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PREVALENCE OF BREASTFEEDING INDICATORS IN MIDDLE EAST AND NORTH AFRICAN COUNTRIES: A META-ANALYSIS OF NATIONAL HEALTH SURVEYS (2010-2020)

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ABSTRACT

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Title: Prevalence of Breastfeeding Indicators in Middle East and North African Countries: A Meta-Analysis of National Heath Surveys (2010-2020)

Supervisor of Thesis: Dr. Manar, E., Elhassan.

Introduction: Breastfeeding is the clinical gold standard for an infant's nourishment. Worldwide, less than one in two newly born infants are breastfed within the first hour of birth and only 44% of infants are exclusively breastfed. Despite the importance of breastfeeding, rates in the Middle East and North African (MENA) region are still not within the 2030 World Health Organization targets to reach 70% for early initiation of breastfeeding within the first hour (EIBF), 70% for exclusive breastfeeding under 6 months (EBF), and 80% for continued breastfeeding at one year (CBF).

Aim: This study aims to estimate the overall prevalence of EIBF, EBF, and CBF for the MENA region by income level, delivery mode (cesarean section), baby-friendly hospital initiative (BFHI), survey period, and ethnicity.

Methods: A meta-analysis was conducted using national estimates from the Multiple Indicator Cluster Survey and the Demographic Health Survey. Overall pooled prevalence estimates of EIBF, EBF, and CBF were calculated using a random-effects model. Forest plots were used to display results from individual studies and pooled analyses. Cochrane Q statistic (chi-square test) and I-squared statistics were used to assess heterogeneity among surveys. Subgroup analysis and meta-regression were conducted to investigate the effects of income levels, cesarean section, BFHI, survey period, and ethnicity on the prevalence of the breastfeeding indicators. Sensitivity analysis was performed to examine the effect of outliers.

Results: A total of 12 national surveys were included in this meta-analysis. The overall pooled prevalence of EIBF was 42% (95% CI: 33%, 52%), EBF 32% (95% CI: 24%, 41%), and CBF 63% (95% CI: 53%, 73 %). Breastfeeding practices decreased as income levels increased, except for EIBF. As cesarean section rates increased to more than 10%, the prevalence of breastfeeding indicators decreased. Availability of BFHI enhanced the high rates of breastfeeding practices. EIBF was higher among Arab mothers, however, EBF and CBF were higher among non-Arab mothers. Breastfeeding indicators were higher among countries with survey period 2012-2015 than countries where data were collected after 2015; this result was statistically significant only for the CBF indicator (Meta-regression β= -0.264; $p <0.001$).

Conclusion: MENA region reported a lower overall prevalence of EIBF, EBF, and CBF as compared to the World Health Organization's targets by 2030. There is a need for effective collaboration efforts between different entities to conduct community-based interventions that support optimal breastfeeding practices to achieve Sustainable Development Goals (SDGs) goals by 2030. More research is needed to explore the association of breastfeeding practices using modeling of individual data.

LIST of ABBREVIATIONS

IYCF: Infant and Young Child Feeding

MICS: Multiple Indicator Cluster Survey

DHS: Demographic Health Survey

EIBF: Early Initiation of Breastfeeding

EBF: Exclusive Breastfeeding Under Six Months

CBF: Continued Breastfeeding at One Year

WHO: World Health Organization

UNICEF: United Nations International Children's Emergency Fund

CDD: Centers for Disease Control and Prevention

LMICs: Low-Income and Middle-Income Countries

HICs: High Income Countries

C-section: Cesarean Section

BFHI: Baby-Friendly Hospital Initiative

SDGs: Sustainable Development Goals

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

1.1 Background

Breastfeeding is considered the clinical gold standard for infants' nourishment (1). According to the World Health Organization (WHO), breastfeeding is one of the most important and effective public health practices that affects overall child health and survival. Worldwide, 800,000 children's lives would be saved every year if they were exclusively breastfed for the first 6 months (2).

Breastfeeding is defined as the normal way of providing a natural source of food to enhance infants' growth and development (3). Breast milk is important up to the second year of a child's age because it provides all the essential nutrients that an infant needs from the first month of birth (4).

However, globally, less than half 48% of children are breastfed within the first hour of birth and 44% of infants are exclusively breastfed (5). Among young children aged 12–23 months, less than two in three are getting advantages from breastfeeding continuation (5). In the Middle East and North Africa (MENA) region, about one in every three infants benefits from early initiation of breastfeeding (5). The term MENA refers to Morocco in northwest Africa, Iran in southwest Asia, and Sudan in Africa. The MENA region consists of 19 countries; however, some organizations include four additional countries (6).

1.2 Breastfeeding Core Indicators

Breastfeeding indicators are established to have a unified set of measures that can be easily interpreted and operationally useful to assess infant and young child feeding practices (IYCF) (7). In this research, we focused on three IYCF indicators: early initiation of breastfeeding (EIBF), exclusive breastfeeding under 6 months (EBF), and continued breastfeeding at one year (CBF). EIBF, i.e., the proportion of children born in the last 24 months who were put to the breast within one hour of birth (7). WHO guidelines state that “all mothers should be supported to initiate breastfeeding as soon as possible after birth, within the first hour after delivery” (8). EIBF has multiple benefits: it supports the practice of skin-to-skin contact, which provides short-and long-term benefits for the mother and the baby. Also, skin-to-skin contact regulates infants’ body temperatures and stimulates their bodies to be filled with beneficial bacteria from their mother’s skin (9). Furthermore, EIBF is a strong predictor of exclusively breastfeeding the infant for the next 6 months (10). EBF is the proportion of infants aged 0-5 months who are fed exclusively with breast milk (7). EBF includes breast milk that the infant has received from the mother or a wet nurse. The infant should not receive other liquids or foods except oral rehydration salts, drops, and syrups (vitamins, minerals, and medicines) (11). The rationale for this indictor encompasses protecting children from diarrhea, lower respiratory infections, acute otitis, and obesity (12). CBF, is the proportion of children aged 12-15 months who are fed breast milk during the previous day (7). CBF has been linked to a lower risk of breast and ovarian cancer, rheumatoid arthritis, high blood pressure, heart disease, and diabetes (13).

1.3 Importance of Breastfeeding Indicators

The Maternal, Infant, and Young Child Nutrition (MIYCN) sets out six WHO global nutrition targets that must be met by 2025, one of which is to increase EBF to 50% by 2025 (14). However, the United Nations Decade of Action on Nutrition recommended that governments use SMART goals to make effective, long-term changes and improve global nutrition targets. These targets were originally set for 2025 but were recently extended to 2030 (15). Hence, breastfeeding global target rates were adjusted to be aligned with Sustainable Development Goals (SDGs) ambition levels (16). The targets for global breastfeeding rates in 2030 are 70% for EIBF, 70% for EBF, and 80% for CBF (17). Many of the 17 SDGs, including poverty, hunger, health, education, gender equality, and sustainable consumption, can be achieved by breastfeeding (15). Breastfeeding can help in eradicating extreme poverty and hunger since increased breastfeeding is associated with adding US$302 billion per year (15). Moreover, breastfeeding indicators are important in terms of meeting the global strategy for IYCF (18). This strategy is intended to assess the state of IYCF practices, policies, and programs in their respective countries. The goal of such an assessment is to identify strengths and weaknesses with the aim of improving the protection, promotion, and support of optimal IYCF (18). Thus, high priority is given to promoting the consistent use of breastfeeding indicators as the main measurement tool for accurate monitoring and evaluation of child-feeding trends (18).

1.4 Strengths of Using National Surveys

Household surveys are the main sources for collecting national data related to women's and children's health (19). National surveys have many strengths, like providing high-quality, accurate, reliable, timely, and consistent data at the national level (19). This is critical at both the country and global levels as it provides a comprehensive understanding of health status and how it changes over time. Also, national surveys play a vital role in public health decisions and actions, including policymaking, planning, programming, monitoring, and achieving the health-related Millennium Development Goals (MDGs) (19). Similarly, sound data in national surveys support countries to effectively manage their health systems and allocate resources according to population need (19).

1.5 Factors Affecting Prevalence of Breastfeeding Indicators in the MENA Region

The prevalence of breastfeeding practices in MENA countries might be affected by many factors. Evidence from literature found an association between breastfeeding indicators and different income groups (12, 20-22). Moreover, studies found an association between EIBF, EBF, and CBF with delivery mode, particularly (C-section) (20, 22). Other studies have found a link between breastfeeding prevalence and baby-friendly hospital initiatives (BFHI) (23, 24). Ethnicity was also one of the factors that could be related to differences in breastfeeding practices (25-27). Furthermore, maternal employment, age, education, and rooming-in practices may predict breastfeeding continuation practices (20).

1.6 Rationale for Pooling Data in the MENA Region

Pooling two or more data sets is a strategy used to obtain an overall estimate of the outcome of interest (28). Moreover, pooling data increases the sample size and leads to more efficient and precise overall estimates (28). Obtaining an overall estimate enables the researcher to assess variability or heterogeneity in the study findings (28). Besides, simple data pooling provides an overall summary of subgroup data, which enables highlighting factors that could affect breastfeeding initiation and continuation to design effective interventions.

Many previous studies have been conducted on the overall prevalence of breastfeeding practices in different regions. One study was a meta-analysis in 29 sub-Saharan African countries (29). However, none of the existing studies estimated the prevalence of breastfeeding indicators in the MENA region using national representative health surveys. In the paucity of data on breastfeeding indicators in MENA countries, the present meta-analysis study aims to fill the scientific gaps with the following aims.

1.7 Aims

- To estimate the overall prevalence of the following major breastfeeding indicators; EIBF, EBF, and CBF for the MENA region by conducting a meta-analysis using DHS and MICS national health surveys.
- To estimate the overall prevalence of breastfeeding indicators by income level, delivery mode (C-sections), BFHI, survey period, and ethnicity in the MENA region using DHS and MICS national health surveys.

CHAPTER 2: LITERATURE REVIEW

2.1 Breastfeeding Benefits

2.1.1 Breastfeeding Benefits for Infants

Breastfeeding has several health benefits for infants, mothers, and the whole community. Starting with breastfeeding benefits for the infant, it enhances both sensory and cognitive development as well as helps children achieve better intelligence assessments. Moreover, breastfeeding protects infants against both communicable and non-communicable diseases (30). Furthermore, it decreases the under-five infant mortality rate related to common childhood diseases (30). Accordingly, in 75 high-mortality low and middle-income countries (LMICs), about 820,000 lives or more (87% of them considered infants under 6-months of age) could be saved every year by improving breastfeeding continuation (14). Evidence in the literature suggests that breastfeeding reduces the incidence of sudden infant death syndrome that may occur during the first year of a child’s age (31). In addition, children who have continued breastfeeding are less vulnerable to developing type-1 and type-2 diabetes mellitus (31).

2.1.2 Breastfeeding Benefits for Mothers

Breastfeeding affects maternal health and well-being. It decreases the risk of ovarian and breast cancer and helps with the better spacing of pregnancies (30). About 19,494 annual deaths from breast cancer could be prevented (12). Besides, it reduces postpartum bleeding, menstrual blood loss, and the risk of hip fractures and osteoporosis in the postmenopausal period. Also, it helps the mother return to her pre-pregnancy weight in a short period of time (31).

2.2 Measurement of Breastfeeding Indicators

Breastfeeding indicators were primarily measured by conducting household surveys as the main measurement tool (7). Age groups used for each breastfeeding indicator differed. However, WHO recommended the use of children less than 24 months of age as the main sample from which most of the indicators can be generated (11). Also, the 24-hour recall period is found to be widely used in dietary intake surveys (7). Retrospective methods were not used to measure breastfeeding indicators, except for these two indicators: "EIBF" and "children ever breastfed." Instead, current status data or point-in-time data were used for data measurement (7). To clarify, the child's current age and other information for the 24 hours prior to the survey were used to report breastfeeding indicators because the 24-hour recall period is widely used in dietary intake surveys (7).

In addition, it was stated by Greiner (2014) that the degree of accuracy in measuring breastfeeding indicators depends on several factors, such as indicator definition, timing, recall duration, analysis methods, and sample biases (32).

A guidance document published by WHO (2021) recommended a set of IYCF indicators (33). Worldwide, these indicators were considered the foundation for collecting and reporting data on IYCF practices. In 2008, the indicator set was divided into eight core and seven optional indicators (33). However, in 2021, there was no distinction in IYCF indicators and all of them were recommended. Moreover, after revising the earlier IYCF set, new indicators were added with some adjustments, deletions, and replacements (33). The new IYCF set includes 17 indicators which are presented in table 1:

Table 1. IYCF indicators and their definitions

IYCF Indicators
1. Ever breastfed (EvBF)
2. Early initiation of breastfeeding (EIBF)
3. Exclusive breastfeeding under six months (EBF)
4. Continued breastfeeding 12–23 months (CBF)
5. Introduction of solid
6. Semi-solid or soft foods 6–8 months (ISSSF)
7. Minimum dietary diversity 6–23 months (MDD)
8. Minimum meal frequency 6–23 months (MMF)
9. Minimum milk feeding frequency for non-breastfed children 6–23 months (MMFF)
10. Minimum acceptable diet 6–23 months (MAD)
11. Bottle feeding 0–23 months (BoF)
The newly added indicators:
12. Exclusively breastfed for the first two days after birth (EBF2D): the proportion of children born in the last 2-years and were put to the breast within one hour of birth
13. Mixed milk feeding under six months (MixMF): the proportion of infants aged 0-5 months and who were fed formula and/or animal milk besides the breast milk during the previous day. This indicator could be beneficial in documenting advocacy purposes, for example, to measure the extent of using non-human milk to supplement breastfeeding.
14. Egg and/or flesh food consumption 6–23 months (EFF): the proportion of children aged 6-23 months and consumed egg and/or flesh food during the previous day.

Table 2. Continuation

IYCF Indicators
It is crucial to measure EFF since diets with insufficient egg and/or flesh food were less likely to meet nutrient needs for IYCF.
15. Sweet beverage consumption 6–23 months (SwB): the proportion of children aged 6-23 months and were consumed a sweet beverage during the previous day. The rationale for adding this indicator, i.e., consumption of sweet beverages, was linked to a high weight and BMI; in addition, consumption of sugar-sweetened beverages was linked to high risk of obesity during childhood.
16. For zero vegetable or fruit consumption 6–23 months (ZVF): the proportion of children aged 6-23 months who did not consume any vegetables or fruits during the previous day. ZVF was added to the IYCF indicator set because it was found that a low intake of vegetables and fruit was related to a higher risk of non-infectious diseases.
Infant feeding area graphs (AG): the proportion of infants aged 0-5 months and were fed exclusively with breast milk, breast milk, and water only, breast milk and non-milk liquids, breast milk, and animal milk/formula, breast milk, and complementary foods, and not breastfed during the previous day. This indicator is valuable in terms of conducting a situation analysis and monitoring.

2.3 Breastfeeding Status in Different Regions

Data extracted from UNICEF global databases based on MICS, DHS, and other nationally representative sources for the period 2014-2020 showed several findings related to breastfeeding (5). The prevalence of the EIBF indicator differs widely between regions. For instance, the proportion of this indicator was 70% in Eastern

Europe and Central Asia and 64% in Eastern and Southern Africa (5). In contrast, the prevalence in the MENA was only 34%, i.e., about half of the prevalence in Eastern and Southern Africa (5). Also, in regards to feeding infants with anything other than breast milk, for every three newborns, one of them was receiving food or liquids other than breast milk during the first days of life (5). This led to delay the first contact between the mother and her baby and difficulties in starting breastfeeding (5).

There are regional disparities in the prevalence of EBF (5). In 2021, South Asia had the highest EBF prevalence 57%, and Eastern and Southern Africa had the second-highest prevalence, with nearly 55% of EBF (5). In contrast, North America reported the lowest rate of EBF (26%), as well as the prevalence in the MENA region was considered low at 33% (5). Additionally, the prevalence of CBF has been relatively the same since 2010; the percentage was 69 in 2010 and 66 in 2020 (5).

A time-series study gathered cross-sectional data from nationally representative surveys to estimate trends in IYCF indicators in 13 countries from 2000 to 2019 (21). The study indicated similar breastfeeding trends to previous findings: an increased rate of EBF was observed in all regions of the world, while for the MENA region, the rates decreased from 42.9% (95% CI 25.2 to 60.6) in 2000 to 30.2% (95% CI 20.4 to 39.9) in 2019 (21). Similarly, the trend data for the proportion of CBF showed a decline in rates; in 2000, the prevalence was 76.6% (95% CI 64.4 to 88.8); however, in 2019, the prevalence reached 71.1% (95% CI 49.7 to 92.5), indicating a 7% reduction in 20 years (21).

The Centers for Disease Control and Prevention (CDC) Breastfeeding Report Card (2020) presented data on breastfeeding practices in the United States (US) (34). The report found that in 2017, most American mothers started breastfeeding 84.1%, while 58.3% of them breastfed their infants for 6 months, of which 25.6% were exclusively breastfed. Furthermore, CBF was found to be 35.3% (34). Moreover, among infants born in 2017, the proportion of breastfed infants who received formula before 2 days of age was 19.2% (34).

A recent review study in 2019 collated national breastfeeding data from 11 European countries using self-administered questionnaires and documentation from healthcare professionals (35). Among the 11 studied countries, 56% to 97% of newborn infants received breast milk (35). Although EIBF rates were considered high in all countries, they started to decline gradually with time, which reduced the rates of EBF (35). Therefore, compared to other parts of the world, the WHO European region reported low breastfeeding practices, i.e., <25% of EBF (35).

A cross-sectional study conducted in East Asia and Pacific countries showed rates of some breastfeeding indicators (22). EIBF was 59% and EBF was 83.5% (22). However, in 2019, UNICEF reported that EBF in this region wad 30% , suggesting a clear decline observed between 2016-17 and 2019 (5).

Locally, research has been conducted in Qatar to highlight the breastfeeding practices of Arab mothers through assessing breastfeeding indicators as well as their determinants (36). This cross-sectional study was conducted in primary health care centers in Qatar from June to October 2009. A total of 770 Arab mothers were selected with their children who were below 2 years (36). The process of data collection was completed using an interview-administered questionnaire. The authors found that the age range for the children was 91 weeks and the majority of the mothers were below 35 years old. EIBF was 56.9% (437/768), and 84.7% (651/768) of those mothers breastfeeding their infants in the first 24 hours before hospital discharge (36). EBF was found to be 18.9%, while CBF was 49.9% (36).

Another cross-sectional study was done in Qatar in 2018 among women attending primary health care centers (37). The purpose of the study was to evaluate knowledge, attitude, and practice (KAP) and their association with CBF. The study included 195 Qatari and non-Qatari mothers who were randomly selected and data were collected using a self-administered questionnaire (37). The study illustrated that approximately 42% of participating mothers stopped breastfeeding before their children reached 11 months of age (37). Also, findings showed an association between the number of children and child sex with the infant age at which breastfeeding was stopped. Mothers who had only one child or a female child stopped breastfeeding before six months of the infant's birth (37).

2.4 Factors Influencing Breastfeeding Continuation

We reviewed the literature related to factors that affected breastfeeding indicators and their continuation. Many factors appeared to be associated with the prevalence of breastfeeding indicators. However, the current study focused on more prevalent factors that had a major impact on breastfeeding rates. These factors include income levels, mode of delivery (C-section), BFHI, and ethnicity.

2.4.1 Breastfeeding and Income Level

The global picture of breastfeeding considerably varies between low, middle-income, and high-income countries (HICs) because of differences in a country's classification by income (38). Generally, 95% of infants receive breast milk at some point in their lives. However, in LMICs, only 4% (i.e., 1 in 25 infants) were not breastfed, while in HICs, around 21% (more than 1 in 5 infants) were not receiving breast milk (38).

A clear disparity in breastfeeding practices can be observed in HICs; for example, approximately all infants are breastfed in Oman, Sweden, and Uruguay (38).

On the other hand, proportions were much lower in some countries, like the US, where the percentage of infants who ever received breastmilk was 74%, and in Ireland it was only 55% (38). Such differences do not exist in LMICs; even in the countries with the lowest breastfeeding rates, nearly 9 out of 10 babies are breastfed (38).

A systematic review and meta-analysis assessed breastfeeding indicators based on country income groups and pointed out that breastfeeding practices are among the top concerns in both developed and developing countries (12). The prevalence of breastfeeding at all ages was high in low-income countries, yet EIBF and EBF were low in all countries, even in LMICs and among all income groups (12). Approximately, 101.1 million children in LMICs were not breastfed according to international breastfeeding guidelines. Thus, the prevalence of breastfeeding indicators' decreased as national wealth increased (negative association), except for EIBF (12).

With regards to infants below 6 months of age, 63% were not exclusively breastfed at the time of the national survey in LMICs, corresponding to 53% in low-income countries, 61% in LMICs, and 63% in upper-middle-income countries (12). For children aged 6–23 months, 37% did not receive any breast milk in LMICs, corresponding to 55% in upper-middle-income countries, 34% in LMICs, and 18% in low-income countries (12). In addition, based on a document published by UNICEF, evidence showed that mothers from poor households and living in HICs were less likely to breastfeed. In contrast, mothers from wealthy households and living in LMICs were more likely to breastfeed (38).

The global prevalence of CBF was highest in LMICs such as Sub-Saharan Africa, South Asia, and Latin America compared with HICs, where breastfeeding rates were lower than 20% (12). For instance, in the United Kingdom, it was less than 1%, in the US it was about 27%, while in Norway and Sweden it was 35% and 16%, respectively (12).

The study found a strong negative correlation (Pearson's r=–0·84; p<0·0001) between EBF and log gross domestic product per person (12). Also, breastfeeding at 12 months was common in low-income and LMICs (12). However, the regression analyses showed that CBF decreased by 10% for each doubling in the gross domestic product per capita (12).

In addition to the wide variation of breastfeeding rates between countries with different income levels, the prevailing difference within a country, particularly between rich and poor population groups, is considered the worst (38). About two-thirds of children continue to breastfeed until age 2-years in the poorest families, compared to only 41% in the richest families (38). For example, we can see this gap in the West and Central Africa, where breastfeeding continuation at 2 years is 63% among the poorest households compared to 26% only in the richest households (38).

2.4.2 Breastfeeding and Cesarean Section

Breastfeeding practices are affected by several obstetrical interventions such as C-section, which increase breastfeeding concerns worldwide (39). Breastfeeding practices for women who underwent C-section are influenced by certain factors like mothers' health, emotional responses to the surgery, infant health, and behavior (39). Mostly, after C-sections, women will have a reduction in mobility, which could delay attending to basic infant needs, including breastfeeding. In addition, the pain that mothers suffer mainly during the first 24-hours after delivery negatively affects breastfeeding practices (39).

A meta-analysis of nationally representative data from 33 countries in sub-Saharan Africa examined the influence of C-sections on breastfeeding indicators

(EIBF, EBF, and children ever breastfed) using DHS surveys implemented between 2010 and 2017/2018 (39). The study demonstrated that, compared to vaginal birth, C-sections resulted in a 46% reduction in the prevalence of EIBF (pooled adjusted prevalence ration (aPR), 0.54 (95% CI 0.48 to 0.60) (39). In addition, there was a weak association between EBF (pooled aPR, 0.94 (95% CI 0.88 to 1.01) and children ever breastfed (pooled aPR, 0.98 (95% CI 0.98 to 0.99) with C-sections compared to vaginal birth (39).

Similarly, another systematic review and meta-analysis study was done in 2012 to assess if C-section delivery (pre-labor or in-labor) is associated with a reduction in breastfeeding rate compared to vaginal delivery (40). The study showed that rates of EIBF were lower among women who underwent C-section delivery compared with women who had vaginal delivery (pooled OR: 0.57; 95% CI: 0.50, 0.64), and rates were lower in pre-labor as compared to in-labor C-section delivery (pre-labor OR: 0.83; 95% CI: 0.80, 0.86; in-labor OR: 1.00; 95% CI: 0.97, 1.04) (40). In terms of EBF, there is no significant association between C-section delivery and breastfeeding up to 6 months postpartum (OR: 0.95; 95% CI: 0.89, 1.01) (40). When all maternal populations were considered in the analysis, irrespective of EIBF status, the study found that EBF decreased before C-section delivery compared to vaginal delivery (pooled OR: 0.81; 95% CI: 0.67, 0.98) (40). However, when the authors limited the analysis to mothers who initiated breastfeeding only, EBF was not statistically significant between C-section delivery and vaginal delivery (OR: 1.01; 95% CI: 0.86, 1.20) (40).

Another study found that infants of offspring mothers who underwent C-sections may have a higher probability of being admitted to neonatal intensive care units as a result of respiratory disorders (41). Consequently, the likelihood of EIBF might be significantly reduced due to the potential for physical separation between mother and infant. Furthermore, a reduction in breastfeeding initiation could be due to some physiological causes relevant to C-section delivery (41). For instance, it is assumed that the hormonal pathway that triggers “lactogenesis” is possibly interrupted because of maternal fatigue or declined oxytocin secretion that happened after planned C-sections, which is done before the onset of labor (41).

Likewise, a study conducted in Canada in 2016 found that women who had planned C-section did not have the intention of or were not initiating breastfeeding (7.4% and 4.3%, respectively) compared to women with infants born vaginally (3.4% and 1.8%, respectively) and emergency C-section (2.7% and 2.5%, respectively) (42). Moreover, the study showed that mothers who delivered by C-section had a higher prevalence of breastfeeding cessation before 12 weeks postpartum (OR= 1.61; 95% CI: 1.14, 2.26) as compared to women with vaginal birth, after controlling for several factors such as income, education, parity, preterm birth, maternal physical and mental health, ethnicity, and breastfeeding difficulties (42).

Research in the Chinese population was conducted to determine the association between breastfeeding practices and C-section delivery (43). It was a systematic review and meta-analysis of 13 relevant analytical studies from January 1990 to June 2015 (43). The study found a 47% reduction in the odds of EBF following C-sections compared with vaginally born children (pooled OR 0.53, 95% CI 0.41, 0.68) (43). Additionally, the odds of breastfeeding during the four months postpartum were lower in mothers who underwent C-sections than in vaginal deliveries (pooled OR 0.61, 95% CI 0.53, 0.71) (43). The study found a negative association between C-sections and breastfeeding continuation practices (43). Subgroup analyses were also performed by study design, time points of breastfeeding outcomes, and breastfeeding definitions. All subgroup results showed that the increase in C-section rates is associated with lower breastfeeding uptake (43).

When considering C-sections based on income distribution, low-income and middle-income countries have high rates of C-sections as well as significant inequalities between poor and rich mothers (44). It reflects a lack of access to specialized health facilities among the poorest women due to shortages in transportation, surgical health facilities, and skilled birth attendants. On the other hand, rich populations have high access to health care services, which explains the overuse of C-sections for non-medical reasons among rich women (44).

Regarding the ideal and acceptable C-section rates, WHO established a document in 1985 under the title “Statement on Cesarean Section Rates”, to investigate the ideal C-section rate within a given country or population, and at a worldwide level using best available data and internationally accepted methods (45). The findings from the document were as follows: 1) Only when medically indicated C-sections are beneficial in reducing maternal and infant mortality (45). 2) The ideal rate for C-section is between 10-15% at the population level since this range is associated with a reduction in adverse health consequences such as maternal, neonatal, and infant mortality. It is no longer evident that any C-section rate above 10% will benefit both women and infants effectively. These cut-off points were released 30 years ago by the International Healthcare Community during the panel of reproductive health experts by WHO (45). 3) C-sections can result in major and permanent health disabilities as well as death, particularly in countries that lack sufficient specialized health care providers and are unable to perform safe surgery with minimal adverse surgical complications (45). Therefore, it is always recommended to conduct C-sections based on a woman’s needs and not only strive to accomplish a specific rate. 4) High C-section delivery rates are associated with adverse health outcomes like maternal and perinatal morbidity. Effects on psychological or social well-being have not been investigated yet (45).

C-section rates continued to increase in both developed and developing countries even after the release of the WHO document. Accordingly, health care professionals, scientists, epidemiologists, and policy-makers expressed the importance of reviewing and revising the 1985 recommended rate as more evidence became available on the effectiveness and possible harms of C-sections as well as the advancement of clinical obstetric care along with new assessment methodologies (45). Therefore, in 2014, the WHO systematically reviewed the most recent ecological studies on C-sections (45). The study concluded that there is a negative association between C-section rates >10% and maternal, neonatal, and infant mortality. Therefore, C-section rates of up to 10% are both protective and ideal. However, there is no such association between any C-section above 10% and a reduction in mortality (45).

Furthermore, they found no association between increased rates of C-section and reduced mortality after controlling for socioeconomic factors, except when the rates of C-section were less than or equal to 10% (45). If the rate of C-section was higher than 10% and up to 30%, the impact on mortality reduction would disappear (45). Any association resulted in observational studies does not imply causation (45).

