Epidemiological Features of Spontaneous Abortion in the North Africa and the Middle East From 1990 to 2019: Results From the Global Burden of Disease Study 2019

Mehdi Moradinazar; Ph.D. 1, Reza Rostami; M.Sc. 1, Nazila Armaghan; M.D. 2, Mohammad Shakiba; M.D. 3, Amirreza Rai; M.D. 4, Sogand Abbasí Azizi; M.Sc. 1, Ebrahim Shakiba; Ph.D. 1

1 Behavioral Disease Research Center, Kermanshah University of Medical Sciences, Kermanshah, Iran
2 School of Medicine, Kermanshah University of Medical Sciences, Kermanshah, Iran
3 Cardiovascular Research Center, Health Institute, Kermanshah University of Medical Sciences, Kermanshah, Iran
4 School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

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Abstract
Objective: Spontaneous abortion is one of the most common problems which a woman may encounter during her pregnancy which is one of the most important causes of maternal death. Therefore, the aim of this study was to report the epidemiological features of spontaneous abortion in North Africa and the Middle East (NAME) countries.

Materials and methods: The study population included 21 countries in the NAME region with a population of more than 600 million. The Global Burden of Disease (GBD) 2019 database was used. Incidence rates, the prevalence rates, death rates, the disability adjusted life years (DALYs) rates by age-standardized rate (ASR) per 100,000 people were measured. Also, the attributed burden to iron deficiency was reported.

Results: In 2019, the highest prevalence 39.44 (95% CI, 24.58_59.26) and incidence 4794.16 (95% CI, 3491.77_6353.03) rates of spontaneous abortion were in Afghanistan. In 2019, the highest spontaneous abortion related-death 5.88 (95% CI, 3.23_8.97) and DALYs 339.12 (95% CI, 184.29_516.95) rates by ASR were in Yemen. In MENA, average prevalence (44.7 to 19.82) and incidence (5434.95 to 2409.61) rates have decreased by nearly 56%, and also average and the disability adjusted life years (DALYs) rates have decreased by nearly 89% between 1990 and 2019. The highest spontaneous abortion-related DALYs rate was attributed to iron deficiency. In 2019, Yemen (29%) had the highest attributed burden to iron deficiency.

Conclusion: This study on 21 countries in the NAME region with a population of more than 600 million showed that average prevalence and incidence rates of spontaneous abortion have decreased by nearly 56%, and also average and the disability adjusted life years (DALYs) rates have decreased by nearly 89% between 1990 and 2019.

Keywords: Spontaneous Abortion; Burden of Disease; Middle East; North Africa

Introduction
Abortion is described as removing conception products from the uterus before the 20th week of pregnancy and or delivery of a fetus with a weight of less than 500 g (1, 2). Abortion is either spontaneous or induced. Spontaneous abortion, also known as miscarriage, is one of the most common problems which a woman
may encounter during her pregnancy which mostly predominates from hormonal problems, maternal disorders, and chromosomal abnormalities (3). Lifestyle, diet, smoking, and alcohol are also other important risk factors for miscarriage (4). A miscarriage is the natural death of a fetus in the womb.

With nearly 130 million births per year across the world, a 15% risk of miscarriage proposes nearly 23 million miscarriages per year or 44 per min. given that the miscarriages and preclinical pregnancy losses are usually managed at home, the absolute number of miscarriages is significantly higher than reported (5). Moreover, miscarriage is associated with long-term health problems (such as thromboembolism, cardiovascular disease, and etc.) and psychological consequences (such as bereavement, anxiety, depression, suicide, and etc.) (6). Also, miscarriage is one of the most important causes of maternal death (7).

In the MENA region, most health determinants are similar, however, there is a significant discrepancy in health and disease index among these countries (8). On the other hand, health policymakers nationally should be informed about their country’s health compared with other countries with the same socioeconomic statuses. They can also use other countries’ experiences in improving their health care. GBD studies provide an opportunity to compare countries and describe the pattern of diseases (9).

Health policymakers require actual and reliable up-to-date reports of spontaneous abortion and miscarriage across different countries and populations. Such estimates set priorities and help to tailor cost-effective health interventions and resource allocation. Epidemiological study plays an important role in the recognition of occurrence, patterns, related risk factors, and etiology of diseases. Therefore, the aim of this study was to determine the epidemiological features and the burden of spontaneous abortion in the MENA countries to develop beneficial policies for decreasing the incidence, mortality, and consequences of spontaneous abortion in these regions.

**Materials and methods**

**Geographical location and population:** NAME region, with a population of more than 600 million (608,713,600), consists of 21 countries including Afghanistan, Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Palestine Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, Turkey, United Arab Emirates (UAE), and Yemen (10), which were compared in terms of age, sex, and risk factors for neurological disorders.

**Data collection and quality control:** We used the latest data refresh from the Global Burden of Disease (GBD) (the 2019 update) in the current study. The data of GBD estimate the incidence, prevalence, mortality, and disability-adjusted life-years (DALYs) of 369 diseases and injuries, and 84 risk factors in terms of location, age, and sex in 204 countries and regions from 1990 to 2019 (https://vizhub.healthdata.org/).

