Accessibility to Obstetric Care and Its Impact on Maternal Health in Southeastern oases, Morocco

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Abstract. Limited access to obstetric care for pregnant women in rural areas increases the risk of maternal mortality. A geographic information system (GIS) was used to analyze spatial and temporal access to obstetric care in southeastern Morocco. The obstetric records of 1,304 pregnant women were examined to determine the diagnosis upon arrival and the duration of ambulance transport. According to maps generated by the GIS, 19 obstetric cases were more than 100 kilometers away from the regional hospital, and 16 cases required over two hours for transport to the regional hospital. Univariate binary logistic regression analysis confirmed that delays exceeding two hours between the sending hospital and the receiving regional hospital increased the likelihood of pregnant women arriving with hemorrhage (OR: 2.82 (1.38, 5.79), p = 0.005). The study revealed the consequences of restricted access to obstetric care on the health of pregnant women, highlighting the need for targeted strategies to improve access to obstetric services in this region.

Keywords: Maternal health, Obstetric care, Limited access, Oasis, Morocco.

1. Introduction

Accessible, high-quality emergency obstetric and neonatal care is essential for preventing the main causes of maternal death [1]. Access to maternity care in a given area is linked to its proximity and the ease of access for pregnant women [2]. Distance can result in delays in emergency deliveries, leading to complications for both the mother and newborn, potentially resulting in maternal death [3].

Globally, maternal mortality is highest in areas with poor access to health care; it was 430 per 100,000 live births in low-income countries, compared to 12 per 100,000 live births in high-income countries [4].Studies indicate that limited access to maternal care affects pregnant women in both high- and low-income countries, though it is more prevalent in low- and middle-income nations.

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In the Americas, research conducted in Brazil found poor access to antenatal and skilled care services, which led to complications during pregnancy, childbirth, and the postpartum period [5]. In rural Alabama, one study showed that limited access to obstetric services is associated with a higher risk of macrosomia and premature birth [6]. Furthermore, rural Alabama counties without access to a labor and delivery unit during the 15-year period from 2003 to 2017 reported statistically significantly higher rates of infant, neonatal, and perinatal mortality [7].

In Asia, specifically Myanmar, women in rural areas with inadequate healthcare coverage or facilities are the most vulnerable to anemia [8]. In India, rural women face a greater risk of adverse birth outcomes, such as miscarriage, stillbirth, and infant mortality, compared to their urban counterparts [9]. In Nepal, marginalized women in remote areas must monitor their own pregnancies due to limited access to healthcare [10]. In the Thailand-Myanmar region, the distance to clinics significantly predicts loss to follow-up, miscarriage, malaria infection during pregnancy, and access to antenatal care after the first trimester [11].

In Europe, rural women in Georgia must travel long distances to access healthcare, often resulting in childbirth complications and increased risk of death [12]. In France, the distance to maternity hospitals exacerbates the risk of adverse perinatal outcomes, such as abnormal fetal heart rate, meconium-stained amniotic fluid, and roadside births [13]. A study in the UK found that women living more than 35 km from an obstetric unit had a five-fold increased risk of pre-hospital birth compared to those residing within 35 km [14].

In Africa, particularly Ethiopia, a shortage of maternity care in remote areas leads to a higher probability of neonatal mortality Pregnant women in rural communities with limited access to antenatal care are also at a significantly higher risk of anemia during pregnancy [15]. In Sierra Leone, a correlation was observed between self-reported travel times and maternal and perinatal mortality rates due to postpartum hemorrhage [16]. A study in Benin discovered that even a one-kilometer increase in the distance to the nearest health facility reduced the number of women receiving antenatal care [17].

In Morocco, maternal mortality rates are higher in rural, isolated, and inaccessible areas than in urban regions (111.1 deaths per 100,000 live births in rural areas versus 44.6 deaths per 100,000 live births in urban areas) [18]. The marked differences between rural and urban areas (the prevalence rate in rural areas is twice as high as in urban areas) explain the importance of conducting studies in rural areas in Morocco to study the accessibility of women of rural areas to obstetric care and their impact on maternal health.

The Drâa-Tafilalet region, located south of the Atlas Mountains in Morocco, comprises 125 communes: 16 urban and 109 rural, with 65.7% of the population living in rural areas [19]. In this context of extreme rurality, investigating access to care and its impact on maternal health in the region is essential.

The aim of this study was to analyze access to obstetric care and its impact on maternal health in the Drâa-Tafilalet region. We used GIS (Geographic Information System) to conduct a spatiotemporal analysis of healthcare structures in the region and performed univariate binary logistic regression to assess the impact of access to care on maternal health.