Generally, C-section was not at the desired WHO recommended levels as it contributes to major effects on breastfeeding practices, which may increase incidence rates of breastfeeding cessation. Hence, more research is required to understand the trends and influence of C-sections on breastfeeding indicators in order to reduce unnecessary C-section delivery effectively.

2.4.3 Breastfeeding and Policy: Baby-Friendly Hospital Initiative (BFHI)

The BFHI was established in 1991 by WHO and UNICEF to provide a basis to protect, promote, and support breastfeeding in maternity facilities globally (46). The BFHI is following the Ten Steps for successful breastfeeding as well as ensuring adherence to the Code of Marketing of Breast-milk Substitutes (BMS). Evidence showed that implementation of the Ten Steps led to a substantial improvement in breastfeeding indicator rates (46).

The implementation guidance of BFHI focuses on strategies to improve universal breastfeeding coverage and ensure sustainability (47). This guidance emphasized the integration of the national BFHI program into the health-care system through fulfilling 9-key responsibilities, including: establishing a national coordination body; incorporating the Ten Steps into national policies and standards; ensuring that health-care professionals are competent; using systematic assessment tools to evaluate adherence to the Ten Steps; offering incentives; providing technical assistance; continuous implementation monitoring; program advocating and communicating; and identifying and allocating sufficient resources (47). Different global health-policy documents have highlighted the significance of the Ten Steps, such as WHA resolutions in 1994 and 1996, the 2002 Global strategy for IYCF, and the 15th anniversary of the Innocenti Declaration (24) in 2005 (48). This reflects the importance of establishing maternity, neonatal, and child health services that incorporate the Ten Steps of the BFHI (48).

The BFHI has been implemented in almost all countries around the world, with different coverage degrees. Generally, the majority of countries have low coverage of BFHI (48). In 2011, 28% of maternity and newborn facilities were designed as baby-friendly (48). However, in 2017, the worldwide proportion of babies born in facilities designated as baby-friendly was only 10% (48). The effect of BFHI is probably higher than its implementation as some facilities may implement some of the Ten Steps without having reached the designation as baby-friendly, which results in an effective impact (48).

A systematic review of 58 studies on maternity and newborn care showed that adherence to the Ten Steps led to positive effects on breastfeeding rates, like EIBF, EBF, and total duration of any breastfeeding (48). Also, the review demonstrated a dose-response relationship between the number of BFHI steps and the probability of enhancing breastfeeding outcomes (48).

On a local scale, the Global Breastfeeding Score-card 2018 report in Qatar stated that 49.5% of births in Qatar occurred in maternity facilities that promote BFHI (49). This enables women to increase their breastfeeding practices through better policies and programs (49). Furthermore, the report indicated that in Qatar, EIBF was 34%, EBF was 29%, CBF was 65%, and 32% of babies continued to breastfeed until age 2-years (49).

2.4.4 Breastfeeding and Ethnicity

According to the CDC, there were disparities in breastfeeding rates and practices among different racial and ethnic groups (25). For instance, Asian women (defined as people of origin from the Far East, Southeast Asia, or the Indian subcontinent) were the only ethnic group that achieved the Healthy People 2020 goal by reaching 81.9% of EIBF, followed by Hispanic women (25). On the other hand, African-American women had the lowest breastfeeding prevalence, including EIBF (60%), EBF (28%), and CBF (13%) in comparison to all other US ethnic groups (25). Although some advancement has been made in breastfeeding rates for African American women, their breastfeeding practice rates are still 2.5 times lower than white women (26). Also, differences in breastfeeding rates exist between Arab and non-Arab mothers since religious beliefs and cultural practices shape breastfeeding prevalence and attitudes of mothers living in Arab and Muslim communities (50). Breastfeeding rates were considered high among Arab mothers, in which Islam encouraged women to breastfeed their children for 2 years (50). Nevertheless, the early introduction of liquids and food supplementation was widespread, particularly among Arab mothers (50). A study in Jordan showed that 59% of breastfed mothers introduced supplementation other than breast milk, like sweetened water, during the first 6 months of the infant's age (51). This practice is usually done as an effect of Arabic culture. Mothers believe that giving their babies supplements at an early age shows that they love and care for them (51).

2.5 Gap in Research

The literature has many studies published in different MENA countries describing the prevalence of breastfeeding indicators and investigating factors that affect breastfeeding continuation. However, to date, none of the studies has brought together the existing evidence on the prevalence of breastfeeding indicators to obtain a single meaningful estimate in the context of the MENA region. Also, much of the available evidence exploring the impact of income level, C-section, BFHI, and ethnicity on breastfeeding was conducted at a country level rather than a regional level. Hence, this study seeks to address the gap in the literature by estimating the overall prevalence of breastfeeding indicators in the MENA region as well as estimating the pooled prevalence of breastfeeding indicators by different factors to highlight differences in breastfeeding practices.

In addition, the current study will help plan and implement targeted health interventions to improve breastfeeding practices among mothers in the MENA region at a scale that could achieve significant public health impact. Moreover, it will enable stakeholders and policy-makers to design national public health policies.

CHAPTER 3: METHODS

3.1 Objectives

3.1.1 Primary Objective

To estimate the overall prevalence of EIBF, EBF, and CBF indicators in the MENA region using national health surveys.

3.1.2 Secondary Objective

- To estimate the overall prevalence of breastfeeding indicators by income level in the MENA region using national health surveys.
- To estimate the overall prevalence of breastfeeding indicators by mode of delivery (C-section) in the MENA region using national health surveys.
- To estimate the overall prevalence of breastfeeding indicators by the availability of BFHI in the MENA region using national health surveys.
- To estimate the overall prevalence of breastfeeding indicators by survey period in the MENA region using national health surveys.
- To estimate the overall prevalence of breastfeeding indicators by ethnicity in the MENA region using national health surveys.

3.2 Study Design

The current study is a meta-analysis based on breastfeeding indicators data from the most recent Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Survey (MICS).

3.3 Data Sources

The study examined breastfeeding indicators in the MENA region using cross-sectional national data from the latest DHS and MICS between the periods 2010-2020. All national surveys conducted in the MENA region were considered. Other national health surveys conducted in the MENA region, such as the Pan Arab Project for Family

Health (PAPFAM), were not included in this study because they did not include sufficient and up-to-date breastfeeding indicators. Additionally, some other national surveys have a specific focus on topics other than child and maternal health.

It is well-known that estimates extracted from surveys are affected by non-sampling errors for multiple reasons, such as missing data, coverage error, and measurement or response error (52). One of the ways to overcome the issue of non-sampling errors is to combine information from more than one survey. This allows the researcher to benefit from each survey's strengths, thereby adjusting for non-sampling errors and enhancing the estimates of interest (52). Therefore, we aim to pool information from two different surveys (MICS and DHS) while conducting this meta-analysis.

The selection of surveys for the meta-analysis was made according to the criteria for high-quality surveys developed in 1997 by the American Association of Public Opinion Research (AAPOR) and the Section on Survey Research Methods of the American Statistical Association (ASA) (53). Based on these criteria, the included surveys should have good coverage of the target population and a high response rate to avoid any bias due to missing data. Both criteria were developed to ensure that the selected surveys were representative of the population of interest (53). Hence, MICS and DHS were the most applicable surveys as per the AAPOR criteria. Also, since they were considered to be high quality based on their methodology and content, both surveys had sufficient sample sizes and were representative of the target population. Questionnaires were pre-tested and obtained high response rates, with a minimum of 93%, as shown below in Table 2.

MICS and DHS programs have freely available data for public users and country reports that involve complete survey results. Typically, MICS and DHS are conducted every 3-5 years, allowing trend data production for comparison (54, 55).

3.4 National-Scale Data on IYCF Practices: MICS and DHS

MICS and DHS were the surveys included in the present analysis. These surveys were designed to collect statistically sound and internationally comparable estimates of more than 130 indicators evaluating women's and children's health conditions (56, 57).

Data collection in MICS and DHS is conducted by specific teams, including extensively trained interviewers, supervisors, and measurers (who are responsible for taking of anthropometric measurements of children). The field supervisor monitors the team during the fieldwork to ensure that interviewers are following guidelines. Additionally, the field supervisor is responsible for revisiting households for quality measures to confirm that questionnaires are completed and the correct information is recorded (56, 57).

The MICS and DHS are the primary sources of global health indicators for maternal and child health (MNCH) in developing countries. Both surveys collect data on several topics, including fertility levels, marriage, fertility preferences, family planning methods, child feeding practices, nutrition, adult and childhood mortality, HIV/AIDS, women's empowerment, and domestic violence (54, 55).

MICS has multiple rounds. In 1995, UNICEF conducted the first round of the MICS. It is currently is its seventh round where the data collection stage has begun. This study was based on data obtained from MICS rounds four, five, and six conducted between 2010 and 2019 (58). By contrast, DHS has two types: Standard DHS Surveys and Interim DHS Surveys. Our study used only the Standard DHS Survey because it has larger sample sizes (between 5,000 and 30,000 households) (57).

3.5 Breastfeeding Indicators

The nutrition-related section in the MICS and DHS includes specific indicators related to breastfeeding and infant feeding practices. Standardized methodology and a standard core questionnaire were customized based on country-specific context and pre-tested to collect representative information about breastfeeding indicators (56, 57).

The breastfeeding indicators that were used in our study are expressed mathematically below (7, 11):

1. Early initiation of breastfeeding (EIBF):

$$\frac{Children\ born\ in\ the\ last\ 2\ years\ who\ were\ put\ to\ the\ breast\ witin\ one\ hour\ of\ birth}{Total\ number\ of\ children\ born\ in\ the\ last\ 2\ years}$$

2. Exclusive breastfeeding under 6 months (EBF):

$$\frac{Infants\ 0-5\ months\ of\ age\ who\ recived\ only\ breast\ milk\ during\ the\ previous\ day}{Total\ number\ of\ infants\ 0-5\ months\ of\ age}$$

3. Continued breastfeeding at 1 year (CBF):

$$\frac{Cildren\ 12-15\ months\ of\ age\ who\ recieved\ breast\ milk\ during\ the\ previous\ day}{Total\ number\ of\ children\ 12-15\ months\ of\ age}$$

3.6 Differences in the Calculation of Breastfeeding Indicators in MICS and DHS

This section discusses the variation in breastfeeding indicators in MICS and DHS in terms of the methodological aspects. There are four differences considered: data collection, survey designs, reference period, and population coverage.

3.6.1 Data Collection

In terms of data collection, MICS calculates breastfeeding indicators using the data collected from the Children Under-5 Questionnaire, while DHS uses Women's Questionnaire to collect breastfeeding indicators (59).

3.6.2 Survey Designs

Regarding survey designs, the DHS includes household residents, visitors, and guests who stayed on the household in the night preceding the interview. Additionally, breastfeeding information is collected only for biological mothers aged 15-49 years. This is irrespective of whether the child lives in the household or not (59).

On the other hand, MICS includes usual household residents who are not necessarily present in the household at the survey time. Besides, mothers' or caregivers' information is collected for all children living in the household (including orphans and foster children). There are no age restrictions for the mothers or caretakers of the eligible children (59).

3.6.3 Reference Period

In the DHS, breastfeeding indicators are collected for live birth(s) born between 2 or 5 years preceding the survey. MICS on the other hand collects breastfeeding information based on women with a live birth in the last two years preceding the survey, including children who died after birth (59).

3.6.4 Population Coverage

While collecting breastfeeding indicators, the DHS considers only the youngest child while MICS considers all children as population coverage (59).

3.7 Sampling Design

MICS and DHS surveys used standardized study designs and nationally representative samples. The employed sampling procedure in both surveys was a multistage stratified cluster sampling design based on an existing sample frame, such as the latest population census. In the first stage of the sample design, the primary sampling units were drawn, and census enumeration areas were selected with a probability proportional to population size. A listing of households are compiled from the selected enumeration areas. In the second stage, households and eligible women are selected using systematic random sampling to form the survey clusters (59, 60).

3.8 Study Selection Criteria

The following inclusion criteria were considered to identify the relevant or eligible study surveys:

- DHS or MICS published between (2010-2020) to ensure complete coverage of breastfeeding indicators among selected countries;
- Any survey published in English, Arabic, and French languages;
- Original surveys presenting primary data on the three selected breastfeeding indicators, i.e., EIBF, EBF, and CBF;
- Use of the UNICEF and WHO definitions for the selected breastfeeding indicators; Selection of MENA countries based on the MENA region definition of The World Bank, WHO—Eastern Mediterranean Region (WHO-EMR), the Joint United Nations Program on HIV/AIDS (UNAIDS), the Global Burden of Disease Study (GBD), and The United Nations Children's Fund (UNICEF);.

3.9 Exclusion Criteria

The excluded surveys included:

- MICS and/or DHS surveys that did not report key breastfeeding indicators;
- MICS and/or DHS surveys that were not nationally representative. For example, Egypt MICS5 2013-2014 which is a sub-national survey;
- MENA region countries that lack both MICS and DHS data;

3.10 Selected Countries and Sample Sizes

The MENA region does not have a standardized list of countries as each list categorizes each country differently (6). Due to the diversity in the classification of MENA countries, we decided to use more than one definition to include the maximum number of MENA countries in our study. Hence, we relied on multiple definitions of the MENA region. Selection of MENA countries was based on the MENA region definition of The World Bank, WHO —Eastern Mediterranean Region (WHO-EMR), the Joint United Nations Program on HIV/AIDS (UNAIDS), the Global Burden of Disease Study (GBD), and The United Nations Children's Fund (UNICEF). We ended up with the following 28-countries; Afghanistan, Algeria, Bahrain, Cyprus, Djibouti, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Malta, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Somalia, State of Palestine, Sudan, Syria, Tunisia, Turkey, United Arab Emirates, Western Sahara, and Yemen (61-65).

The 12-MENA countries met our inclusion criteria and were included in the meta-analysis: Algeria, Egypt, Iraq, Jordan, Qatar, State of Palestine, Sudan, Tunisia, Yemen, Afghanistan, Pakistan, and Turkey. The remaining MENA countries (Oman, Bahrain, Djibouti, Iran, Kuwait, Libya, Morocco, Saudi Arabia, Syria, United Arab Emirates, Malta, Israel, Cyprus, Lebanon (Palestinian refugees), Somalia, and Western Sahara) were not included in the analysis due to either a lack of availability of MICS and/or DHS surveys or a lack of national data. Also, in the case of repeated surveys for a single country, we include the most recent survey. Country selection is illustrated in the PRISMA flowchart (66) (Figure 1).

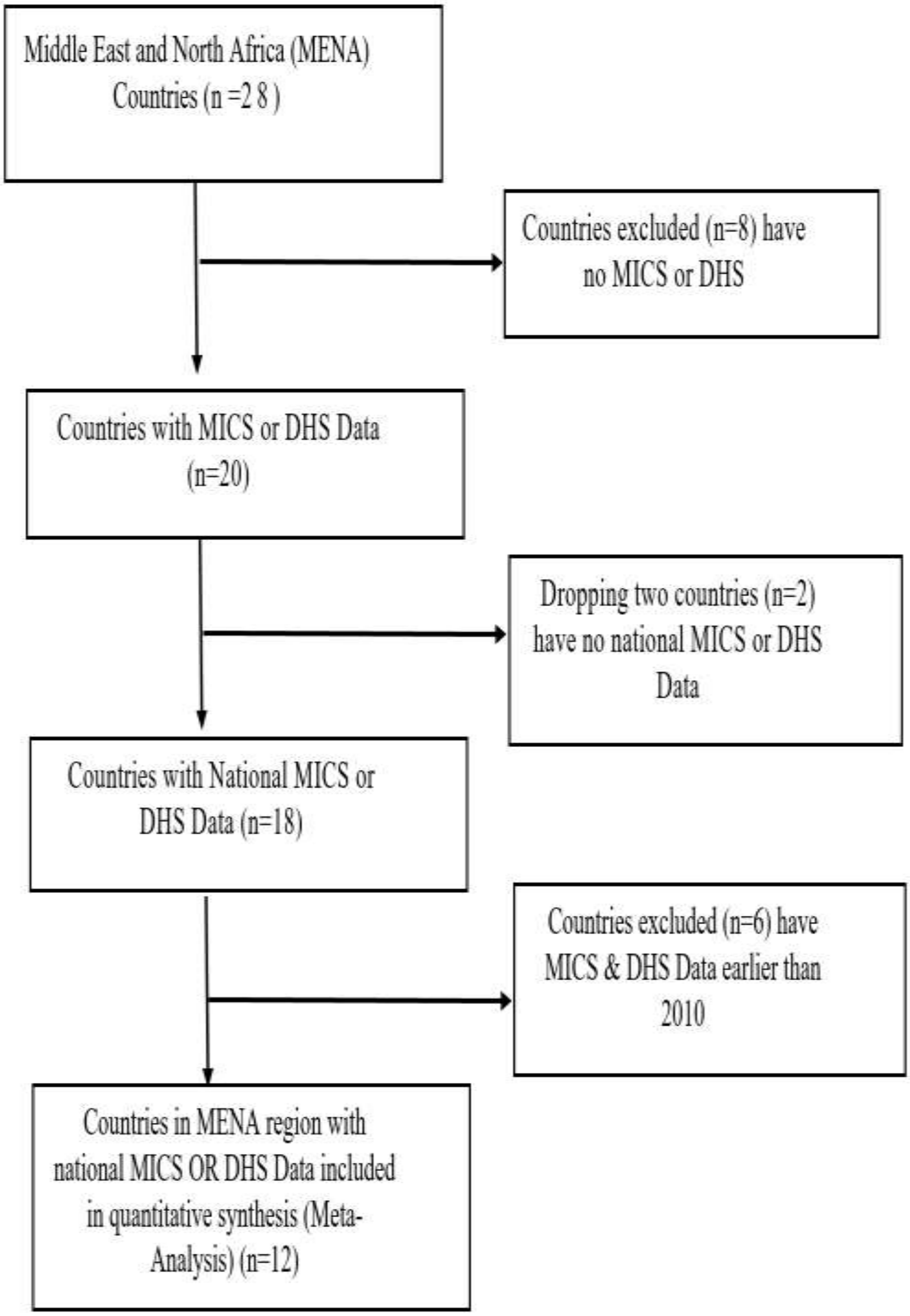

Figure 1. PRISMA flow chart for country selection based on inclusion and exclusion criteria

3.11 Statistical Analysis

Meta-analysis is a quantitative statistical method that pools findings from previous research studies. In the present study, meta-analysis was used to pool survey data from different countries. Meta-analysis is widely used because it provides precise overall pooled estimates of the study outcome while increasing the statistical power. Moreover, a rigorous meta-analysis helps in assessing sources of variability or heterogeneity, often due to statistical and clinical sources. Subgroup analysis was used to provide descriptive estimates for comparison, but without inferring any statistical significance of the results (67). In addition, as recommended in the Cochrane Handbook for Systematic Reviews of Interventions, meta-regression was also used to enable formal statistical testing, which allows for quantification of heterogeneity in study outcomes (68). However, before pooling data, we standardized the methods of calculating estimates using the MICS definitions. This is because the reference period for MICS data are based on births in the 2 years preceding the survey, while DHS data are based on births in the 5 years preceding the survey.

Regarding statistical methods, Stata version 15 (69) was used to perform some early phases of the analysis and MetaXL software version 5.3. (70) (71) was also used to carry out the meta-analysis. Individual level data were used to perform calculations for each indicator, using weights to account for complex survey design. The Stata survey command '*svyset*' was used to specify the variables that identify the survey design characteristics, primary sampling units, and strata, as well as the default method for estimating standard errors. Moreover, we used the survey tabulation '*svytab*' command to produce a two-way table of cell proportions. The table includes weighted frequency count and total count for our study outcomes along with their standard errors (SE) and 95% confidence intervals (CIs) after the survey design characteristics have already been *svyset*. For variance estimation, the Taylor series linearization (TSL) method was used. It was chosen as this method is appropriate in cases of complex sample design, including clustering and multi-stage sampling (72). The TSL method treats any linear statistic like proportions as a ratio estimate (the total sample value for a variable and the total number of cases in the group of interest) (72). Further, we considered the sample design while combing survey estimates If the survey sample was drawn using a simple random sample approach, the within-survey variances will be correctly estimated. However, if the sample was drawn using a complex sampling approach (e.g., clustered sampling), the within-survey standard errors for the difference may be over-estimated if the design induced correlation between the solo and group practice estimates in the particular survey is unknown (73).

Initially, the variance of estimates was calculated based on the binomial distribution using the sample size. There are two popular statistical models to conduct meta-analysis: the fixed-effect (FE) model and the random-effects model (RE) (73). In this study, the overall pooled prevalence was estimated using RE since heterogeneity was anticipated across estimates from different countries. A FE model was not used as it assumes that the estimates are homogenous or constant across the set of surveys. Hence, with the RE model, the true estimates were assumed to have been sampled from a common probability distribution. In this case, between-survey variability was considered in the estimates of variance of the combined prevalence (73). Furthermore, a very recent study conducted a meta-epidemiological review of recently published systematic reviews of prevalence found that the majority of the selected reviews used a RE model (n= 141, 93.4%) to obtain overall pooled estimates (74). The use of an RE model across different reviews was commonly encouraged (74).

Before pooling the data using the RE model, prevalence variances were stabilized with the double arcsine transformation. This transformation was used to overcome the issue of variance instability and confidence limits outside the 0-1 range, which can occur due to overweighting proportions close to 0% or 100% (75). In terms of transformation in MetaXL, a continuity correction was automatically applied for studies where the observed prevalence was either 0 (adjusted to 0.0005) or 1 (adjusted to 0.9995).

We produced forest plots of the pooled prevalence and associated 95% CIs of three breastfeeding indicators. Cochrane Q statistic (chi-square test) and I-squared (I^2) statistics were used to assess heterogeneity among the DHS and MICS data of different countries (76). In addition, sensitivity analysis was used to examine the effect of outliers by comparing the pooled prevalence before and after the elimination of countries with an extreme (too small or too large) sample size. The presence of outliers was detected with Stata using graphical methods like box plots, histograms, and spike plots. Another useful approach was the *extreme* command in Stata to identify the extremely high and low values.

3.11.1 Subgroup Analyses by Income Level, C-section, and Availability of BFHI

Subgroup analysis was carried out by dividing countries based on three pre-specified characteristics. The first characteristic was income level groups as categorized by the World Bank (low-income countries, lower-middle income countries, upper-middle income countries, and high-income countries). The World Bank classifications were based on GNI per capita in current USD, which was calculated using the World Bank Atlas method. The thresholds for each income group were as follows; < $1,036 for low-income groups, $1,036 - $4,045 for lower-middle income groups, $4,046 - $12,535 for upper-middle income groups, and > $12,535 for high income groups (77).

The second characteristic was C-section rates at the population level. In this study, MENA countries were divided into two caesarean section subgroups (≤10% and >10%).

The third characteristic was the availability of BFHI in selected countries. Ten countries were grouped as having baby-friendly hospitals (Afghanistan, Egypt, Iraq, Jordan, Oman, Pakistan, Qatar, Sudan, Tunisia, & Turkey) compared to three countries without baby-friendly hospitals (Algeria, State of Palestine, and Yemen) (23, 78).

3.11.2 Further Subgroup Analysis

Further subgroup analyses were carried out to investigate and understand the potential sources of high heterogeneity in the pooled prevalence as a main estimate, although we cannot be sure about the source of heterogeneity. Included surveys were split into two subgroups according to pre-defined characteristics before inspecting the results of the current meta-analysis. The two characteristics were the survey period (2012-2015 or 2016-2020) and ethnicity (Arab vs. non-Arab). The following Arab countries were considered in our study: Algeria, Egypt, Iraq, Jordan, Qatar, Sudan, State of Palestine, Tunisia, and Yemen. The non-Arab countries were Afghanistan, Pakistan, and Turkey (79). In terms of ethnicity, it was evident that breastfeeding practices in Arab communities were different than in non-Arab communities. As an example, mothers from Arab cultures are generally pleased if they have a baby boy. Consequently, they will do their best to ensure the baby grows up to be a healthy man. As a result, there is a tendency to breastfeed their male infants longer than their female infants (37). This deprives female infants of breastfeeding benefits and may have long-term consequences, in addition to perpetuating gender inequalities (37).

According to a published article aimed at guiding systematic reviews of observational studies, the period of the survey was one of the variables that could be used to explore the overall heterogeneity of the results (80). This is because breastfeeding practices have changed over time and healthcare services related to breastfeeding have also changed. We hypothesized that the period of the survey could have importance in terms of varying results. Therefore, we explored the differences in breastfeeding prevalence among the subgroups categorized based on 2012-2015 and 2016-2020.

3.12 Ethical Consideration

Our study used existing public domain survey datasets, which are freely available online with all identifier information removed. Consequently, the Institutional Review Board (IRB) was not required.

3.13 Source of Funding

This project has not been funded by any partner or organization.

CHAPTER 4: RESULTS

4.1 Baseline Characteristics

A total of 12 countries were included from the MENA region with MICS and DHS data with information on EIBF, EBF, and CBF. The total sample size from all 12 countries was 193,477. The year of data collection was between 2012 to 2020. Furthermore, the response rate of households' surveys maybe considered very high as it ranged from 93.3% to 99.5% (Table 2).

Table 3. Summary of MICS and DHS data sets included in the analysis

Country	Year of Survey	Source	Sample Size (Households Interviewed)	Households response rate (%)
Algeria	2018-19	MICS4	29919	96.7%
Afghanistan	2015	Standard DHS	24395	97.8%
Egypt	2014	Standard DHS	28175	98.4%
Iraq	2018	MICS6	20214	99.5%
Jordan	2017-18	Standard DHS	18802	98.3%
Pakistan	2017	Standard DHS	974	98.9%
Qatar	2012	MICS4	4501	99.1%
Sudan	2014	MICS5	16801	98%
State of Palestine	2019-20	MICS6	9326	97.1%
Tunisia	2018	MICS6	11225	97.8%
Turkey	2013	Standard DHS	11794	93.3%
Yemen	2013	Standard DHS	17351	96.3%

Table 3 presents the demographic characteristics of countries, including their total population (as of 2020), GDP per capita (as of 2020), and life expectancy (as of 2021). Qatar has the highest GPD per capita (US$) of 50,805.5 as well as the highest life-expectancy (80.73 years). Afghanistan has the lowest GDP per capita (US$) of 508.8 and the lowest life expectancy (65.98 years).

Based on the World Bank classification by income level, Qatar was included among the list of HICs. Upper-middle income countries included Jordan, Iraq, and Turkey, whereas LMICs included Algeria, Pakistan, Tunisia, Egypt and the State of

Palestine. On the other hand, Sudan, Yemen, and Afghanistan were included as part of low-income countries (Table 3).

Table 4. Demographic characteristics of the study countries (77, 81-84)

Country	Income level category	Population (in millions) (2020)	GDP Per Capita (US$) (2020)	Life Expectancy (Years) (2021)
Algeria	Lower-middle	44.23	3,310.4	77.50
Afghanistan	Low-income	38.93	508.8	65.98
Egypt	Lower-middle	102.33	3,547.9	72.54
Iraq	Upper-middle	40.22	4,157.5	71.08
Jordan	Upper-middle	10.21	4,282.8	75.01
Pakistan	Lower-middle	220.89	1,193.7	67.79
Qatar	High-income	2.88	50,805.5	80.73
Sudan	Low-income	43.85	595.5	66.09
State of Palestine	Lower-middle	5.12	3,235.0	74.62
Tunisia	Lower-middle	11.92	3,319.8	77.36
Turkey	Upper-middle	84.34	8,538.2	78.45
Yemen	Low-income	29.83	620.24	66.44

Table 4 shows the prevalence of three breastfeeding indicators, calculated based on individual-level data in all countries. The table presents the prevalence of EIBF for the last-born children in the 2 years preceding the survey, EBF for infants 0-5 months, and CBF for children 12-15 months. It can be seen that Sudan had the highest prevalence (0.69; 95% CI: 0.67- 0.71) whereas Pakistan had the lowest prevalence (0.20; 95% CI: 0.17- 0.22) of EIBF. However, the number of last-born children was highest (n=11,539) in Afghanistan for this indicator, with a 40.9% prevalence of early breastfeeding.

Similar to the first indicator, data on EBF showed that Sudan had the highest prevalence of 0.55 (95% CI: 0.51-0.59) whereas Yemen experienced the lowest prevalence of only 0.10 (95% CI: 0.08-0.12). In addition, data on the number of children between zero to five months again stayed the highest for Afghanistan (n=3,182).

