Country-level patterns in unintended pregnancy and abortion 2015–2019:

a description of country-specific estimates from a Bayesian hierarchical model

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Abstract

Objective

Internationally comparable estimates of unintended pregnancy and abortion incidence can illuminate disparities in sexual and reproductive health and autonomy. Country-specific estimates are essential to enable international comparison, and to inform country level policy and programming.

Methods

We developed a Bayesian model which jointly estimated unintended pregnancy and abortion rates using all available data on pregnancy determinants and outcomes. We reported annualized estimates for 166 countries in 2015-2019, and examined how distributions of country estimates varied between Sustainable Development Goal (SDG) regions.

Findings

Estimated unintended pregnancy rates ranged from 11 (80% UI: 10 to 12) in Montenegro to 145 (137 to 152) in Uganda per 1000 women ages 15-49. Between-country heterogeneity was substantial in all SDG regions, but was greatest in Sub-Saharan Africa. Estimated abortion rates ranged from 5 (5 to 6) in Singapore to 87 (62 to 122) in Georgia. Variation between country estimates was similar in all SDG regions except for Europe and Northern America, where estimated abortion rates were generally lower.

Conclusion

The estimates suggest that unintended pregnancy and abortion are reproductive health experiences shared by individuals in countries throughout the world. This evidence highlights the importance of investing in access to contraception and comprehensive abortion care, including in regions which may have lower rates of unintended pregnancy or abortion, respectively, as countries may differ substantially from regional averages.

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Internationally comparable estimates of unintended pregnancy and abortion incidence can illuminate disparities in sexual and reproductive health and autonomy. Model-based estimates of regional averages have been published periodically that make global comparisons over time possible (1–7). However, these analyses do not provide the country-specific estimates that would allow country stakeholders to understand their own sexual and reproductive health context and to compare with other countries which may differ in policies and other factors which influence individuals' ability to access care (8) .

Gaps in the evidence base pose substantial challenges for developing abortion estimates for most countries. Abortion is highly restricted in a large number of countries, and many countries where abortion is broadly legal lack robust systems for collecting abortion data, including several countries in southern and eastern Europe (6,7,9,10).

Many countries, including high-income countries, also lack data on the proportions of births that are from unintended pregnancies. Abortion incidence is by and large a function of the incidence of unintended pregnancy and the proportion of individuals experiencing unintended pregnancy who want and are able to obtain an abortion. Thus, unintended pregnancy estimates are needed to contextualize differences in abortion rates across countries.

Country-specific estimates of unintended pregnancy and the proportion of these that end in abortion provide the opportunity to highlight the universal need for access to comprehensive sexual and reproductive health services, including quality abortion and post-abortion care. For these reasons, a substantial number of in-country studies have been undertaken since the 1990s to fill in gaps in the evidence base, including in 28 countries in Africa, Asia, and Latin America (11–13).

Comparing cross-sectional studies is complicated as evidence may date to different time periods and because of methodological differences between studies. Also, different regions have seen investment in abortion data collection at different points in time. In sub-Saharan Africa, for example, the most recent nationally representative study estimated abortion incidence in Ghana for 2017. In Latin America, by contrast, the most recent such study estimated the number of abortions which occurred in Mexico in 2009 (14). Although country-specific evidence has been limited in comprehensiveness and recency, however, these studies provide estimates for a

substantial number of countries over time. This expansion of the evidence when used in concert with other data on contraceptive needs and use, pregnancy intentions and births helps make it feasible to develop a model which accounts for differences in data sources and time periods and produce estimates for an even larger set of countries worldwide (13).

Several global studies have used model-based approaches to develop country-specific estimates of reproductive health indicators for a large number of countries, such as maternal mortality and demand satisfied for modern methods of contraception, and that enable country comparison (15–18). We applied a similar approach, and developed a statistical model that uses all available data on the determinants of unintended pregnancy, and on pregnancy outcomes, in order to estimate unintended pregnancy and abortion jointly. Time trends in global and regional estimates from this model have been described previously (7). This paper presents the first ever standardized set of estimates of unintended pregnancy and abortion for countries across the world and describes levels and patterns for 2015-2019.

