

RESEARCH ARTICLE

Trends, wealth inequalities and the role of the private sector in caesarean section in the Middle East and North Africa: A repeat cross-sectional analysis of population-based surveys

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OPEN ACCESS

Citation: McCall SJ, Semaan A, Altijani N, Opondo C, Abdel-Fattah M, Kabakian-Khasholian T (2021) Trends, wealth inequalities and the role of the private sector in caesarean section in the Middle East and North Africa: A repeat cross-sectional analysis of population-based surveys. PLoS ONE 16(11): e0259791. <https://doi.org/10.1371/journal.pone.0259791>

Editor: M. Mahmud Khan, University of Georgia, UNITED STATES

Received: April 14, 2021

Accepted: October 22, 2021

Published: November 16, 2021

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Data Availability Statement: Demographic and Health Surveys (DHS) data are available at: <https://dhsprogram.com/data/available-datasets.cfm> & Multiple Indicator Clusters Surveys (MICS) data are available at: <https://mics.unicef.org/surveys> DHS datasets include: Egypt, 2008 (URL: <https://dhsprogram.com/methodology/survey/survey-display-294.cfm>); Egypt 2014 (URL: <https://dhsprogram.com/methodology/survey/survey-display-397.cfm>); Jordan, 2017-18 ([https://](https://dhsprogram.com/methodology/survey/survey-display-397.cfm)

Abstract

Objective

To examine trends and variations of caesarean section by economic status and type of healthcare facility in Arab countries in the Middle East and North Africa (MENA).

Methods

Secondary data analysis of nationally representative household surveys conducted between 2008–2020 across nine Arab countries in the MENA region. The study population was women aged 15–49 years with a live birth in the two years preceding the survey. Temporal changes in the proportion of deliveries by caesarean section in each country were calculated using generalised linear models and presented as risk differences (RD) with 95% confidence intervals (95%CI). Caesarean section was disaggregated by household wealth index and type of healthcare facility.

Results

Use of caesarean section ranged from 57.3% (95%CI:55.6–59.1%) in Egypt to 5.7% of births (95%CI:4.9–6.6%) in Yemen. Overall, the use of caesarean section has increased across the MENA region, except in Jordan, where there was no evidence of change (RD -2.3 (95%CI: -6.0 –1.4)). Across most countries, caesarean section use was highest in the richest quintile compared to the poorest quintile, for example, 42.8% (95%CI:38.0–47.6%) vs. 22.6% (95%CI:19.6–25.9%) in Iraq, respectively. Proportion of caesarean section was

dhsprogram.com/methodology/survey/survey-display-500.cfm); Jordan, 2012 (<https://dhsprogram.com/methodology/survey/survey-display-403.cfm>); Yemen, 2013 (<https://dhsprogram.com/methodology/survey/survey-display-358.cfm>) MICS datasets include: Algeria, 2012–13; Iraq, 2018; Iraq, 2011; Qatar, 2012; State of Palestine, 2014; State of Palestine, 2010; Sudan, 2014; Sudan, 2010; Tunisia, 2018; Tunisia, 2011–12.

Funding: The author(s) received no specific funding for this work.

Competing interests: I have read the journal's policy and the authors of this manuscript have the following competing interests: Professor Abdel-Fattah's full declaration is on his webpage [URL: <https://www.abdn.ac.uk/iahs/research/obsgynaeprofiles/m.abdelfattah>]. All other authors have no conflicts of interest to report.

higher in private sector facilities compared to public sector: 21.8% (95%CI:18.2–25.9%) vs. 15.7% (95%CI:13.3–18.4%) in Yemen, respectively.

Conclusion

Variations in caesarean section exist within and between Arab countries, and it was more commonly used amongst the richest quintiles and in private healthcare facilities. The private sector has a prominent role in observed trends. Urgent policies and interventions are required to address non-medically indicated intervention.

Introduction

Caesarean section is a lifesaving obstetric surgery that reduces maternal morbidity and mortality [1]; however, both its under use and over use illustrate lack of appropriate care [2]. Caesarean section usage has been increasing over the past decades, nonetheless, this rise is not mirrored by similar improvement in maternal and neonatal mortality [1, 3]. Optimal proportion of caesarean section usage is believed to range between 10–15% of deliveries to prevent maternal and neonatal mortality and morbidity, whilst rates above 20% have been shown not to improve maternal and neonatal mortality [1, 4, 5].

