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Quantification of local populations' demand for prehospital emergency care in Jimma city, Ethiopia

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ABSTRACT

***Background**: Little is known about the burden of acute illness and injury that would be addressed with improved prehospital care in Ethiopia. This study aimed to quantify the burden of emergency conditions that potentially benefited from implementing prehospital care service in Jimma city, Oromia region, Ethiopia.*

***Method**: This study is a secondary analysis of a dataset originally created to characterize the burden of emergency conditions presented to public hospitals in Jimma city from 2014 to 2017. We included 19885 eligible cases out of 39537 emergency cases who visited hospitals and rated them for amenability to prehospital care using previous definitions devised for priority emergency conditions in Low-and Middle-Income-Countries. In addition, a demographic health report for the same period was obtained from Jimma health office and used to quantify the population-normalized rates of demand for prehospital care in the study area. Descriptive analysis was used to summarize demographic data, causes of visits, and need for prehospital care. The odds ratio was calculated to assess the demand for prehospital care across major clusters of diseases, and statistical significance was considered at a P-value<0.05.*

***Result**: We identified that 51.1% (n=10163) of all emergency visits to local hospitals with acute conditions would have benefitted from receiving prehospital care. Maternal emergencies (22.2%, n=2255), lower respiratory infections (20.8%, n=2116), and trauma (27.8%, n=5527) were leading conditions in need of prehospital care. On average, there were 3388 acute events per year, or 1 acute event per every 56 individuals in the population, which could have potentially benefited from prehospital care.*

***Conclusion**: This study identified a significant proportion of emergency conditions could have experienced improved health outcomes if prehospital services had been available and rendered in Jimma city. These results provided additional justification for developing formalized prehospital services in Jimma, and the need for continued investigation of the health benefits of prehospital care in Ethiopia.*

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1. Introduction

African nations suffer from an overwhelming morbidity and mortality burden attributed to acute disease and emergent conditions [1]. This includes acute complications of maternal diseases, childhood illnesses, and communicable diseases [2-5]. Moreover, this is accompanied by a rapidly growing double burden from injury and time-sensitive acute complications of non-communicable diseases. As a result, these countries urgently require a robust emergency care system to alleviate the disproportionate burden of acute disease [5, 6]. However, an effective emergency care system should be comprehensive and part of the continuum of care [2, 3, 7, 8]. Prehospital care (PHC) is an essential part of this component delivered at out-of-health facilities to reduce the likelihood of death or disability [2, 9]. Despite this, the development of PHC in the region has been slow for various reasons [6, 10]. Even though the causes of poor PHC systems are multifactorial, the lack of documented data on the burden of emergency conditions is a notable reason [6, 9]. The lack of documented data has obscured an understanding of the existing burden and potential health impact of PHC availability and hampered attempts to tailor the service to regionally specific demands [9]. A series of African Federation for Emergency Medicine (AFEM) consensus conferences have devised a roadmap to develop PHC systems in the low-resource settings of Africa since 2011 [5, 6, 9]. The 2013 AFEM consensus conference has underlined the need for evidence-based advocacy for the development of PHC systems locally and across the region [9]. However, this requires a documented local or regional burden of acute disease data, which would help to understand the local public health priorities and design appropriate region-specific systems along with the potential benefits of implementing PHC systems [9].

Similar to other African countries, the development of the PHC system remained neglected in Ethiopia despite being one of the countries with the highest rates of mortality and morbidity attributed to acute and emergency conditions [11, 12]. Moreover, the actual burden of acute disease, particularly the burden of diseases amenable to emergency care in a prehospital setting, has not been quantified in Ethiopia. Therefore, there is an undisputed need to quantify the local (or national) burden of acute disease and priority conditions that could potentially benefit from PHC and to reveal how building the proper systems could help to address this and improve health outcomes. Moreover, Jimma is one of the major cities in Ethiopia and the largest city in the southwest region, recently targeted by the Ministry of Health (MoH) for prehospital care system development. Hence, there is a clear need for data to support the ongoing efforts to establish the prehospital system in Jimma city, as well as similar sites across the country. Therefore, this article aims to extrapolate the local need for PHC from an existing dataset to establish a benchmark for future interventions in Jimma City, the largest city in Southwest Ethiopia.