Data and methods

We provide a general overview of the study methodology below, referencing more extensive summaries in our study protocol,(19) and in a more extensive technical description of our data and methods (13), following the Guidelines for Accurate and Transparent Health Estimates Reporting Statement (20).

In brief, we searched for all available data on the proportions of births from unintended pregnancies (hereafter, intention data) and all available data on the incidence of abortion from 195 countries and territories covering any year or years as early as 1990. A transparent and systematic process was followed as outlined in the study protocol (pp. 2-3). Ultimately, we obtained data from 166 of these countries and territories (appendix figure a1). These countries represent 98% of the global population of women between the ages of 15 and 49 (hereafter, reproductive-age) in 2015–2019.

Although substantial amounts of data were available, the extent and quality of these varied widely across regions and over time (11,13).

Nationally representative surveys of women which asked questions about pregnancy intentions were available in all regions. Most of these data were from the Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS), or Reproductive Health Surveys (RHS), which are periodically conducted in many low- and middle-income countries (483 surveys from

114 countries) (21–23). One-time studies comprised a relatively small portion of the data on pregnancy intentions for low- and middle-income countries (22 studies from 14 countries, 11 of which also had data from the DHS, RHS or MICS surveys). In contrast, such studies comprised nearly all of the data from high-income countries (33 studies from 23 countries), with periodic surveys conducted only in the United States (4 surveys).

Abortion data are available from official statistics, surveys of women, or published studies (appendix figure a2), and the utility of these data varies across data types and sources. Official statistics can be incomplete, for example, where abortion is illegal or a substantial number of abortions occur outside the health sector. In surveys, women tend not to acknowledge all abortions. Published studies vary in methodology and quality (6,12,24,25). Of a total of 1895 observations from 104 countries, 751 observations came from 38 countries where official statistics were complete (in those years). Another 78 were estimates from nationally representative published studies conducted in 27 countries. Of these, 43 were from the United States or Australia. Another 35 estimates were from 25 low- and middle-income countries. In eight of these countries, two studies were conducted, and in one country (Bangladesh) three studies were conducted. Of the nine countries in which more than one study was conducted, five have no estimates since 2009. Since official statistics are generally unavailable or unreliable outside of high-income countries in which legal abortion is broadly available, this means that these cross-sectional studies have been the main source of information on abortion incidence outside of the high-income countries of western Europe and northern America.

Estimating unintended pregnancies requires information on the numbers of births, the proportions of these that were from unintended pregnancies, and the numbers of abortions. Population estimates and birth rates are published by the United Nations Population Division (UNPD) in the World Population Prospects (26). The UNPD also produces estimates of the numbers of women who are married, and women's contraceptive needs and use, separately by marital status, and compiles survey data on contraceptive method mix (27,28). Considering all available data, therefore, we developed a theoretical framework in which pregnancy is a function of the number of women in population groups delineated by marital status, contraceptive needs and use, adjusting for method mix, and the number of women in each of these groups, while abortion is a function of subgroup-specific pregnancy rates and probabilities that a pregnancy would end in an abortion.

These are key proximate determinants of fertility (29,30). However, pregnancy rates may also vary due to unobservable factors and measurement error. Therefore, we used Bayesian hierarchical random walk models to develop estimates using this framework (13).

In summary, for each country, resulting pregnancy and abortion estimates were based on relevant country-specific inputs for the period 1990 to 2019 and informed by regional levels and trends for data-sparse periods. Specifically, data inputs were given by available pregnancy and abortion data, information on contraceptive needs and use by union status, and birth rates from the World Population Prospects (15,26–28). Estimates were informed by regional levels and trends for data-sparse periods through the use of random walk models to obtain time trends in countries and regions, hierarchical models to share information on group-specific pregnancy rates and propensities to abort across countries within regions, and model-based estimates of a series of parameters for variability, across countries and periods, in subgroup-specific pregnancy rates and probabilities that a pregnancy would end in abortion. We performed out-of-sample validation exercises in which we randomly excluded a fifth of all data, or, systematically for each country, all a country's data (i.e., a country jackknife), to assess model performance, and we reviewed model performance overall, by data type, and by world regions. The findings from these exercises are consistent with our model producing unbiased estimates, with well-calibrated uncertainty intervals (13).

