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ORIGINAL RESEARCH

A Retrospective Analysis of Disease Epidemiology, Comorbidity Burden, Treatment Patterns, and Healthcare Resource Utilization of Migraine in the United Arab Emirates

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ABSTRACT

***Introduction*:** Migraine is a recurrent, disabling neurological disorder with a substantial global disease burden. However, limited real-world data are available on the patient characteristics, treatment patterns, comorbidities, and economic burden of migraine in the United Arab Emirates (UAE). In this study, we evaluated the disease burden, comorbidities, treatment patterns, specialties involved in migraine diagnosis, and healthcare resource utilization (HCRU) and associated costs in patients with migraine in Dubai, UAE.

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Methods: A retrospective, secondary database cohort study was conducted from 01 January 2014 to 31 March 2022 using the Dubai Real-World Database. Patients aged ≥ 18 years with at least one diagnosis claim for migraine with continuous enrollment during the study period were included. Patients were stratified into treatment sub-cohorts. Outcomes were evaluated in terms of clinical characteristics, comorbidities, specialists visited, treatment patterns, and HCRU.
Results: The study included 203,222 patients (mean age: 40 years), with male predominance (55.4%). About 13.4% of patients had specific cardiovascular comorbidities. Frequently prescribed drug classes were nonsteroidal anti-inflammatory drugs (84.4%), triptans (29.8%), and beta-blockers (12.8%), while only 1.0% of patients with migraine were prescribed newer medications like calcitonin gene-related peptide antagonists. General medicine was the most frequently visited specialty on the index date (51.5%). The all-cause and migraine-specific median gross costs during the 12-month post-index period were US $1252.6 (2.4–564,740.7) and US $198.1 (0–168,903.3) respectively, with maximum contribution from inpatients. The contribution of migraine-specific median costs to all-cause median costs was highest for the diagnosis-related group (64.9%), followed by consumables (35.2%), medications (32.0%), procedures (24.5%), and services (24.5%).
Conclusion: Migraine significantly impacts healthcare costs in the UAE. The role of newer therapies in migraine management should be explored to reduce the associated socioeconomic burden and improve patients' quality of life.

Keywords: Migraine; Epidemiology; Healthcare resource utilization; Treatment patterns; Comorbidity; e-Claims data study

Key Summary Points

Why carry out this study?

Migraine is a neurological disorder with a substantial socioeconomic burden and high global prevalence, including in the United Arab Emirates (UAE).

The current treatment landscape for migraine is associated with unmet needs including patient dissatisfaction with the prescribed treatment, inadequate disease management and clinical outcomes, and increased healthcare resource utilization (HCRU) and pharmacy cost.

We conducted a retrospective e-claims database study to estimate the disease burden, comorbidities, treatment patterns, specialties involved in the diagnosis of migraine, and HCRU of patients with migraine in Dubai, UAE.

What was learned from the study?

This study demonstrated that cardiovascular comorbidities were more prevalent in the study population; nonsteroidal anti-inflammatory drugs, triptans, and beta-blockers constituted the most frequently prescribed treatments, while prescription of novel drugs such as calcitonin gene-related peptide antagonists was very low.

HCRU and costs due to inpatient visits, consumables, and medications were substantial in the study population during the post-index period.

INTRODUCTION

Migraine, a recurrent, neurological disorder with debilitating symptoms, is a major public health concern. It is regarded as the second leading cause of disability globally, affecting around 15% of the population worldwide [1]. According to the 2016 Global Burden of Disease Study, approximately 1.04 billion people suffered from

migraine and had high disability weight, with 45.1 million years of life lived with disability (YLD) [2]. Migraine prevalence is influenced by age, gender, and sociodemographic variables and often goes undiagnosed [3]. It is more prevalent among females 15–49 years of age [2]. A systematic review reported migraine prevalence of 2.6–32.0% in Arab countries, with females being more susceptible [4]. In the United Arab Emirates (UAE), migraine prevalence was found to be 1.56 million, with 0.76 million YLD [2].

Genetic factors and comorbid conditions are documented risk factors for migraine and augment disease severity [3]. A population-based study demonstrated the association of migraine with cardiovascular diseases, hypertension, diabetes, and hypercholesterolemia [5]. Neurological, psychiatric, and sleep disorders are more frequent among patients with migraine when compared with the general population [6, 7].

Migraine is associated with psychological effects, functional delays, activity impairment, and decreased productivity, leading to low health-related quality of life (QoL) [3, 8, 9]. Studies conducted using migraine-specific QoL questionnaires showed low QoL scores [8, 10]. The high Headache Impact Test (HIT-6) score (66.99 ± 6.79) and Migraine Disability Assessment Scale score (23.43 ± 12.32) obtained in a separate study also confirmed impaired migraine-specific QoL [11].

Treatment strategies for migraine include both acute and preventive medications for mitigating migraine attacks, alleviating pain, managing comorbid conditions, minimizing disabilities, and restoring function. Acute migraine treatment minimizes migraine attack symptoms and includes nonsteroidal anti-inflammatory drugs (NSAIDs), triptans, and emergency medications (intravenous metoclopramide, subcutaneous sumatriptan, dexamethasone, intravenous acetylsalicylic acid) [12, 13]. Preventive treatment reduces the frequency and intensity of migraine attacks and includes antiepileptic drugs, beta-blockers, antidepressants, serotonergic antagonists, calcium channel antagonists, angiotensin modulators, and nutrients and herbal products [14–16]. A study reported the highest prescription refills for NSAIDs, followed by triptans [17]. Apart from pharmacological agents, certain non-pharmacological approaches may be used for clinical benefits, including behavioral techniques, acupuncture, and noninvasive or invasive neuromodulation [18].