2. Methodes

The obstetric care data were obtained from the Regional Health Delegation of the Draa Tafilalet region, which includes the total number of provinces, obstetric care facilities, and classifications based on rurality, level, and mode of referral during the period of 2022-2023. The provinces of Zagora and Ouarzazate were excluded from this study due to the rarity of referrals and counter-referrals to the Moulay Ali Cherif Regional Hospital.

We used Google Maps tools to determine the geographic coordinates (latitude and longitude) and filed the data in geographic format (Shapefile), integrating the coordinates in ArcGIS 10.8 software. The same coordinate system, WGS 84, was utilized (**Figure 1**).

To conduct a spatial analysis of the birth centers relative to the nearest hospital, we applied the Euclidean distance tool in ArcGIS. The geographical coordinates of the regional hospital served as a reference point to analyze the Euclidean distance between all healthcare facilities depicted in Figure 1 and the Moulay Ali Cherif Regional Hospital (**Figure 2**).

To identify remote areas with significantly longer travel times for obstetric emergencies, we assessed the time required to transfer patients from several facilities to the regional hospital. The distance in kilometers between the birthing centers and the regional hospital was calculated and divided by the average ambulance travel speed, assuming an average speed of 80 km/h (time = distance in km / average ambulance speed). Spatial interpolation using the Kriging tool was then applied to estimate travel times across the study area (**Figure 3**).

To evaluate the impact of extended transfer times on pregnant women arriving with hemorrhage, we classified the hemorrhage cases received during the study period (1304 cases) according to transfer duration and performed a univariate binary logistic analysis using SPSS software (**Tables 1 and 2**).

3. Results

In the provinces included in the study, there is one regional hospital (Moulay Ali Cherif), two provincial hospitals (Midelt and Tinghir), five local hospitals (Boudenib, Kellat Mgouna, Erfoud, Goulmima, and Rich), and 40 birthing centers (**Figure 1**).

No obstetric care facilities are located within a radius of less than 10 kilometers from the Moulay Ali Cherif Regional Hospital. Four obstetric care facilities fall within a radius of 10 to 50 kilometers from the regional hospital. Twenty obstetric care facilities are situated within a radius of 50 to 100 kilometers from the regional hospital. Fourteen facilities are located within a 100 to 150-kilometer radius, and five obstetric care facilities are more than 150 kilometers away (**Figure 2**).

Within a journey time of 30 minutes to 1 hour, seven care facilities are accessible. Between 1 and 1.5 hours away, there are 13 care facilities. Ten facilities are between 1 and 2 hours away. Nine facilities have a travel time of 2 to 2.5 hours, and finally, seven care facilities take over 2.5 hours to reach the regional hospital. In total, 16 of the care facilities analyzed require more than 2 hours to reach the regional hospital (**Figure 3**).

Analysis through binary logistic regression indicates a highly significant result for transfer durations exceeding 2 hours (from the delivery center to Moulay Ali Cherif Regional Hospital) and the risk of a pregnant woman arriving with hemorrhage (OR: 2.82 (1.38-5.79), P=0.005). In contrast, the result was not significant for transfer durations of less than 1 hour (OR: 1.29 (0.75-2.23), P=0.354) (**Tables 1 and 2**).