Of the 166 countries and territories with at least one datum, 16 were in the super-region for the Middle East and North Africa (appendix table a1). Our ability to assess model performance for countries in this super-region was limited as no reliable abortion data were available there. As a result, we report results for 150 countries and territories.

The World Health Organization (WHO) conducted a country consultation in which countries were asked to comment on our data and methods. This does not imply that countries approved or endorsed our estimates. Though this paper focuses on the situation in 2015-2019, estimates for all five-year time periods are *(note to reviewers: will be)* available on the Guttmacher and World Health Organization (WHO) websites.

Point estimates were computed with 80% uncertainty intervals (UI) using the medians and 10th and 90th percentiles of posterior distributions of model parameters. The interpretation of these intervals is that for any estimate, there is a 10% chance that the true value falls below, or lies above, the interval.

We describe the distributions of country-specific estimates within Sustainable Development Goal (SDG) regions (appendix table a1) using the total and interquartile ranges (IQR).

The interquartile range for a region is the difference between the third and first quartiles of its distribution of country-specific estimates. The interpretation of an interquartile range is that half of the country-specific estimates within a group of countries differ by at least this much. Quartiles may not correspond to specific countries. For ease of exposition, when describing quartiles (including medians), we report the countries whose point estimates most closely approximate these.

When describing the total ranges for a region, we report the countries with the least and greatest estimates excepting outliers, as well as the countries with outlying estimates – which we define as countries whose estimates differ from the median by more than 2½ times the interquartile range (31,32).

Results

Unintended pregnancy

Examining the model-based estimates reveals substantial disparities in unintended pregnancy rates between countries, including between countries within the same region (figure 1 and table 1). These also reveal several instances in which countries with comparatively large populations skew the estimates for their regions.

The greatest differences between countries were found within Sub-Saharan Africa, which also had the greatest average unintended pregnancy rate (figure 2, left panel, and appendix table a2). Overall, across all countries in Sub-Saharan Africa, estimates ranged from 49 unintended pregnancies (UI 39 to 59) in the Niger to 145 unintended pregnancies (137 to 152) in Uganda per 1000 women of reproductive age. The interquartile range for this region was roughly bounded by Guinea and Gabon, whose respective estimates were 69 (61 to 79) and 109 (98 to 124) unintended pregnancies per 1000 women ages 15-49. This means that roughly half of countries in sub-Saharan Africa had greater or lesser rates.

Substantial differences between countries were also evident in Eastern and Southeastern Asia. Overall, unintended pregnancy rates in this region ranged from 18 (UI 15 to 23) to 85 (73 to 100) unintended pregnancies per 1000 reproductive-age women, respectively estimated for Singapore and Viet Nam. The interquartile range roughly corresponded to the Philippines and Myanmar, whose estimated unintended pregnancy rates were 51 (45 to 56) and 74 (68 to 79), respectively.

The regional average was somewhat skewed by the estimate for China, which is the most populous country in the region. There, we estimated an annual average rate of 64 unintended pregnancies (48 to 87) per 1000 women ages 15-49. Hence, although the median roughly corresponded to the estimate for Indonesia, which was 40 (28 to 56), the regional average estimate was 58 unintended pregnancies (48 to 73) per 1000 women of reproductive age.

Between-country heterogeneity was also substantial in Central and Southern Asia. In this region, the distributions of country estimates differed markedly by subregion. In the Central Asia subregion, half of the countries had unintended pregnancy rates ranging from 28 (UI 23 to 35) to 39 (33 to 46) unintended pregnancies per 1000 women of reproductive age, respectively estimated for Uzbekistan and Kyrgyzstan. In contrast, the interquartile range for Southern Asia spanned from 59 (54 to 64) to 71 (65 to 77) unintended pregnancies per 1000 reproductive-age women, respectively estimated for Bangladesh and Pakistan.