A detailed description of the metrics, data sources, and statistical modeling of GBD 2019 have been documented elsewhere (11). Annual data on age-standardized rate (ASR) of prevalence, incidence, DALYs, and death of maternal abortion and miscarriage were derived from the Global Health Data Exchange (GHDx) query tool. The original data was estimated by the GBD for maternal disorders such as miscarriage were obtained mainly from vital registration systems, sample registration systems, household surveys, censuses, demographic surveillance sites, and maternal and child surveillance systems. In the GBD dataset, designing for all countries is based on the quality and accessibility of data. To reliable and accurate comparisons between various countries and times, the same method was applied for each location and year in MENA Region.

Due to public availability of GBD, ethics approval and informed consent were not required.

**Definition of spontaneous abortion:** Spontaneous abortion (ICD-10 code= O03) was identified from the 10th revision of the International Classification of Diseases and injuries discharge diagnosis codes. Spontaneous abortion, is referred to as a miscarriage, is the loss of pregnancy naturally before twenty weeks of gestation (3). GBD study evaluated the different risk factors attributable to spontaneous abortion-related DALYs consisting of iron deficiency. Further information is available at http://vizhub.healthdata.org/gbd-compare/.

**Statistical analysis:** The main outcome measures of our study were the prevalence, incidence, deaths, and DALYs associated with spontaneous abortion. The rates in GBD are standardized based on the total world population. DALYs are the sum of the years of life lost (YLLs) and the years lived with disability (YLDs) (12, 13). YLLs are counted as the product of the estimated number of deaths and a standard life expectancy at the age of death. YLDs are computed by multiplying the prevalence of individual consequences of the disease, by their corresponding disability
weights, which quantify the severity of consequences as a number between 0 (full health) and 1 (death). Details of data sources and estimation methods have been published here (11, 14). Also, all estimates were reported in terms of counts, age-standardized rates (ASR) per 100,000 population (15, 16).

To do this study, all data were extracted from GBD (https://vizhub.healthdata.org/). In general, the external validity of GBD was evaluated by performing cross-validation on a limited number of sequelae due to the computational time and complexity of this analysis. Then, we analyzed the data based on the study’s objectives e.g. age groups, risk factors, and etc. Also all estimates were reported with 95% uncertainty intervals (UI). By the way, all analyses and figures were applied by Microsoft Office Excel 2016.

Results
In 1990, the highest incidence rates of spontaneous abortion were in Turkey 7901.26 (95% CI, 5654.1–10,465.37), Bahrain 7723.23 (95% CI, 5706.25–10,036.26), and Tunisia 7593.7 (95% CI, 5534.24–9958.13), and also the countries of UAE 2733.13 (95% CI, 2032.48–3512.61) and Kuwait 2881.92 (95% CI, 2150.8–3768.19) had the lowest incidence rate, respectively. But in 2019, Afghanistan 4794.16 (95% CI, 3491.77–6353.03) and Sudan 4314.6 (95% CI, 3276.89–5593.48) had the highest incidence rates of spontaneous abortion, and the lowest rates were in UAE 1005.21 (95% CI, 812.16–1234.7) and Libya 1028.62 (95% CI, 9.51). The incidence rate of spontaneous abortion decreased by nearly 89% from 1990 (4.51 (95% CI, 208.3–39.83)) to 2019 0.48 (95% CI, 0.33–0.65) was found to be lower than the global average 0.98 (95% CI, 0.82–1.17) Table 1.

In the countries of the NAME region except for Yemen and Afghanistan, in 2019, the DALYs rate of spontaneous abortion was reported to be lower than the average global Figure 1.

Between 1990 and 2019, average DALYs rates by ASR have decreased in all countries of the NAME region. In the MENA region, the DALYs rate of spontaneous abortion decreased by 89% from 263.15 (95% CI, 215.39–318.04) to 29.37 (95% CI, 20.83–39.83) between 1990 and 2019. The DALYs rate of spontaneous abortion in the NAME region 29.37 (95% CI, 20.83–39.83) was found to be lower than the global average 56.7 (95% CI, 47.49–67.19) in 2019. Between 1990 and 2019, the highest decrement of the spontaneous abortion-related DALYs with a 98% decrement was related to Oman (190.80 to 3.98) Figure 2.

Between 1990 and 2019, average death rates by ASR have decreased in all countries of the NAME region. In NAME, average death rates by ASR have decreased by nearly 89% from 1990 4.51 (95% CI, 3.66–5.46) to 2019 0.48 (95% CI, 0.33–0.65). Between 1990 and 2019, the highest decrement of spontaneous abortion-related death with a 99% decrement was related to Turkey (3.37 to 0.04) followed by UAE with 99 decrements (2.054 to 0.027) Figure 3.