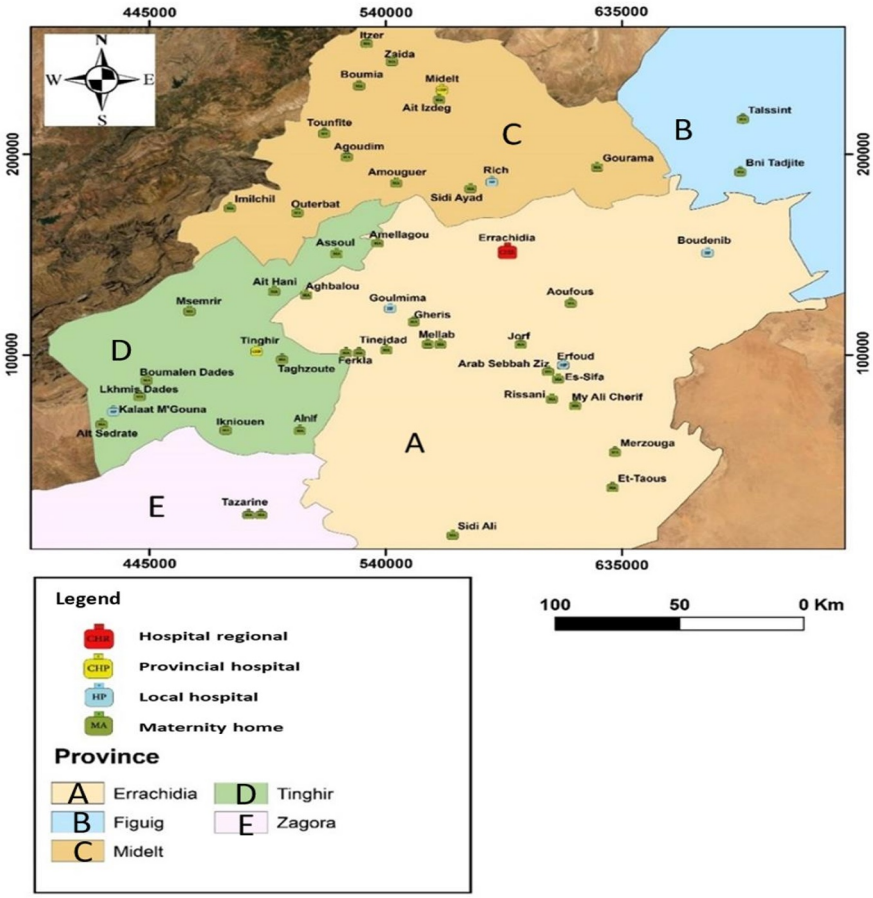

Figure 1. Distribution of maternity homes and hospitals

Table 1: number of cases of hemorrhage collected at the regional hospital

Reception with haemorrhage	**Number of Transferred**	**%**
Yes	55	4.2
No	1249	95.8
Total	1304	100

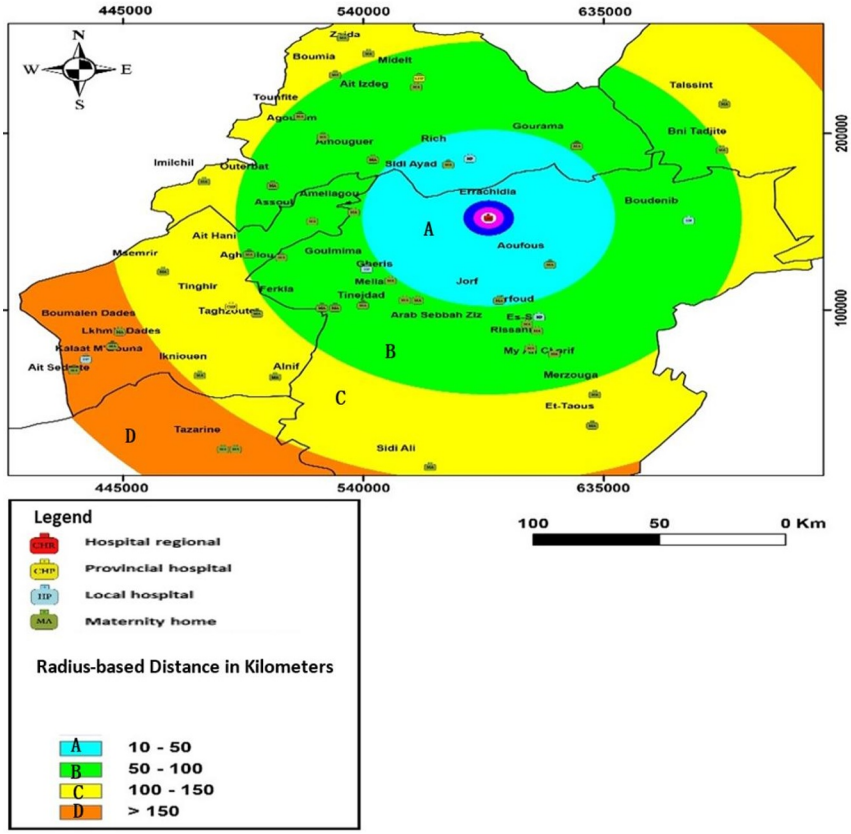

Figure 2. Euclidean distance between healthcare facilities and the regional hospital

Table 2: Adjusted odds ratio impact of duration on admission with hemorrhage

Time between transfer and reception with haemorrhage	**OR adjusted (IC à 95 %)**	**p Value**
> 2 h	2.82 (1.38-5.79)	0.005
≤ 1 h	1.29 (0.75-2.23)	0.354