Smaller differences were found between countries in their estimated unintended pregnancy rates in Latin America, excepting outliers. Two Latin American countries had outlying estimates; annually on average an estimated 107 (UI 84 to 137) unintended pregnancies occurred in Haiti and 104 (82 to 135) in Bolivia per 1000 reproductive-age women. Across all other countries in Latin America, unintended pregnancy rates ranged from 42 (35 to 49) to 90 (75 to 108) unintended pregnancies per 1000 women of reproductive age, respectively estimated for Uruguay and Peru. Latin American unintended pregnancy rates in general were greatest except for those found in sub-Saharan Africa. However, the interquartile range of unintended pregnancy rates in Latin America was much narrower, and spanned from 58 (50 to 66) to 82 (70 to 97) unintended pregnancies per 1000 women of reproductive age, respectively estimated for El Salvador and Trinidad and Tobago.

Europe and Northern America exhibited the smallest differences between countries in estimated unintended pregnancy rates. While one country had an outlying estimate—an estimated 64 unintended pregnancies (UI 55 to 75) occurred annually on average per 1000 women of reproductive age in Russia—rates in Europe and Northern America otherwise ranged from an estimated 11 unintended pregnancies (10 to 12) in Montenegro to 43 unintended pregnancies (31 to 66) in Romania per 1000 women of reproductive age. Meanwhile, the interquartile range roughly corresponded to North Macedonia and Czechia, whose estimates were, respectively, 23 (20 to 26) and 35 (32 to 38) unintended pregnancies per 1000 women of reproductive age.

Abortion

Estimated abortion rates differed substantially between countries within the same region (figure 3). However, the distributions of country-specific estimates were broadly similar in Latin America, Sub-Saharan Africa, Eastern and Southeastern Asia, and Central and Southern Asia (figure 2, right panel).

Regional averages were skewed by countries with larger populations that had higher abortion rates in some parts of the world. In Eastern and Southeastern Asia, for example, the estimated annual abortion rate in 2015-2019 was 43 (UI 34 to 54), and the median was 27 (21 to 39). The difference between these was large because the regional average rate was heavily influenced by China, where the estimated abortion rate was 49 (42 to 58), and by the estimate for Viet Nam, where it was 64 (51 to 77) abortions per 1000 women of reproductive age. The regional average in Central and Southern Asia was similarly affected by the estimate for India. Hence, the average abortion rates for these regions were substantially greater than the abortion rates estimated for most of the countries within them.

By contrast, the regional average abortion rates in Sub-Saharan Africa and Latin America were more similar to countries at their respective medians. Moreover, while the regional average abortion rate in Eastern and Southeastern Asia was much greater compared to Latin America or Sub-Saharan Africa, Latin America and Sub-Saharan Africa actually had slightly greater median abortion rates.

In Latin America, half of countries had rates that ranged from 24 (UI 17 to 32) to 41 (34 to 40) abortions per 1000 women of reproductive age, the estimates for El Salvador and Peru, respectively. Uruguay, where an estimated 11 (11 to 12) abortions per 1000 women ages 15-49 occurred each year on average, was an outlier. Otherwise, estimates ranged from 16 (7 to 28) to 51 (46 to 56) abortions per 1000 women ages 15-49, respectively estimated for Nicaragua and Cuba.

Countries in Sub-Saharan Africa overall exhibited abortion rates which were similar to countries in Latin America. Half of the countries in Sub-Saharan Africa had estimates which ranged from 21 (UI 15 to 28) to 41 (29 to 57) abortions per 1000 women ages 15-49, the respective estimates for Djibouti and Liberia. Madagascar and Guinea-Bissau were outliers, but their rates were estimated with substantial uncertainty (figure 2). Otherwise, abortion rates ranged from 15 (11 to 20) to 49 (22 to 92), respectively estimated for the Niger and Cabo Verde.

We also found a broadly similar distribution of country estimates in Central and Southern Asia, where half of countries had rates ranging from 28 (UI 21 to 36) to 48 (46 to 51) abortions per 1000 reproductive-age women, the estimates for Sri Lanka and India, respectively.

The distributions of country-specific abortion estimates were largely similar for most regions because, even as unintended pregnancy rates were generally greatest in Sub-Saharan African and Latin American countries, individuals with unintended pregnancies were generally more likely to obtain abortions in Asian countries (appendix figure a3 and figure 2, center panel).