2. Methodology

Study Design

A multi-facility-based cross-sectional study was employed.

Setting

The study was conducted at public hospitals and the Jimma City Health Office in Jimma, Ethiopia. Jimma is located 352 km southwest of the capital city, Addis Ababa. At the time of this study, Jimma University Medical Center (JUMC) and Shenen

Gibe Hospital (SGGH) were the only public hospitals in Jimma. JMC is a tertiary teaching hospital serving an estimated 20 million people and functions as the referral center for the south-western part of Ethiopia. SGGH is a regional hospital serving Jimma City's population and the Jimma Zone's surrounding districts. At the time of this study, Jimma was home to more than 212,000 people and had 17 smallest administrative units known as Kebele.

Population

All emergency patients originated from Jimma City and presented to SGGH and JUMC from September 07, 2014, to September 11, 2017. A total of 19,894 eligible cases which originated from Jimma City were included out of 39,537 emergency patients who visited the study hospitals.

Data source and data collection methods

This is a secondary analysis of a dataset collected by the same authors to characterize the burden of emergency conditions seen at the study hospitals [13]. A previously published article provided the details of the definitions used for case review, data source, and data collection methods [13]. All the cases originating from Jimma City were included in this study. A demographic health report for the same period was also obtained from the Jimma health office (Figure 1).

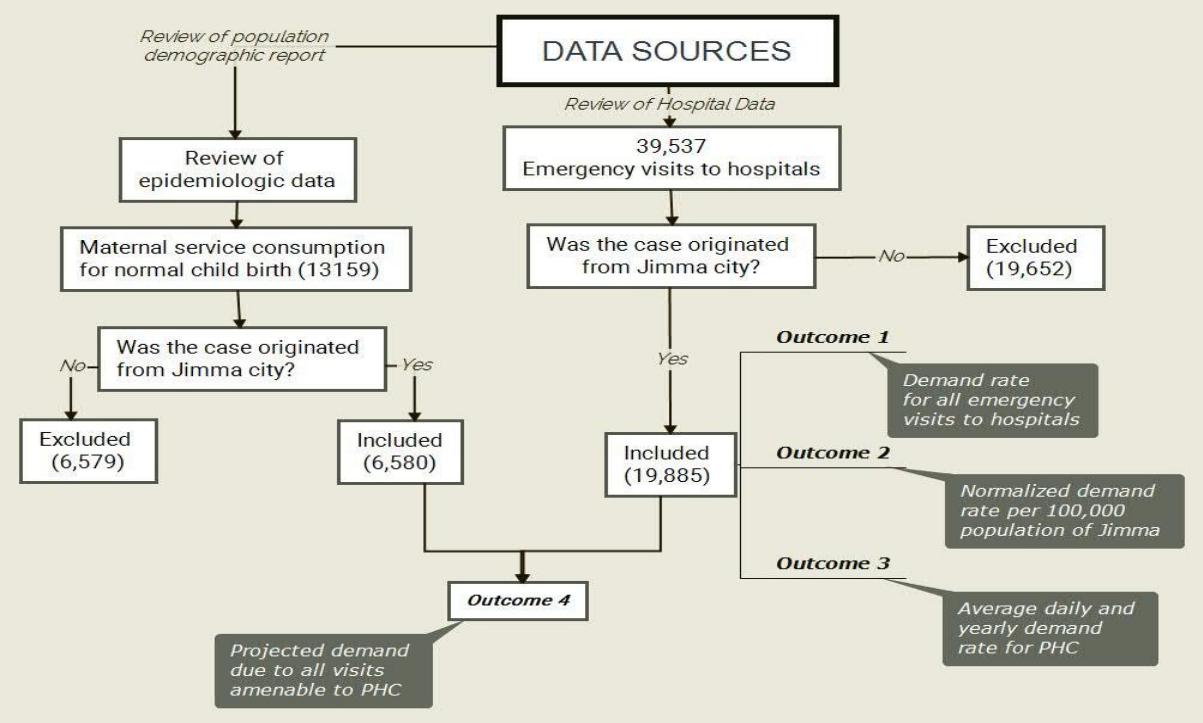

Figure 1: Case inclusion process and outcome measures

Case classification

There are no established algorithms for extracting data on emergency conditions amenable to emergency care from existing data sets in Sub-Saharan Africa [6]. As a result, we adapted a set of case definitions developed and used previously by Kobusingye et al., [2] Thind at al.,[14] and Hsia et al.,[15] to identify emergency conditions that may be addressed by prehospital care in low-and middle-income countries (LMICs). In addition, the