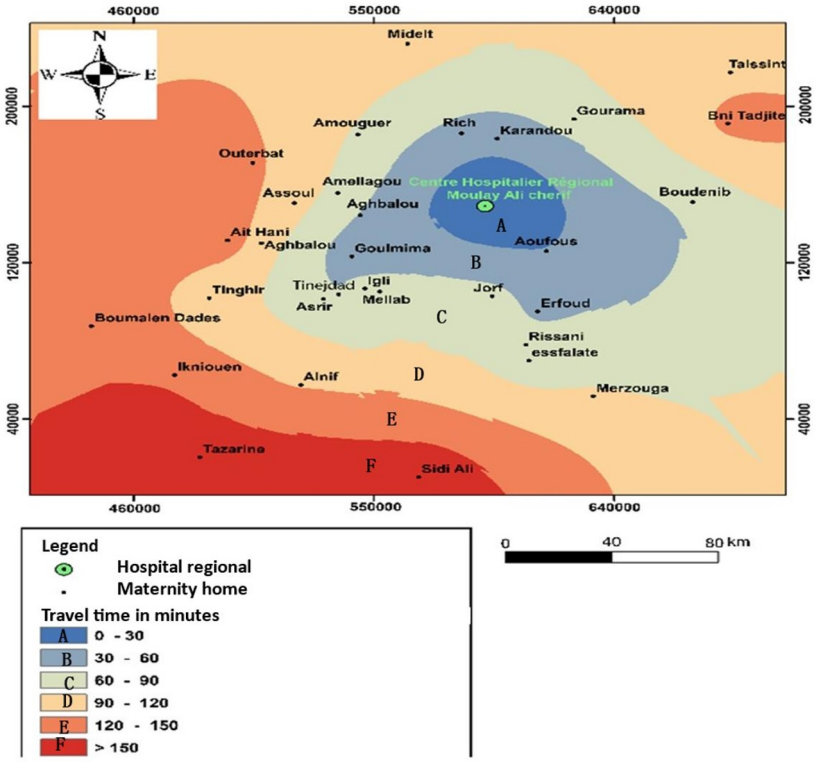

Figure 3. Travel time in minutes between the maternity houses and the regional hospital

4. Discussion

The provinces under study show notable differences in the accessibility of maternal health services, as evidenced by the geographic distribution of obstetric care facilities. The results raise significant questions about equity in access to emergency care because most obstetric centers are located far from the main regional hospital, Moulay Ali Cherif.

Only 7 facilities are accessible in less than an hour, while 16 require over two hours of travel time. This situation highlights a division of services, with inadequate coverage in remote areas. In a context where obstetric complications, such as hemorrhage, require rapid treatment to reduce maternal and neonatal mortality, this is particularly concerning. According to the study, being 10 kilometers from a healthcare facility significantly increases the risk of neonatal death. Furthermore, distance also impacts the use of prenatal care, institutional delivery, and postpartum counseling services, leading to their underutilization [15].

Analysis using binary logistic regression reveals a significant association between a journey time of over 2 hours and the risk of a transferred pregnant woman arriving in a state of hemorrhage (OR: 2.82, IC 95%: 1.38-5.79, p = 0.005). A Canadian study found that women who experienced postpartum hemorrhage for more than an hour had a much higher risk of complications than those who experienced it for less than an hour [14].

The results of this study call for the optimization of healthcare infrastructure in these provinces. Priority must be given to reducing distances and travel times, either by building

new facilities in underserved areas or by implementing intermediate solutions such as mobile obstetric emergency units. Additionally, strengthening the capacity of peripheral birthing centers is crucial for stabilizing patients before transfer. These approaches align with the World Health Organization (WHO) recommendations, which advocate for universal coverage of essential obstetric services within a 2-hours travel time for every pregnant woman [20].

However, certain limitations should be noted. The analysis does not account for contextual factors such as the quality of road infrastructure, delays associated with referral systems, or patients' initial clinical conditions. Future studies should include a qualitative approach to better understand these factors and their impact on clinical outcomes.

5. Conclusion

This study aims to provide crucial information to inform decision-makers and healthcare professionals on measures to improve access to emergency obstetric care in the Drâa-Tafilalet region. By identifying spatial constraints and understanding their impact, more effective solutions can be developed to ensure quality maternal health services and reduce risks to mothers and fetuses.

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Author contribution
Fieldwork, data collection and writing were done by KA, FZ contributed to the writing, statistical analysis was done by MM, and study design and corrections were overseen by BEB.

Ethics approval and consent to participate
Not applicable.

Consent for publication
All the authors have agreed to publish this article.

Competing interests
The authors declare that they have no competing interests.

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Data of this study are available from the authors.

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