Although a vital part of obstetric medicine, caesarean section should be avoided unless clinically indicated due to the potential complications for mother and child [6]. In particular, in the short term, caesarean section increases the risk of haemorrhage, organ injury, infection and anaesthetic complications [7]. In the longer term, it is a leading risk factor for placental spectrum disorders and uterine rupture [8] and may have long term complications for infants including asthma and obesity [9, 10]. The risk of these adverse outcomes in subsequent pregnancies increases with repeated caesarean section [11–13]. Specifically, in resource-constrained settings, the risk of maternal deaths and adverse outcomes such as a near-miss is higher following a caesarean section compared to vaginal birth [14], and the risk increases with repeated caesarean sections [15]. In particular, a systematic review showed that maternal mortality following a caesarean section was 100 times higher in low resource settings compared to high income countries [16].

In parallel to the global overuse of caesarean sections, large inequalities exist in its use between different regions of the world and within countries, including the Middle East and North Africa (MENA) region [17, 18]. Within country inequalities in low and middle-income countries are represented by a higher use among the richest quintiles, among more educated women and in private facilities [3, 17, 19]. Considering the strong and growing influence of the private healthcare sector in the MENA region [20], a closer examination of inequalities can provide a better understanding of healthcare systems in the region. This study aims to examine trends of caesarean section and describe variations in caesarean section use by economic status and type of healthcare facility (private/public sector).

Methods

Data

This was a secondary data analysis of the two most recent Demographic and Health Surveys (DHS) or Multiple Indicator Cluster Surveys (MICS) for nine countries in the MENA region, conducted between 2008 and 2020. These are publicly available data from (<http://dhsprogram.com/>) or (<https://mics.unicef.org/>). DHS/MICS are nationally representative household surveys of women at reproductive ages, their infants and households, which are collected in low- and

middle-income countries. The sampling frame for each national survey includes area units across the entire country and the employed sampling procedure was a multi-stage stratified cluster sampling design. Data were collected from each household by trained interviewers using a standard questionnaire. The questionnaire includes self-reported information about sociodemographic, household characteristics and health modules, including maternal and child health and details on childbirth. Both the survey design and questionnaires are similar between MICS and DHS, across countries and over time, which allows for valid comparisons [21].

Setting

All countries within the MENA region where Arabic is the national language and had available national DHS/MICS data between 2008–2020 were included in the analysis. These include: Algeria, Egypt, Iraq, Jordan, Palestine (State of Palestine or Palestinian territories), Qatar, Sudan, Tunisia and Yemen. Countries that had multiple surveys over the study period were included for the trend analysis.

Population

The study population included women aged 15–49 years who had a live birth in the two years preceding the survey date and who reported on the mode of delivery for their last birth. Self-reported data on caesarean section were derived using the following question for the DHS and MICS surveys: “*Was (NAME) delivered by caesarean, that is, did they cut your belly open to take the baby out?*”. Self-reported measures of maternal indicators have been shown to be valid and reliable [22, 23]. In a number of datasets, mode of delivery was missing for women who gave birth at home or outside of healthcare facilities; data for these women were recoded as having vaginal births. Women who did not answer the question on mode of delivery were excluded from the analysis; this proportion never exceeded 3.7% among eligible women. A small number of women had multiple births in the two years preceding the survey, and for the purposes of this study, the analysis only included data on the last live birth (one birth per woman).

Variables

The primary variables explored in the analysis were place of birth (private, public, home or other) and quintiles of wealth index. Public facilities were those defined by the MICS and DHS questionnaire, in general they included government-operated hospitals and clinics. Private sector facilities included private doctors, clinics or offices and hospitals, and facilities operated by other private organisations such as non-governmental organisations [19]. Wealth index is a measure of economic status and was constructed using ownership of household assets [24].

Comparability and harmonisation

To ensure comparability across MICS and DHS questionnaires, women were included if they reported a live birth in the two years preceding the survey. MICS surveys asked women about births in the two years preceding the survey, whilst DHS asked women about births in the preceding five years. To reduce the recall period in the DHS dataset to match that of the MICS, we restricted the sample to women who delivered in the two years preceding the survey using the date of interview and date of last birth. Data items in the DHS and MICS surveys were mapped for comparability and recoded, if necessary, to create a harmonised variable.

Data analysis

The prevalence estimates of caesarean section were calculated with 95% confidence intervals. The absolute annual change was calculated by subtracting the caesarean section rate in the latest survey from the previous survey, divided by the number of years between the two surveys. Trends over the two surveys were also calculated using generalised linear models and presented as an absolute risk difference between the two survey periods with 95% confidence intervals. Use of caesarean section was disaggregated by household wealth index and type of healthcare facility (private/public sector) and presented using equiplots and line graphs. The absolute number of births by healthcare facility type and the proportion of caesarean sections that occurred within the type of healthcare facility were presented using bar graphs. The complex survey design was accounted for in the analysis; in particular, proportions were weighted and accounted for clustering and stratification in the survey design. Analyses were conducted using Stata version 15.