In terms of the third indicator (CBF), Sudan experienced the highest prevalence with 0.89 (95% CI: 0.87-0.92) while Jordan had the lowest prevalence of 0.36 (95%

CI: 0.31-0.43). In a similar fashion to the previous two indicators, the number of children aged between 12 to 15 months, was the highest for Afghanistan (n=2,524).

Table 5. Prevalence (PR) of early initiation of breastfeeding among last-born children who were born in the last 2 years before the survey, PR of exclusive breastfeeding under 6 months among children between 0-5 months, PR of continued breastfeeding at one year, 95% confidence intervals and standard errors (12- MENA Countries 2010-2020)

Country	PR of early initiation of breastfeeding	95% CI	SE	Number of last born children	PR of exclusive breastfeeding under 6 months	95% CI	SE	Number of Children 0-5 Months
Algeria	0.32	0.32-0.34	0.0088	5686	0.29	0.26-0.31	0.0132	1413
*Afghanistan	0.41	0.38-0.43	0.0126	11539	0.43	0.41-0.45	0.0097	3182
*Egypt	0.27	0.26-0.29	0.0073	6297	0.40	0.36-0.42	0.0149	1489
Iraq	0.32.	0.29-0.35	0.0123	6218	0.26	0.24-0.28	0.0140	1509
*Jordan	067	0.64-0.69	0.0131	3424	0.27	0.24-0.32	0.0207	980
*Pakistan	0.20	0.17-0.22	0.0119	3935	0.47	0.42-0.49	0.0201	1147
Qatar	0.34	0.28-0.39	0.0265	799	0.29	0.22-0.37	0.0356	162
Sudan	0.69	0.67-0.71	0.0101	5622	0.55	0.51-0.59	0.0206	1516
State of Palestine	0.41	0.38-0.43	0.0132	2445	0.43	0.39-0.48	0.0214	668
Tunisia	0.32	0.28-0.36	0.0161	1230	0.14	0.11-0.16	0.0118	299
*Turkey	0.65	0.62-0.67	0.0142	3326	0.30	0.25-0.35	0.0251	300
*Yemen	0.53	0.51-0.52	0.0105	6110	0.10	0.08-0.12	0.0107	1654

CI: 95% Confidence Interval
SE: Standard Error
(*): Countries with DHS data sets

Table 4. Continuation

Country	PR of continued breastfeeding at one year	95% CI	SE	Number of Children 12-15 Months
Algeria	0.49	0.45-0.53	0.0215	1000
*Afghanistan	0.78	0.73-0.79	0.0151	2524
*Egypt	0.80	0.75-0.81	0.0149	1038
Iraq	0.45	0.39-0.50	0.0282	1103
*Jordan	0.36	0.31-0.43	0.0304	486
*Pakistan	0.70	0.62-0.72	0.0251	769
Qatar	0.65	0.53-0.75	0.0567	152
Sudan	0.89	0.87-0.92	0.0123	1019
State of Palestine	0.50	0.45-0.55	0.0265	472
Tunisia	0.45	0.38-0.53	0.0388	198
*Turkey	0.68	0.65-0.71	0.0137	209
*Yemen	0.71	0.66-0.73	0.0165	1299

CI: 95% Confidence Interval
SE: Standard Error
(*): Countries with DHS data sets

4.2 Prevalence of Breastfeeding

The pooled prevalence of EIBF was 42% (95% CI: 33%- 52 %) as presented in the forest plot (Figure 2). For EBF, the overall prevalence estimate was 32% (95% CI: 24%- 41%) (Figure 3). Lastly, the overall pooled prevalence for CBF was found to be 63% (95% CI: 53%- 73 %) (Figure 4). High considerable heterogeneity was observed among EIBF, EBF, and CBF prevalence results of the selected countries (I^2 = 100%, 99%, and 99%), respectively (Figure 2, 3, and 4).

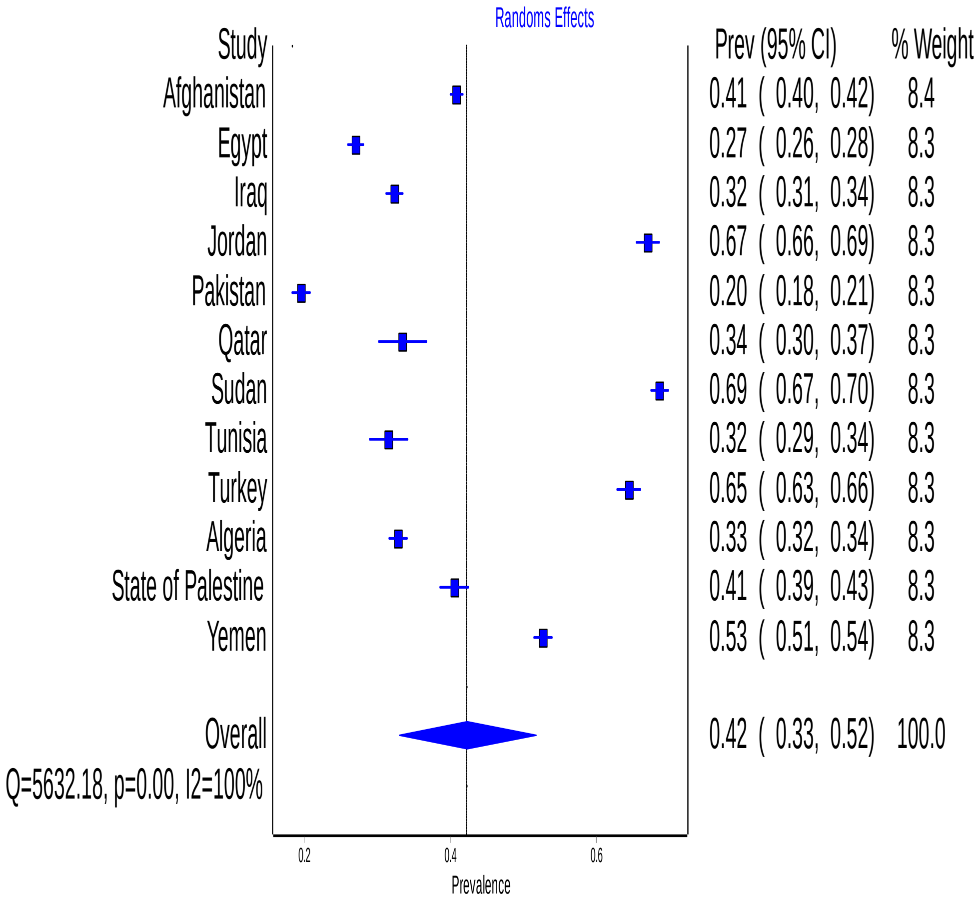

Figure 2. Pooled prevalence of EIBF in 12 MENA countries

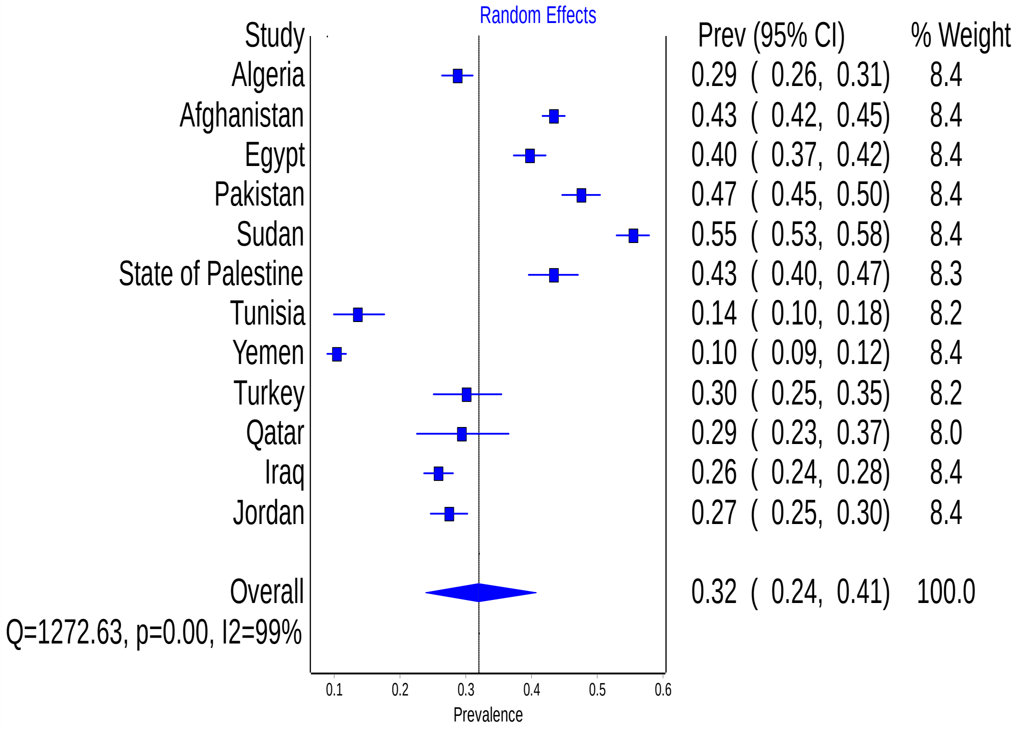

Figure 3. Pooled prevalence of EBF in 12 MENA countries

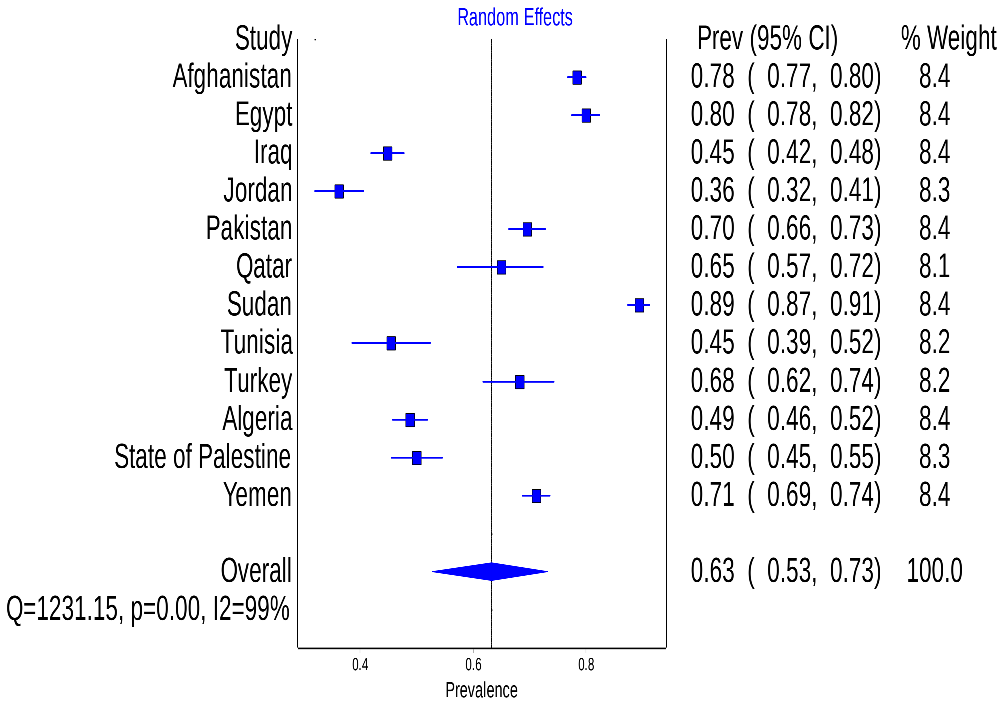

Figure 4. Pooled prevalence of CBF in 12 MENA countries

4.3 Subgroup Analysis

Pooled estimates of EIBF, EBF and CBF by countries' income level, rates of C-sections, and BFHI are shown in Figures 5 to 12.

4.3.1 Income level

The pooled prevalence of EIBF was similar among upper-middle income countries (prevalence 55%; 95% CI: 30%- 79%) and low-income countries (prevalence: 54%; 95% CI: 30%- 71%) (Figure 5). There was considerable heterogeneity in EIBF prevalence across countries of various income groups, (I^2= 100%, 100%, and 99%) (Figure 5).

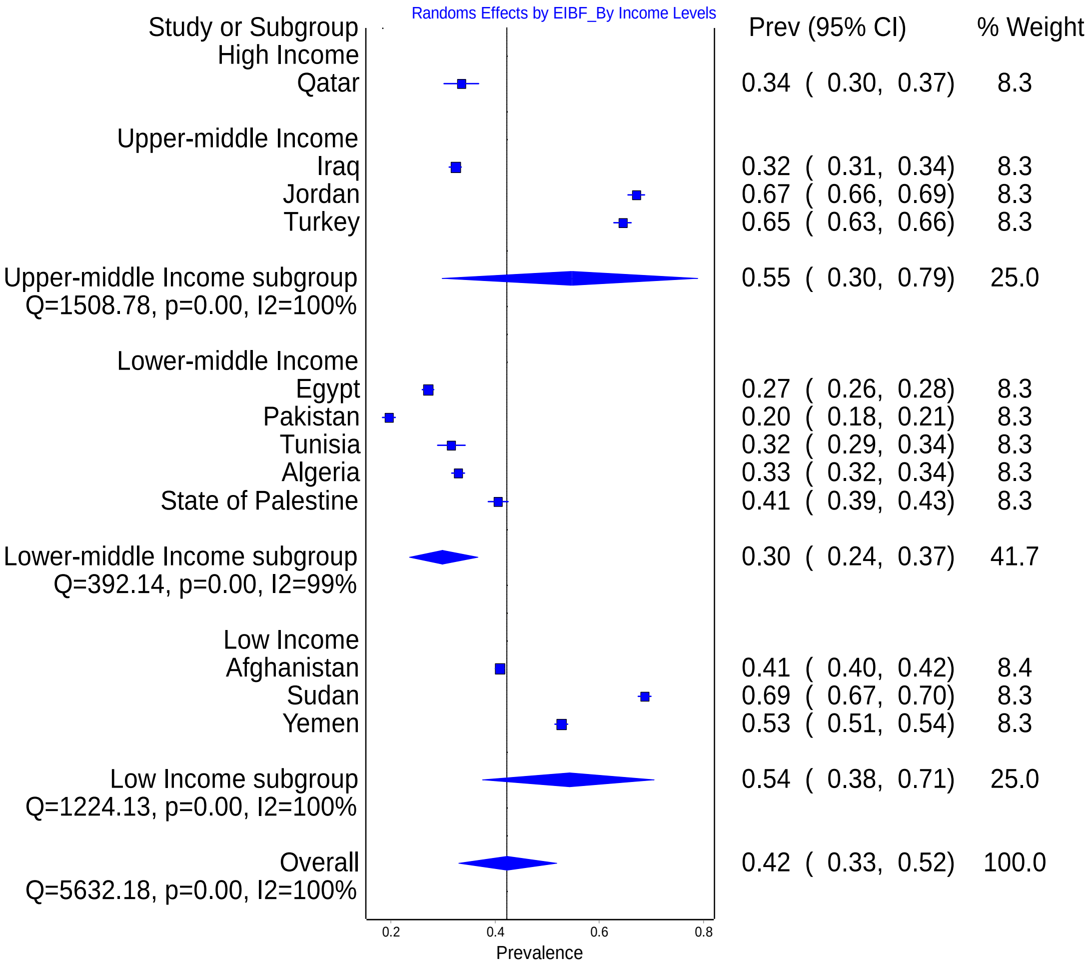

Figure 2. Pooled prevalence of EIBF by income levels in 12 MENA countries

The analysis of EBF indicated that the overall prevalence among LMIC and low-income groups were the same 34% (95% CI: 25%, 24%) and 34% (95% CI: 9%, 63%), respectively. The prevalence was 27% (95% CI: 24%, 28%) among the upper-middle income countries, the Q value=2.62 (p-value= 0.27) and $I^2 = 24\%$ which indicates no heterogeneity among surveys with upper-middle income countries (Figure 6).

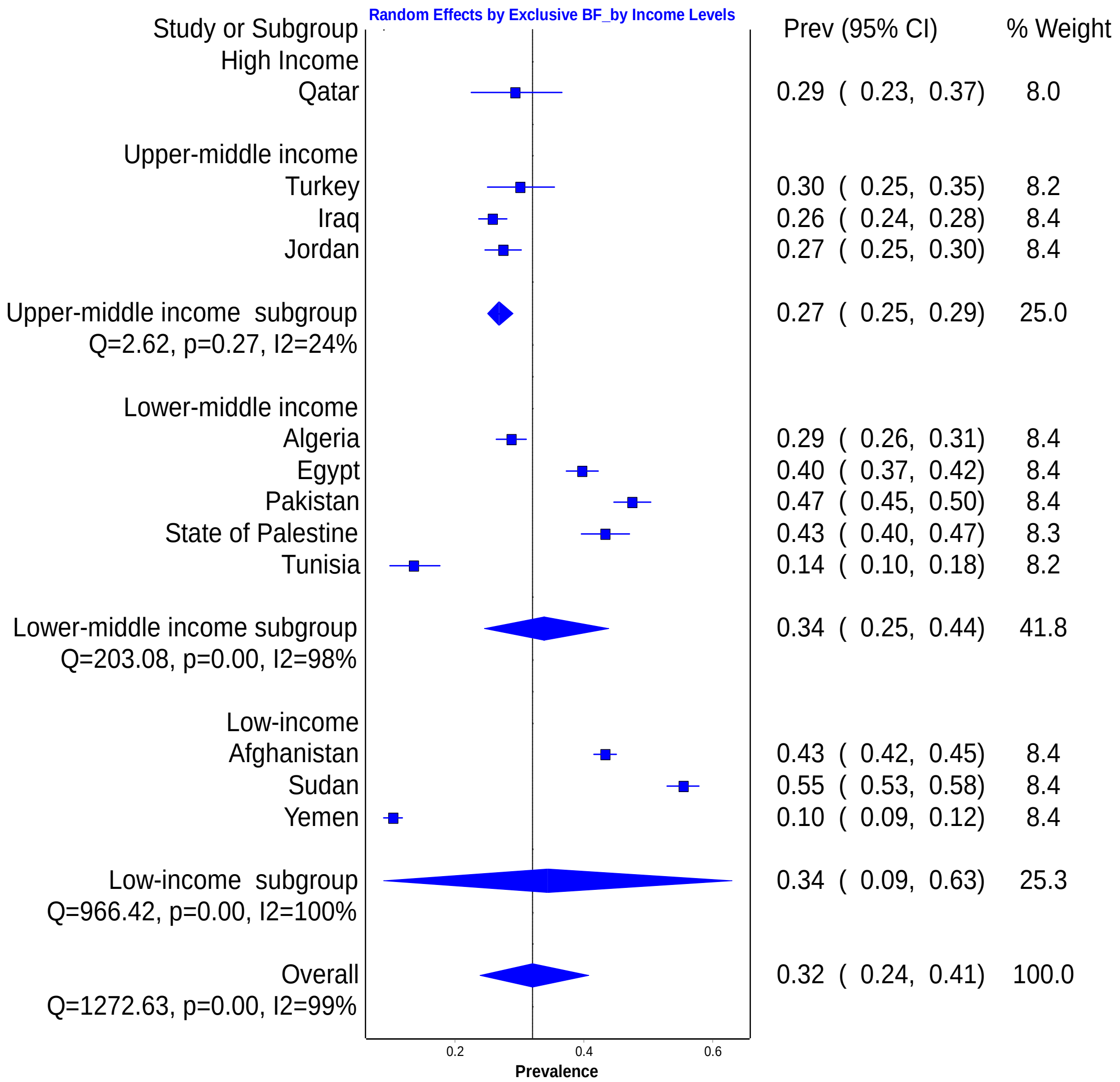

Figure 3. Pooled prevalence of EBF by income levels in 12 MENA countries

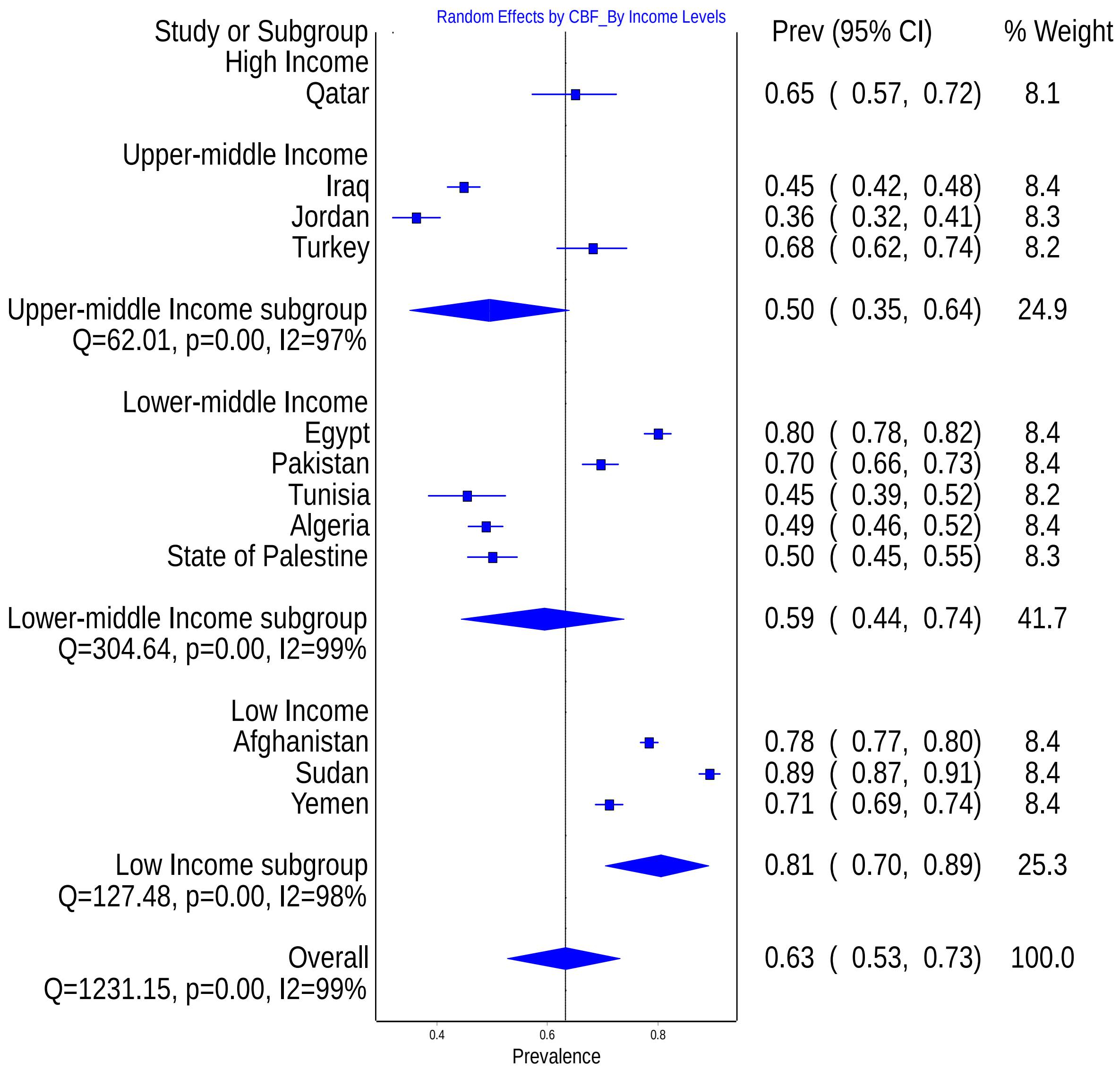

Figure 4. Pooled prevalence of CBF by income levels in 12 MENA countries

As for the CBF indicator using income groupings, it can be seen that low-income countries had the highest prevalence (81%; 95% CI: 70%, 89%) followed by LMICs (prevalence: 59%; 95% CI: 44%, 74%). The lowest prevalence was observed among upper-middle income countries (prevalence: 50%; 95% CI: 35%, 64%) (Figure 7). Based on I^2 values, major heterogeneity was detected in CBF prevalence between countries with different income groups.

4.3.2 Cesarean Section

Findings indicated that the prevalence of EIBF was more than half among countries with C-section rates ≤10% (prevalence: 54%; 95% CI: 38%, 71%) (Figure 8). On the other hand, the overall prevalence of EIBF was lower 38% (95% CI: 28%, 50%) in MENA countries with C-section rates >10% (Figure 8).

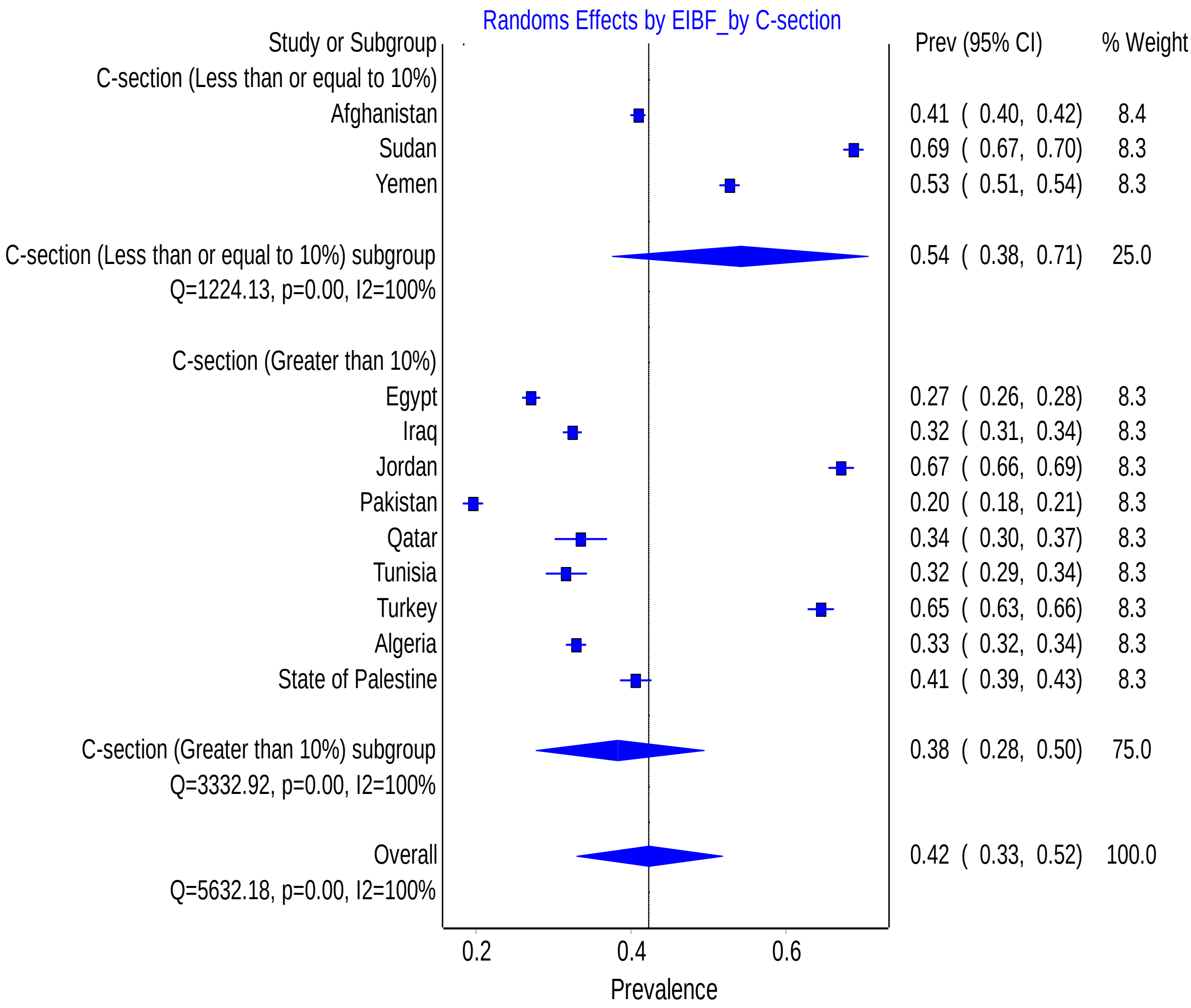

Figure 8. Pooled prevalence of EIBF by C-section rates in 12 MENA countries

The forest plot below shows the pooled prevalence of EBF in selected MENA countries based on two C-section categories (≤10% & >10%). Only 3% difference in the EBF rates for both C-section categories, with the prevalence among countries with C-sections ≤ or >10% being 34% (95% CI: 9%, 63%) and 31% (95% CI: 25%, 38%), respectively (Figure 9).