The current migraine treatment landscape is faced with certain unmet needs including dissatisfaction with the prescribed treatment as a result of adverse side effects or safety concerns (satisfaction with preventive and acute medications being 40.8% and 27.1%, respectively) [19]. Inadequately managed migraine poses a risk of medication overuse, headache, chronification, and healthcare resource utilization (HCRU) inefficiency [20, 21]. Thus, newer treatment modalities are being explored. Calcitonin gene-related peptide (CGRP), of the trigeminovascular system, is indicated as a key neuropeptide in migraine pathophysiology. Hence, pharmacological agents targeting this pathway might prove beneficial in migraine treatment [22]. While the use of first-generation CGRP antagonists—i.e., gepants—were limited due to hepatotoxicity, the newer-generation gepants (rimegepant, ubrogepant, and atogepant) were found to be tolerable, safe, and effective [23, 24]. Additionally, anti-CGRP monoclonal antibodies (erenumab, fremanezumab, galcanezumab, eptinezumab) have been approved by the US Food and Drug Administration and European Medicines Agency owing to their convincing safety and efficacy outcomes in clinical trials [24–29].

Besides a high clinical burden, the prevalence of migraine and migraine-related disabilities causes increased HCRU and pharmacy use [30, 31]. Along with direct costs (medical costs), indirect costs including productivity loss and comorbid conditions form the major share of migraine-associated economic burden [3, 6]. A retrospective analysis using a claims database demonstrated that direct all-cause healthcare costs (US $11,010 vs. US $4436) and indirect costs (US $11,294 vs. US $8945) were higher among patients with migraine than among patients without migraine [30]. The highest costs were attributable to procedure/imaging costs, followed by pharmacy costs [32]. In a retrospective study, for a 6-month follow-up period, the total cost for migraine treatment was €448.43 [33].

Despite holistic improvement throughout the migraine treatment landscape with the advent of newer treatment modalities, unsatisfactory clinical outcomes and unmet needs persist. Real-world studies on the characteristics, treatment patterns, comorbidities, and economic burden of migraine in the UAE are currently scarce. These data are paramount for developing tailored therapeutic regimens to reduce migraine-associated costs. Additionally, such data will benefit stakeholders, researchers, and policymakers by bridging knowledge gaps. Thus, this retrospective e-claims database study aimed to estimate the disease burden, comorbidities, treatment patterns, and specialties involved in the diagnosis of migraine, as well as assessing the HCRU of patients with migraine in Dubai, UAE.

METHODS

Study Design

This retrospective, secondary database cohort study used insurance e-claims data from the Dubai Real-World Database (DRWD). Data were extracted for all patients with the first migraine claim available during the index period (01 January 2015–31 March 2021) and analyzed for the study period 01 January 2014–31 March 2022. The date of the first migraine claim available during the index period was termed the index date. The first migraine diagnosis date during the index period was considered the index diagnosis date (IDD). The 12-month period prior to and following the index date were termed the pre-index and post-index (follow-up) periods, respectively (Fig. 1).

Data Sources

The DRWD e-claims database is the largest claims database in Dubai, covering approximately 100% of the population insured by Dubai private health insurance. It provides anonymized patient-level data for all insurance claims related to demographics, diagnoses, procedures (medical, surgical, and diagnostic), prescriptions, and other services. Nearly 89% of the Dubai population comprises expatriates covered by private insurance, while the remaining 11% (comprising the local Emirati population) are insured via public funding [34].

Study Population

The International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes were used to identify the study population (Table S1). The study included patients aged ≥ 18 years with at least one diagnosis claim (principal, secondary, and admitted) for migraine (as per ICD-10 CM codes) during the study period (01 January 2014–31 March 2022) and during the index period (01 January

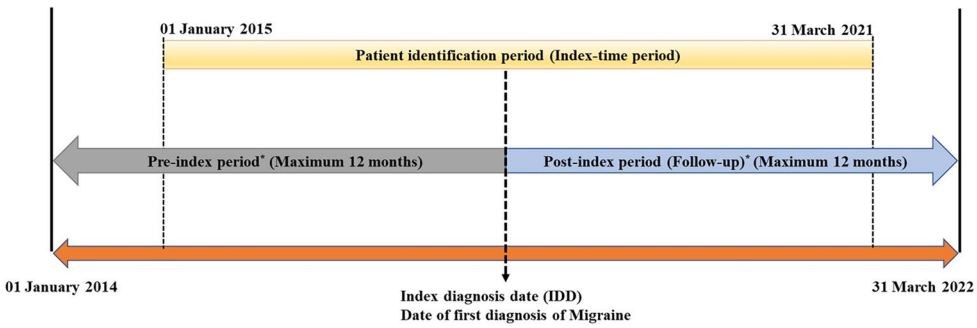

Fig. 1 Flowchart depicting study design. *Patients must have at least one claim (migraine/non-migraine) anytime during the 12-month pre-index period and the 12-month post-index (follow-up) period (a surrogate for continuous enrollment)

2015–31 March 2021). Patients having continuous enrolment with at least one claim (migraine or non-migraine) during the 12-month pre-index and post-index periods were included. No explicit exclusion criteria were defined for patient selection; however, patients who did not satisfy the continuous enrolment criteria were excluded from the study.

Patients were divided into three sub-cohorts (or treatment cohorts) based on the medications they received (Table S2): patients with a migraine diagnosis code and prescribed preventive medications alone (preventive migraine), patients with a migraine diagnosis code and prescribed acute medications alone (acute migraine), and those with a migraine diagnosis code and prescribed both acute and preventive medications (preventive + acute migraine). For HCRU and associated cost evaluation, data on preventive migraine, acute migraine, and preventive + acute migraine sub-cohorts were analyzed.

Ethical Considerations

The study was observational in nature and involved analysis of previously collected anonymized structured data and did not impose any form of intervention. Hence, obtaining informed consent was not required for the study. Further, no institutional review board approval was required as it did not involve the collection, use, or transmission of individually identifiable data. The study adhered to the Health Insurance Portability and Accountability Act of 1996 to prevent disclosure of patient health information.

The dataset utilized for the present study was publicly inaccessible. This dataset was obtained from the Dubai Health Insurance Corporation (DHIC) after adhering to all the required legal procedures to acquire and utilize these anonymized patient claims data. Under the terms of the data sharing contract with DHIC, IQVIA received a legitimate and exclusive right to use certain components of the dataset as specified in the contract. IQVIA was given authorization to apply the data for conducting anonymized and uniform analyses and research projects pertaining to health insurance claim records. Additionally, IQVIA was allowed to distribute the results and insights from the anonymized and uniform dataset to its clients for research purposes involving health insurance claim information. IQVIA pledged to adhere to established procedures to maintain compliance with applicable regulations, including those related to data privacy.

