1</td>
<td>DTD; neurologist-diagnosis and EEG + Scan</td>
</tr>
<tr>
<td>Egypt 2 [24]</td>
<td>–</td>
<td>2012</td>
<td>C</td>
<td>12093</td>
<td>82.7</td>
<td>DTD among children; neurologist-diagnosis and EEG + Scan</td>
</tr>
<tr>
<td>Egypt 3 [31]</td>
<td>Both</td>
<td>2010</td>
<td>All</td>
<td>6498</td>
<td>150</td>
<td>DTD; neurologist-diagnosis and EEG + Scan</td>
</tr>
<tr>
<td>Egypt 4 [32]</td>
<td>U</td>
<td>2012</td>
<td>All</td>
<td>33283</td>
<td>48</td>
<td>DTD for multiple neurological disorders; neurologist-diagnosis</td>
</tr>
<tr>
<td>Egypt 5 [35]</td>
<td>Both</td>
<td>2013</td>
<td>All</td>
<td>8027</td>
<td>123</td>
<td>DTD; neurologist-diagnosis; Psychiatrist, and EEG + Scan</td>
</tr>
<tr>
<td>Palestine [40]</td>
<td>–</td>
<td>2013</td>
<td>–</td>
<td>–</td>
<td>11.3</td>
<td>MOH/thesis estimate</td>
</tr>
<tr>
<td>Palestine [41]</td>
<td>–</td>
<td>2005</td>
<td>All</td>
<td>10.4</td>
<td></td>
<td>MOH survey</td>
</tr>
</tbody>
</table>

C, children; DTD, door-to-door; EEG, electroencephalogram; I, incidence/100,000; MOH, Ministry of Health; N, population size; R, rural; U, urban.
While limiting ourselves to a single definition of active epilepsy could have increased precision, it would also have significantly decreased the number of studies that could have been finally included and may then have not justified doing an analysis at all. Active epilepsy, in general, refers to cases that have not yet resolved, and the patients have not yet clinically outings the condition. Inactive epilepsy, on the other hand, means that the patient no longer has active disease. However, it does not imply cure nor does it guarantee that seizures will not occur in the future. According to the ILAE, active epilepsy is defined as at least one epileptic seizure in the last five years irrespective of treatment. This definition was however not used by any of the authors. Besides these, changes in the reporting practices and parameters over time may have had some impact on our results. Yet, our target was to highlight the importance of focusing on active epilepsy vis-à-vis lifetime epilepsy as the former provides a more accurate picture of the disease burden, and better identifies those in need of intervention from public health agencies.

5. Conclusions

Several countries in the Arab world are yet to have any fundamental data on epilepsy that can offer opportunities for conducting novel initiatives on epilepsy in these scientifically-silent countries. The prevalence of epilepsy is far higher (about three times) than what has been previously reported for this region. The first-ever regional estimate of the median incidence of epilepsy suggests that the rate is similar to other regions such as North America. Our work proposes that 1.43 million people have lifetime epilepsy in this region, and only about 56.0% of them require active therapeutic interventions for their epilepsy. Also, 204,777 new cases of epilepsy are likely to be occurring every year in this region. There is an urgent need to standardize methods, initiate systematic investigations, test interventions, and quantify many of the Arab world-specific epilepsy risk factors including substance abuse, consanguinity, neurocysticercosis, etc. We aimed to provide an alternative method of literature search especially suited for regions which are not necessarily English or PubMed driven and where scientific capacity is yet to achieve its full potential, a general search engine like Google can outscore the more traditional ones like PubMed in terms of both the yield and the speed at which the results are obtained.

Conflicts of interest

No conflicts of interest.

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References