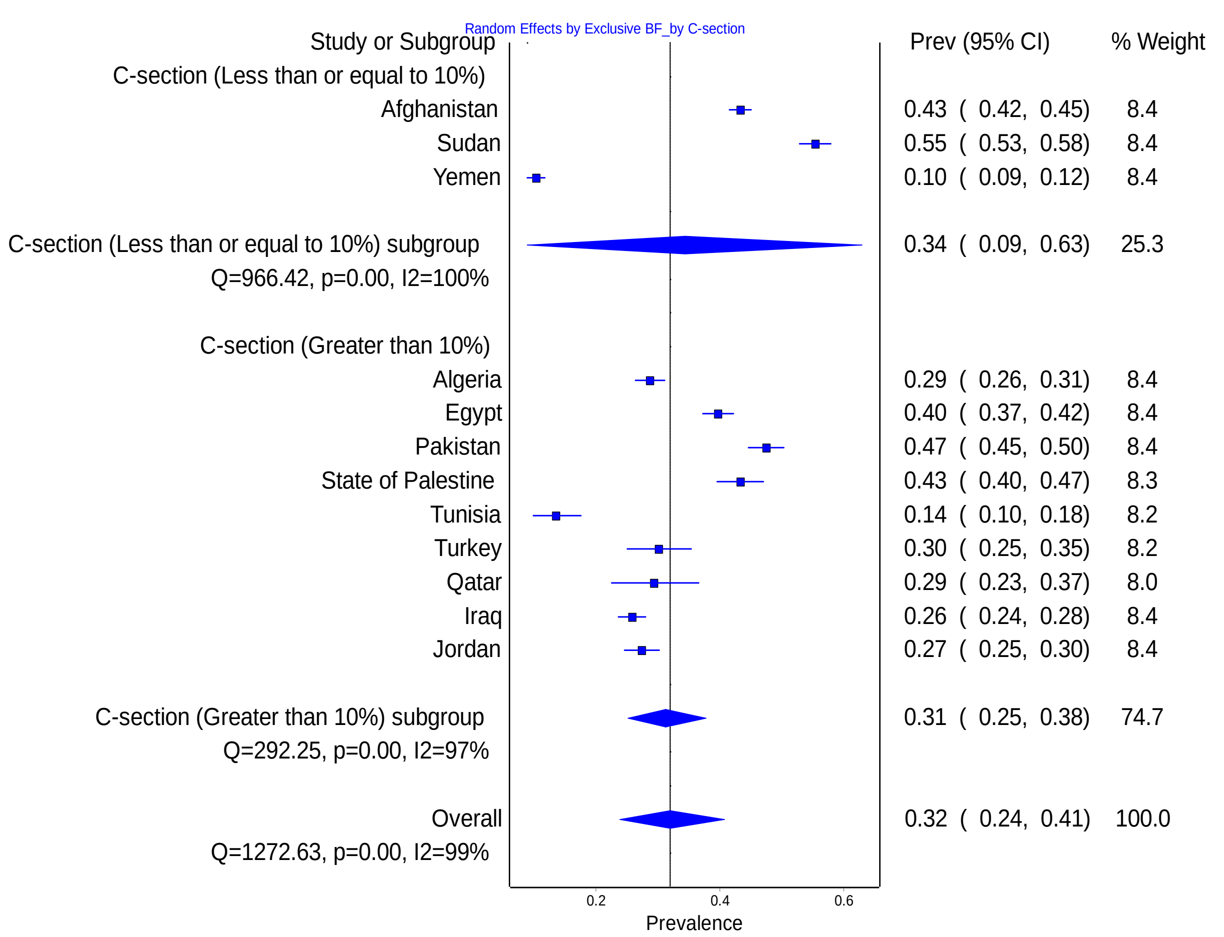

Figure 5. Pooled prevalence of EBF by C-section rates in 12 MENA countries

In contrast, the prevalence of CBF among countries with C-section ≤10% (prevalence: 81%; 95% CI: 70%, 89%) was much higher in comparison to countries with C-sections birth >10% (prevalence: 57%; 95% CI: 46%, 68%) (Figure 10). Considerable heterogeneity was detected in EIBF, EBF, and CBF prevalence between countries with C-sections ≤ and > 10% as I^2 values ranged between 100 and 79%.

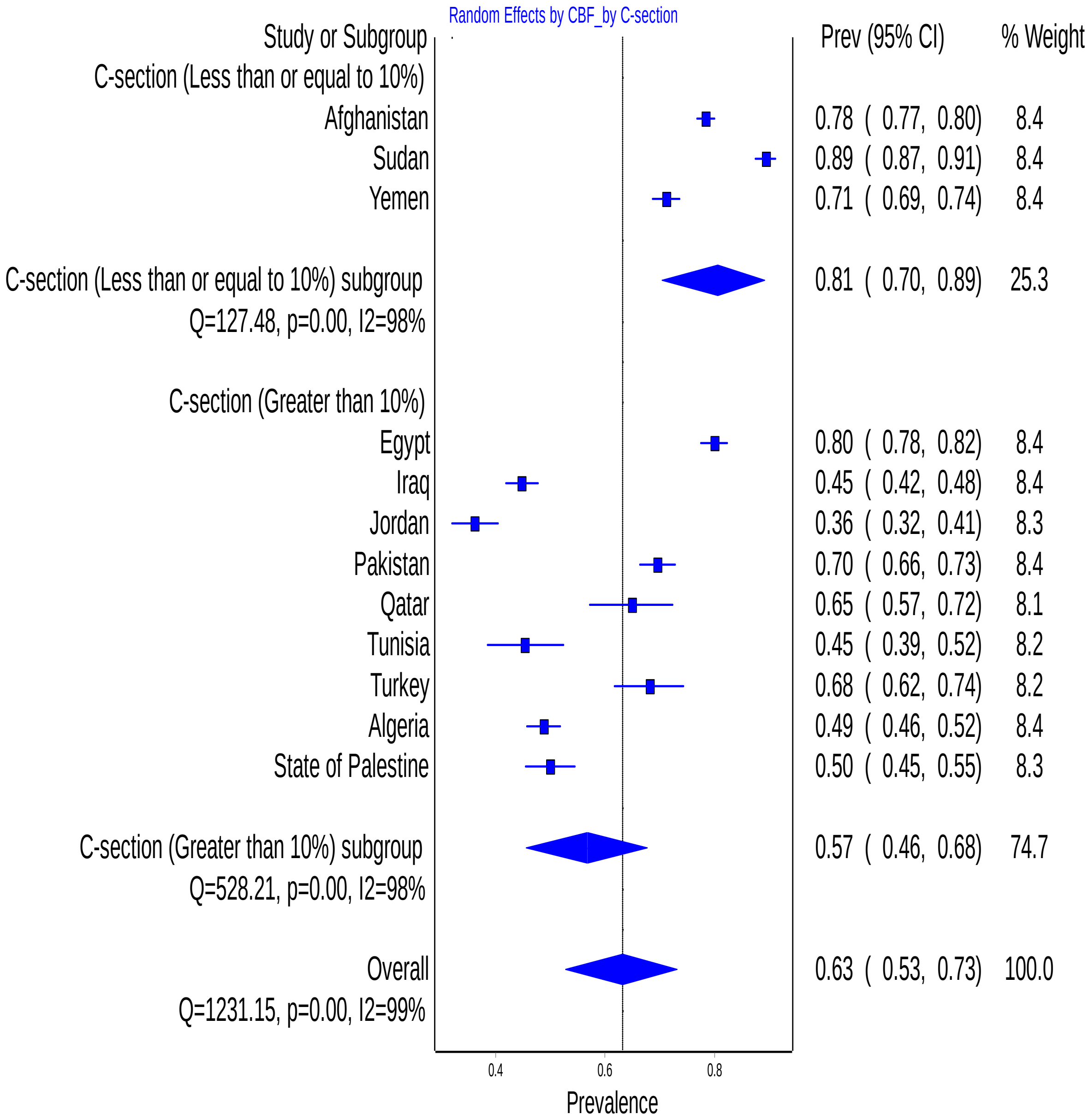

Figure 10. Pooled prevalence of CBF by C-section rates in 12 MENA countries

4.3.3 Baby-Friendly Hospital Initiative (BFHI)

Countries with or without BFHI had similar pooled prevalence of 42% (95 CI: 30%, 55%) and 42% (95 CI: 29%, 55%), respectively, for EIBF (Figure 11). Similar, to previous subgroups heterogeneity is high among both BFHI groups (Figure 11).

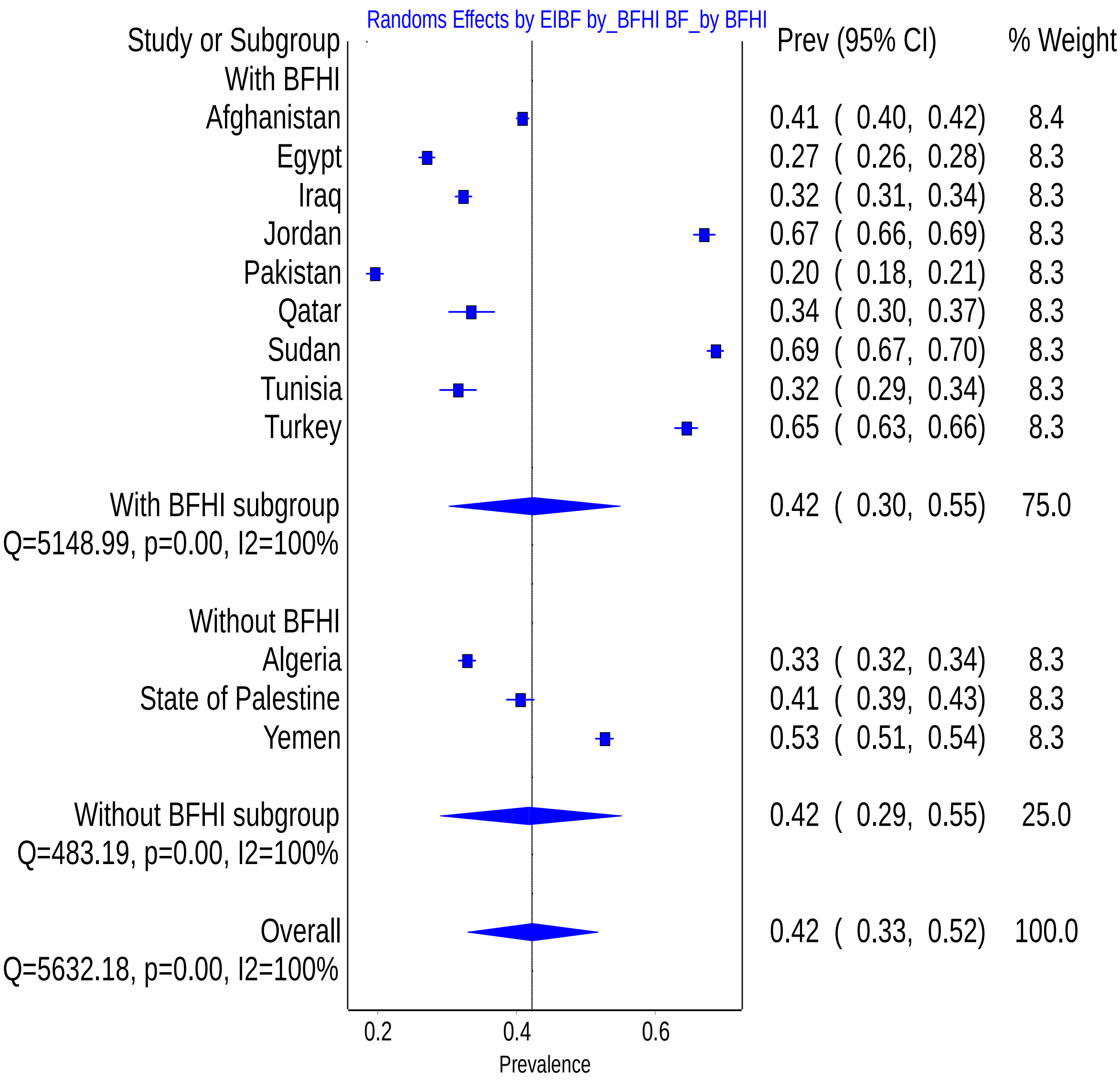

Figure 11. Pooled prevalence of EIBF by BFHI in 12 MENA countries

The prevalence of EBF was somewhat higher in countries with BFHI (Afghanistan, Egypt, Pakistan, Sudan, Tunisia, Turkey, Qatar, Iraq, and Jorden) [34% (95% CI: 27%, 42%)] than in countries without BFHI (Algeria, State of Palestine, and Yemen) (prevalence: 26%; 95% CI: 8%, 47%) (Figure 12). High differences was observed in EBF prevalence with both BFHI groups ($I^2 = 100\%$).

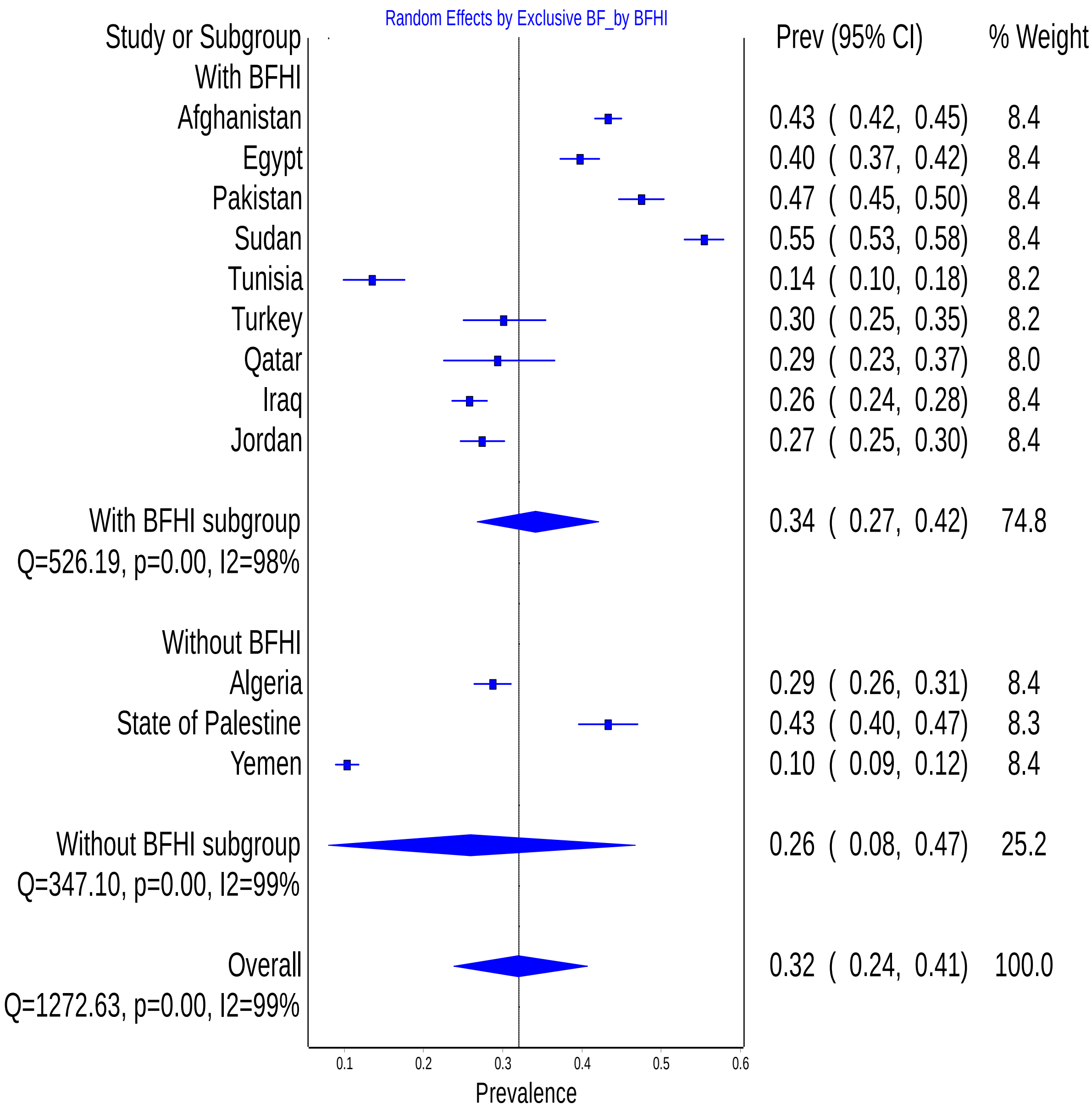

Figure 12. Pooled prevalence of EBF by BFHI in 12 MENA countries

Similarly, the prevalence of CBF was higher among countries where BFHI was available (prevalence: 71%; 95% CI: 55%, 86%) as compared to countries without BFHI (prevalence: 60%; 95% CI: 42%, 77%). Variability in CBF prevalence is still high among countries with and without BFHI (Figure 13).

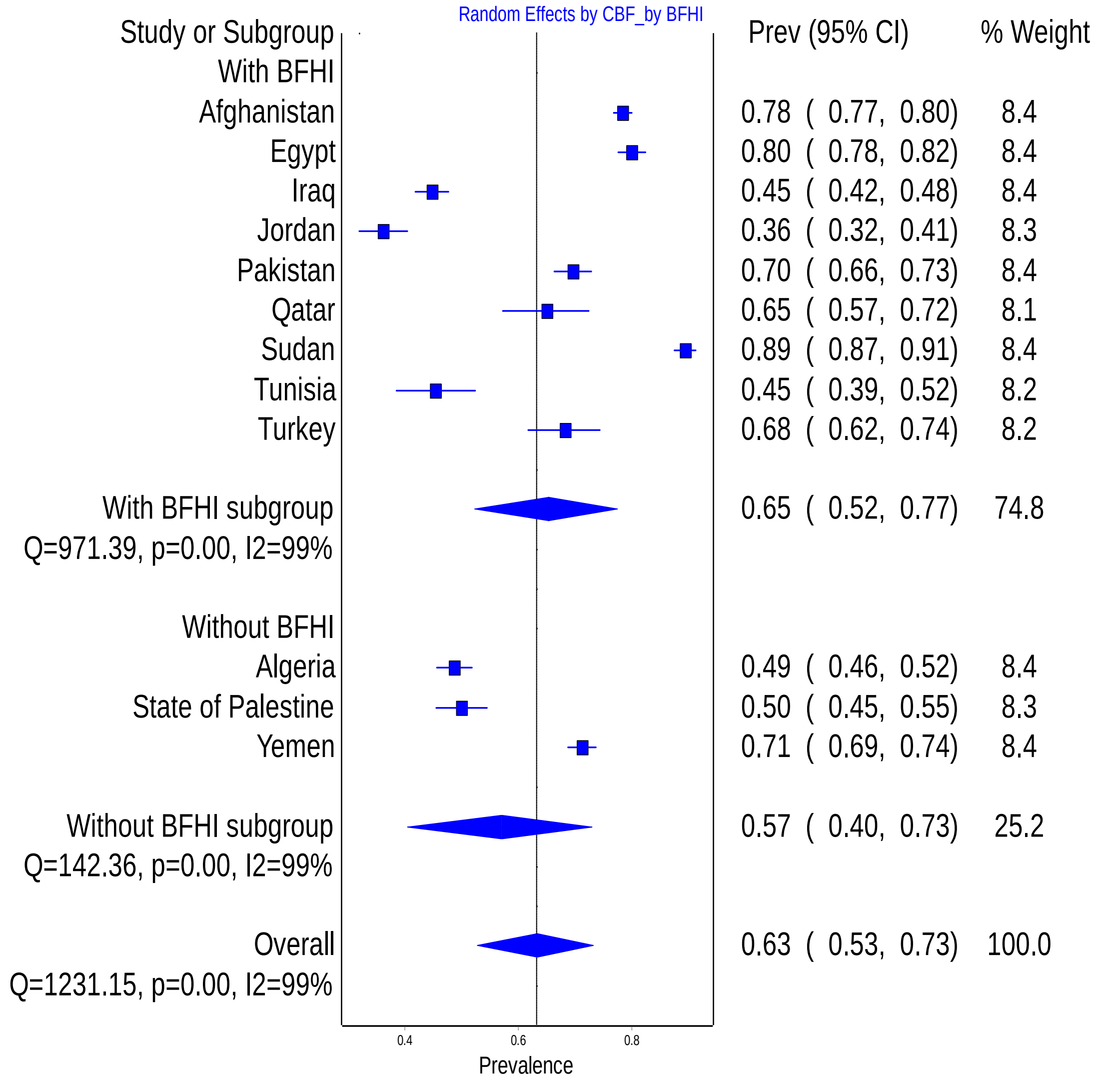

Figure 13. Pooled prevalence of CBF by BFHI in 12 MENA countries

4.4 Additional Subgroup Analysis

Studies were further divided based on survey period and ethnicity (Arab vs non-Arab).

4.4.1 Survey Period

As shown in Figure 14, those countries with somewhat older data (2012-2015) reported a higher prevalence of EIBF, i.e., 48% (95 CI: 34%, 61%) as compared to the countries where data were collected after 2015 (prevalence: 37%; 95 CI: 24%, 50%). Heterogeneity was significantly high among both subgroups, I^2 value of 100%) (Figure 14).

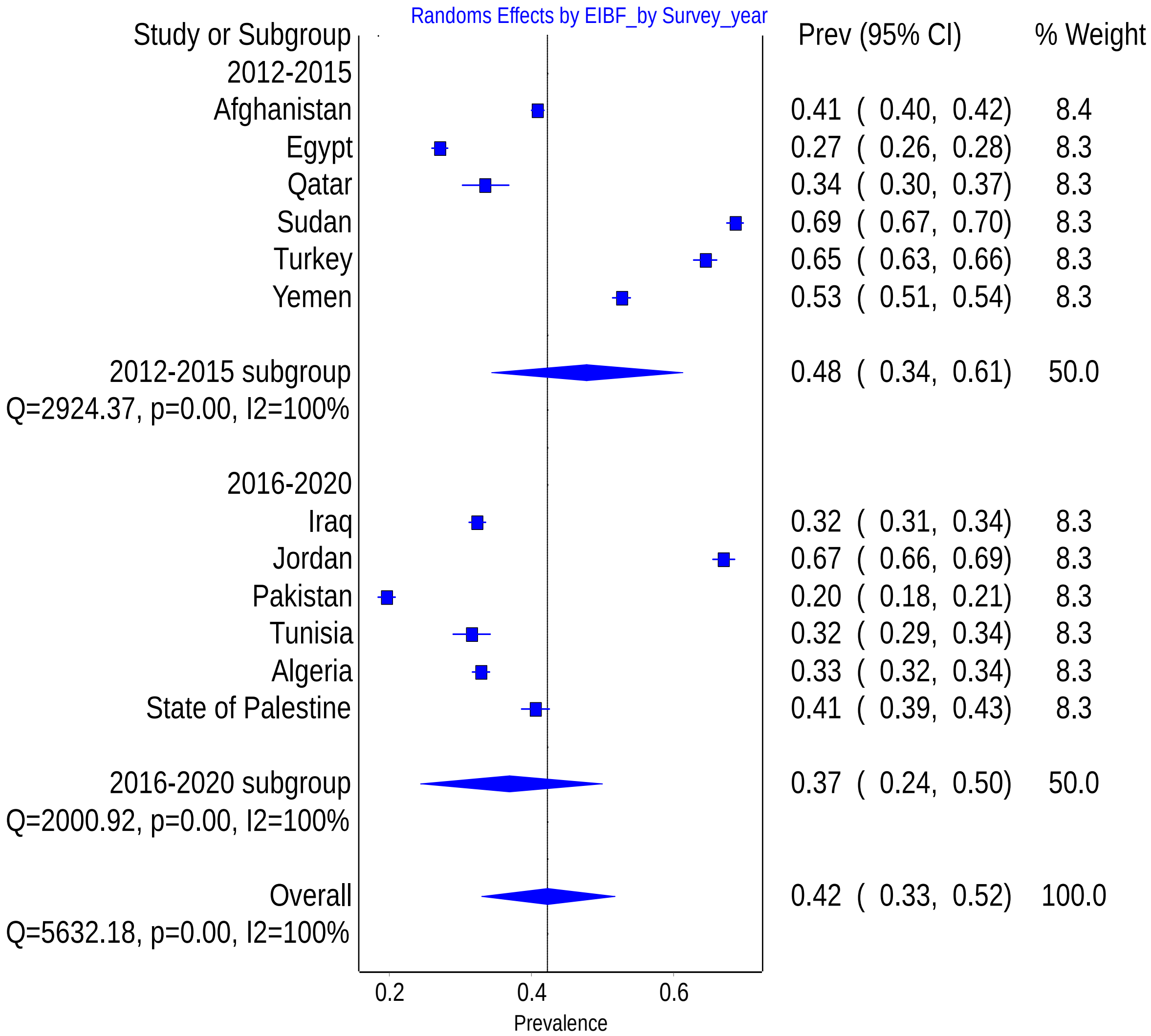

Figure 14. Pooled prevalence of EIBF by survey period in 12 MENA countries

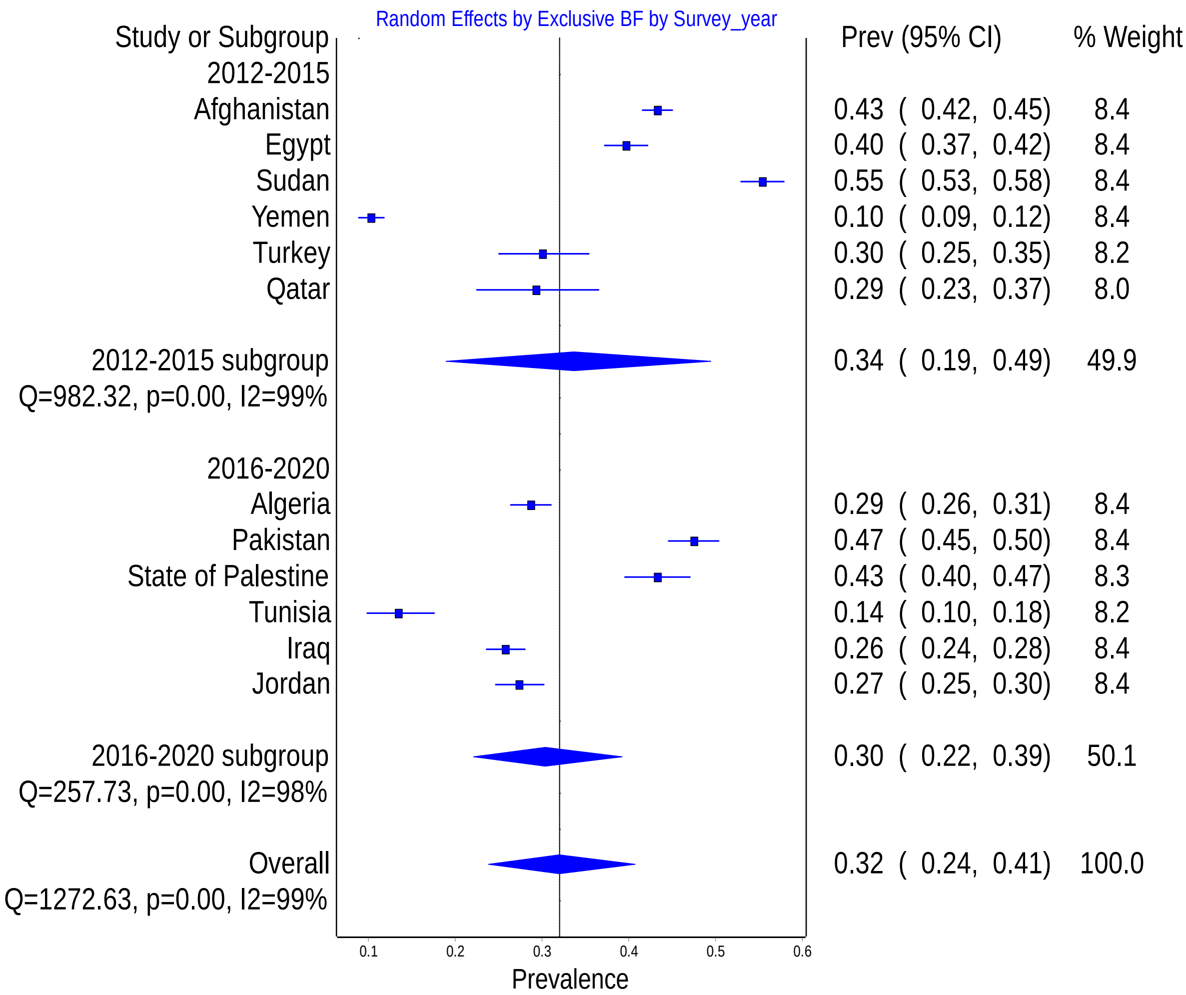

Figure 15. Pooled prevalence of EBF by survey period in 12 MENA countries

Concerning EBF, figure 15 shows that the prevalence was 34% (95% CI: 19%, 49%) for surveys where data were collected between 2012 to 2015 as compared to surveys where data were collected after 2015 (prevalence: 27%, 95% CI: 25%, 30%). The heterogeneity was extremely high in both subgroups with almost similar I^2 value, 99% in the subgroup of 2012-2015 and 98% in data were collected after 2015 (Figure 15).