Ethical approval

This study involved secondary data analysis of publicly available MICS and DHS data. As a result, ethical approval from the American University of Beirut was not required.

Results

Sample

The final sample size of the included surveys ranged from 767 women in Qatar's 2012 survey to 13,986 women in Iraq's 2011 survey. The number of women included from each country and survey year is summarised in [S1 Table](#). Three countries only had one survey available during the study period, and these were Algeria, Qatar and Yemen. Whilst Egypt, Jordan, Iraq, Palestine, Sudan and Tunisia had two surveys and were analysed as repeat cross-sections. The Sudanese data did not include granular information on facility type in 2010, and the data from Qatar lacked the wealth index variables so these two countries were excluded from the respective disaggregated analyses.

Caesarean section rates

In the most recent survey, use of caesarean section ranged from 5.7% of births (95%CI:4.9–6.6%) in Yemen to 57.3% of births (95%CI: 55.6–59.1%) in Egypt. Other than Sudan and Yemen, use of caesarean section was above 10% in all other countries ([Fig 1](#)). Except for Jordan, the proportion of caesarean sections, out of all births, increased between the first and second survey period in all other MENA countries included in the analysis. The largest increase occurred in Egypt, with an average annual change of 4.5% or a risk difference of 26.7% (95% CI: 24.1–29.3%) between the periods covered by the two surveys ([S2 Table](#)). There were similarly large increases in Tunisia between 2010–2012 and 2016–2018 and Iraq between 2009–2011 and 2016–2018 with a risk difference of 17% and 11%, respectively. Jordan was an exception as it had no statistically significant change between 2010–2012 and 2016–2018 shown by a risk difference of -2.3 (95%CI: -6.0–1.4).

Equity analysis

The use of caesarean section varied broadly across wealth quintiles for Egypt, Iraq, Sudan, Yemen and Tunisia ([Fig 2](#) and [S3 Table](#)). For example, in the Egyptian 2014 survey, the use of caesarean section ranged from 43.4% (95% CI:39.8–47.1%) in the most deprived quintile to 72.4% (95% CI: 69.3–75.4%) in the wealthiest quintile. In Yemen, the proportion of caesarean section was highest for the top wealth quintile at 14.6% (95% CI: 11.9–17.8%) compared to the