Baseline Variables and Outcome Measures

- Sociodemographic characteristics (age, gender, insurance plan, and nationality) were analyzed during the index period (01 January 2015–31 March 2021).
- Number and percentage of new visits and repeat visits of the overall study population were analyzed per annum for the period 01 January 2015–31 December 2020.
- Specific cardiovascular comorbidities (myocardial ischemia/infarction, cerebrovascular disease, peripheral vascular disease, arrhythmias, venous thromboembolism, congestive heart failure, pulmonary embolism, uncontrolled hypertension, and intestinal ischemia) were evaluated during the study period (01 January 2014–31 March 2022).
- Specialty analysis was performed at the index date. During the post-index period, specialty analysis (type of specialty involved prior to neurologist visit) and average time (number of days) and time (in months) for neurologist consultation post other specialty visits since IDD were examined.
- Treatment patterns, by drug class and prescribed lines of treatment (LOTs) for migraine, were assessed for the 12-month follow-up period.
- During the 12-month post-index period, all-cause and migraine-specific HCRU were determined in the three individual sub-cohorts of patients with migraine (acute, preventive, and acute + preventive) and in the overall population. HCRU cost, by visit type (number of claims and cost for outpatients, inpatients, and emergency room [ER] visits) and activity type (number of claims and cost of medications, procedures, Healthcare Common Procedure Coding System (HCPCS)

[consumables], and services), was assessed during the post-index period. Results for visit type and activity type have been presented as gross cost (sum of the amount paid by insurance and out-of-pocket expenditures by the patient) and net cost (amount paid by insurance provider), respectively. All costs were converted from Arab Emirates dirhams (AED) to United States dollars (USD), after adjusting for the purchasing power parity (PPP) conversion rate of 2.09 for the year 2023. Claims amounting to less than $0 were excluded from the analysis.

- HCRU and associated median costs in the combined sub-cohort of patients with migraine diagnosed with specific cardiovascular comorbidities were evaluated during the follow-up period by visit type and activity type, as well as overall (without visit and activity split), and have been presented as gross costs and net costs, respectively. All costs were converted from AED to USD, after adjusting for the PPP conversion rate of 2.09 for year 2023. Claims less than US $0 were excluded from the analysis. Patient counts were not mutually exclusive.

Data Analysis

Descriptive analyses were performed to understand the qualitative and quantitative nature of the data collected and the characteristics of the target population. Study variables were analyzed for the overall population as well as the three sub-cohorts. HCRU and associated costs (all-cause and disease-specific) were analyzed for the three sub-cohorts without encounter and activity split. Number and percentage of new visits, repeat visits, HCRU, and costs (including patients with specific cardiovascular comorbidities by encounter or activity type) were analyzed for all patients with migraine. Continuous variables are reported as mean (and standard deviation) or median and interquartile range, where appropriate. Categorical variables are summarized as frequencies and percentages (*n*, %). Data are presented by sub-cohort, where appropriate.

RESULTS

Demographics and Clinical Characteristics of Patients with Migraine

Of 451,983 patients, 203,222 were selected for the analysis and divided into five treatment cohorts: 105,158 (51.7%) patients with acute migraine; 8308 (4.1%) with preventive migraine; 30,314 (14.9%) with preventive + acute migraine; 98 (0.05%) patients undergoing non-pharmacological treatments; and 59,344 (29.2%) patients classified as others (having a migraine-related claim but having no related treatment defined in the medication list) (Table S3).

The mean age of the population of 65,982 (32.5%) patients with available demographic data was 40 years, and 45.6% were 35–44 years of age (Table 1). Overall, a higher proportion of males were affected (55.4%). Most patients (n = 47,775, 72.4%) opted for an enhanced insurance plan. Overall, patients were predominantly Indian (n = 27,303, 41.4%), Pakistani (n = 8174, 12.4%), or Filipino (n = 8003, 12.1%).

Number and Percentage of New Visits and Repeat Visits Among Patients with Migraine

A decrease in the percentage of new visits was observed each year, from 0.9% in 2015 to 0.8% in 2020 (Fig. 2). The percentage of repeat visits was recorded to be 0.9% and 0.9% in 2015 and 2020, respectively.

Cardiovascular Comorbidities in Patients with Migraine

Among 203,222 study patients, 27,148 (13.4%) had cardiovascular comorbidities during the study period. The ICD-10 codes used to define the different comorbidities have been elaborated in Table S4.

Increased prevalence of cardiovascular comorbidities in the preventive sub-cohort (22.1%; n = 1835/8304), followed by preventive + acute

Table 1 Patient demographic and clinical characteristics for the overall and sub-cohort population (sub-cohort 1: preventive, sub-cohort 2: acute, sub-cohort 3: preventive + acute)