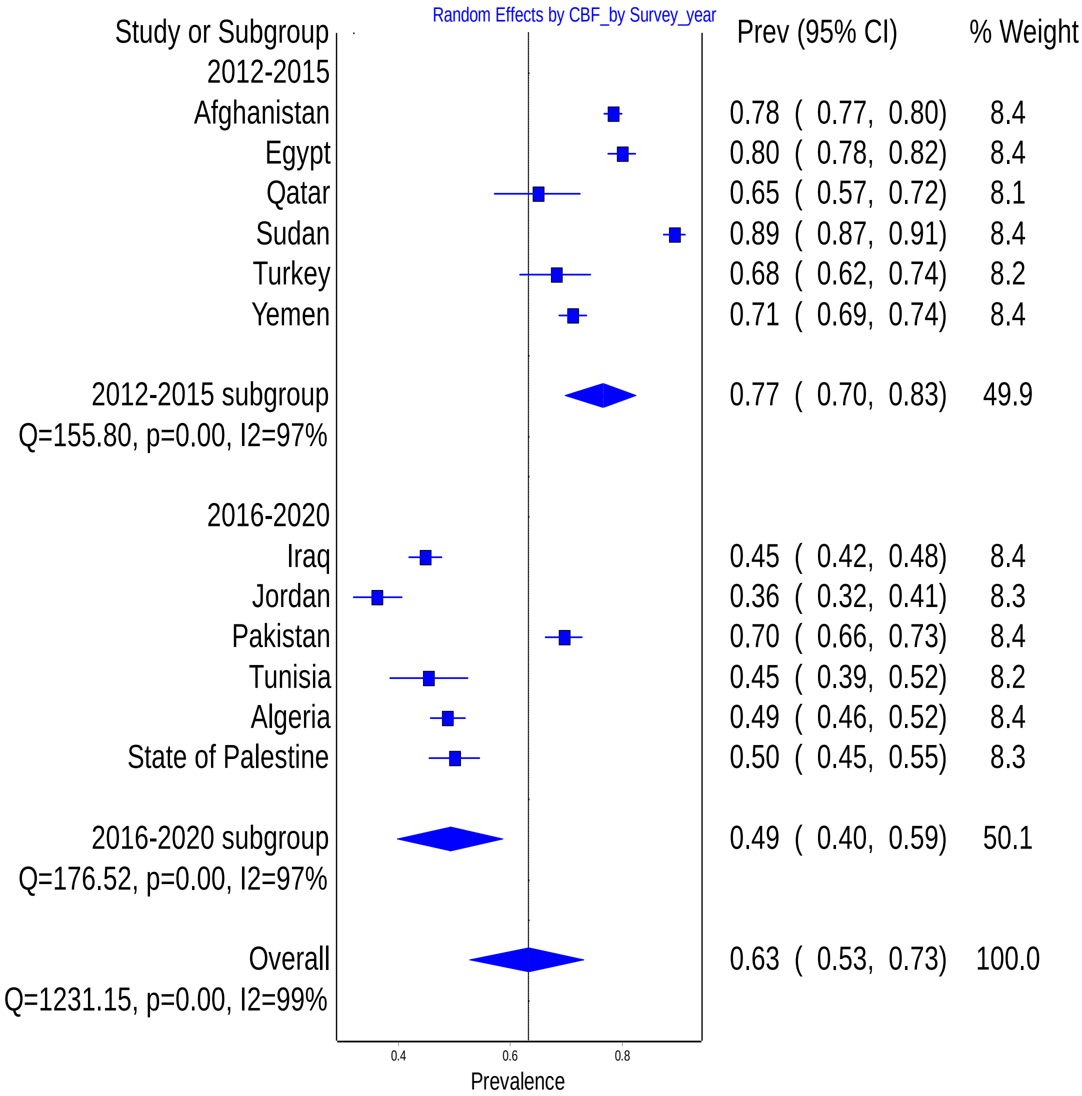

Figure 16. Pooled prevalence of CBF by survey period in 12 MENA countries

Figure 16 shows that the prevalence of CBF was higher among the countries where data were collected between 2012 to 2015 (prevalence: 77%; 95% CI: 70%, 83%), than countries with data collection after 2015 (prevalence: 45%, 95% CI: 39%, 52%). The level of heterogeneity was high in the two subgroups (Figure 16).

4.4.1 Ethnicity

Figure 17 shows that 43% (95% CI: 32%, 54%) of mothers in Arab countries were starting breastfeeding within first hour of infants birth as compared to 41% (95% CI: 19%, 64%) in Non-Arab countries. Heterogeneity was also high among Arab countries and non-Arab countries (Figure 17).

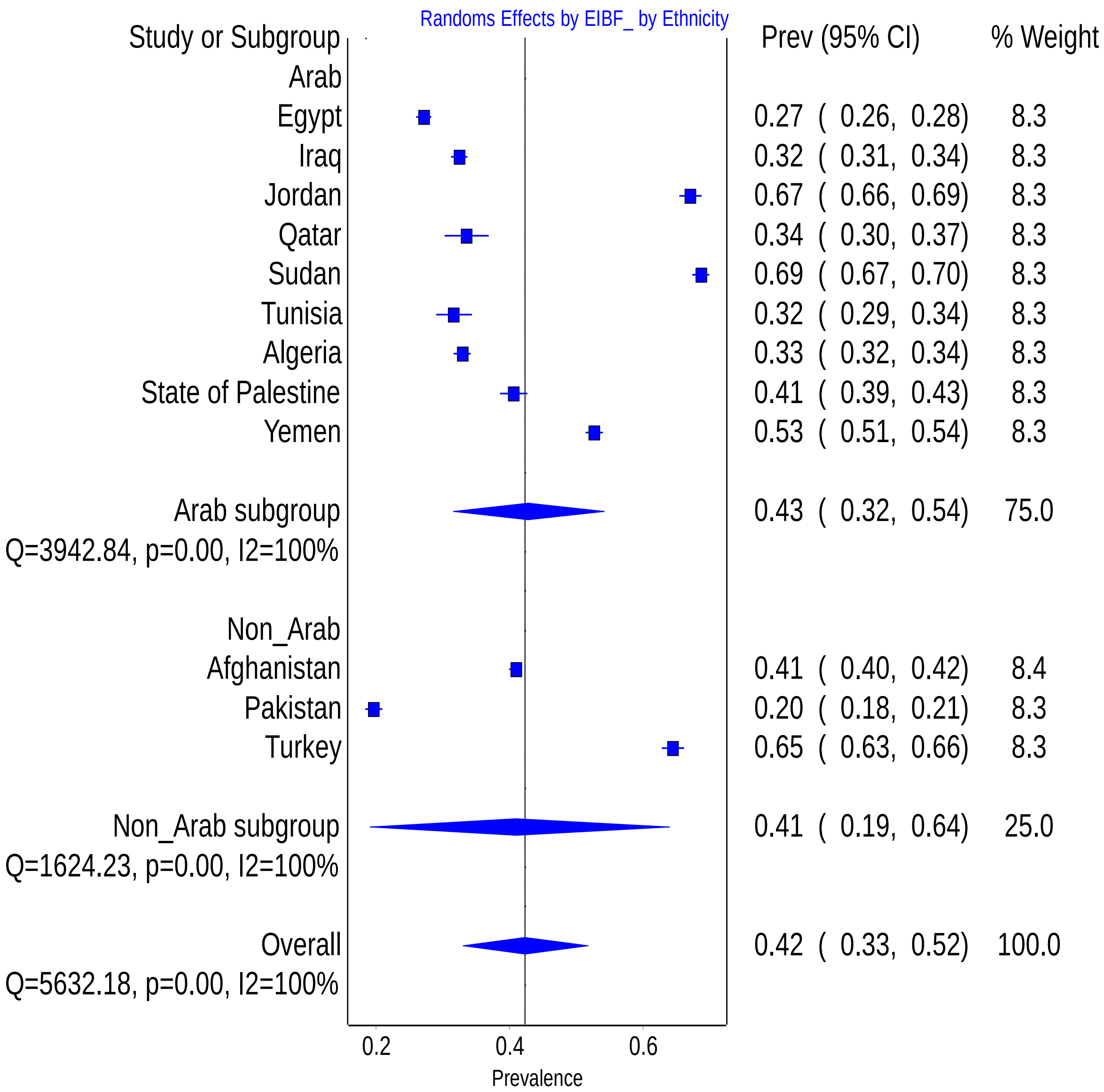

Figure 17. Pooled prevalence of EIBF by ethnicity in 12 MENA countries

Concerning EBF, the prevalence was higher among non-Arab countries (prevalence: 41%, 95% CI: 34%, 48%) as compared to Arab countries (prevalence: 29%; 95% CI: 19%, 40%) (Figure 18). Moreover, a significant heterogeneity was observed among the subgroup of Arab countries with (I^2= 99%) also among the non-Arab countries (I^2 = 93%) (Figure 18).

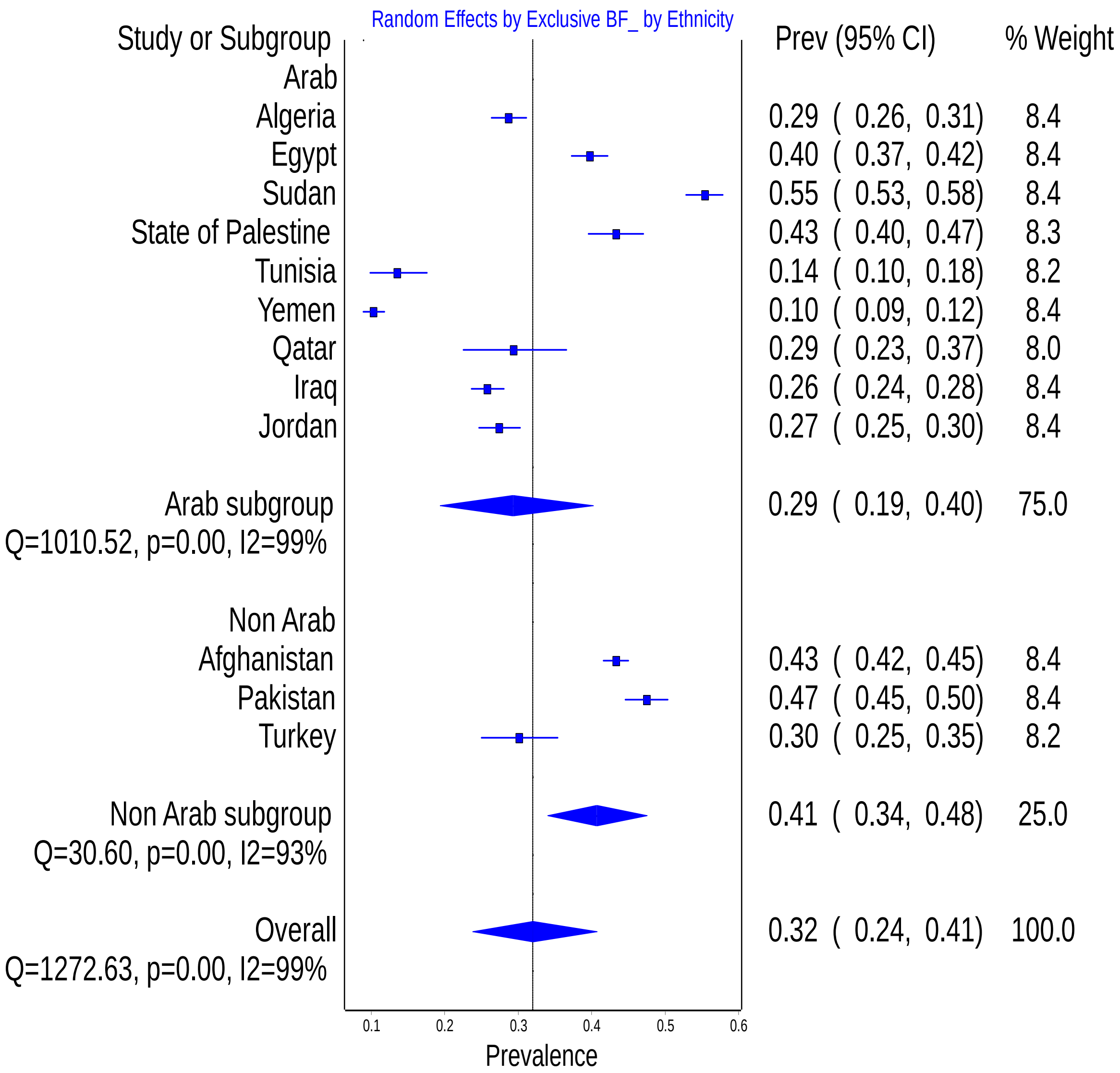

Figure 18. Pooled prevalence of EBF by ethnicity in 12 MENA countries

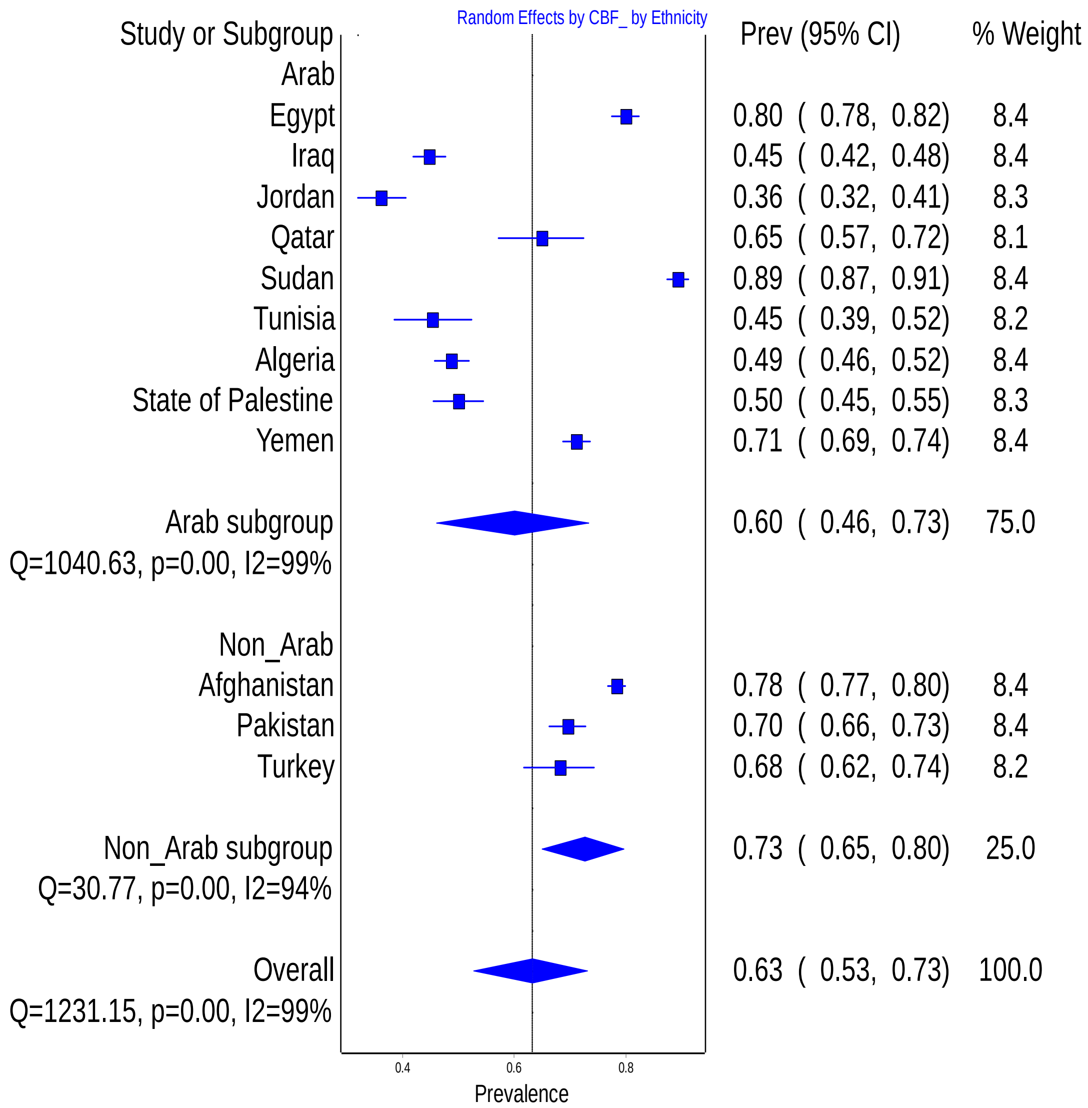

Figure 19. Pooled prevalence of CBF by ethnicity in 12 MENA countries

Similarly, the prevalence of CBF among non-Arab countries was higher (prevalence: 73%; 95% CI: 65%, 80%) as compared to Arab countries (prevalence: 60%, 95% CI: 46%, 73%) (Figure 19). Moreover, similar to previous results of EBF, a high heterogeneity was observed among Arab countries as well as the non-Arab countries (Figure 19).

In short, results from subgroup analysis, indicate that none of the pre-specified variables are important sources of heterogeneity (i.e., the heterogeneity remains very high). Hence, a meta-regression was performed to enable formal statistical testing that supports comparison statements with p-values.

4.5 Univariate and Multivariable Meta-Regression

In building the univariate model, none of the predictors were statistically significant with EIBF and EBF to be included in the full model.

Only the variable *"survey period"* in the multivariable model was associated with statistically significant variability (β= -0.264; p <0.001) in CBF prevalence. The surveys collected after 2015 are associated with a decrease in CBF prevalence by 0.26 as compared to older surveys (2012-2015), holding other variables in the model constant (Table 5).

Table 6. Multivariable meta-regression analysis, random effects (RE) for CBF

Variable	Coefficient	Standard Error	Z-value	95% Lower	95% Upper	P-value
Intercept	0.8671	0.1368	6.34	0.5989	1.1353	0.001
Sample size	0	0	-0.25	-0.0001	0.0001	0.8
Income	-0.0982	0.0546	0.07	-0.2053	0.0087	0.072
C-section	0.0858	0.1376	0.53	-0.1839	0.3557	0.533
Survey period	-0.2641	0.0761	-3.47	-0.4133	-0.1149	0.001*
Ethnicity	-0.065	0.1368	0.33	-0.1959	0.0659	0.33

*: p-value <0.05 is considered significant

Based on I^2 value, 94% of the residual variation is due to heterogeneity, with the other 6% attributable to within-study sampling variability. The model explained 70.5% of the between-study variability in CBF prevalence, and the remaining between-study variance appears small at (Tau^2= 0.0081). The Wald test for all five covariates gives a p-value<0.001, indicating some evidence for an association of at least one of the covariates with the CBF prevalence (Table 6).

Table 7. Residual heterogeneity of the (RE) model

Residual heterogeneity
Tau^2 = 0.0081
I^2= 93.84%
H^2= 16.24
R^2= 70.55%
Wald test = 29.53, df= 5, p-value <0.001

4.6 Sensitivity Analysis

For the purpose of sensitivity analysis, Stata was used to explore a potential outcome using box plots, histogram, spike plot, and extremes test. Afghanistan was one of the countries with an extreme sample size for all included breastfeeding indicators (number of last-born children in the two years preceding the survey=11,539, number of children 0-5 months=3,095, and number of children 12-15 months=2,511). Accordingly, Afghanistan was excluded from the data and pooled prevalence analysis were performed again using the RE model for all three primary outcomes of breastfeeding, i.e. EIBF, EBF, and CBF.

Table 7 shows the prevalence of EIBF after removing Afghanistan was 42% (95% CI: 32%, 54%; Cochran's Q, p =<0.001; I^2 =100%, 95% CI: 32%- 54%), and this does not differ from the original results shown in Figure 2. For the outcome of EBF, a very slight difference in the pooled prevalence was observed after removing Afghanistan (prevalence: 31%; 95% CI: 22%- 41%; Cochran's Q, p =<0.001; I^2 = 99%, 95% CI: 22%- 41%) vs. original analysis (prevalence: 32% - Figure 3). For the CBF, sensitivity analysis indicated that the prevalence was 62% (95% CI: 50%- 73%; Cochran's Q, p =<0.001; I^2 =99%, 95% CI= 50%- 73%), this outcome decreased by

1% only as compared to the original pooled prevalence (Figure 4). Even after excluding the country with outlier sample size, heterogeneity in the overall prevalence of all breastfeeding indicators remains considerable (Table 7).

Table 8. Sensitivity analysis of EIBF, EBF, and CBF

Breastfeeding Indicator	Pooled prevalence	95% CI	Cochran's Q value	Cochran's Q p-value	I^2 value
EIBF	0.42	0.32-0.54	5615.36	<0.001*	100%
EBF	0.31	0.22-0.41	1138.90	<0.001*	99%
CBF	0.62	0.50-0.73	1051.71	<0.001*	99%

CI: 95% Confidence Interval
: Higgin's I^2 value
*: p-value <0.05 is considered significan

CHAPTER 5: DISCUSSION

5.1 Main Findings

This is the first meta-analysis that estimated the overall prevalence of key breastfeeding indicators (EIBF, EBF, and CBF) in the MENA region using 12 national household surveys. It also explored potential factors that may affect breastfeeding prevalence. In this study, the overall estimated prevalence of EIBF was 42% (95% CI: 33%- 52%), the lowest prevalence was observed for EBF 32% (95% CI: 24%- 41%), and CBF had the highest prevalence at 63% (95% CI: 53%- 73%).

Most countries reported EIBF prevalence rates of less than 50%.; only four countries (Jordan, Sudan, Turkey, and Yemen) reported prevalence rates above 50%. Despite the benefits of EIBF for child health and survival, this practice is still considered low in the MENA region. Most infant mortality issues occur during the neonatal period, particularly in the first week, making an infant highly vulnerable in the first 7 days of life (85). Thus, EIBF becomes critical as it prevents or reduces the incidence of infectious diseases and complications of preterm birth and lowers the prevalence of infant death (85). Moreover, mothers who initiate breastfeeding after one hour of delivery are more likely to terminate breastfeeding earlier (18).

EBF was strongly associated with increasing child survival rates while lowering the risk of infectious diseases (18). The breastfeeding data in the 21st century report by WHO disclosed that, on average, infants less than 6 months of age who were not breastfed had a 3-4 times higher risk of mortality than infants who received any breast milk (14). Additionally, the risk of infant mortality in LMICs for those who were exclusively breastfed was only 12% compared to those who were not breastfed (14). Thus, a rigorous needs assessment should be conducted to explore the barriers to breastfeeding initiation and continuation practices, followed by the implementation of effective promotion strategies and programs.

WHO created guidelines rating for EIBF and EBF indicators (18). The rating for EIBF was as follows: poor initiation (0 to 29%), fair (30 to 49%), good (50 to 89%), and very good (90 to 100%) (18). The rating percentages of infants 0-5 months exclusively breastfed were categorized as follows: poor rating (0 to11%), fair (12 to 49%), good (50 to 89%), and very good (90 to 100%). Therefore, the present meta-analysis suggests a fair overall prevalence of EIBF and EBF in the 12 MENA countries based on WHO stipulated rates. However, having fair prevalence rates is still unsatisfactory. The EIBF and EBF rates in this meta-analysis were below the global average (EIBF 48% and EBF 44%) (5). Moreover, the prevalence of EIBF and EBF was lower than the WHO target of raising breastfeeding indicators to at least 70% by 2030 (17).

In this meta-analysis, the overall prevalence of EIBF was 10% higher than the MENA prevalence reported by UNICEF in 2020 (34%) (5). This variation could be due to differences in the definition of the MENA region. For instance, UNICEF considered Sudan as part of the Eastern and Southern Africa (ESA) region; however, based on our definition, Sudan is one of the MENA countries. Another possible reason could be the inclusion of EIBF data older than 2010, but in the present study, we only included data after 2010. Similarly, the current EIBF prevalence estimate (42%), while slightly higher than the East Asia and Pacific estimate (38%) (5). The proportion of EIBF in our findings was approximately 8% points higher than results from a review study conducted in 2017 in the Middle East (11). In contrast, the practice of EIBF in this study was considerably lower compared to the prevalence in Eastern Europe and Central Asia, Eastern and Southern Africa, and Latin America and the Caribbean (70%, 64%, and

54%, respectively) (5). Also, the overall prevalence of EIBF in this study was 10% lower than EIBF in a meta-analysis carried out in 29 countries in sub-Saharan Africa (29). The rate of EIBF was 52% (95% CI: 43%, 62%) (29). Furthermore, the percentage of EIBF in our study was slightly lower than the percentages in South Asia (50%) and West and Central Africa (46%) (5).

It is crucial to have a profound knowledge of the factors that affect EIBF to understand the variation in the estimates within MENA countries and between world regions. Studies found a statistically significant association between maternal employment and EIBF (20, 36, 86, 87). Another possible factor is rooming-in, which was positively associated with EIBF (11). Pre-lacteal feeding was another factor influencing EIBF (20). Planned pregnancy and vaginal delivery were also among factors that affected EIBF [odds ratio (OR=2.02)] and (OR=0.3), respectively (88).

Several additional factors were affecting EIBF rates, like the place of residence, place of delivery, prior breastfeeding history, parents' education level, infant's sex, infant's birth weight, and advertisements for breast milk alternatives, as identified by Alzaheb (2017) (20). These factors should be taken into account while planning for breastfeeding programs in the MENA region to reach the EIBF target rates WHO has set.

A vast amounts of evidence demonstrated that higher levels of EBF resulted in significant protection against common infections during infancy. However, the rates in the MENA region have not substantially increased (14). In the present meta-analysis, EBF was 32%, less than the current World Health Assembly target of 50% by 2025 (14). Even looking into the individual country estimates, it is observed that all countries had a prevalence of 6-month breastfeeding being less than 50%, except for Sudan at 55%.

The pooled estimate of EBF in this research was 32%, which is similar to the MENA percentage in the UNICEF report on EBF (33%) (5). However, both estimates were very low as compared to the WHO global rate of achieving 70% of EBF by 2030 (16). Contrary to our findings, rates of EBF in South Asia (57%), Eastern and Southern Africa (55%), and Eastern Europe and Central Asia (41%) were substantially higher than rates in the MENA region (5). On the other hand, in this analysis, the prevalence of EBF was higher than the prevalence in North America (26%) (5). In addition, the proportion of EBF in our findings was approximately 12 percentage points higher compared to a review study done in the Middle East (20). The possible reason for the difference between the present study and the review by Alzaheb could be due to variation in the target population. Our study targeted the MENA countries; however, the Alzaheb study targeted only the Middle East. Nine countries were included in their analysis: Qatar, Lebanon, Saudi Arabia, Iran, United Arab Emirates, Turkey, Syria, Egypt, and Kuwait. Another reason may be the sample size of the included studies; the sample size used in the Middle East review was smaller compared to our sample size.

It is important to explore factors that affect EBF prevalence in MENA countries as well as in comparison to other regions. Many previous studies in the literature identified an association between the level of a mother's education and exclusive breastfeeding practices (20, 88). Also, it was evident that maternal employment influenced EBF rates (20, 36). Another related factor was maternal age, particularly mothers at intermediate ages, as likelihood of EBF was found to be higher among mothers in this age (20) (89-92). Furthermore, mode of delivery affects EBF (20, 87, 93, 94). A number of additional factors were found to impact EBF rates, such as number of children, night feeding, place of residence, breastfeeding initiation, total family income, mother's nationality, maternal birth place, birth weight, infant's age and sex, advice from family members, prelacteal feeding, planned pregnancy, rooming-in, past breastfeeding history, antenatal care visits, and lastly maternal smoking status (20).

Our study found that eight countries recorded CBF of more than 50%, which is higher than the overall prevalence (63%). However, this rate is still lower than the WHO target of achieving 80% of CBF by 2030 (17). Similar results were also shown in a recent time-series analysis conducted in 2021 in different regions. The article revealed that CBF in the MENA region showed a baseline rate near to 80% during 2000 with some reduction over time (21). A report on breastfeeding indicators published by UNICEF found that the percentage of CBF in the year 2015 was 71% (95). In general, the present meta-analysis found a similar pattern of CBF rates in MENA countries as compared to the existing continued breastfeeding rates in the literature. The rate was higher in past years, but it has decreased over time.

Research on factors associated with differences in rates of CBF in the MENA region found that prevalence of CBF declined with different levels of maternal education (96). The work environment also impacted prolonged breastfeeding, as employed mothers had higher early breastfeeding cessation than non-employed mothers (32). Also, the variation may be due to several factors such as infant's sex with favoring male infants (37). Mothers' perception that they "did not know how to breastfeed" or "was not making enough milk" were other factors affecting breastfeeding continuation practices (37). Moreover, maternal smoking, early pacifier use, and maternal-infant feeding attitudes probably played a role in different CBF rates (97).