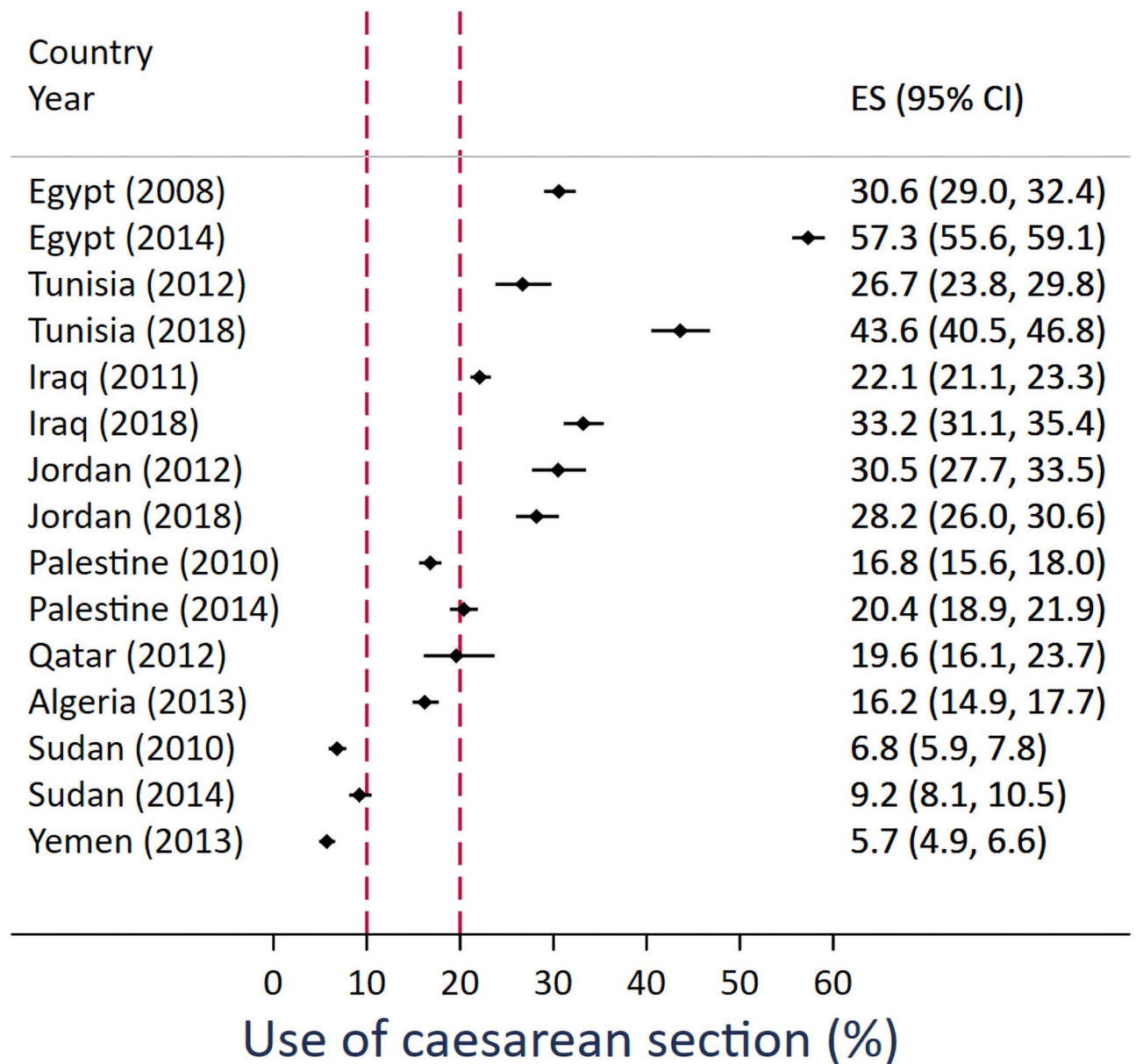


Fig 1. Proportion of caesarean sections at last birth that occurred in the previous two years before the survey in nine countries in the Middle East and North Africa. Red line indicate internationally agreed-upon limits for underuse and overuse of caesarean section.

<https://doi.org/10.1371/journal.pone.0259791.g001>

bottom wealth quintile at 1.4% (95% CI: 0.8–2.3%). In nearly all countries, across all survey years, the highest use of caesarean section was among the wealthiest quintiles and the lowest use was among the most deprived quintiles; for example, in Iraq's 2018 survey: 42.8% (95% CI:38.0–47.6%) vs. 22.6% (95%CI:19.6–25.9%), respectively. In countries that had multiple surveys, the use of caesarean section increased in all wealth quintiles between the two cross sections. Jordan was an exception, and experienced a decline in the use of caesarean section in the periods covered by the 2012 and 2018 surveys in all quintiles other than the second most deprived quintile. In 2018, there was no difference in caesarean section use across wealth quintiles in Jordan.

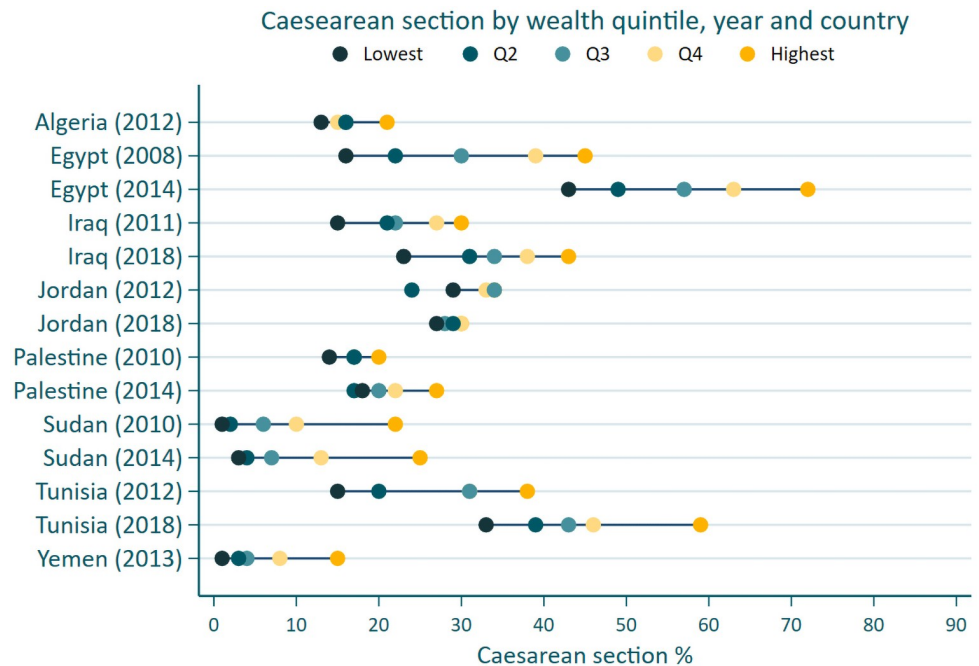


Fig 2. Proportion of caesarean sections by country, survey period and wealth quintile.