Baseline characteristics	Overall		Sub-cohort 1		Sub-cohort 2		Sub-cohort 3	
	N	%	*N*	%	*N*	%	*N*	%
Overall study population in the index period	203,222	100%	8304	4.1%	105,158	51.7%	30,314	14.9%
Patients with demographic data available (considered for further analysis)	65,982	32.5%	2552	30.7%	34,635	32.9%	10,164	33.5%
Patients with demographics data missing	137,240	67.5%	5756	69.3%	70,523	67.1%	20,150	66.5%
Mean age in years (SD)	40 (9)		43 (10)		40 (8)		41 (9)	
18–24	1013	1.5%	51	2.0%	422	1.2%	149	1.5%
25–34	16,049	24.3%	423	16.6%	8840	25.5%	2090	20.6%
35–44	30,105	45.6%	1073	42.0%	16,012	46.2%	4801	47.2%
45–54	14,283	21.6%	683	26.8%	7238	20.9%	2411	23.7%
55–64	3745	5.7%	244	9.6%	1785	5.2%	595	5.9%
65+	787	1.2%	78	3.1%	338	1.0%	118	1.2%
Gender								
Male	36,580	55.4%	1549	60.7%	19,795	57.2%	4970	48.9%
Female	29,402	44.6%	1003	39.3%	14,840	42.8%	5194	51.1%
Insurance plan								
Basic	18,207	27.6%	482	18.9%	10,593	30.6%	1919	18.9%
Enhance plan	47,775	72.4%	2070	81.1%	24,042	69.4%	8245	81.1%
Nationality								
India	27,303	41.4%	1167	45.7%	14,247	41.1%	4363	42.9%
Pakistan	8174	12.4%	263	10.3%	4694	13.6%	1166	11.5%
Philippines	8003	12.1%	170	6.7%	4614	13.3%	1002	9.9%
Egypt	3779	5.7%	176	6.9%	1813	5.2%	718	7.1%
Bangladesh	1811	2.7%	74	2.9%	980	2.8%	274	2.7%
Jordan	1564	2.4%	62	2.4%	762	2.2%	253	2.5%
Emirates	1449	2.2%	48	1.9%	762	2.2%	210	2.1%
Syria	1200	1.8%	62	2.4%	553	1.6%	234	2.3%
Britain	1179	1.8%	56	2.2%	532	1.5%	137	1.3%
Sri Lanka	1140	1.7%	30	1.2%	614	1.8%	182	1.8%
Nepal	1070	1.6%	37	1.4%	626	1.8%	141	1.4%
Lebanon	1018	1.5%	66	2.6%	432	1.2%	203	2.0%
Iran	500	0.8%	54	2.1%	224	0.6%	80	0.8%

SD standard deviation

A patient can present in more than one Charlson Comorbidity Index (CCI) component; hence patient counts are not mutually exclusive

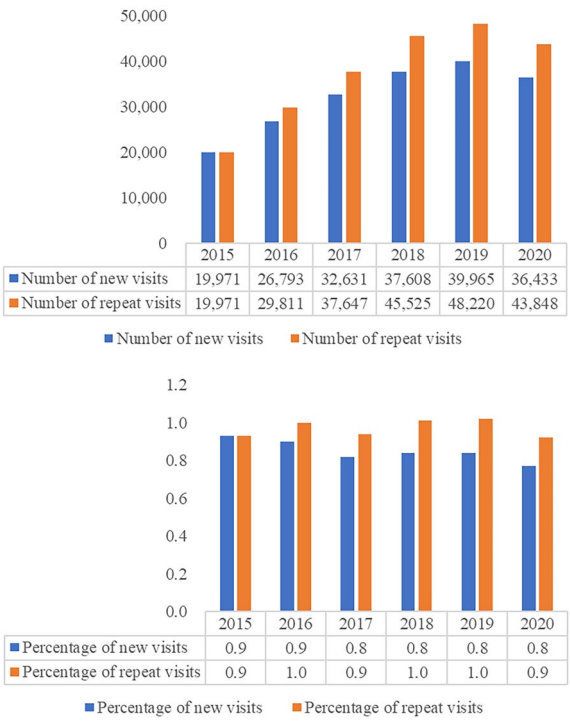

Fig. 2 Comparison of number and percentage of new visits and repeat visits in patients with migraine

(18.5%; $n = 5613/30,314$), and acute (11.2%; $n = 11,761/105,158$) patients with migraine (Table S5). Overall, myocardial ischemia/infarction ($n = 12,498$, 6.1%), cerebrovascular disease ($n = 8463$, 4.2%), peripheral vascular disease ($n = 5059$, 2.5%), arrhythmias ($n = 3498$, 1.7%), and congestive heart failure ($n = 2671$, 1.3%) were the most frequently reported cardiovascular comorbidities during the study period (Tables S5 and S6). A similar trend was observed across individual sub-cohorts. It should be noted that patients were not mutually exclusive.

Treatment Patterns and Line of Treatment

During the 12-month post-index period, data relevant to treatment patterns were available for 141,447 (69.6%), 8177 (98.4%), 103,445 (98.4%), and 29,825 (98.4%) patients in the overall cohort, preventive migraine, acute migraine, and preventive + acute migraine sub-cohorts, respectively (Table 2). Overall, NSAIDs ($n = 119,355$, 84.4%), triptans ($n = 42,138$, 29.8%), and beta-blockers ($n = 18,157$, 12.8%) were the frequently prescribed drug classes. Patients in the acute migraine sub-cohort were primarily prescribed NSAIDs ($n = 93,310$, 90.2%) and triptans ($n = 29,496$, 28.5%), while beta-blockers ($n = 3937$, 48.1%) and anticonvulsants ($n = 2878$, 35.2%) were frequently prescribed for patients in the preventive migraine sub-cohort. In the preventive + acute migraine sub-cohort, the majority of the patients were prescribed NSAIDs ($n = 26,045$, 87.3%), beta-blockers ($n = 14,218$, 47.7%), triptans ($n = 12,642$, 42.4%), and anticonvulsants ($n = 11,259$, 37.8%).

The LOT analysis showed that the treatments prescribed as LOT1 to patients with migraine were either monotherapies or combination therapies of NSAIDs, triptans, anticonvulsants, beta-blockers, Botox, and CGRP antagonists. In the post-index period, the most commonly prescribed LOT1 was NSAIDs ($n = 7642$), followed by triptans ($n = 3374$), NSAIDs + triptans ($n = 2182$), beta-blockers + NSAIDs ($n = 1243$), and anticonvulsants ($n = 1194$). Few patients received LOT2 and LOT3, possibly due to continuation of LOT1. No patient received a true LOT3.

Specialty Analysis

In the overall population, general medicine ($n = 104,714$, 51.5%) was the most frequently visited specialty at the index date, followed by neurology ($n = 41,466$, 20.4%), and internal medicine ($n = 28,625$, 14.1%) (Table 3). At the index date, 64.2% of patients ($n = 67,466$) in the acute migraine sub-cohort had the first consultation with general medicine practitioners, while 58.1% of patients ($n = 4828$) in the preventive migraine sub-cohort and 50.8% of patients ($n = 15,413$) in the acute + preventive sub-cohort had their first specialty consultation with a neurologist.