5.2 Reasons of Differences in Breastfeeding Indicators by Region

Breastfeeding indicators varied widely by region, which was related to multifactorial determinants (98). Cultural factors played a role in some regions having disparities between different racial and ethnic groups, resulting in low breastfeeding practices. For example, inequalities exist between black and white infants in LMICs (99). On the other hand, positive breastfeeding trends in other regions were probably due to national efforts and supportive measurements that addressed political, financial, societal, and cultural barriers (98-100). For instance, breastfeeding peer support service (BPSS) was one of the methods that were used in the United Kingdom (UK) to increase breastfeeding initiation and duration (100). Also, policies support women's right to breastfeed in public and allow working mothers to breastfeed by providing basic accommodations for breastfeeding mothers at work (99).

5.3 Study Subgroups

Generally, the pooled prevalence of breastfeeding indicators varied according to income levels, C-section rates, availability of BFHI, ethnicity, and survey period. Heterogeneity remains high, and none of these variables investigate sources of heterogeneity.

In this meta-analysis, the results of subgroup analysis based on income level showed some variations with the highest overall prevalence of EIBF in the upper-middle income group (55%), followed by the low-income group (54%). In comparison, the lowest prevalence was found in LMICs (30%).

Moreover, the highest prevalence of EBF was among lower-middle income and low-income groups with 34% (95% CI: 25%, 44%) and 34% (95% CI: 9%, 63%), respectively. However, the lowest prevalence was reported among the upper-middle income group (27%). For CBF, the highest prevalence was indicated in the low-income group (81%), whereas the lowest prevalence was found in the upper-middle income group (50%). From this information, we generally concluded that the highest prevalence rates for the three breastfeeding indicators were mainly found in countries with low-incomes and LMICs. In contrast, the lowest pooled estimates were found mostly in upper-middle income groups.

Most of the available evidence on breastfeeding and income levels was on a global rather than a regional scale, though comparisons are still valid. According to UNICEF (2018), the percentage of children left without breastfeeding was still high, especially in the world's HICs (101, 102). It was estimated that 21% of babies were not breastfed in HICs compared to only 4% in LMICs (101).

There is a lack of evidence on breastfeeding coverage in MENA countries based on different income groups. Specifically, data about EIBF in most HICs was very minimal, which told us very little about this indicator (101). However, a review study was conducted in HICs from different regions, including the Eastern Mediterranean region, found a noticeable decline in breastfeeding rates in the first months of an infant's life (102). A review study in the Middle East estimated the effect of family income on EBF and found that the total family income was associated with EBF (20). A study conducted in Qatar showed that EBF was significantly lower among mothers with monthly income levels less than 5000 Riyal/month and higher than 20,000 Riyal/month. This finding was statistically significant with a p-value=0.012 (36). Also, among mothers with a monthly income ≥ 20,000 Riyal, only 13.4% of them exclusively breastfed their infants (36).

An analysis by UNICEF looked into CBF and its correlation with income level and found that CBF rates were highest among mothers from the poorest households compared to the richest households (95). As per the wealth quintile in 2015 in the

MENA region, CBF rates were 45% in the richest quintile, while 55% in the poorest quintile (95). Furthermore, the 2017 data from the MENA region found that 20% of children from the richest households continued receiving breast milk, as compared to 31.5% of children from the poorest households (101).

All previous findings on breastfeeding and income levels were consistent with our results. The lowest breastfeeding rates were more prevalent in upper-middle income and HIC groups, while the highest breastfeeding rates were mainly among LMICs and low-income groups (12). In LMICs, CBF was negatively associated with household socioeconomic status (103). On the other hand, the situation is the opposite in HICs where higher levels of mothers' education were positively associated with longer breastfeeding durations (104). This confirmed that the difference in prolonging breastfeeding practices between varying income groups was still the same throughout the years. A considerable gap was seen between high- and low-income countries in terms of breastfeeding practices and continuation. This calls for a solution, particularly in countries with high-income groups. Such solutions could include raising awareness about the importance of breastfeeding from birth through the age of two and establishing legal measures to control the marketing of infant formula and other breast milk alternatives.

Regarding C-section rates and the pooled prevalence of breastfeeding indicators, our subgroup analysis revealed that countries with C-section rates ≤10% had higher breastfeeding rates than countries with C-section rates >10%. However, these results were not statistically significant.

Our results were similar to the Middle East review findings, where a negative association was identified between EIBF and C-section (20). They also found that C-section delivery was considered a risk factor and a barrier that reduces the probability of EIBF (20). Likewise, a statistically significant negative association was found between the mode of delivery, particularly C-section and EBF (20). Furthermore, a very recent scoping review was conducted in the Middle East, stating that C-sections were associated with a lower rate of EIBF and early cessation of EBF as compared to vaginal birth (105).

The current findings were comparable with the following two studies. The first one was a meta-analysis study from recent DHS surveys conducted in sub-Saharan Africa (39). The authors found an inverse association between C-section delivery and EIBF (pooled adjusted prevalence ratio, 0.54 (95% CI 0.48 to 0.60), an almost 46.0% reduction in rates of EIBF after C-section compared with infants born vaginally (39). Also, lower rates of EBF were associated with high rates of C-sections (pooled adjusted prevalence ratio, 0.94 (95% CI 0.88 to 1.01) (39). Another comparable study was done by Takahashi et al. (2017) in 24 countries from three continents: Africa, Latin America, and Asia (106). Overall, EIBF was initiated in 57.6% of neonates. However, it was significantly lower among women who delivered by C-section (adjusted odds ratio; AOR 0.28; 95% CI 0.22–0.37) (106). Generally, our findings on breastfeeding and C-section deliveries were consistent with the previous studies in other regions, as per the research findings mentioned above, at least in terms of descriptive results.

For several reasons, women who underwent C-sections were less likely to breastfeed their infants for several reasons. For example, the surgery reduces a mother's mobility, affecting basic infant needs, including making breastfeeding practices more difficult and uncomfortable (39). In addition, C-sections are linked to a higher risk of maternal infection, uterine hemorrhage, and infant respiratory disorders (107) (108). This leads to poor maternal and infant health status, which could negatively affect breastfeeding practices (107, 109). Accordingly, it is crucial to focus on successful breastfeeding practices for mothers who underwent C-section delivery through providing physical and psychological programs that support mothers to initiate breastfeeding (39). These programs affirms that the infant will receive “colostrum” (the first breast milk) (39). Furthermore, it reduces the need for breast milk substitutes, particularly artificial milk, thereby minimizing newborn mortality (39).

The analysis showed that countries offering BFHI had higher EBF and CBF rates compared with countries without BFHI (34%) and (65%), respectively. Except for EIBF, results showed no difference in the pooled prevalence between countries with and without BFHI (42% for both groups). One potential reason for not seeing a difference could be the absence of integrated ten steps into national quality standards and poor oversight of BFHI steps in some countries. Notably, one of the ten steps for certification as a baby-friendly hospital is helping the mother to initiate breastfeeding within one half-hour of birth (78).

Our findings on breastfeeding and BFHI were somehow contrary to a study conducted in the Eastern Mediterranean Region (EMR) (23). Even with advanced BFHI implementation, EMR countries had a reduction in breastfeeding rates (23). However, countries with low BFHI implementation had low rates of EBF and high rates of CBF (23). The authors stated a higher need for political power and community-based interventions to enhance breastfeeding and strengthen BFHI in the EMR region (23). This indicated the effectiveness and the positive impact of BFHI on breastfeeding practices and continuation.

A comparable narrative systematic review was done to evaluate the effects of BFHI on breastfeeding and infant health outcomes globally and in the US (110). The article showed that BFHI implementation was associated with a higher rate of EIBF

(110). Moreover, adapting the BFHI Ten Steps had a significant positive effect on the prevalence of EBF (110).

5.4 Additional Subgroups

The results of additional subgroup analysis illustrated that countries where the DHS and MICS surveys were implemented between 2012 to 2015 had a higher pooled prevalence of breastfeeding indicators compared to countries where the data were collected after 2015. It may take some time for countries with survey period 2016-2020 (Algeria, Iraq, Jordan, Pakistan, State of Palestine, and Tunisia) to increase the percentage of breastfeeding practices. The possible justification for low breastfeeding rates in countries with recent data is the increase in the percentage of women in the workforce (20). As of 2020, about 47% of all women globally participated in the labor force (111). Also, there was a marked increase in the early introduction of supplemental feeding (112). These reasons may act as barriers to initiating and continuing breastfeeding practices.

One more subgroup analysis was performed based on ethnicity, i.e., Arab vs. non-Arab. For EIBF, the pooled estimate was slightly higher among Arab countries with 43% as compared to 41% in Afghanistan, Pakistan, and Turkey (non-Arab countries). However, EBF and CBF were higher among non-Arab countries with 41% and 73%, respectively, compared to Arab countries (29% and 60%, respectively). This is in line with a descriptive cross-section study among a sample of 90 Arab mothers in the US (27). The majority of participating mothers (87%) disclosed that they breastfed their infants, but with low rates of EBF (15.6%) (27). The study revealed that Muslim communities' religious beliefs and cultural practices support mothers' breastfeeding decisions and attitudes (27). This was stated clearly in the Holy Quran, that "mothers shall breastfeed their children for two whole years for those who desire to complete the appropriate duration of breastfeeding" (37). Thus, the prevalence of Arab mothers who initiate breastfeeding was considered high because it is one of the practices encouraged by Islam (27). On the other hand, the practice of introducing complementary food at the early age of a child's life was widely spread among Arab mothers, reflecting the impact of Arabic culture, norms, and traditions that the mothers acquired from their mothers and grandmothers (36).

In short, EIBF, EBF, and CBF were all recommended by WHO. Breastfeeding is an investment in health, not only a lifestyle decision since it benefits infants, mothers, and the community. There is a high need for improving breastfeeding practices, particularly in the MENA region. Such efforts include breastfeeding education and information through programs that support mothers' knowledge, skills, attitudes, or behaviors about the importance of breastfeeding, especially during the prenatal and intrapartum periods. Moreover, supporting breastfeeding in the workplace could be done by developing corporate policies to support breastfeeding women. Also, it is vital to encourage the establishment of BFHI in countries that did not implement the project and work with countries that have implemented BFHI but have not reached full program implementation yet. It is essential to design a robust internal monitoring system to ensure adherence to the ten steps of BFHI.

5.5 Implications

The current study provides baseline information and addresses a gap in the literature regarding the pooled prevalence of key breastfeeding indicators in the MENA region. Understanding breastfeeding situations in MENA countries will provide robust evidence for global and regional monitoring, and planning health programs that support breastfeeding practices for a full 2-years. Also, increasing breastfeeding rates would reduce treatment costs of common childhood illnesses and save healthcare system budgets. Examining and understanding factors associated with lower breastfeeding prevalence opens gates for new research by exploring possible risk factors more in-depth. Identifying breastfeeding determinants will help design policies and strategies that promote breastfeeding rates until they reach the targets recommended by WHO. This will improve the health and well-being of mothers and their infants since the prevalence of major health issues, including obesity and diabetes, will be reduced.

Regarding disseminating study results, firstly, we are aiming to disseminate this research paper by publishing its findings in national journals. Secondly, the findings showed poor compliance with national breastfeeding recommendations. Hence, we aimed to identify key implications for key stakeholders and policymakers. The knowledge that was gained from this research could be disseminated to implement national public health awareness campaigns on the importance of breastfeeding, which will target the local community. Research showed that implementing BFHI will improve the optimal level of breastfeeding outcomes by following the BFHI's Ten Steps to Successful Breastfeeding. Furthermore, developing clinical guidelines and requiring mandatory reporting of hospital C-section rates, as well as investigating performance against the guidelines. All of these measures will help in reducing unnecessary C-sections.

A variety of strategies can be used in different settings to encourage high rates of breastfeeding indicators (EIBF, EBF, and CBF). Breastfeeding promotion should begin during the prenatal period to build a theoretical base. Transforming the theoretical part into practical support which can take place in the hospital to initiate breastfeeding by facilitating skin-to-skin contact between mothers and infants. Furthermore, mothers should be taught how to express breast milk in order to maintain lactation if they are separated from their babies. Also, healthcare facilities that provide post-natal care and services should support mothers in practicing rooming-in throughout the day and night. On the other hand, exclusive and continued breastfeeding practices will be encouraged by using multifactorial strategies such as creating a physically and emotionally comfortable home environment. Importantly, policies that target nursing mothers should be implemented in the workplace. Providing evidence-based information and local role models for breastfeeding can positively affect community cultural beliefs.

5.6 Study Strength and Limitation

To the best of our knowledge, this is the first meta-analysis that compiles and compares findings from 12 MENA countries on three key breastfeeding indicators. It also, includes the use of a nationally representative large sample size over a long period of time (2010 - 2020). This study analyzed data from two national surveys (MICS and DHS) that were comparable in terms of sampling and survey design, population coverage, and reference period (as it was standardized using the MICS reference period, which is based on births in the 2 years preceding the survey). Also, making use of MICS and DHS helps to ensure high coverage of breastfeeding indicators in the MENA region. Meta-regression was applied to support comparison statements with a statistical testing. Lastly, a sensitivity analysis was also performed to calculate the pooled estimates based on removing countries with extreme prevalence (outliers).

Despite the strengths of our study, it does have a number of limitations. The prevalence of breastfeeding indicators might be overestimated or underestimated because the data were collected from self-reports. In addition, both DHS and MICS used a 24-hour recall period to estimate breastfeeding indicators, which could lead to a considerable overestimation of EBF proportions. Since some children who were receiving other supplementary liquids on an irregular basis may not have received this supplementary the day preceding the survey. Also, in terms of CBF, the age range covered is reflected in the title of the indicator on continued breastfeeding. Due to the age interval, the indicator underestimates the percentage of children who were breastfed at one year.

Although both surveys maintain a high degree of comparability, it is essential to highlight a few differences related to survey designs. The two surveys used different house rosters to determine the eligible individual interviews. For instance, DHS included daily household residents, visitors, and guests who stayed in the house the night preceding the interview. Also, DHS collects data from biological mothers (age 15-49) regardless of whether the child is living in the household. On the other hand, MICS includes usual household members who are not necessarily present in the household at the survey time. Information is collected for all children in the household, including orphans and foster children, even for children with mothers, not 15-49 years. However, this difference has minimal consequences on our results as the sample sizes will not change much.

We faced another limitation during the calculation of the EBF indicator. DHS and MICS included questions on liquids and foods given to the children the previous day. However, these questions were not identical. Even with the same survey type, there were some variations between countries since infant feeding practices were adapted based on a country’s geography, wealth, and culture. The DHS, for example, includes variables such as "gave a child chocolates, sweets, candies, pastries, etc." and "gave a child oil, fats, butter, products made of them." Also, the Palestinian MICS survey had a question about drinking boiled or drenched natural herbs like anise, mint, and chamomile, while this question was not asked in other MICS surveys. Therefore, the accuracy of the EBF indicator is influenced by the range of food groups being questioned and the variation in food groups included in survey questions. This could affect the comparability of the estimates between MICS and DHS.

Further to the previous limitations, sample designs have a large impact on survey data, particularly in the magnitude of the study's specific variances (73). In the case of our study, the surveys were cross-sectional, and the employed sampling procedure was a complex multi-stage stratified cluster sampling design. We re-analyzed the data using SE that considered the complex survey design, accounting for clustering, stratification, and weighting. Applying the simple random sampling formulas in the calculation of SE assumes the binomial variance and does not account for survey design.

Our standard analysis used the simple random sampling formulas to calculate SE, which was also used in several other studies (29, 39, 113). The analysis showed a slight change in some pooled prevalence compared to the overall pooled prevalence using individual estimates and sample sizes (Appendix A, B, and C). Another limitation is that the pooled results were crude (at the ecological level) and were calculated by stratifying countries according to income level, C-section level, availability of BFHI, ethnicity, and survey period. The estimates were not adjusted for potential confounding factors.

Finally, it is quite unlikely that investigating sources of heterogeneity will yield useful results unless a large number of studies or surveys are involved, particularly with performing meta-regression. It is recommended that at least 10 studies be available for each characteristic being modeled. Still, ten studies will be insufficient when covariates are distributed unevenly across studies.

CHAPTER 6: CONCLUSION

This study aimed to estimate the prevalence of key breastfeeding indicators - EIBF, EBF, and CBF - in the MENA region using the statistical approach of meta-analysis because there is a lack of studies that focus on pooling breastfeeding data in this region. The prevalence of these breastfeeding indicators was quantified by income level, mode of delivery (C-section), BFHI, survey period, and ethnicity based on data from DHS and MICS for the period of 2010-2020. The results of this research revealed that in the MENA region, the rate of EIBF was 42%, the rate of EBF was 32%, and the rate of CBF was 63%, which was the highest. Overall, the reported breastfeeding rates among different MENA countries were lower than the current WHO recommendations and far behind the targets for 2030.

The study has also illustrated that breastfeeding practices are likely shaped by various factors. Breastfeeding rates decreased as the income level increased, except for EIBF. Moreover, countries with C-section rates >10% reported a lower prevalence of all three breastfeeding indicators. Similarly, BFHI was among the factors that influenced breastfeeding, such that MENA countries with BFHI had higher rates of EBF and CBF, although the prevalence rates of EIBF were similar irrespective of BFHI availability. Regarding survey period, breastfeeding rates were higher among survey data collected between 2012 to 2015 compared to survey data collected after 2015. In terms of ethnicity, EIBF was the only high indicator among Arab countries as compared to non-Arab countries. In contrast, EBF and CBF were higher among non-Arab mothers than among Arab mothers. None of the studied factors were significantly associated with breastfeeding indicators, except CBF and survey period.

Supported by our results, we recommend more future research in this field to look into temporal changes in breastfeeding proportions and explore factors that impact breastfeeding indicators as well as their possible association with breastfeeding patterns and practices using modelling of individual data. For instance, conducting studies using all national surveys in modelling and adjusting for potential confounders (e.g., looking at the association between breastfeeding and wealth or breastfeeding and mode of delivery). Still, there is a need for effective collaboration efforts between communities, health care systems, health care providers, public health professionals, and other organizations at national, regional, and international levels to support mothers and babies to increase breastfeeding rates. Also, this will help overcome any related challenges that will help to achieve SDGs goals by 2030.

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APPENDIX A: FIGURE 20 – 22

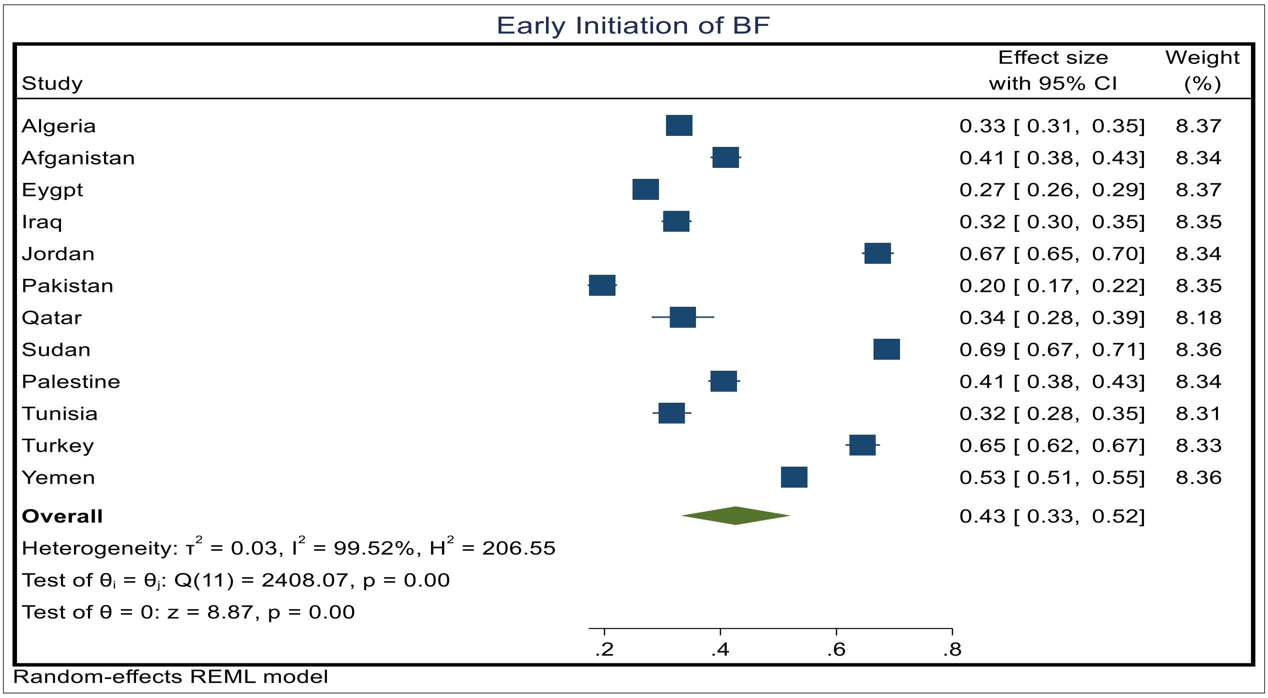

Figure 20. Pooled prevalence of EIBF in 12 MENA using (SE) in Stata

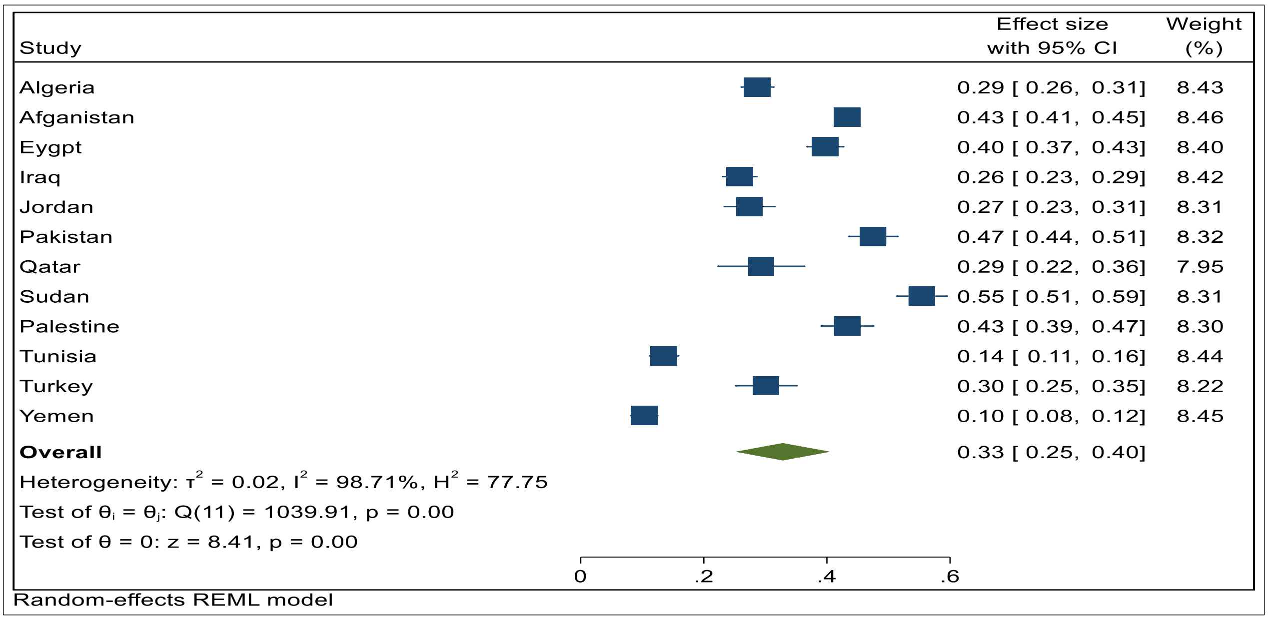

Figure 21. Pooled prevalence of EBF in 12 MENA countries using (SE) in Stata

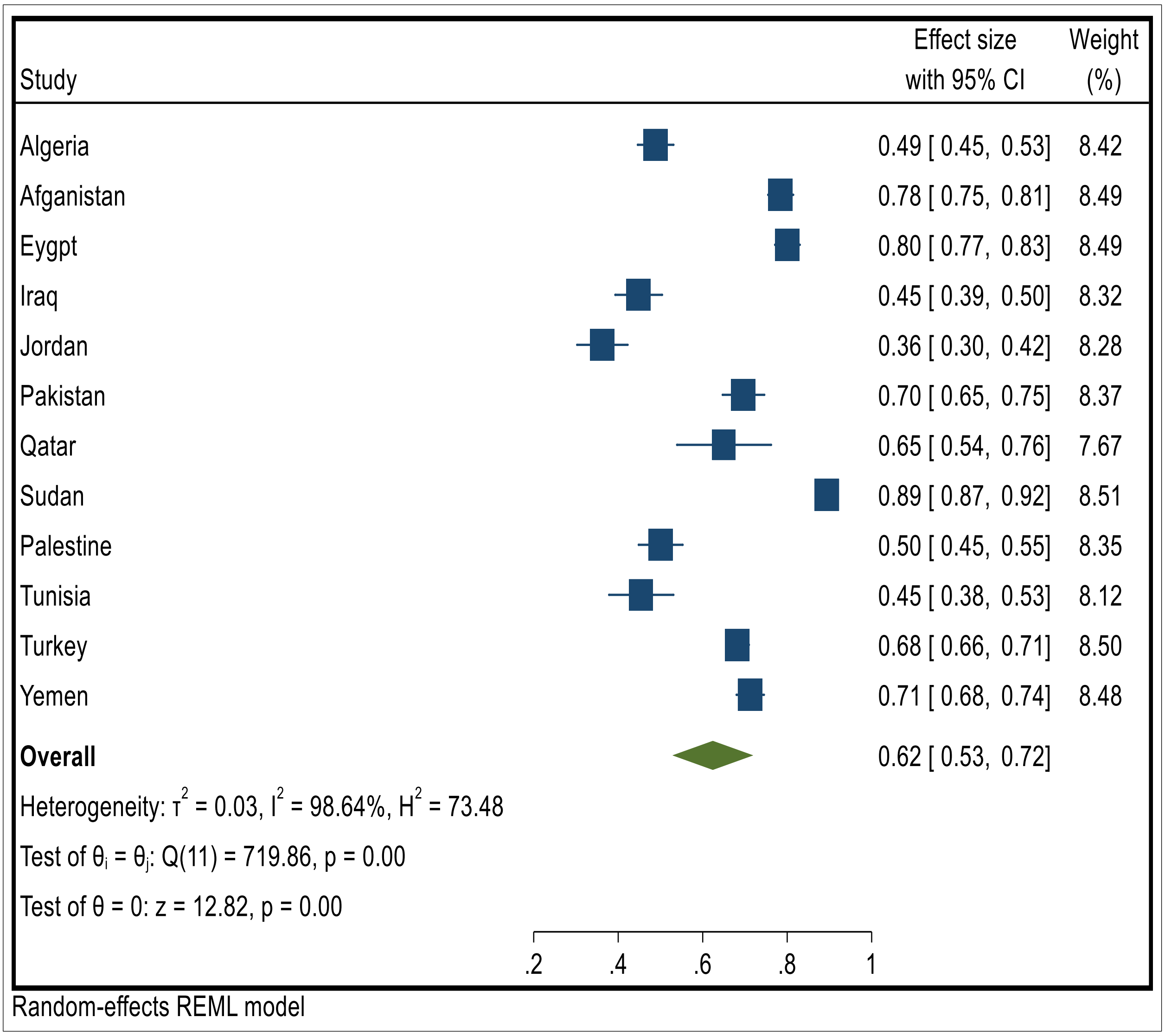

Figure 22. Pooled prevalence of CBF in 12 MENA countries using (SE) in Stata

APPENDIX B: FIGURE 23 – 31

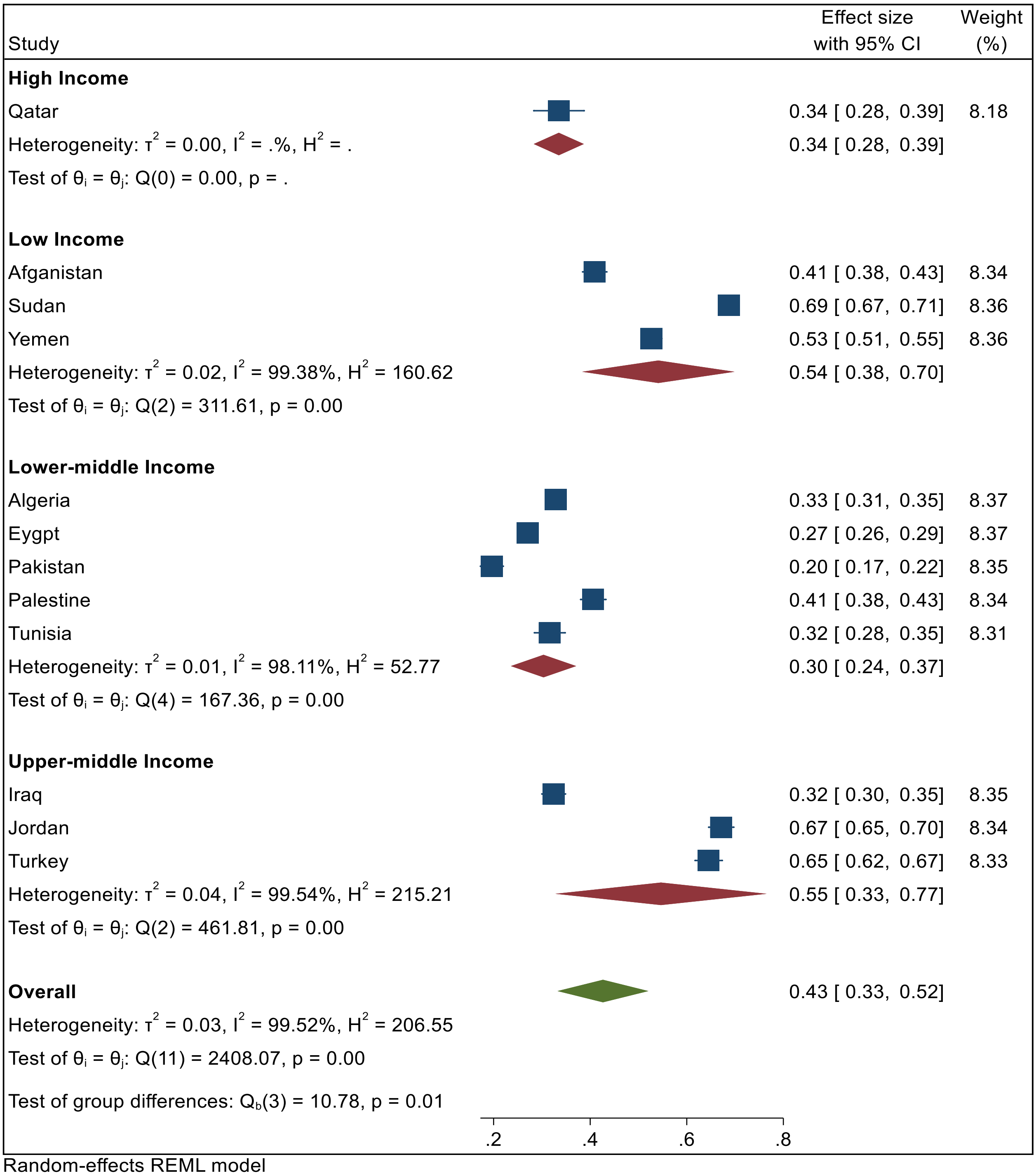

Figure 23. Pooled prevalence of EIBF by income level in 12 MENA countries using (SE) in Stata