national priority diseases, the top causes of mortality and morbidity burden in Ethiopia, were considered [11]. Each case suitability for PHC was assessed and classified into aggregate broad disease categories based on the adapted definitions and the reason for emergency presentation to the hospital [2, 14, 15]. We adopted three broad aggregate disease categories, including (1) communicable, maternal and neonatal conditions, (2) non-communicable diseases, and (3) injury; each case was classified into either of these categories based on the primary cause of presentation [2, 14, 15]. These broad aggregate disease categories were further classified into thirteen sub-categories. The first aggregate category involves six disease sub-categories, including diarrheal diseases, lower respiratory infections, childhood conditions, infectious diseases, maternal conditions, and neonatal conditions. The second aggregate category involves five disease sub-categories, including cardiovascular diseases, respiratory diseases, diabetic conditions, neurological conditions, and digestive diseases. The third sub-category was injury, which includes unintentional and intentional injuries.

Data analysis

Using the aforementioned definition, each patient presentation was independently reviewed by two Ethiopian Emergency Medicine experts in our database who classified them as either benefiting from PHC or not. The cases were classified based on a primary cause and or associated causes of emergency presentation (See Supplementary Note). Cohen's kappa coefficient was calculated to assess inter-rater agreement. Cases without agreement were reviewed again and discussed by the same two reviewers until all differences were reconciled. The data was manually checked and cleaned for completeness in the Microsoft Excel Spread Sheet. The cleaned data was imported to SPSS Version 23.0 for Windows for analysis. Descriptive statistics were used to summarize demographic data, causes of presentations, and projected PHC demand rates. Odds ratios were calculated to determine differences in proportions of PHC demand across major aggregate disease groups. Statistical significance was considered at a P-value<0.05.

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Ethical considerations

Ethical approval and clearance were obtained from Jimma University, Institute of Health Institutional Review Board (IRB).

Outcome measures

The primary outcome measure was the potential demand for PHC, quantified as different rates. This includes the following: (1) PHC demand rate for all emergency visits to hospitals; (2) population-normalized demand: rate of PHC demand per 100,000 population of Jimma (using average population obtained from the city's demographic health report); and (3) average daily and yearly demand for PHC. In addition to projecting the actual demand for PHC service, we also obtained normal maternal childbirth cases from the local epidemiologic report for the study period involved in the final analysis. The national policy towards maternal health considers every childbirth case as a candidate for obstetric emergency transportation in Ethiopia[16]. The interaction between the recruiting process of the cases and outcome measures are presented in

3. Results

A total of 19894 eligible emergency cases that originated from Jimma City were included in the analysis of this study. This accounts for 55.6% of total emergency cases (39537) and 31.8% of

overall admissions (69119) to the hospitals during the study period.

3.1. Characteristics of the patients

According to the findings of this study, more than half (51.1%, n = 10,163) of the cases were patients who could have benefited from PHC. Male patients accounted for 50.3% (n = 9997) of total presentations, while females were the leading gender group that potentially benefited from PHC (28.3%, n = 5622). The mean (±SD (standard deviation)) age of overall patients was 22.2 (±15.48) years. The young age group of 15–29 years was the leading age group that presented with emergency conditions (49.7%, n = 9877) and potentially benefited from PHC (21.8%, n = 4344). Patients who presented during the rainy season (Jun–Aug) accounted for one-third (29%, 5779) of the total visits and were a leading group who potentially benefited from PHC (14.5%, n=2882) (

Table 1).