The data pertinent to patients visiting other specialties prior to a neurologist in the 12-month post-index period were available for 3.9% of patients ($n = 7910$). The specialties visited prior to a neurologist consultation included general medicine ($n = 4538$, 57.4%), internal medicine

Table 2 Treatment pattern for the overall and sub-cohort population for the 12-month post-index period (sub-cohort 1: preventive, sub-cohort 2: acute, sub-cohort 3: preventive + acute)

	Overall		Sub-cohort 1		Sub-cohort 2		Sub-cohort 3	
	N	%	*N*	%	*N*	%	*N*	%
Overall study population in the index period	203,222	100	8304	4.1	105,158	51.7	30,314	14.9
Treated Population in the 12-month follow-up period	141,447	69.6%	8177	98.4%	103,445	98.4%	29,825	98.4%
Treatment pattern								
NSAIDs	119,355	84.4%	0	0.0%	93,310	90.2%	26,045	87.3%
Triptans	42,138	29.8%	0	0.0%	29,496	28.5%	12,642	42.4%
Beta-blocker	18,157	12.8%	3937	48.1%	2	0.0%	14,218	47.7%
Anticonvulsants	14,138	10.0%	2878	35.2%	1	0.0%	11,259	37.8%
Tricyclic antidepressants	5663	4.0%	1444	17.7%	1	0.0%	4218	14.1%
Antiemetic	4109	2.9%	0	0.0%	3122	3.0%	987	3.3%
Stimulants	2176	1.5%	0	0.0%	1793	1.7%	383	1.3%
CGRP	1451	1.0%	215	2.6%	0	0.0%	1236	4.1%
Antihypertensive	776	0.5%	112	1.4%	0	0.0%	664	2.2%
Hypnosis	594	0.4%	0	0.0%	269	0.3%	325	1.1%
ACE inhibitors	597	0.4%	116	1.4%	0	0.0%	481	1.6%
Botox	489	0.3%	162	2.0%	0	0.0%	327	1.1%
Ca antagonist	419	0.3%	68	0.8%	0	0.0%	351	1.2%
Opioids	360	0.3%	0	0.0%	182	0.2%	178	0.6%
SSRI	171	0.1%	75	0.9%	0	0.0%	96	0.3%
Antidepressant	67	0.0%	28	0.3%	0	0.0%	39	0.1%
Ditans	39	0.0%	0	0.0%	5	0.0%	34	0.1%

ACE angiotensin-converting enzyme; *CGRP* calcitonin gene-related peptide; *NSAID* nonsteroidal anti-inflammatory drug; *SSRI* selective serotonin reuptake inhibitor

Patients can present in more than one treatment; hence patient counts are not mutually exclusive

(*n* = 1285, 16.2%), and ear, nose, throat (ENT) (*n* = 583, 7.4%). The average number of days taken to visit a neurologist was 65, and the number ranged from 1 to 364 days. More than half of the patients (*n* = 4428, 56.0%) visited a neurologist within a month (Table 3).

HCRU and Associated Costs

Overall HCRU and Associated Costs

HCRU and associated cost data related to combined sub-cohorts of patients with migraine

Table 3 Specialty visited by overall population and sub-cohort population (sub-cohort 1: preventive, sub-cohort 2: acute, sub-cohort 3: preventive + acute)

	Overall		Sub-cohort 1		Sub-cohort 2		Sub-cohort 3	
	N	%	*N*	%	*N*	%	*N*	%
Overall study population in the index period	203,222	100	8304	4.1	105,158	51.7	30,314	14.9
First-time visit specialty analysis								
Specialty	*N*	%	*N*	%	*N*	%	*N*	%
General medicine/family medicine	104,714	51.5%	1017	12.2%	67,466	64.2%	7743	25.5%
Neurology	41,466	20.4%	4828	58.1%	10,655	10.1%	15,413	50.8%
Internal medicine	28,625	14.1%	1064	12.8%	14,358	13.7%	4423	14.6%
ENT	8637	4.3%	615	7.4%	4076	3.9%	1402	4.6%
Ophthalmology	6755	3.3%	116	1.4%	1624	1.5%	386	1.3%
Unknown specialty	5708	2.8%	188	2.3%	3238	3.1%	759	2.5%
Emergency medicine	2199	1.1%	12	0.1%	1611	1.5%	312	1.0%
Obstetrics/gynecology	1988	1.0%	16	0.2%	993	0.9%	130	0.4%
Specialty patients visit prior to neurologist visit (12-month follow-up period)								
Patient visits other specialties prior to neurologist visit in 12-month follow-up period	7910	3.9%	278	3.3%	2806	2.7%	4178	13.8%
General medicine/family patient visits other specialties prior to neurologist visit in 12 months of follow-up	4538	57.4%	94	33.8%	1748	62.3%	2397	57.4%
Internal medicine	1285	16.2%	55	19.8%	386	13.8%	737	17.6%
ENT	583	7.4%	35	12.6%	159	5.7%	322	7.7%
Ophthalmology	337	4.3%	26	9.4%	104	3.7%	131	3.1%
Emergency medicine	305	3.9%	4	1.4%	141	5.0%	129	3.1%
Unknown specialty	255	3.2%	16	5.8%	93	3.3%	87	2.1%
Neurosurgery	117	1.5%	8	2.9%	26	0.9%	66	1.6%
Obstetrics/gynecology	91	1.2%	4	1.4%	38	1.4%	37	0.9%
Cardiology	76	1.0%	9	3.2%	19	0.7%	39	0.9%
Gastroenterology	84	1.1%	8	2.9%	19	0.7%	45	1.1%
Number of patients/days								
Number of patients	7910							
Average number of days to neurologist visit	65 days							
Median number of days to neurologist visit	21 days							
Standard deviation	88 days							
Minimum number of days to neurologist visit	1 day							
Maximum number of days to neurologist visit	364 days							
Average number of days to neurologist visit	65 days							

Table 3 continued

	Overall		Sub-cohort 1		Sub-cohort 2		Sub-cohort 3	
	N	%	*N*	%	*N*	%	*N*	%
Time to neurologist visit								
1 month	4428	56.0%						
2 months	864	10.9%						
3 months	583	7.4%						
4 months	400	5.1%						
5 months	327	4.1%						
6 months	302	3.8%						
1 year	1006	12.7%						

ENT ear, nose, throat

Patient counts are not mutually exclusive because patients might have visited multiple specialties on the first visit

(acute, preventive, and acute + preventive) were available for 143,780 patients with migraine during the 12-month post-index period including the index date (Table S7). The median all-cause and migraine-specific claims during the post-index period were 10.0 (1.0–323.0) and 2.0 (1.0–71.0), respectively. The percentage contribution of migraine-specific median healthcare cost to all-cause median healthcare cost was 20.7%. Among the three sub-cohorts, all-cause and migraine-specific claims were highest in the preventive + acute sub-cohort (13.0 [1.0–309.0] and 3.0 [1.0–71.0], respectively) with the migraine-specific median cost to all-cause median cost being 26.0%.