In contrast to other regions, abortion rates were generally much lower in Europe and Northern America. Half of the countries in Europe and Northern America had abortion rates which ranged from an estimated 8 abortions (UI 7 to 8) in Belgium to 14 abortions (14 to 15) in France per 1000 women of reproductive age. The median roughly corresponded to Bosnia and Herzegovina where an estimated 11 abortions (8 to 14) occurred annually on average per 1000 women of reproductive age. The regional average abortion rate was 17 (15 to 20), and so was outside the interquartile range; this relates to the estimates for Russia and Romania, which were 45 (34 to 63) and 31 (21 to 48), respectively, per 1000 women of reproductive age. Except for the two outliers, abortion rates in Europe and Northern America ranged from 14 (14 to 15) to 20 (15 to 30) abortions per 1000 reproductive-age women, the estimates for Switzerland and Slovakia.

Abortion rates in Europe and Northern America were lowest in comparison to those generally estimated among the countries in any other region because countries within Europe and Northern America typically exhibited the lowest unintended pregnancy rates, while the proportions of unintended pregnancies ending in abortion in western and northern Europe were also among the lowest. Specifically, these proportions were most comparable to those generally estimated for countries in Latin America and Sub-Saharan Africa.

Discussion

We found substantial differences in the unintended pregnancy rates estimated across countries, which suggests inequality between countries in the extent to which individuals have been able to achieve their reproductive goals. Whereas earlier research has suggested that substantial regional disparities exist in individuals' ability to exercise reproductive autonomy (3,5,7,33), our findings further elucidate variation across countries in all regions. Although estimates were generally higher in Sub-Saharan Africa, not all countries within this region had estimates which were greater than those typically found in other region. Conversely, we also found substantial

differences across Europe where countries generally exhibit the lowest rates of unintended pregnancy.

While there is substantial regional variation in abortion rates, as prior studies have also found (1,4,6,7), when looking at countries within regions, all regions except for Europe and Northern America have similar distributions of country estimates. This emphasizes the importance of investment in quality abortion and post-abortion care including in regions which may have lower rates of abortion as countries may differ substantially from the regional average.

Our study builds on longstanding efforts to strengthen the evidence base through nationally representative studies of unintended pregnancy and abortion in various settings over many years. Although the evidence base makes it possible to produce estimates for a large number of countries, limited data for countries results in sizeable uncertainty intervals. Without investments in robust in-country data collection, we would expect additional uncertainty in an assessment of later time periods. Also, while we were able to compare countries, the availability of disaggregated unintended pregnancy data would further improve our understanding of inequality in reproductive autonomy and inform where investments are most needed.

Along with these limitations, our study also has several strengths. Our analysis contributes to the evidence base by making it possible to contextualize unintended pregnancy and abortion estimates for individual countries as opposed to large regions and to draw comparisons with other countries with similar characteristics. Being able to compare across countries, within the same time period, is a substantial contribution relative to what was possible with the existing literature.

Another strength of our study is that we applied a theoretically grounded Bayesian model to account for differences in key proximate determinants of fertility between countries and time periods as well as differences between sources of data. This study thus builds on an evidence base where unintended pregnancy and abortion estimates are non-standardized, of varying levels of quality, often without information on uncertainty around the estimates, and where there are many gaps in data over time.

Additional research is needed to further understand the underlying causes of the differences and similarities between countries in the incidence of unintended pregnancy and abortion that we identified in this analysis. Future research should examine how different laws and policies influence women's ability to access comprehensive sexual and reproductive health services, including contraception and quality abortion care. Additionally, while this article describes

country-level patterns in 2015–2019, estimates from this model can also be used to examine country-specific trends over time. Our model-based estimates make it possible to examine disparities between countries which relate to inequality in reproductive autonomy. With additional investments in in-country data collection to increase the amount and quality of data, it would be possible to make estimates with greater certainty, monitor trends, and possibly assess the impact of large-scale programmes in the future.

The estimates suggest that unintended pregnancy and abortion are experiences shared by individuals in all countries. Having comparable country-level estimates provides increased insight to inform policies and programmes and further emphasizes the importance of investing in comprehensive sexual and reproductive health services worldwide to support individuals in achieving their reproductive goals.