Between 1990 and 2019, average prevalence and incidence rates by ASR have decreased in all countries of the NAME region. In NAME, average prevalence (44.7 to 19.82) and incidence (5434.95 to 2409.61) rates by ASR have decreased by nearly 56%. Between 1990 and 2019, the highest decrement of spontaneous abortion-related prevalence (4908.38 to 1028.62) and incidence (40.38 to 8.46) with a 79% decrement was related to Libya Figure 3.
In Afghanistan and Yemen, the spontaneous abortion-related DALYs have been peaked between the ages of 35 and 39 Figure 4.

The highest spontaneous abortion-related DALYs rate was attributed to iron deficiency. Iron deficiency in the NAME region was higher than the global average.
In 2019, Yemen (29%) had the highest attributed burden to iron deficiency in the NAME region Figure 5.

Discussion
The results of the current study found that in the NAME region, the incidence and prevalence rates of spontaneous abortion decreased by 56%, and also the mortality and DALYs rates decreased by 89% between 1990 and 2019. Moreover, the incidence and prevalence rates of spontaneous abortion in the NAME region was found to be higher than the global average, however, the death and DALYs rates of spontaneous abortion in the NAME region was lower than the global average. The high incidence and prevalence rates of spontaneous abortion in the NAME reveal the frequent occurrence of unplanned pregnancy, therefore, unwanted pregnancy and abortion can be decreased by informing, access to health services, and also tailoring, expanding, and improving family planning services.
On the other hand, North Africa/Middle East includes low/middle-income countries since low income and material deprivation was associated with poor housing, nutrition, and health care access which in turn negatively affected the general health physically and mentally (17, 18). The countries of Afghanistan and Sudan had the highest prevalence and incidence rates of spontaneous abortion, and the lowest prevalence and incidence rates by ASR were in United Arab Emirates (UAE) in 2019.
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This might be due to civil war, persistent political tensions, dispersion and displacement in Afghanistan and Sudan, which have damaged the population's health and the healthcare infrastructures. Furthermore, UAE is renowned for its high-quality health care services and is known as the destination for medical tourism in the NAME region. As well as, in recent years, this country has realized very health reforms (19). Between 1990 and 2019, the highest decrement of spontaneous abortion-related prevalence and incidence with a 79% decrement was related to Libya.

The result showed that Yemen had the highest death and DALYs rates by ASR among the NAME countries, and also Kuwait had the lowest death and DALYs in 1990 and 2019. Between 1990 and 2019, the highest decrement of spontaneous abortion-related death with a 99% decrement was related to Turkey, and also the highest decrement of the spontaneous abortion-related DALYs with a 98% decrement was related to Oman. This decrement is due to that these countries has improved its health care system in recent decades. For instance, Turkey, between 2003 and 2013, has applied very successful health reforms such as the family medicine model, organizing universal health coverage plan, developing primary health care, and applying integrated care (20).

The highest spontaneous abortion-related DALYs rate was attributed to iron deficiency. In 2019, Yemen (29%) had the highest attributed burden to iron deficiency in the NAME region. The high prevalence of iron deficiency in Yemen could be attributed to malnutrition due to civil and foreign war, less industrialization, and a poor economy.

Strengths and limitations of the study: The strengths of the present study were comparing the data of countries that approximately have the same information registration system and socio-demographic Index. Other strengths of the present study were the comprehensive estimations of spontaneous abortion burden as reported by prevalence, incidence, death, and DALYs between different countries from 1990 to 2019, hence, it can detect the strengths and weaknesses of the health care systems in different countries. All limitations of the GBD study are detailed elsewhere (21) and our study fully was subjected to those limitations. By the way, major limitation of this study is a lack of information on the other risk factors. Furthermore, the quality of the data collection system is different across countries, and the comparison of countries may be ambiguous. In July 2011, Sudan divided into two countries of Sudan and South Sudan but was considered as a single country, showing another limitation of this study. Likewise, the uncertainty intervals do not account for several sources of bias including measurement bias, selection bias due to missing data, and model specification bias. Finally, given GBD estimates are updated annually, the

Figure 5: The DALYs rate of spontaneous abortion attributed to Iron deficiency in 2019

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present limitations should be addressed.

Conclusion
In the NAME region, the incidence and prevalence rates of spontaneous abortion decreased by 56%, and also the mortality and DALYs rates decreased by 89% between 1990 and 2019. Afghanistan and Sudan had the highest prevalence and incidence rates of spontaneous abortion, and Yemen had the highest death and DALYs rates by ASR among the NAME countries between 1990 and 2019. The highest spontaneous abortion-related DALYs rate was attributed to iron deficiency, and Yemen (29%) had the highest attributed burden to iron deficiency. As recurrent miscarriage is a marker for various obstetric risks in future pregnancies, women should receive post-abortion care. As psychological consequences are common after abortion, effective screening and timely treatment for mental health complications of miscarriage need to be available. At the national and state levels, health policymakers can use the information reported in this study to facilitate comparison of rates among countries, to accelerate research, to develop their health planning, to resource allocation, to improve patient care and policy development, and to decrease the burden of spontaneous abortion.

Conflict of Interests
The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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The ethics committee of the Kermanshah University of Medical Sciences approved this study.

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