Table 1: Characteristics of emergency patients presented to public hospitals in Jimma City, Sept 2014 to Sept 2017, (N= 19894)

	Potentially benefitted from PHC		
Characteristics	**Yes**	**No**	**Total**
Age (N=19885)			
0-28 days	1058(5.3)	70(0.4)	1128(5.7)
1-59 months	2064(10.4)	642(3.2)	2706(13.6)
5-14 years	510(2.6)	778(3.9)	1288(6.5)
15-29 years	4344(21.8)	5533(27.8)	9877(49.7)
30-49 years	1583(8.0)	2061(10.4)	3644(18.3)
50-59 years	282(1.4)	324(1.6)	606(3.0)
60+ years	317(1.6)	319(1.6)	636(3.2)
Sex (N=19888)			
Male	4539(22.8)	5458(27.4)	9997(50.3)
Female	5622(28.3)	4269(21.5)	9891(49.7)
Visit type (N=8777)			
New	3762(42.9)	4402(50.2)	8164(93.0)
Repeat	277(3.2)	336(3.8)	613(7.0)
Year of visits (N=19894)			
2014/2015	2091(10.5)	2099(10.6)	4190(21.1)
2015/2016	3906(19.6)	2566(12.9)	6472(32.5)
2016/2017	4166(20.9)	5066(25.5)	9232(46.4)
Seasons of visit (N=19894)			
Wet-cold season	2246(11.3)	2187(11.0)	4433(22.3)
Dry season	2372(11.9)	2463(12.4)	4835(24.3)
Wet-hot season	2663(13.4)	2184(11.0)	4847(24.4)
Rainy season	2882(14.5)	2897(14.6)	5779(29.0)
Number of illness diagnosis on visit (N=19894)			
One	8969(45.1)	9544(48.0)	18513(93.1)
Two and above	1194(6.0)	187(0.9)	1381(6.9)

3.2. Potential benefits from PHC by Aggregate Causes of Visits

Communicable, maternal, and neonatal conditions (CMNs) accounted for the majority of total visits (56.5%, n = 11248) and were also the leading causes of visits that could have benefited from PHC (35.9%, n = 7136) (Figure 2). CMNs have three times the odds of potentially benefiting from PHC as injuries (OR 3.3, CI 95%, 2.8, 3.3; P 0.05) and NCDs (OR 3.0, CI 95%, 3.1, 3.6; P 0.05).