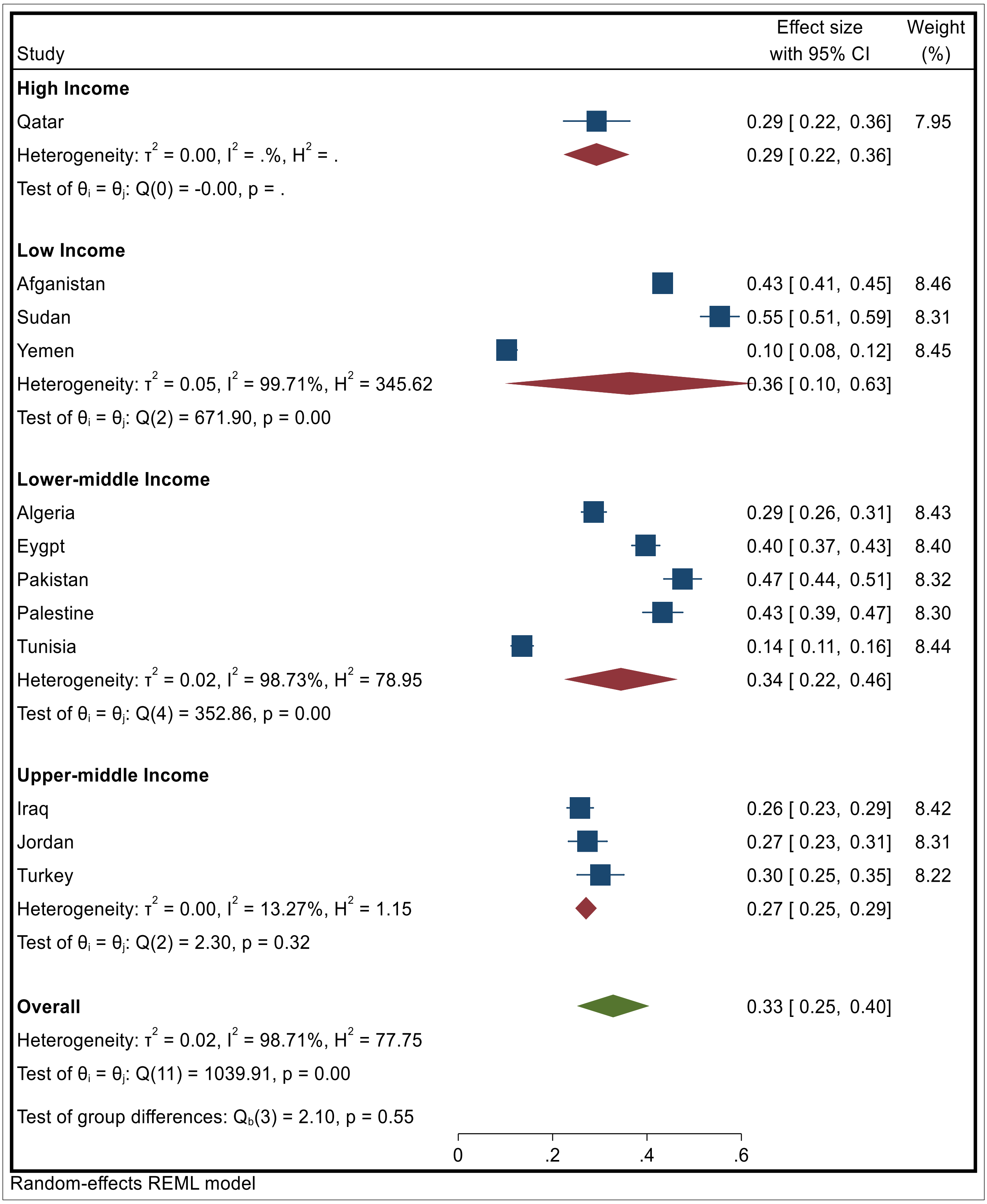

Figure 24. Pooled prevalence of EBF by income level in 12 MENA countries using (SE) in Stata

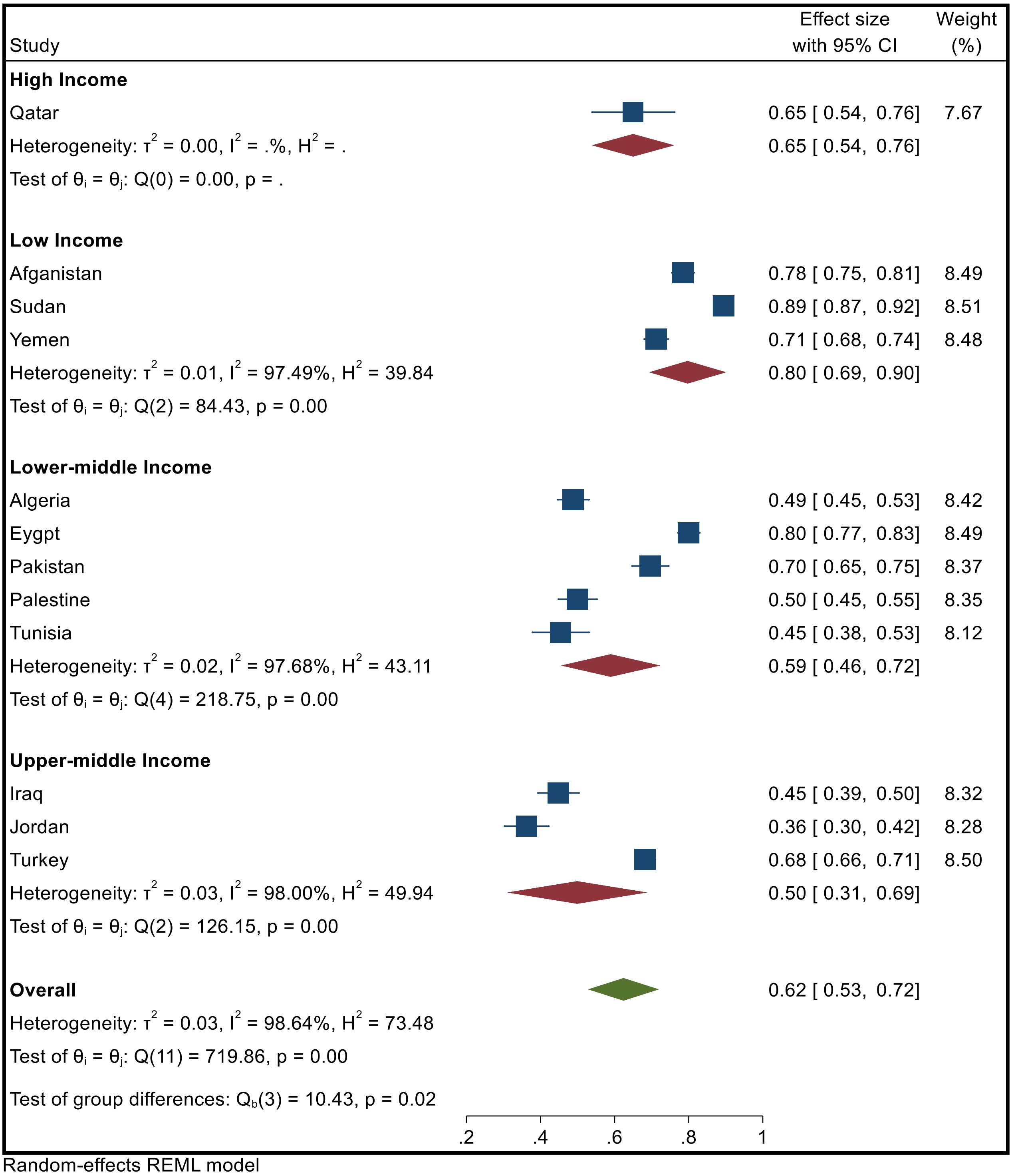

Figure 25. Pooled prevalence of CBF by income level in 12 MENA countries using (SE) in Stata

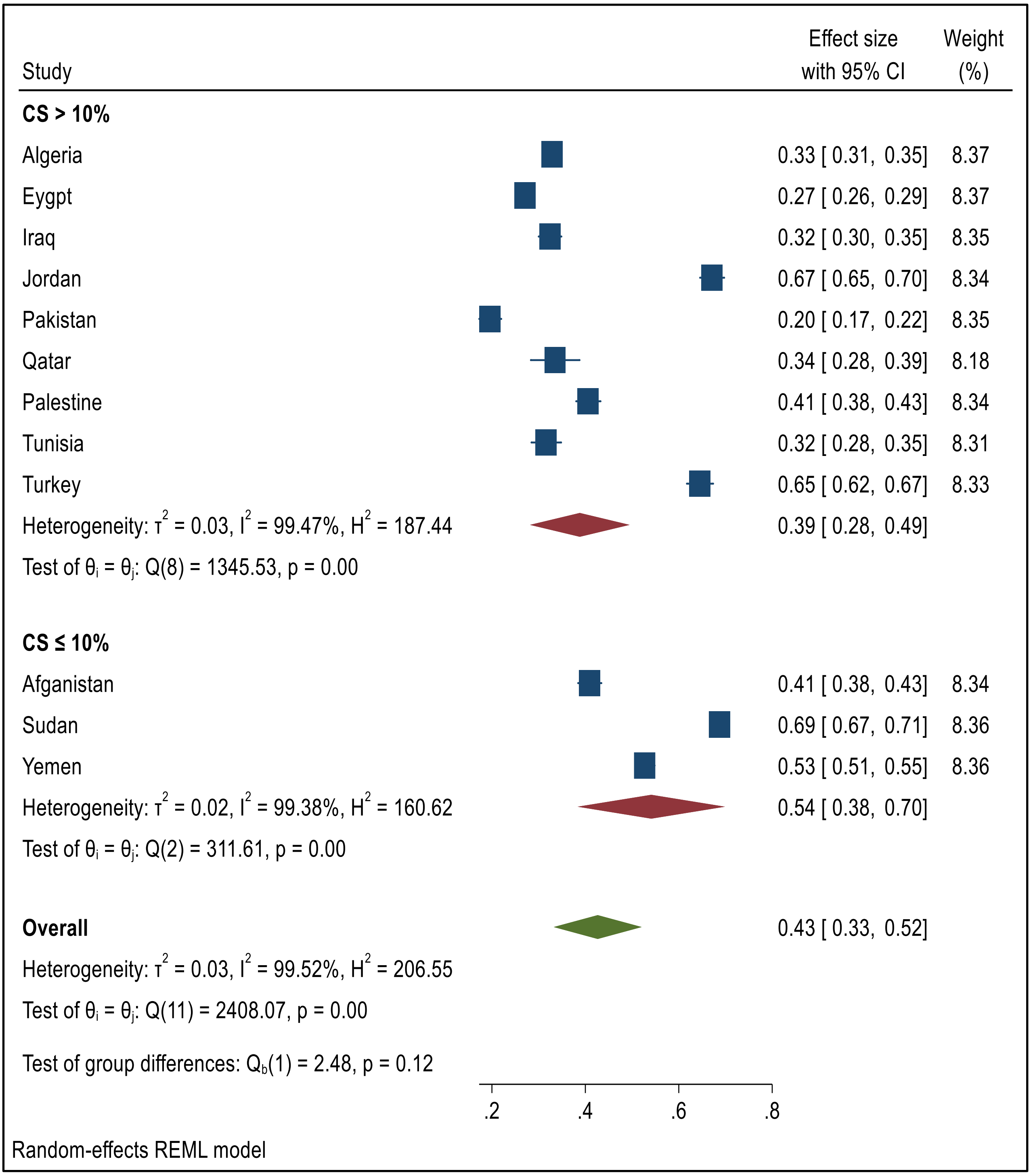

Figure 26. Pooled prevalence of EIBF by C-sections in 12 MENA `countries using (SE) in Stata

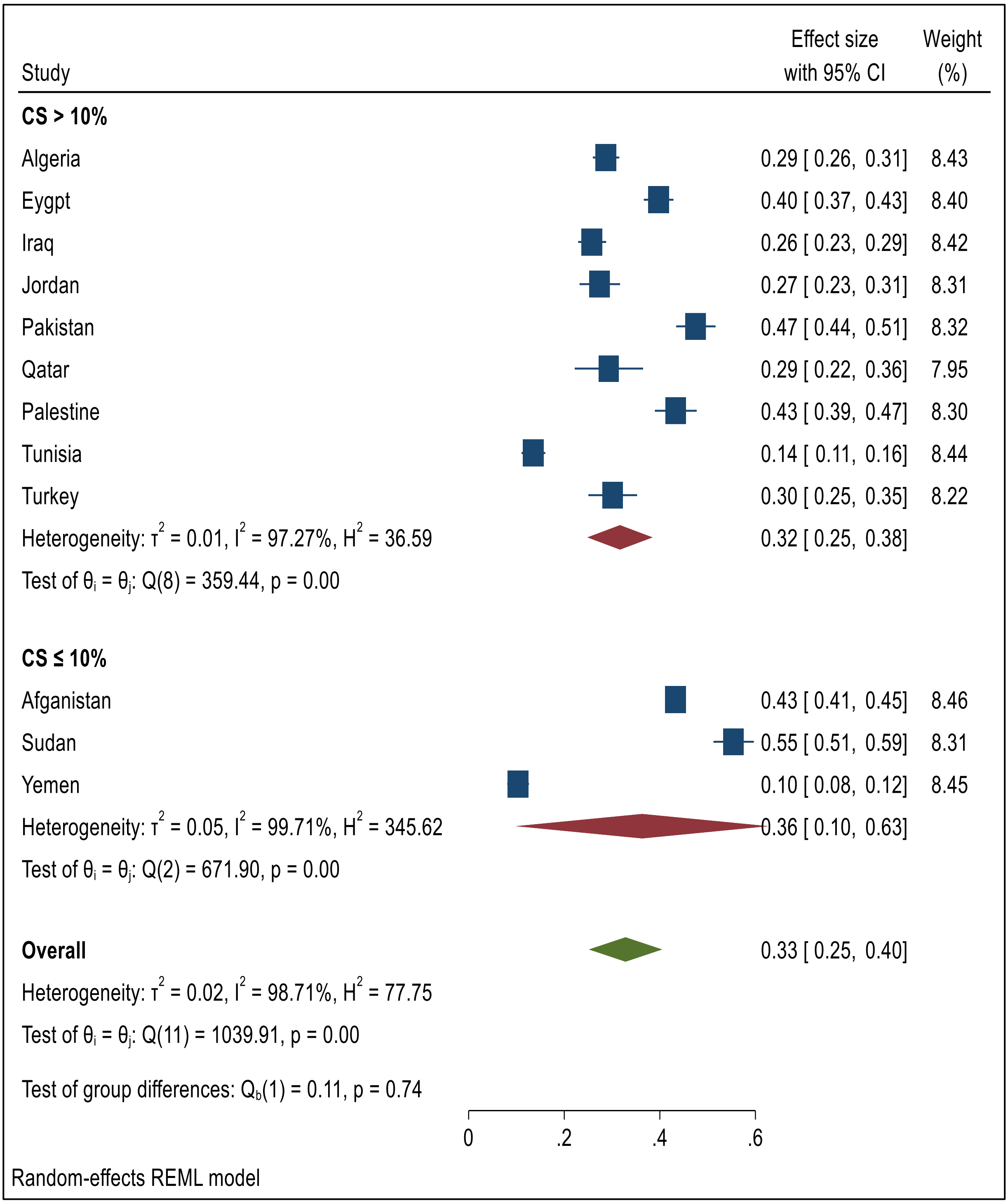

Figure 27. Pooled prevalence of EBF by C-sections in 12 MENA `countries using (SE) in Stata

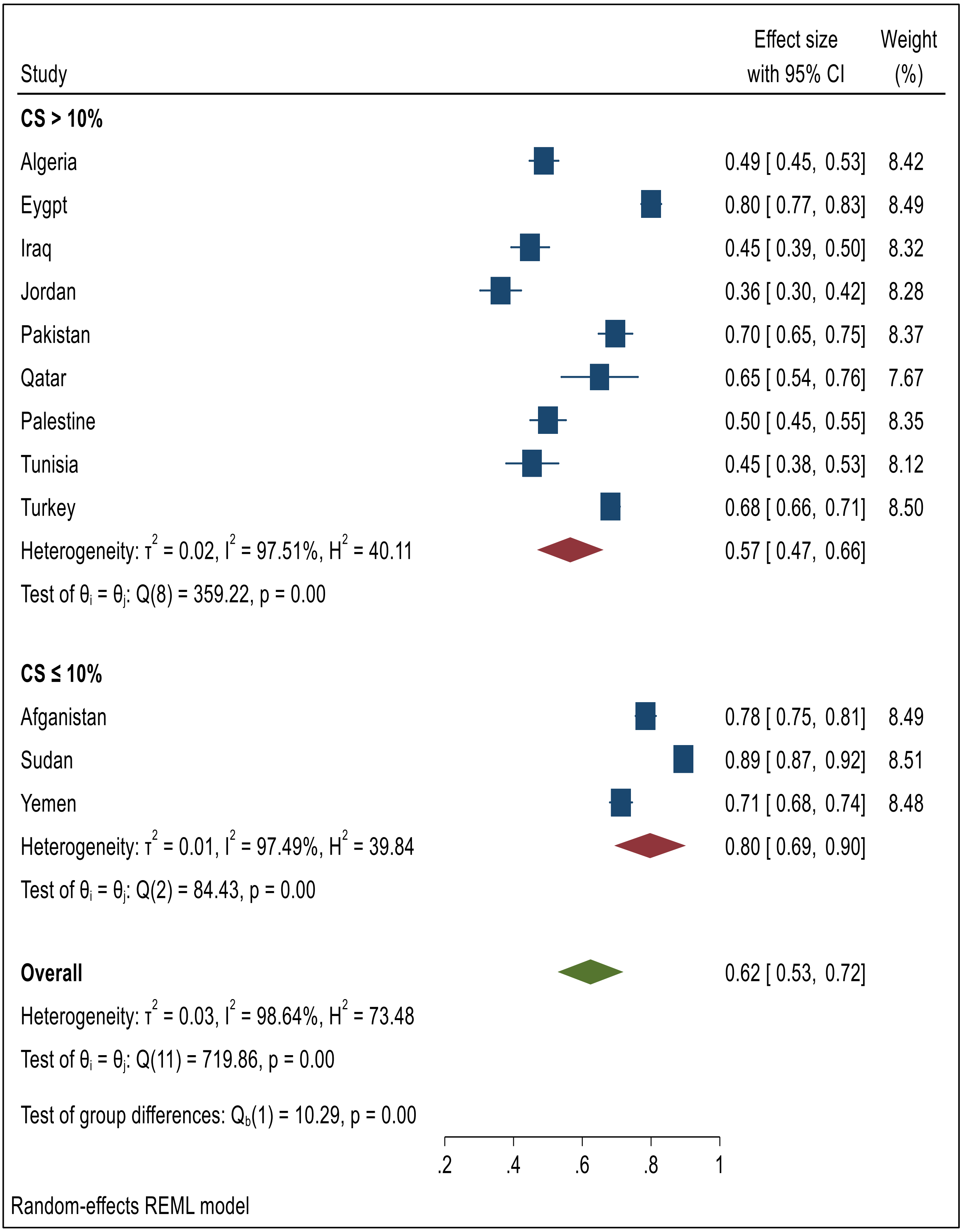

Figure 28. Pooled prevalence of CBF by C-sections in 12 MENA countries using (SE) in Stata

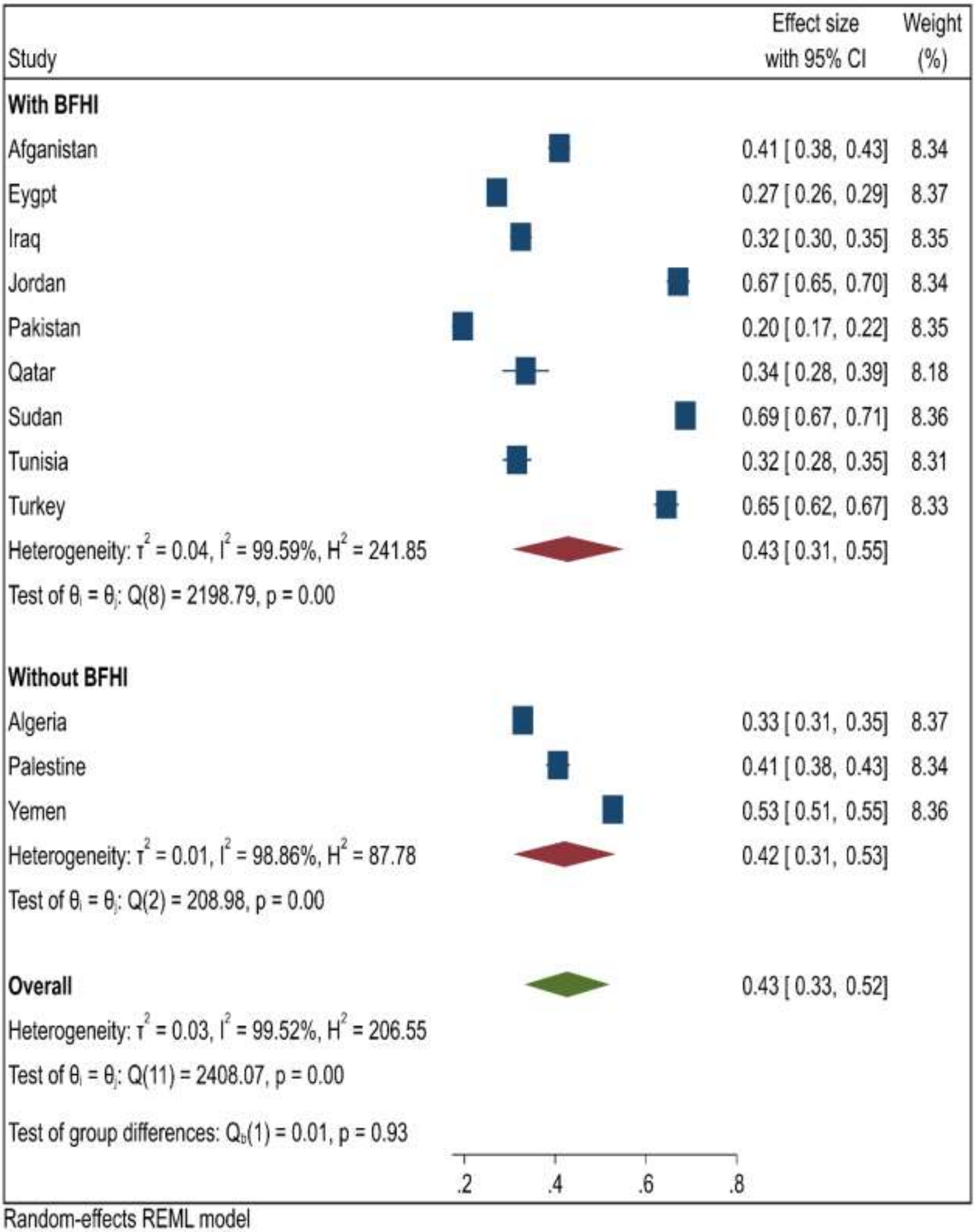

Figure 29. Pooled prevalence of EIBF by BFHI in 12 MENA using (SE) in Stata

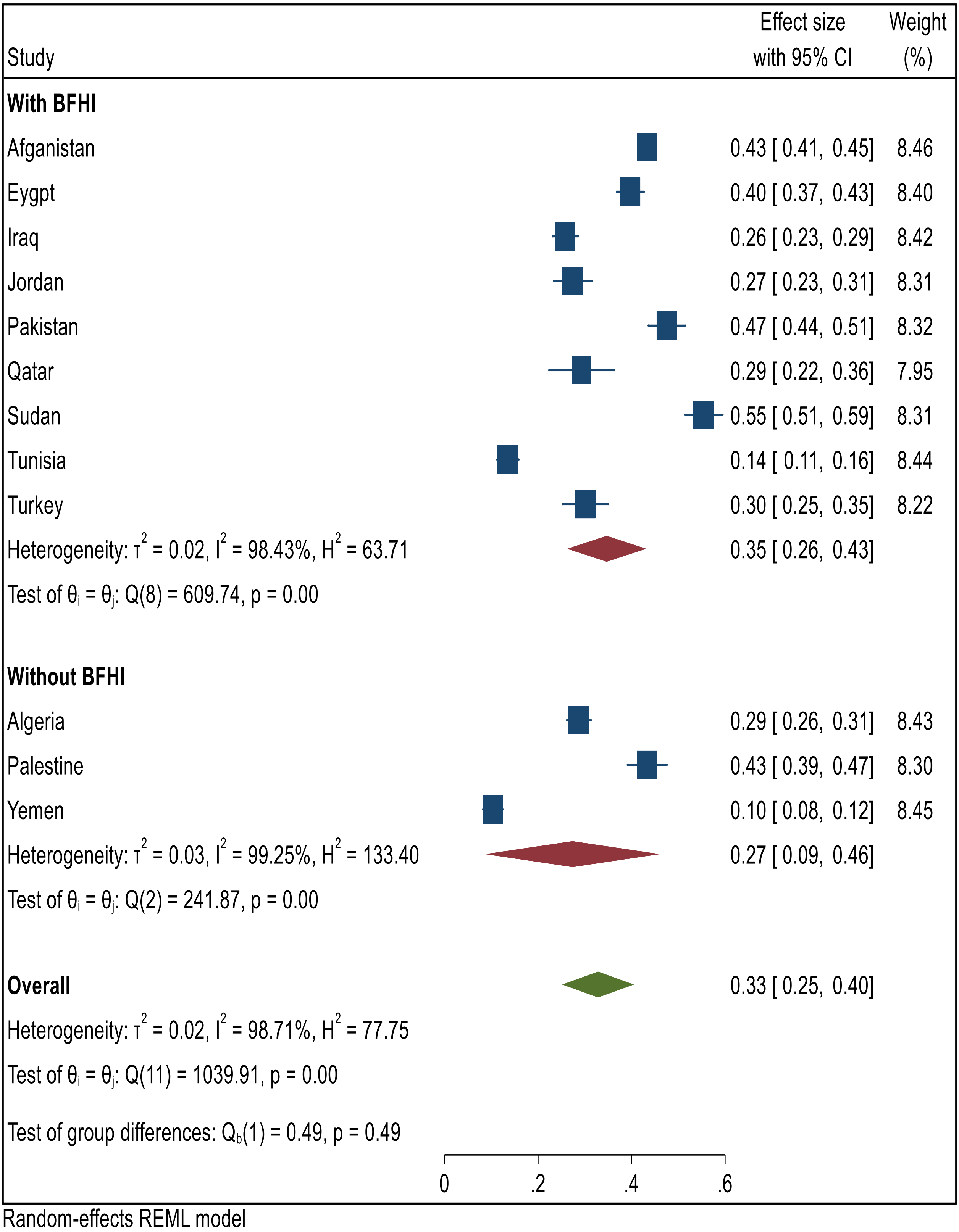

Figure 30. Pooled prevalence of EBF by BFHI in 12 MENA countries using (SE) in Stata