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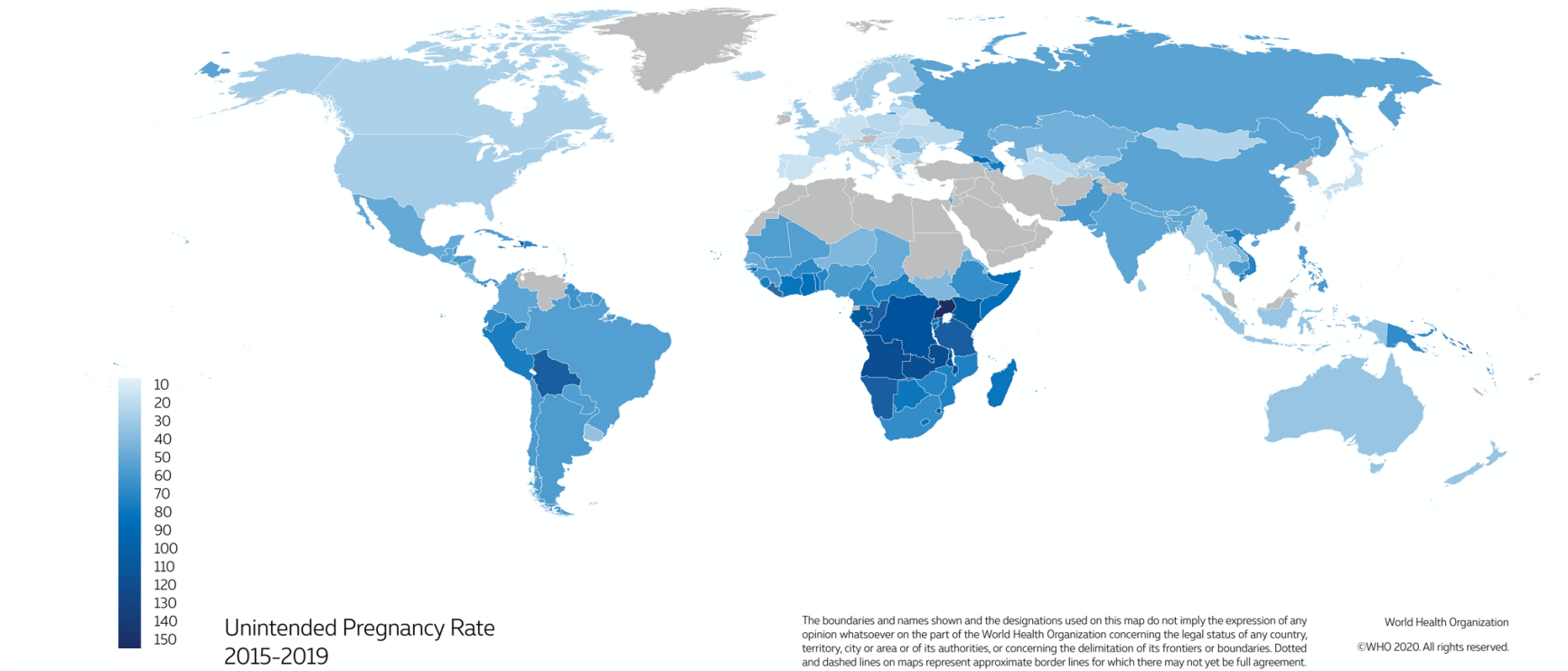

Figure 1. Model-estimated rates of unintended pregnancy per 1000 women ages 15-49 for 150 countries and territories in 2015-2019

Reported estimates are annual averages for 2015-2019. Model-based stimates are reported for 150 countries and territories. Of 195 countries and territories for which model-based estimates were produced, 166 had data on abortion incidence or pregnancy intentions. Another 16 countries were in the Middle East/North Africa model super-region (appendix table a1), where no reliable abortion data were available. For this reason, model-based estiamtes are reported for 150 countries and territories.