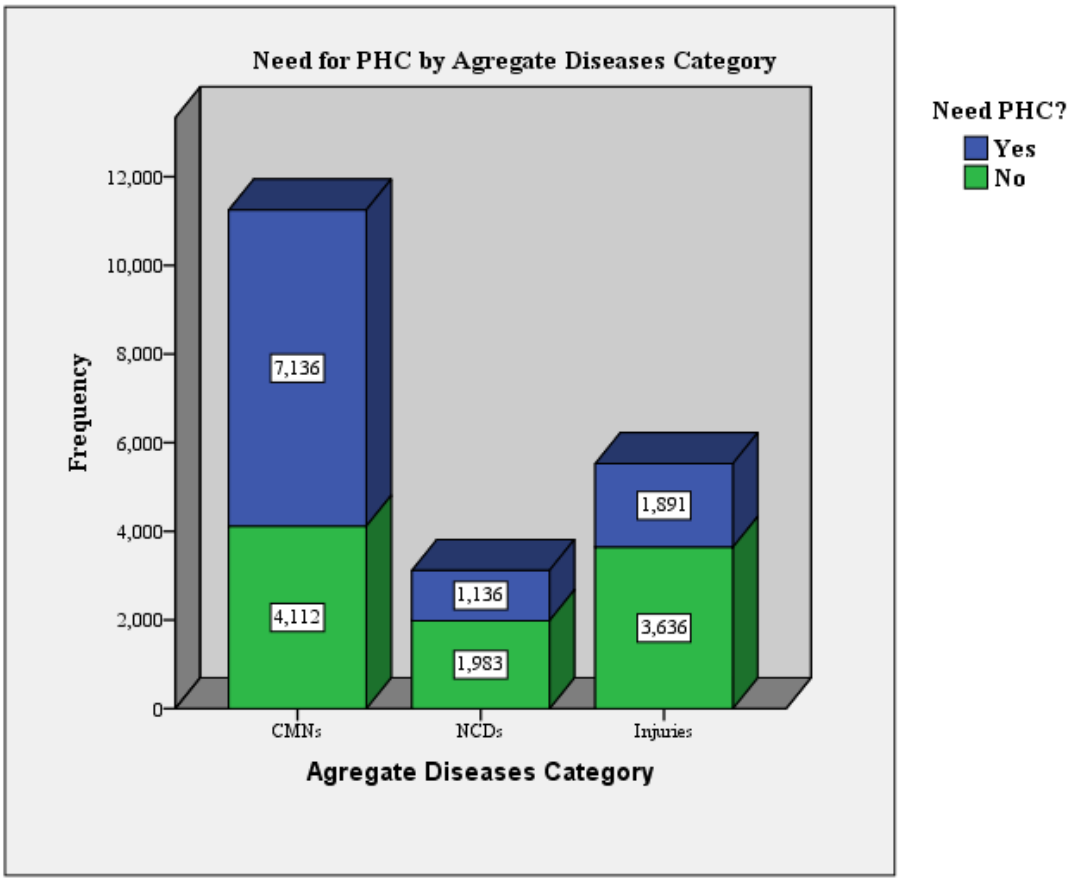

Figure 2: Aggregate causes of presentation among emergency visits to public hospitals in Jimma city, Sept 2014, to Sept 2017, (n = 19894)

3.3. Potential benefits of PHC by Aggregate Sub-Categories

Among all emergency conditions, maternal emergencies (22.2%, n = 2255), lower respiratory infections (20.8%, n = 2116), unintentional injuries (17.5%, n = 1779), and respiratory diseases (4.1%, n = 412), were the leading aggregated sub-categories that potentially benefited from PHC (**Error! Reference source not found.** 2).

Table 2: Aggregate causes of visit potentially benefited from prehospital care (N=10163)

Conditions	Frequency	Percent
Communicable, Maternal and Neonatal conditions (Sub-total) [1]	7136	70.2
Maternal conditions	2255	22.2
Lower respiratory infections	2116	20.8
Neonatal conditions	1156	11.4
Diarrheal diseases	799	7.9
Infectious diseases	529	5.2
Childhood conditions	281	2.8
NCDs (Sub-total) [1]	1136	11.2
Respiratory diseases	412	4.1
Cardiovascular diseases	321	3.2
Diabetic conditions	181	1.8
Digestive diseases	163	1.6
Neurological conditions	59	0.6
Injuries (Sub-total) [1]	1891	18.6
Unintentional injuries	1779	17.5
Intentional injuries	112	1.1

[1] *Not mutually exclusive category*

3.4. Top 20 conditions which could have potentially benefitted from PHC

CMNs aggregate groups dominate the top emergency conditions, which could potentially benefit from PHC. The top five leading conditions were pneumonia (18.3%, n = 1856), complicated labour (13.7%, n = 1393), acute gastroenteritis (7.8%, n = 792), neonatal sepsis (4.4%, n = 448), and asthma (4%, n = 411) (Table 3).

Table 3: Top 20 diagnoses of visits potentially benefited from prehospital care

Ranks	Conditions	Frequency	Percent
1	Pneumonia	1856	18.3
2	Complicated labour	1393	13.7
3	Acute gastroenteritis	792	7.8
4	Neonatal sepsis	448	4.4
5	Asthma	411	4.0
6	Malaria	337	3.3
7	Laceration traumatic wound	336	3.3
8	Perinatal complications	331	3.3
9	Abnormal pregnancy complications	319	3.1
10	Head injury	305	3.0
11	Abortions[1]	276	2.7
12	Tuberculosis	252	2.5
13	Road traffic injury	218	2.1
14	Preterm birth complications[2]	208	2.0
15	Limb fracture	203	2.0
16	Hypertensive heart disease	198	1.9
17	Meningitis	192	1.9
18	Diabetes mellitus	153	1.5
19	Severe acute malnutrition	149	1.5

20	Poisoning	140	1.4

[1]Abortions include all types of abortions; spontaneous abortion, missed and induced abortions (inevitable, septic, and incomplete abortions)

[2] Complications due to preterm birth including hypoglycemia, hypothermia, respiratory complications, low birth weight, anemia, and infections

3.5. Population-normalized rates of PHC demand

To understand the potential need for PHC at the population level, we calculated the population-normalized demand rates. Hence, the total emergency visits to the hospitals (n = 10163) potentially amenable to PHC would be translated to an average of 3388 cases per year and 9 events per day. Moreover, this corresponds to an average of 1787 amenable cases per 100,000 populations per year and 1 event per every 56 individuals within the population of Jimma city. Considering normal childbirth cases (6580) reported for the period, the total estimated conditions amenable to PHC would be 16743 cases (Supplementary Table 1**).**