<https://doi.org/10.1371/journal.pone.0259791.g002>

Facility sector

Within the majority of countries included in the analysis, caesarean section use was highest in private sector facilities compared to public sector facilities; for example, 70.2% (95% CI:68.2–72.1%) vs. 50.9% (95%CI:47.6–54.1%) in Egypt 2012–2014, and 21.8% (95% CI:18.2–25.9%) vs. 15.7% (95%CI:13.3–18.4%) in Yemen 2012–2014, respectively (Fig 3 and S3 Table). The use of caesarean section was similar in both private and public sector facilities in Palestine during both survey periods. In most countries that had multiple surveys, the use of caesarean section increased over time in both the private and public sector facilities, other than Jordan where it declined from 29.6% (95%CI: 26.9–32.5%) to 26.2% (95%CI: 23.9–28.7%) in the public sector between the two survey periods. In the majority of countries, the absolute proportion of births was highest in public sector facilities, other than Egypt, Sudan and Yemen, where more births occurred in the private sector (Egypt) and at home (Sudan and Yemen) (Fig 4). The proportion of all births (both vaginal and caesarean section) in the private sector increased in Egypt, Iraq and Tunisia between survey periods, while it remained unchanged in Jordan.

The distribution of caesarean section by wealth quintile amongst private and public sector facilities is presented in Fig 5. Within the private sector in Egypt, Palestine and Yemen, the highest use of caesarean section was in the wealthiest quintiles. While in Iraq, Tunisia, Jordan, Sudan and Algeria the highest use of caesarean section was in the middle and lowest quintiles. In the public sector, highest use of caesarean section occurred in the wealthiest quintile and lowest in the most deprived quintiles in Algeria, Palestine, Yemen, Tunisia, and Egypt. In the private sector, there was a broad inequality between the poorest and wealthiest quintiles, while in the public sector, the range between the poorest and least wealth quintiles was smaller.