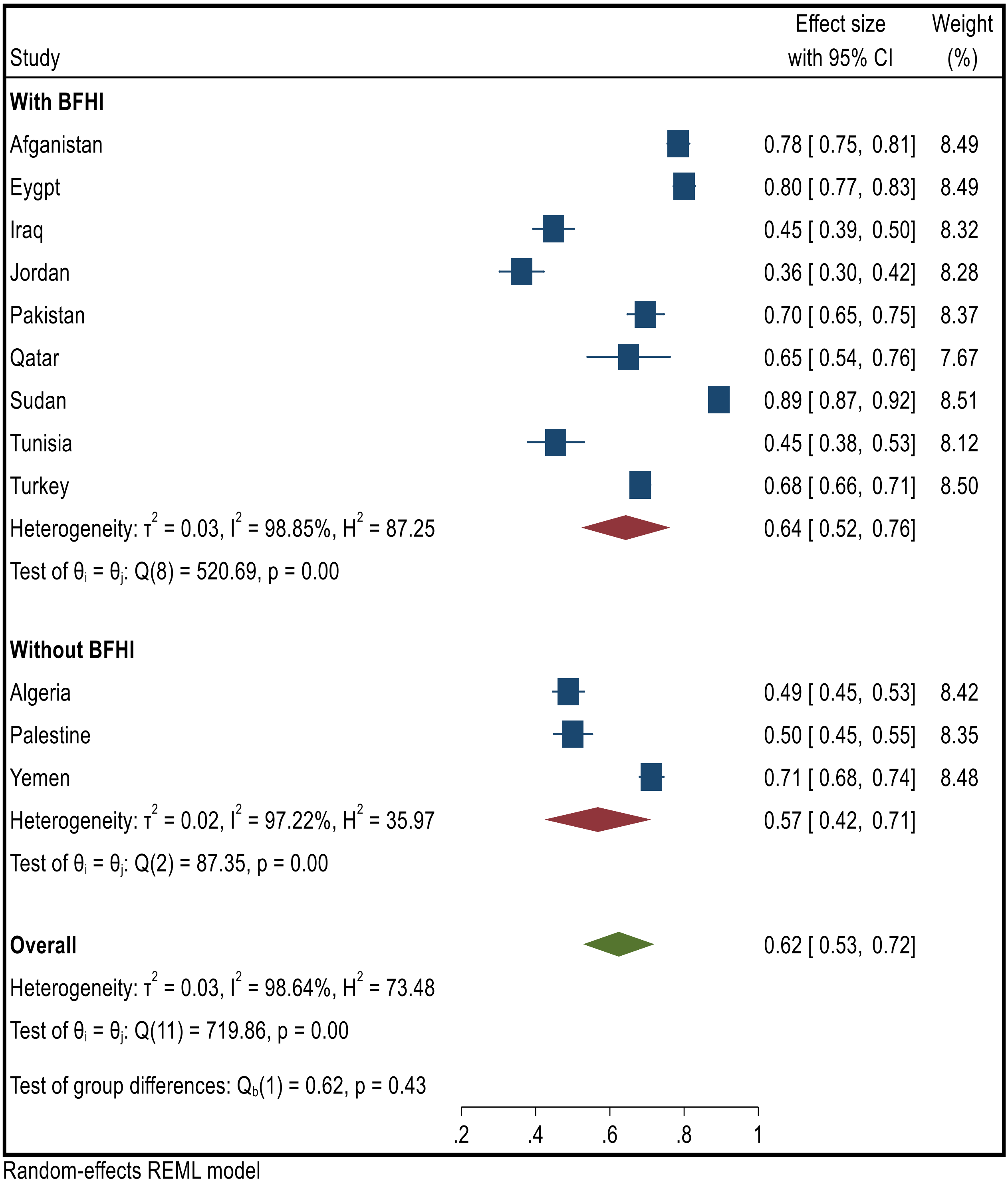

Figure 31. Pooled prevalence of CBF by BFHI in 12 MENA countries using (SE) in Stata

APPENDIX C: FIGURE 32- 37

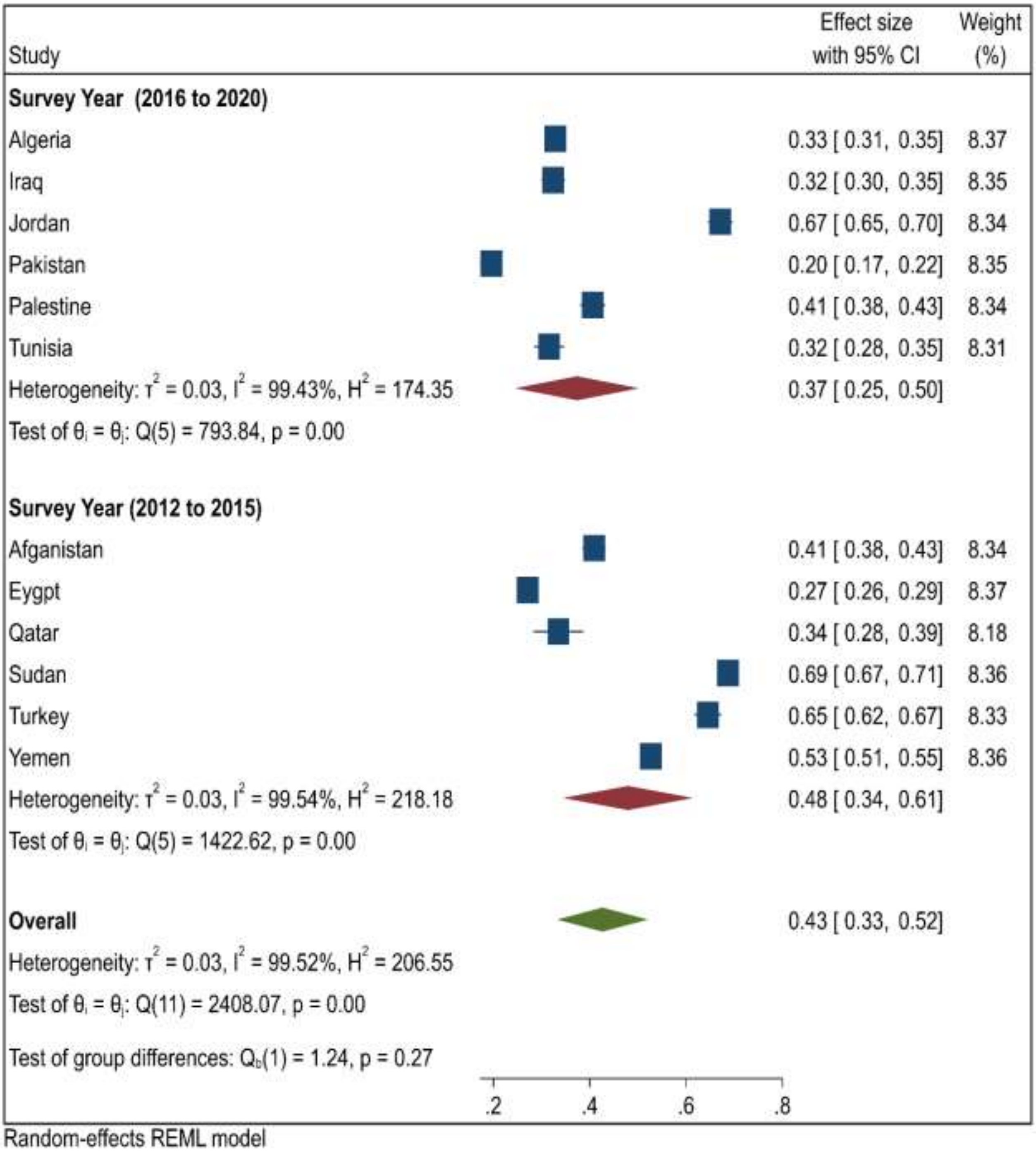

Figure 32. Pooled prevalenceof EIBF by survey period in 12 MENA countries using (SE) in Stata

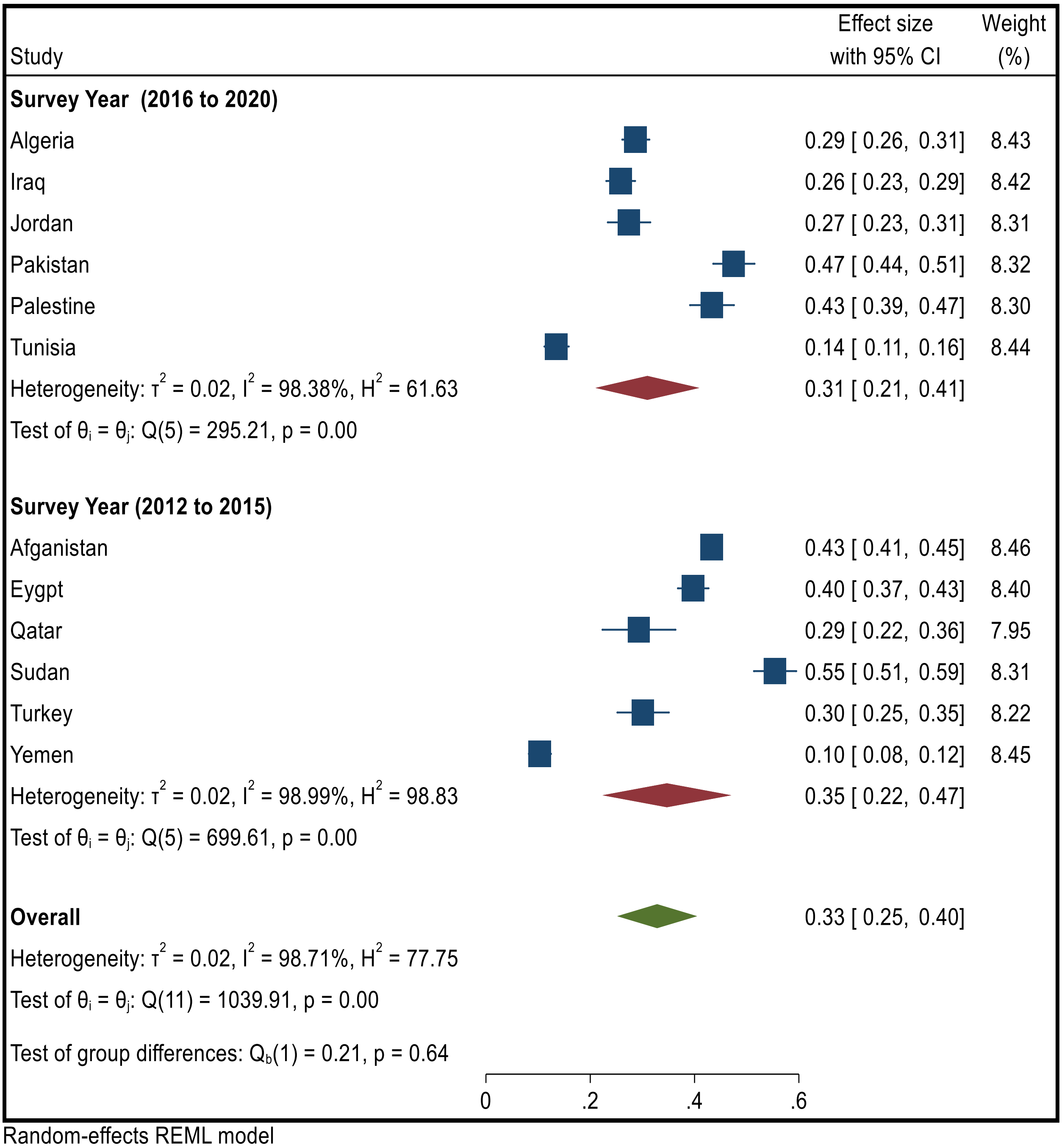

Figure 33. Pooled prevalence of EBF by survey period in 12 MENA countries using (SE) in Stata

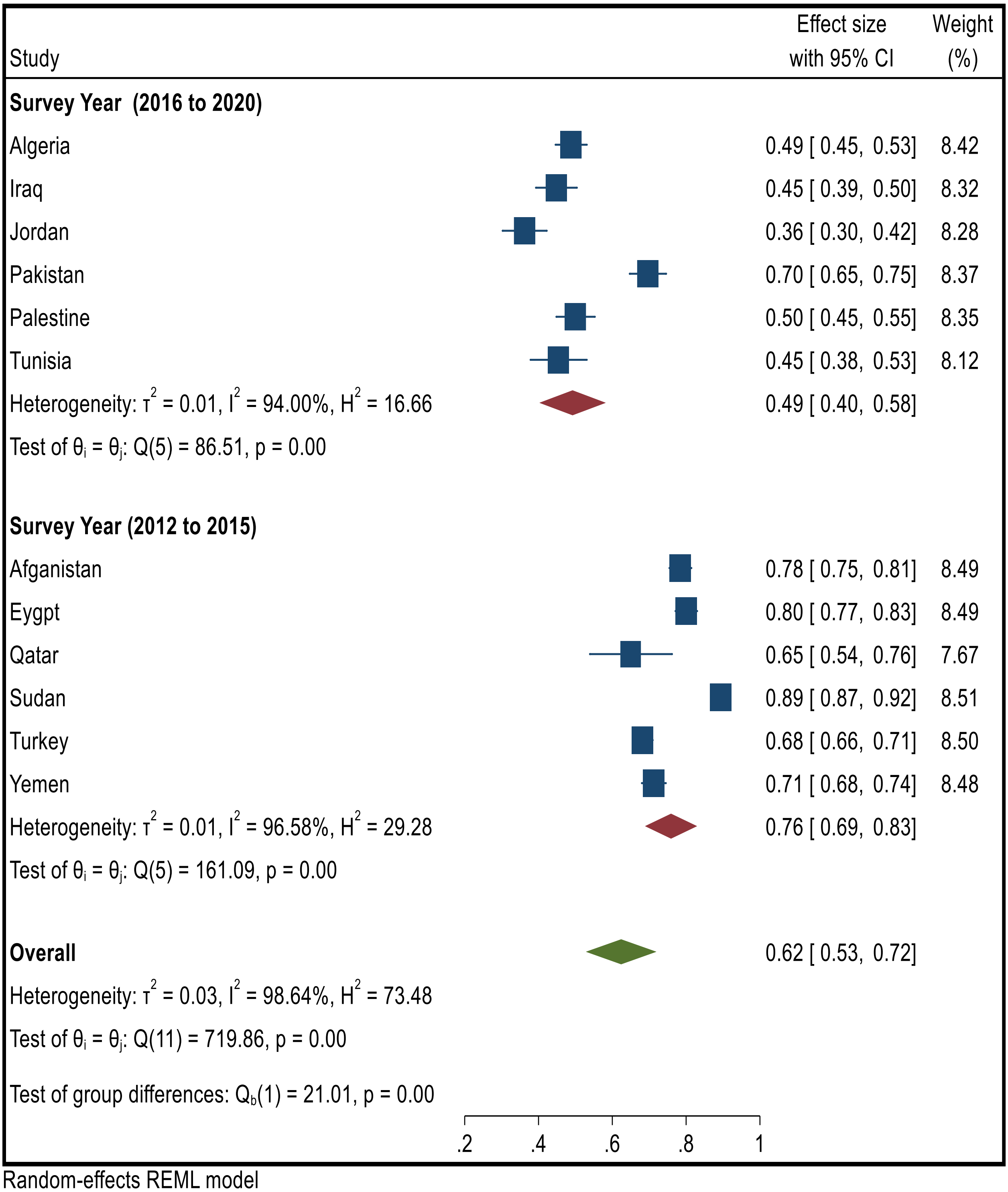

Figure 34. Pooled prevalence of CBF by survey period in 12 MENA countries using (SE) in Stata

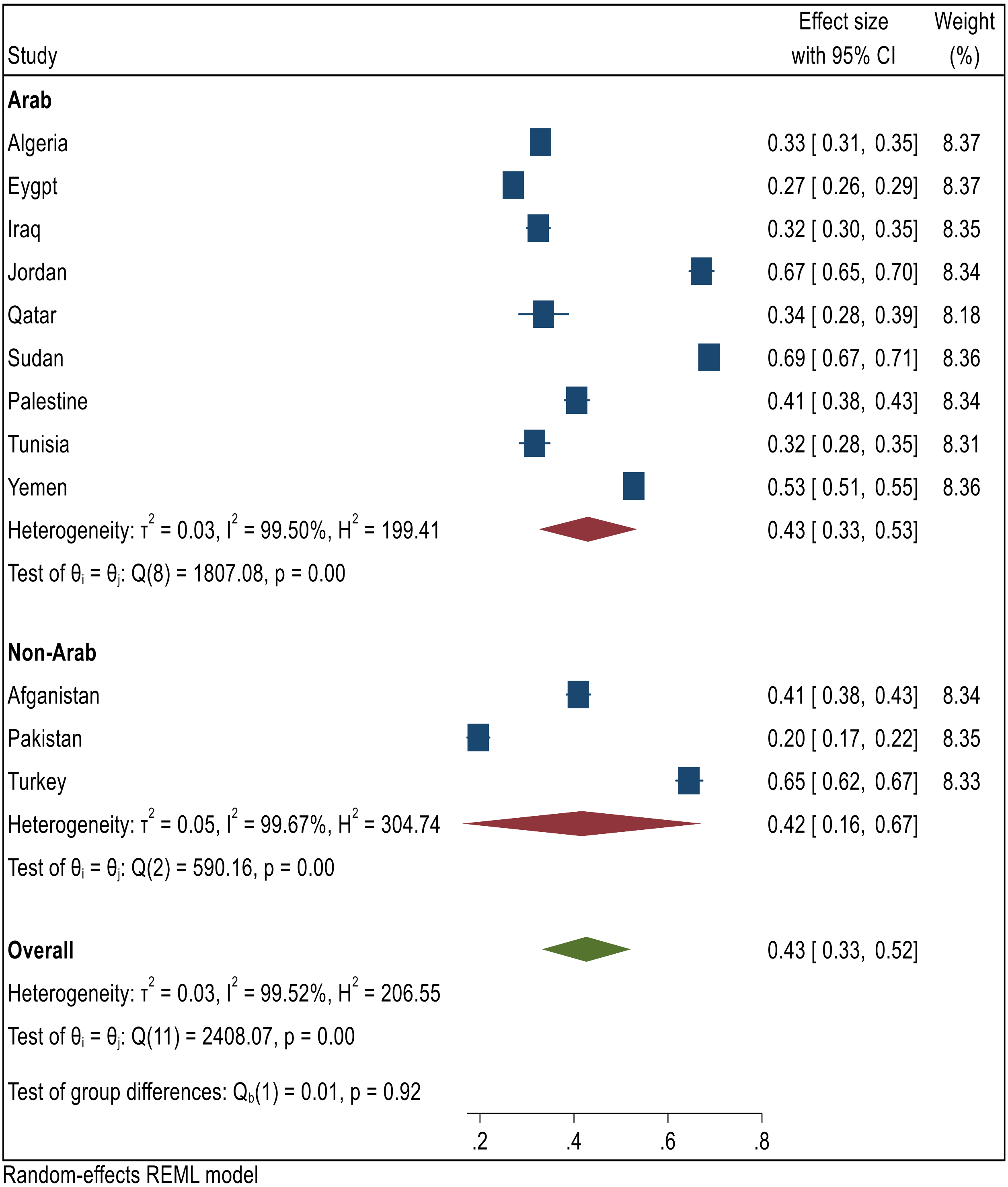

Figure 35. Pooled prevalence of EIBF by ethnicity in 12 MENA countries using (SE) in Stata

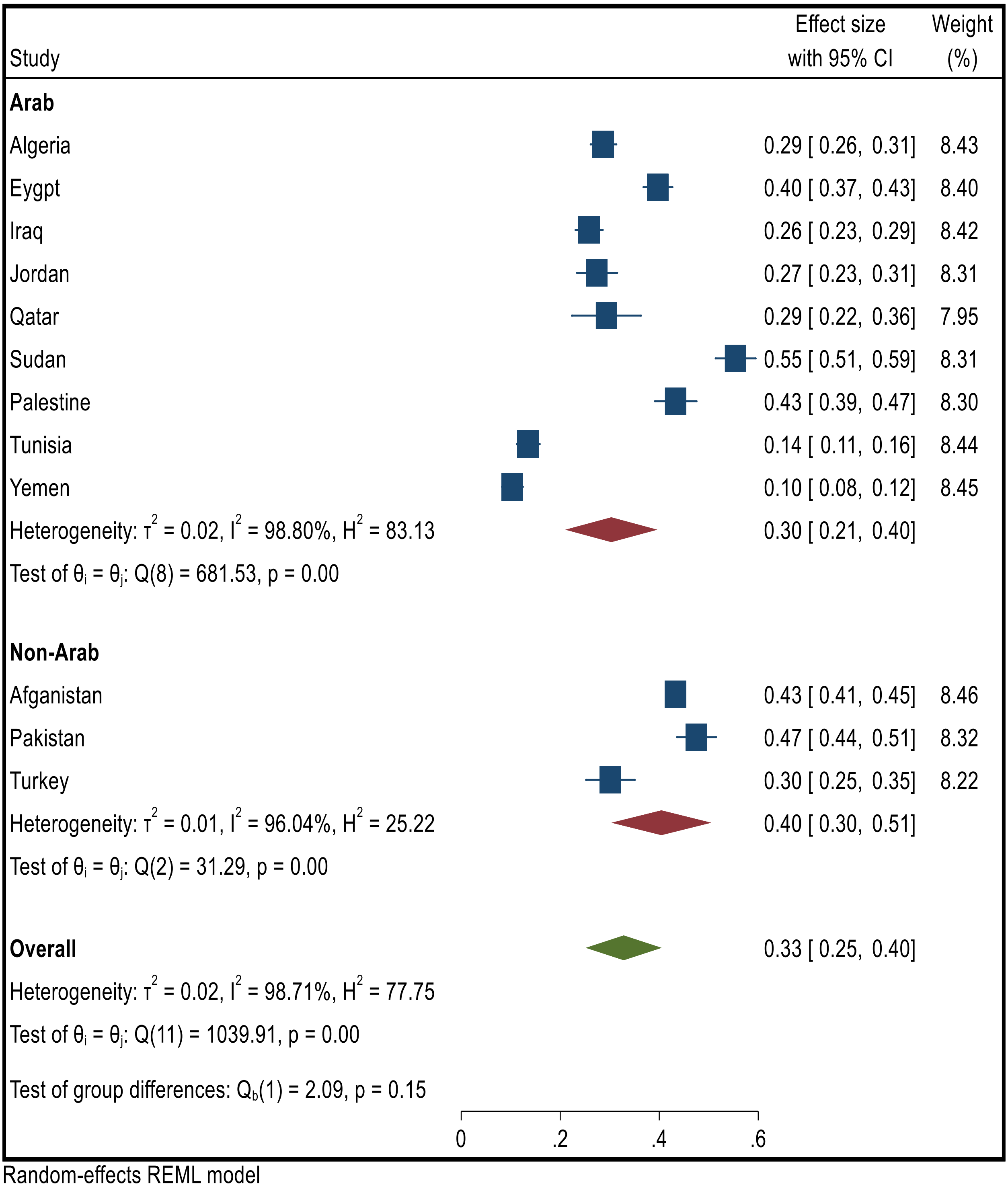

Figure 36. Pooled prevalence of EBF by ethnicity in 12 MENA using (SE) in Stata

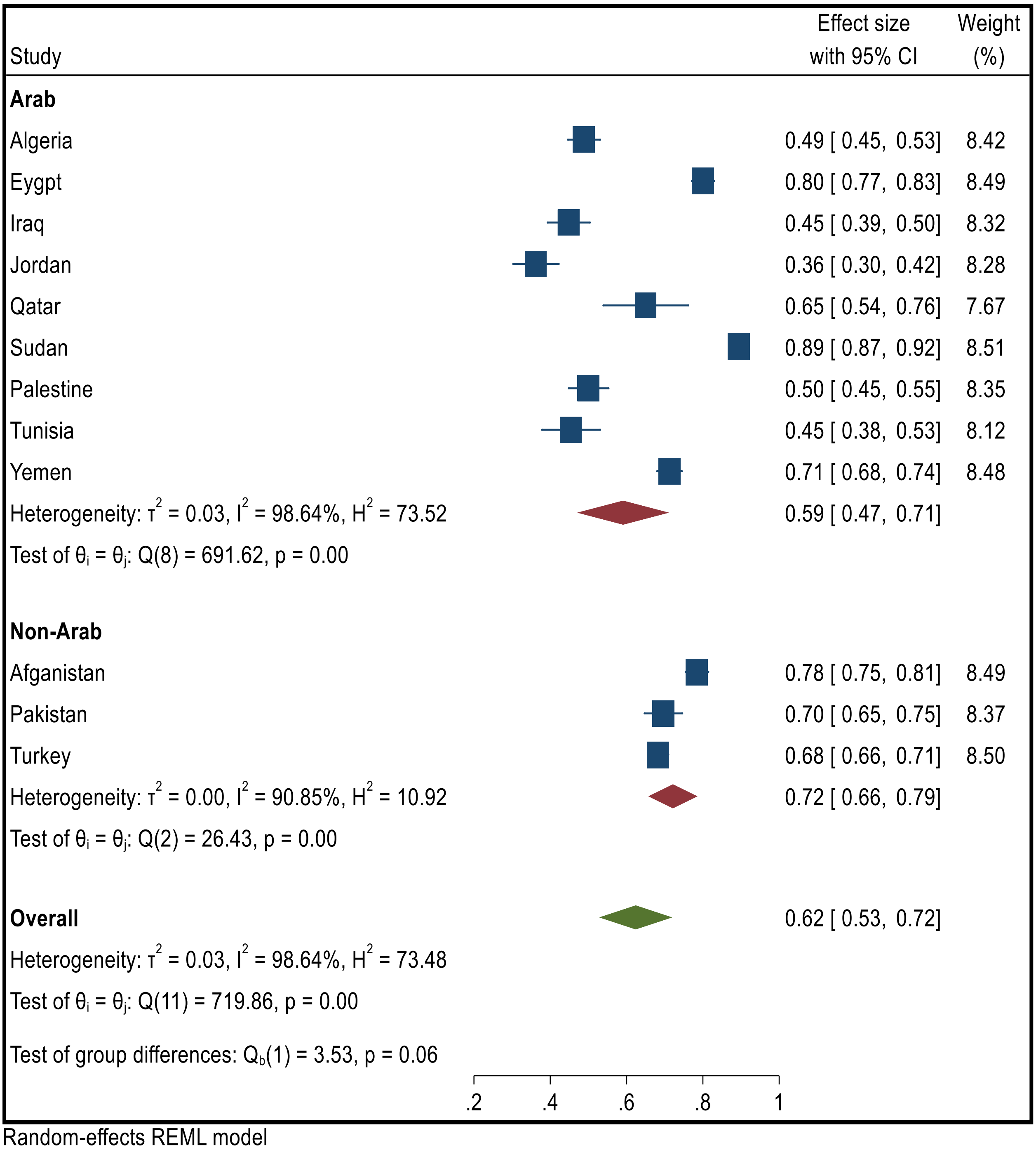

Figure 37. Pooled prevalenceof CBF by ethnicity in 12 MENA countries using (SE) in Stata

The data were reanalyzed in Stata using prevalence for each indicator and SEs accounting for the complex survey design. The output is included in appendices (Appendix A, B, and C). The results indicated that there was slight difference in the overall pooled prevalence when compared with the RE model ran in MetaXel (using prevalence estimates and sample sizes) (Figures 20 to 37).