4. Discussion

This study has identified approximately half (51.1%) of emergency patients presented to hospitals in Jimma City would likely benefit from receiving PHC. Evidence shows improved health outcomes are attainable with well-functioning prehospital emergency care systems, which have been advocated in African countries [6, 10]. Successful integration of PHC into the healthcare system needs to quantify the actual burden of acute and emergency conditions that are amenable to care[9]. In particular, stakeholders need evidence to understand the existing disease burden fully and support the need for better PHC system development [6, 9]. Even though there is a lack of established algorithms and tools to extract disease burden from existing datasets in Sub-Saharan Africa,[6] the present study attempted to estimate the local burden of emergency conditions in need of PHC in Jimma City using an existing dataset.

According to this study, CMNs are the leading cause of visits (35.9%) that could have benefited from PHC, followed by injuries (27.8%). Even though this local finding cannot be compared with an Africa-wide or national report, these clusters of diseases are the most common emergencies and leading causes of morbidity and mortality across Africa and in Ethiopia [11, 17]. Moreover, this study identified the average yearly acute events amenable to PHC as 3388 acute events; this also gives 1 acute event per every 56 individuals in the population of Jimma City. However, a previous study done in the Ashanti region of Ghana in 2015 reported a higher rate (23,500 events/year) and a lower population normalized ratio (1 acute event per 221 people) [18]. The discrepancy may be due to different health-seeking cultural norms and different population demography since the latter study was done in a regional part of the country while the present study reports data for the city level. Nevertheless, planning for the robust PHC system in Jimma City should consider this quantified local prehospital burden of acute diseases.

The present study has identified region-specific burdens of diseases that serve as baseline information for ongoing or future interventions. AFEM suggested a region-specific, tier-based formalized Emergency Medical Service (EMS) form of PHC systems that would be complemented by a community-based first-tier system [6, 9]. Moreover, Kobusingye et al.[2] and Sasser et al.,[3] have reported the cost-effectiveness of the health benefits of a region-specific PHC system in resource-limited settings of LMIC. Hence, we suggest the establishment of formalized EMS that operates on a universal emergency phone number for PHC systems in Jimma city, within the Southwest region of Ethiopia, or even throughout

the country using a context-specific model for PHC system development in resource-limited settings of LMIC. Therefore to realize this, elements of low-resource setting PHC, such as trained providers [19], transportation, equipment, legislation, and guidelines, would be developed gradually and realized with available resources [6, 9]. Moreover, it would be better to learn lessons from previous successful experiences in other LMIC countries, such as the EMS establishment in the Punjab province of Pakistan [20]. Overall, a well-conceived and developed prehospital care system that is properly tailored to the local population and emergency conditions can be implemented as an efficient front-line public health intervention to address the burden of acute disease identified in the present study area with continuous advocacy and support of stakeholders.

Limitations

The generalizability of this result is subjected to certain limitations. We deduced the need for PHC only from the database, which makes definitive diagnosis and ascertaining the true severity of illness slightly error-prone. This could overestimate or underestimate the true need for PHC for any individual patient; however, for a large study population, this is likely to be an overestimated and underestimated likely balance. Furthermore, in this study, only the primary diagnosis of visit was used for classification and the comorbid conditions were not included in further analysis. Therefore, the prevalence of conditions in our cohort does not represent the actual prevalence.

5. Conclusion

This study identified a significant burden of acute diseases that would have benefited from PHC in Jimma City. More than half of patients' emergency visits to local hospitals could have potentially benefited if formal PHC was provided as an EMS system. Acute maternal conditions and infectious illness are the leading conditions amongst the Jimma population in need of PHC. On average, there were 3388 acute events per year in 2014–2017, which is equivalent to 1 acute event per every 56 individuals in the population. The findings of this study highlight the urgent need for the establishment and sustainment of formal prehospital care services in the study area as well as the need for continued investigation of the benefits of prehospital care in Ethiopia.

Author Contributions

All authors have made substantial contributions to this research works, through: (1) the conception and design of the study, or acquisition of data, or analysis and interpretation of data, (2) drafting the article or revising it critically for important intellectual content, (3) final approval of the version to be submitted.

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Conflict of Interest

The author reports no conflict(s) of interest(s) in this work.

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