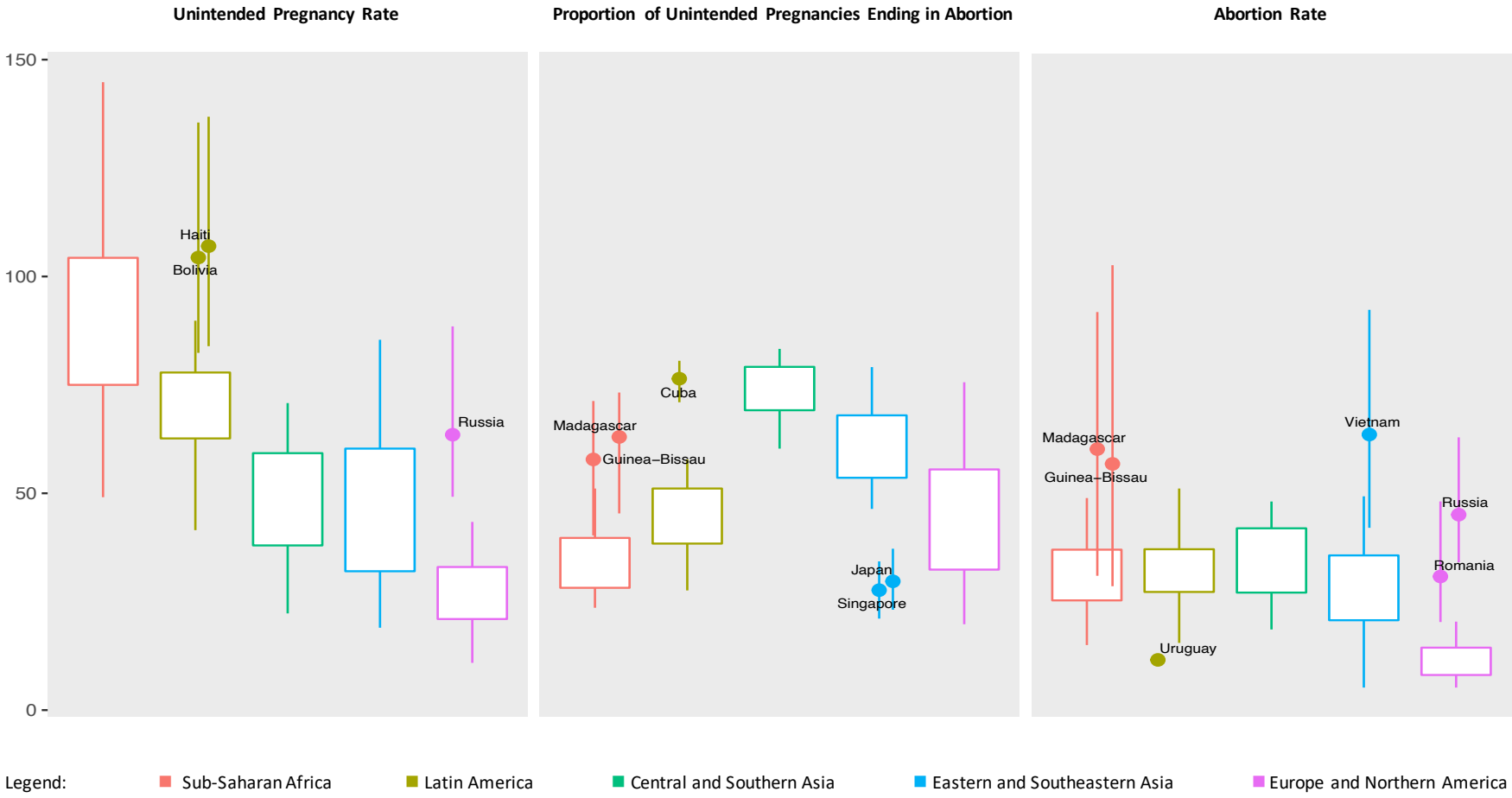

Figure 2. Box and whisker plots of the model-based estimates, for SDG major regions

Note: Boxes show the interquartile ranges (IQRs). Whiskers are up to twice the interquartile ranges. Outlying estimates are outside the whiskers – i.e., at least 2.5 times the IQR away from the medians.