Likewise, the overall median all-cause and migraine-specific healthcare gross costs were US $1252.6 (2.4–564,740.7) and US $198.1 (0–168,903.3), respectively, with the highest in the preventive + acute sub-cohort (US $2030.6 [8.6–564,740.7] and US $424.8 [1.4–9443.5], respectively) (Table S7). Migraine-specific costs contributed 19.9% of the all-cause cost during the post-index period. The highest disease burden among the cohorts in terms of gross cost was in the preventive + acute migraine sub-cohort (27.3%).

HCRU and Associated Cost Based on Visit Type

During the post-index period, the median all-cause claims were highest for outpatient visits (10.0 [1.0–323.0]), followed by ER visits (2.0 [1.0–84.0]) and inpatient visits (1.0 [1.0–14.0]) (Table 4). Migraine-specific claims showed a similar trend, with the highest median claims for outpatient visits (2.0 [1.0–69.0]) followed by ER and inpatient visits.

The associated median all-cause cost was highest for inpatient visits (US $10,445.5 [3.3–557,343.1]), followed by outpatient (US $1146.9 [1.0–251,832.5]), and ER visits (US $423.9 [0–22,016.7]) (Figure S1 and Table 4). Similarly, the associated median disease-specific cost was also highest for inpatient visits (US $4496.7 [20.0–168,903.3]). Study analysis showed that migraine-specific median inpatient cost contributed 75.9% of all-cause inpatient cost during the post-index period.

HCRU and Associated Costs Based on Activity Type

The median all-cause claims were highest for medications (5.0 [1.0–262.0]), services (5.0 [1.0–145.0]), and procedures (4.0 [1.0–265.0]) during the post-index period (Table 5).

Table 4 Healthcare resource utilization and costs by visit type (12-month post-index period)

Analysis of claims			
	Disease-specific	**All-cause**	**Average disease burden**
Outpatient			
N (patient counts)	139,773	143,330	21.0%
Percentage of patients	97.2%	99.7%	
Total	403,042	1,965,371	
Mean	2.9	13.7	
Median	2.0	10.0	
Std	2.7	12.6	
Min	1.0	1.0	
Max	69.0	323.0	
Emergency			
N (patient counts)	10,301	23,575	58.1%
Percentage of patients	7.2%	16.4%	
Total	18,205	71,684	
Mean	1.8	3.0	
Median	1.0	2.0	
Std	1.5	3.5	
Min	1.0	1.0	
Max	31.0	84.0	
Inpatient			
N (patient counts)	1664	7754	88.5%
Percentage of patients	1.2%	5.4%	
Total	1790	9428	
Mean	1.1	1.2	
Median	1.0	1.0	
Std	0.3	0.7	
Min	1.0	1.0	
Max	6.0	14.0	

Table 4 continued

Analysis of claims			
	Disease-specific	**All-cause**	**Average disease burden**
Gross cost (USD)			
Outpatient			
Total	74,487,753.1	361,467,749.8	21.1%
Mean	533.0	2522.0	
Median	180.4	1146.9	
Std	1267.5	4788.0	
Min	0.0	1.0	
Max	62,659.3	251,832.5	
Emergency			
Total	3,924,199.0	18,379,427.3	48.9%
Mean	380.9	779.4	
Median	278.0	423.9	
Std	414.4	1104.8	
Min	1.8	0.0	
Max	6926.3	22,016.7	
Inpatient			
Total	13,189,105.3	80,992,938.8	75.9%
Mean	7926.3	10,445.5	
Median	4496.7	5994.3	
Std	11,512.4	18,234.4	
Min	20.0	3.3	
Max	168,903.3	557,343.1	

USD United States dollars (US $)

Excluded the patients/claims having claim amount less than or equal to US $0 by each cohort

Gross cost = insurance paid amount + patient share

Implied PPP conversion rate (national currency per international dollar): https://www.imf.org/external/datamapper/PPPEX@WEO/OEMDC/ARE

Migraine-specific claims showed similar results, with the highest median claims for medications (1.0 [1.0–65.0]). Claims due to procedures (26.3%) and medications (26.2%) contributed maximally towards the average disease burden. However, the diagnosis-related group (DRG) contributed 89.5% towards the average disease burden.

The maximum median all-cause cost was incurred for procedures (US $484.7

Table 5 Healthcare resource utilization and costs by activity type (12-month post-index period)

	Analysis of claims			Net cost (USD)		
	Disease-specific	All-cause	Average disease burden	Disease-specific	All-cause	Average disease burden
Medications						
N (patient counts)	141,769	143,490				
Percentage of patients	99%	100%				
Total	260,038	1,003,171	26.2%	38,616,889.0	122,333,502.4	32.0%
Mean	1.8	7.0		272.2	852.6	
Median	1.0	5.0		65.6	319.6	
Std	1.6	6.3		975.6	2805.7	
Min	1.0	1.0		0.0	0.0	
Max	65.0	262.0		56,229.7	247,424.9	
CPT (procedures)						
N (patient counts)	72,813	125,923				
Percentage of patients	51%	88%				
Total	110,661	726,626	26.3%	25,891,564.1	182,397,377.5	24.5%
Mean	1.5	5.8		355.5	1448.3	
Median	1.0	4.0		91.4	484.7	
Std	1.2	6.3		1095.7	3360.3	
Min	1.0	1.0		0.3	0.5	
Max	50.0	265.0		59,396.7	182,851.2	
HCPCS (consumables)						
N (patient counts)	3184	14,510				
Percentage of patients	2%	10%				
Total	4017	25,075	73.0%	982,605.3	12,736,378.0	35.2%
Mean	1.3	1.7		308.6	878.0	
Median	1.0	1.0		14.8	191.4	
Std	0.9	2.5		1469.9	3021.1	
Min	1.0	1.0		0.0	0.0	
Max	16.0	151.0		27,836.8	186,845.5	
Services						
N (patient counts)	109,001	135,038				