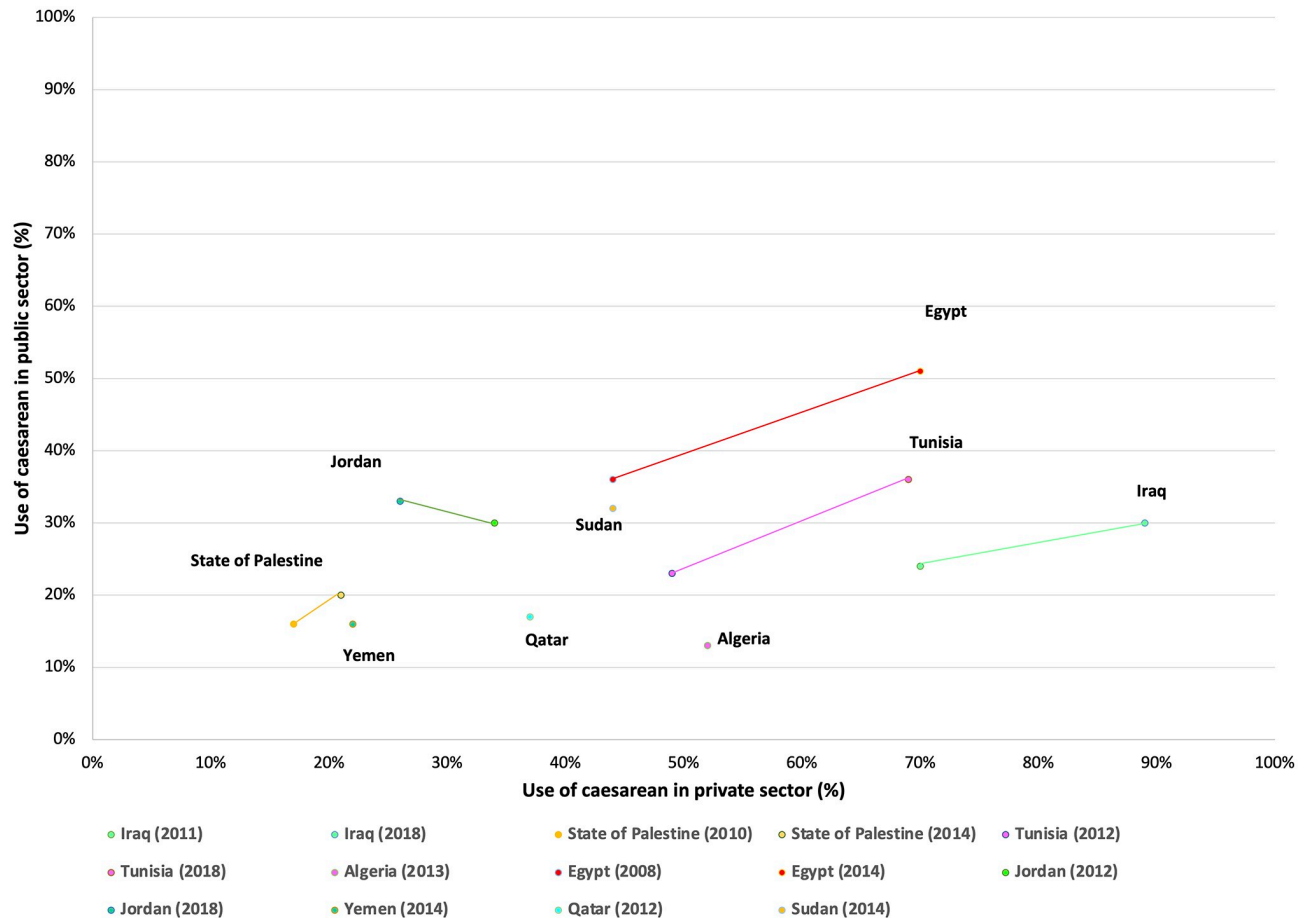


Fig 3. The use of caesarean section in private and public sector facilities by country and survey period.

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Discussion

Main findings

There was a large disparity in the use of caesarean section amongst nine countries in the MENA region. Notably, there was a high use of caesarean section in Egypt, Tunisia and Iraq whilst it was low and likely inadequate in Yemen and Sudan. Caesarean section use increased across time in all countries, excluding Jordan, which had no change between the survey periods. In general, the highest usage of caesarean section was in the private sector and among the wealthiest populations. Over time, caesarean section use increased in both the public and private sector facilities with an increase in private sector births in many countries. For the most part, the majority of births occurred in the public sector in Arab countries of the MENA region, modest increases in caesarean section use in the public sector will result in larger absolute increases in the use of caesarean section overall.

Interpretation

In comparison to other regions, the MENA region has some of the highest use of caesarean section, globally [3, 17]. The results are consistent with the global studies that have shown an increasing trend in caesarean section use during the last decade [3]. In particular, Egypt has

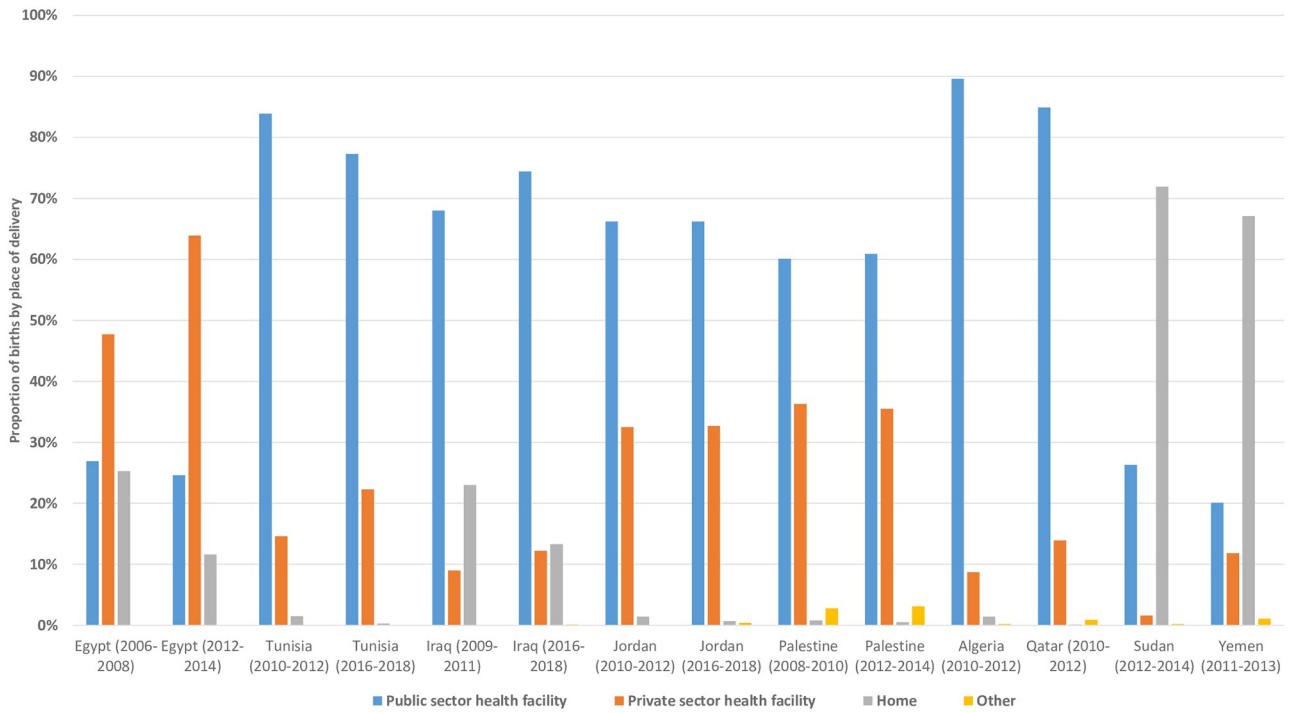


Fig 4. Proportion of all births according to the place of delivery.