Table 5 continued

	Analysis of claims			Net cost (USD)		
	Disease-specific	All-cause	Average disease burden	Disease-specific	All-cause	Average disease burden
Percentage of patients	76%	94%				
Total	181,895	865,723	26.0%	16,758,977.0	84,822,428.2	24.5%
Mean	1.7	6.4		153.6	628.2	
Median	1.0	5.0		57.4	212.0	
Std	1.4	5.7		612.0	1850.2	
Min	1.0	1.0		0.0	0.2	
Max	38.0	145.0		78,589.0	225,702.9	
DRG						
N (patient counts)	131	833				
Percentage of patients	0.1%	1%				
Total	138	981	89.5%	875,181.8	8,578,519.1	64.9%
Mean	1.1	1.2		6680.9	10,298.6	
Median	1.0	1.0		3996.2	7052.2	
Std	0.2	0.6		9157.9	11,294.7	
Min	1.0	1.0		0.0	0.0	
Max	2.0	10.0		68,370.8	139,969.9	

CPT Current Procedural Terminology; *DRG* diagnosis-related group; *HCPCS* Healthcare Common Procedure Coding System; *USD* United States dollars

Net cost = insurance paid amount

Excluded the claims having claim amount less than or equal to US $0

Implied PPP conversion rate (national currency per international dollar): https://www.imf.org/external/datamapper/PPPEX@WEO/OEMDC/ARE

[0.5–182,851.2]), followed by medications (US $319.6 [0–247,424.9]) and services (US $212.0 [0.2–225,702.9]). Migraine-specific findings suggested similar outcomes, with maximum cost associated with procedures (US $91.4 [0.3–59,396.7]). For DRG activity, the median all-cause claim was 1.0 (1.0–10.0), with the corresponding median cost being US $7052.2 [0–139,969.9]. DRG contributed around 64.9% towards all-cause cost. Study analysis showed that 32.0%, 24.5%, 24.5%, and 35.2% of all-cause HCRU cost of medications, procedures, services, and consumables, respectively, were related to migraine (Figure S2 and Table 5).

Overall HCRU and Associated Costs Among Combined Sub-Cohort of Patients with Migraine and Specific Cardiovascular Comorbidities

The disease-specific HCRU and associated costs among the combined sub-cohort of patients with migraine with specific cardiovascular

comorbidities were analyzed for the 12-month post-index period. Most patients had myocardial ischemia/infarction ($n = 5012$), followed by cerebrovascular disease ($n = 4119$) and peripheral vascular disease ($n = 1985$).

The median migraine-specific cost was higher for patients with intestinal ischemia (US $1175.6 [43.1–12,613.9]), pulmonary embolism (US $1039.2 [8.6–126,246.9]), and cerebrovascular disease (US $647.8 [1.0–356,042.1]) than for patients with other specific cardiovascular comorbidities (Table S8).

HCRU and Associated Costs Based on Visit Type by Cardiovascular Comorbidity

The migraine-specific cost was analyzed among the combined sub-cohort of patients with migraine and specific cardiovascular comorbidities for inpatient, outpatient, and ER visits. For inpatient visits, the maximum median cost was observed for patients with arrhythmias (US $9698.6 [1300.0–89,921.5]) and congestive heart failure (US $9148.3 [1369.4–102,176.6]). The highest cost for outpatient visits was reported for patients with pulmonary embolism (US $804.8 [8.6–9903.3]) and venous thromboembolism (US $570.3 [4.8–19,845.9]). Similarly, migraine-specific costs due to pulmonary embolism (US $848.8 [130.1–6701.0]) and venous thromboembolism (US $747.8 [14.4–4915.8]) contributed the most towards ER visits (Table S9).

HCRU and Associated Costs Based on Activity Type by Cardiovascular Comorbidity

Analysis of migraine-specific costs among the combined sub-cohort of patients with specific cardiovascular comorbidities for activity type showed that the median net costs for medications and procedures were highest for patients with congestive heart failure (US $262.2 [0.5–14,233.5]) and intestinal ischemia (US $1255.5 [20.6–8687.6]) (Table S10). For consumables, the net cost was highest for patients with peripheral vascular disease (US $1987.6 [0.5–38,210.5]), while for services, patients with pulmonary embolism incurred the highest cost (US $31,389.7 [52.3–321,694.9]). For DRG-related activity, migraine-specific costs due to congestive heart failure (US $7599.0 [2049.8–89,921.5]) accounted for the maximum share in terms of net cost.

DISCUSSION

Migraine has a considerable economic and societal burden and negatively impacts the QoL and productivity of affected individuals [1, 3, 16]. Despite this, the data on epidemiology, treatment patterns, and economic burden of migraine in the UAE are limited. Therefore, the current analysis evaluated patient demographics, comorbidity burden, treatment patterns, HCRU, and associated costs in patients with migraine in the UAE, using the DRWD.

The current study, contrary to earlier studies, showed a male preponderance in the prevalence of migraine [4, 35, 36]. This may be because the claims database primarily includes a male expatriate population (male to female expatriate ratio: 3:1) [37].

NSAIDs and triptans were commonly prescribed drugs for patients in the acute migraine sub-cohort, while beta-blockers constituted the major prescription drugs for patients in the preventive migraine sub-cohort, in accord with previous studies [17, 38]. Further, we noted the prescription of NSAIDs and triptans as monotherapy and combination therapy in the study population. Although triptans are widely used in acute migraine management in clinical practice, augmentation of therapy, with additional acute treatments, becomes essential when suboptimal responses are encountered.