<https://doi.org/10.1371/journal.pone.0259791.g004>

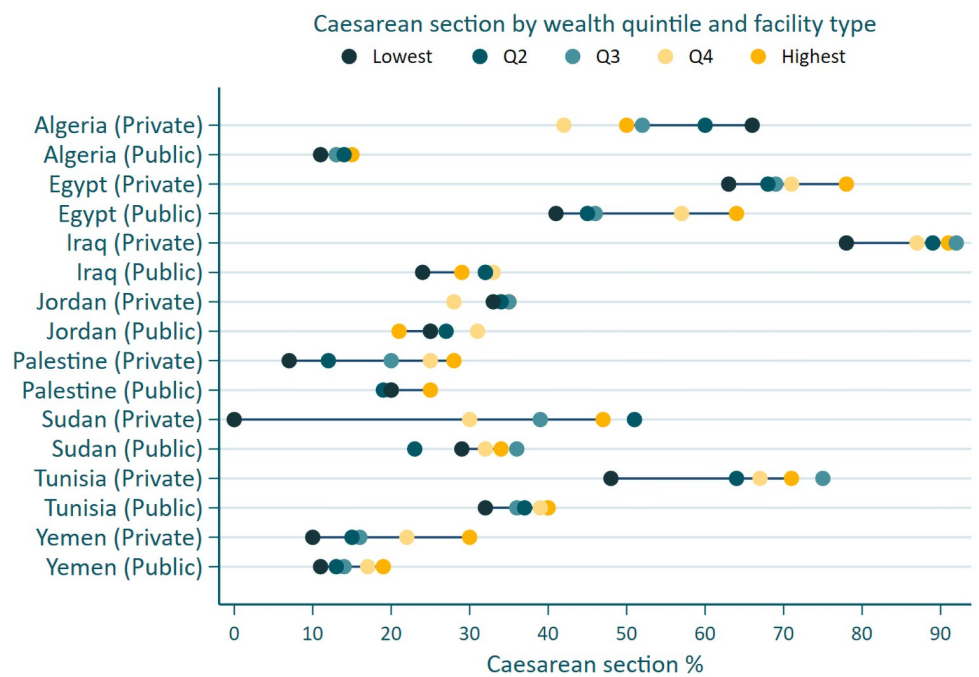


Fig 5. Caesarean section use in public and private sector facilities, by wealth quintile and country, for the most recent survey. Last DHS/MICS survey was used. Qatar did not collect wealth quintile.

<https://doi.org/10.1371/journal.pone.0259791.g005>

one of the highest usage of caesarean section in the world [3] and this study builds on previous literature to show that the rate of caesarean section is also increasing across time [25]. In Arab countries, midwifery models of obstetric care are rarely implemented at a national level due to a shortage of midwives [26]; this is likely to be a contributing factor to the large proportion of caesarean sections in the region [27].

There were also large disparities within the MENA region, as shown by the low usage in Yemen and Sudan, which may be explained by a context of limited resources, fragile healthcare systems and conflict. Yemen has a very low facility birth rate with approximately 70% of births occurring at home [28]. The country's DHS report highlighted that there were 26 neonatal deaths and 48 maternal deaths per 100,000 live births with 42% of women dying at home. Similarly, the maternal mortality ratio across Sudanese states ranged from 63 to 428 maternal deaths per 100,00 live births in the period between 2014–2017 [29]. Consequently, there were likely women in Yemen and Sudan who required lifesaving care in the form of a caesarean section but did not receive the intervention.

Similar to previous studies completed in the region: Jordan, Iraq and Egypt had higher caesarean section births in private hospitals compared to public hospitals [25, 30]. This relationship is likely driven by a multitude of factors including financial gain, fear of litigation and time convenience for healthcare providers [18, 31, 32] as well as women's fear of vaginal birth and labor pain [32–34], lack of choices in models of care for women and the medicalisation of childbirth [35–38]. Previous studies completed in the region have indicated that growth in the private sector is a key driver for the increase in the use of caesarean section [25]. Many countries in this study had a background increase in private sector deliveries, which further suggests that the private sector has a pivotal role in increasing caesarean section usage in the region. The rise of the private sector is multifactorial as many countries do not have national health insurance programs, private insurance is incentivised for the rich, and the public perceives it to be better due to the 'on demand' access and availability of the latest medical technologies [39]. However, the private sector is often poorly regulated and private hospitals are often run with near complete autonomy from the public health system [31, 40, 41].

The study found no difference in caesarean section usage between private and public hospitals in Palestine. A previous study in Gaza, Palestine, showed that caesarean section was more commonly performed in governmental facilities, while there was no association between facility type and caesarean section in the West Bank. This study examined the country level proportions in Palestine and found similar proportions of caesarean births in both private and public hospitals [42]. It is possible that regional level differences in the use of caesarean section exists between facilities. The contextual factors of rising poverty has made the private sector inaccessible to much of the population; in addition, governmental hospital services are available in all areas and the Government Health Insurance, which includes maternal health services, is available at little cost [43–45].

Given the relationship between caesarean section use and the role of the private sector, it is no surprise that the highest usage is in the wealthiest and most affluent populations. In addition, the private sector plays a critical role in the extension of inequalities in caesarean section use in the MENA region. The inequality gap between the wealthiest and poorest shown in this study is consistent with previous studies in other low- and middle-income countries [17, 46–48].

It is interesting to note that there was no change over time in caesarean section usage in Jordan and the inequality gap in the usage of caesarean section did not exist in the most recent survey. The findings are in contrast with previous reports of a continuous increasing trend in caesarean section use in Jordan between 2002 and 2012 [49], and between 1982 and 2017 [50]. The most recent Jordanian study used all governmental and military hospital records and a

collection of private and university hospitals to analyse caesarean section trends between 1982 and 2017 [50]. Future studies should aim to understand whether the lack of change across time is an artefact, whether mechanisms exist for the decrease in the inequality gap, and the role of the private sector in Jordan.

In general, it is likely large proportions of caesarean sections in the MENA region were not medically indicated; thus, the implementation of non-clinical interventions may reduce unnecessary caesarean sections [51]. Betran et al. proposed that structural interventions should target drivers of high use of caesarean section, recognise the context, and be adapted to women's views, cultural norms and clinical practice at the individual and structural levels [51].

Strengths and limitations

This study was limited to countries that had an available MICS or DHS surveys, and there were lack of data from many gulf countries, whilst nearly all MENA nations in North Africa had available data. The gulf countries represent the wealthiest Arab nations and have more advanced health systems. In addition, data were collected through household surveys, and therefore lacked granularity in terms of obstetric history and whether the caesarean section was clinically indicated. In particular, utilising the Robson criteria in future studies based on hospital data would help us understand the proportion of caesarean sections that could have been avoided. Despite these limitations, this study is comprehensive in terms of its exploration of the role of the private sector and relative wealth in the use of caesarean section in the MENA region. There was a limited amount of non-coverage in a number of the surveys due to insecurity or inaccessibility; this included 18/800 (2.4%) clusters in Yemen; [28] six districts from two governorates in Iraq (2018) [52], and 22 clusters out of 780 clusters (2.8%) in Sudan (2014) [53]. Non-coverage may impact the external validity of these surveys; however, this impact is likely to be minimal due to the low exclusion rates.

Conclusion

Variations in the use of caesarean section exist within and between Arab countries in the MENA region, where over-use of interventions is an established routine in some contexts. While in contexts with limited resources, life-saving interventions are unavailable when needed. The MENA region is in need of optimising the use of caesarean section, which includes ensuring access to safe caesarean section when it is required, and health system reform and non-medical interventions to address non-medically indicated caesarean sections.

Significance

A number of Arab countries such as Egypt and Lebanon have known high use of caesarean section; however, more recent data is required to confirm if use of caesarean section is uniform, increasing and related to the private sector in Arab countries. Both extremes of caesarean section overuse and underuse were present in the Arab region and use of caesarean section has increased over time. The largest proportion of caesarean sections occurred in the private sector; however, an increase in caesarean sections in public hospitals is concerning as the majority of births occur in this sector. There is a requirement to act to reduce non-necessary caesarean sections in the Arab region.

Supporting information

S1 Table. Sample selection.
(DOCX)

S2 Table. The change in the proportion of caesarean section over time. Values are percentages (95% Confidence intervals).

(DOCX)

S3 Table. Use of caesarean section by wealth index, delivery place, country and survey year. Values are percentages (95% Confidence intervals).

(DOCX)

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Writing – review & editing: Aline Semaan, Noon Altijani, Charles Opondo, Mohamed Abdel-Fattah.

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