In the current study, 13.4% (27,148 of total 203,222) of patients with migraine had cardiovascular comorbidity and many patients were prescribed triptans, which are contraindicated in patients with cardiovascular disease or risk factors. We would like to explain this observation considering a few limitations we had in our study analysis. We believe that this observation could be due to a large portion (55.4%) of the male population with migraine in our study. We also believe that since the mean age of the study population was 40 years, and

notably 45.6% were 35–44 years of age, it may be that triptan was prescribed considering that the risk of cardiovascular adverse effects was lower in this younger cohort. The third limitation is that we are unable to quantify whether the cardiovascular risk was present before the prescription of triptan, or occurred after the triptan prescription. Therefore, we would need more focused studies to evaluate this potential relationship between triptan and cardiovascular risk.

Currently, the migraine treatment landscape is developing with the advent of novel drugs targeting CGRP or its receptor. These drugs effectively prevent migraine attacks with superior efficacy and safety profiles compared with conventional drugs [24, 39]. Moreover, they have substantially improved clinical outcomes and reduced the economic burden on patients with migraine [32, 40, 41]. Additionally, evidence from clinical trials and real-world studies have shown that anti-CGRP-monoclonal-antibodies (mAbs) are effective in reducing monthly migraine days, with a low discontinuation rate due to adverse events [42]. In an observational real-life study conducted in Spain on patients older than 65 years of age with migraine, the reduction in monthly migraine days after 6 months of treatment with anti-CGRP mAbs was 10.1 ± 7.3 days, with improved patient-related outcomes [43]. In yet another observational study, anti-CGRP mAbs proved to be effective in the treatment of patients with migraine (n = 155) who had failed at least three preventive medications. In the study, 51.6% of patients had ≥ 50% reduction in migraine days/month [44]. The prescription of novel therapies such as CGRP-targeting therapies was noted to be low in our study. It is therefore indispensable to understand the factors driving CGRP prescriptions or other newer drugs in the study population, despite more patients on premium than basic plans.

The clinical guidelines from the Dubai Health Authority include recommendations only for prophylactic or preventive treatment [16]. The recently published UAE consensus-based recommendations on the use of anti-CGRP mABs in the treatment of patients for prevention of migraine recommended anti-CGRP mAbs to be considered as a first-line treatment option for migraine prophylaxis. [45] Furthermore, the UAE consensus in 2024 on the acute management of migraine recommends the use of analgesics (primarily NSAIDs) and migraine-specific treatment with triptans, gepants, or ditans by following a stratified patient-centric care approach, considering the migraine severity, patient's comorbidity, and contraindications to other medications [46].

In our study, the economic burden of migraine was considerable, accounting for 19.9% of all-cause costs incurred due to migraine. Additionally, the cardiovascular comorbidity analysis showed that significant costs were incurred when patients with migraine encountered specific cardiovascular comorbidities. Further, a higher HCRU burden was noted among patients with migraine due to inpatient department visits (81.3%) and medication costs (32.0%). In a real-world claims study, the mean pharmacy cost was found to be 1.8 times higher in patients with migraine than in those without migraine (US $22,429 vs. $13,166) [47]. In another retrospective, observational study, the mean direct and indirect all-cause healthcare costs were US $6575 and US $2350 higher in patients with migraine than in their non-migraine counterparts, respectively [30]. Reports suggest that preventive medication use significantly increased the total direct healthcare cost (US $50,274 ± 76,629) [32].

We now highlight a few limitations of the study. The study covered only the privately insured population of UAE (Dubai), i.e., the expatriate population; thus, the study results may not be generalizable to all patients with migraine. This study does not consider out-of-pocket expenses incurred by patients taking non-reimbursable over-the-counter medications or other alternative therapies. Information bias due to treatment pattern variability across providers could not be avoided. Migraine diagnosis date as per the database may not be the actual date of diagnosis, as patients may have been diagnosed earlier and made the claim later. The study did not collect medical history and pre-index medication data, leading to information bias. In addition, the database did not allow one-to-one mapping between diagnosis and medications/procedures/consumables. Thus, the data on disease-specific medications, HCRU,

and associated costs were only suggestive that a specific medication or service was received that was possibly related to migraine. Hence, some of the reported migraine-specific medications, services, and costs may not be directly related to migraine. However, the study provides an in-depth analysis of the predominantly expatriate population covered by private insurance [34] and may prove beneficial for policymakers and aid in clinical decision-making.

CONCLUSION

Migraine has a substantial disease burden in the UAE and is associated with several comorbidities. Beta-blockers and anticonvulsants were frequently prescribed preventive treatments, while NSAIDs and triptans were common acute migraine therapies. Prescription of novel therapies (CGRP receptor antagonist, ditans) was low. Substantial HCRU and cost burden were primarily incurred for inpatient visits, medications, and procedural costs. Novel therapies, effective in reducing the frequency and intensity of migraine episodes and the socioeconomic burden are important factors in altering the migraine treatment landscape in the UAE. However, analysis of their role in migraine management is warranted.

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Declarations

Conflict of Interest. Mostafa Zayed, Nora Vainstein, Mohamed Fathy, and Ali Aljabban are Pfizer employees. All other authors (Alessandro Terruzzi, Abubaker AlMadani, Suhail Al-Rukn, Mohamed Farghaly, Sara A. Dallal, Anup Uboweja, Ashok Natarajan, Kumaresan Subramanyam, and Badrinath C. Ramachandrachar) report no conflict of interest.

Ethical Approval. The study was observational in nature and involved analysis of previously collected anonymized structured data and did not impose any form of intervention. Hence, obtaining informed consent was not required for the study. Further, no institutional review board approval was required as it did not involve the collection, use, or transmission of individually identifiable data. The study adhered to the Health Insurance Portability and Accountability Act of 1996 to prevent disclosure of patient health information. The dataset utilized for the present study was publicly inaccessible.

This dataset was obtained from the DHIC after adhering to all the required legal procedures to acquire and utilize this anonymized patient claims data. Under the terms of the data sharing contract with DHIC, IQVIA received a legitimate and exclusive right to use certain components of the dataset as specified in the contract. IQVIA was given authorization to apply the data for conducting anonymized and uniform analyses and research projects pertaining to health insurance claim records. Additionally, IQVIA was allowed to distribute the results and insights from the anonymized and uniform dataset to its clients for research purposes involving health insurance claim information. IQVIA pledged to adhere to established procedures to maintain compliance with applicable regulations, including those related to data privacy.

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