Abortion incidence between 1990 and 2014: global, regional, and subregional levels and trends

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Summary

Background Information about the incidence of induced abortion is needed to motivate and inform efforts to help women avoid unintended pregnancies and to monitor progress toward that end. We estimate subregional, regional, and global levels and trends in abortion incidence for 1990 to 2014, and abortion rates in subgroups of women. We use the results to estimate the proportion of pregnancies that end in abortion and examine whether abortion rates vary in countries grouped by the legal status of abortion.

Methods We requested abortion data from government agencies and compiled data from international sources and nationally representative studies. With data for 1069 country-years, we estimated incidence using a Bayesian hierarchical time series model whereby the overall abortion rate is a function of the modelled rates in subgroups of women of reproductive age defined by their marital status and contraceptive need and use, and the sizes of these subgroups.

Findings We estimated that 35 abortions (90% uncertainty interval [UI] 33 to 44) occurred annually per 1000 women aged 15–44 years worldwide in 2010–14, which was 5 points less than 40 (39–48) in 1990–94 (90% UI for decline –11 to 0). Because of population growth, the annual number of abortions worldwide increased by 5·9 million (90% UI –1·3 to 15·4), from 50·4 million in 1990–94 (48·6 to 59·9) to 56·3 million (52·4 to 70·0) in 2010–14. In the developed world, the abortion rate declined 19 points (–26 to –14), from 46 (41 to 59) to 27 (24 to 37). In the developing world, we found a non-significant 2 point decline (90% UI –9 to 4) in the rate from 39 (37 to 47) to 37 (34 to 46). Some 25% (90% UI 23 to 29) of pregnancies ended in abortion in 2010–14. Globally, 73% (90% UI 59 to 82) of abortions were obtained by married women in 2010–14 compared with 27% (18 to 41) obtained by unmarried women. We did not observe an association between the abortion rates for 2010–14 and the grounds under which abortion is legally allowed.

Interpretation Abortion rates have declined significantly since 1990 in the developed world but not in the developing world. Ensuring access to sexual and reproductive health care could help millions of women avoid unintended pregnancies and ensure access to safe abortion.

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Introduction

Periodic estimates of the incidence of induced abortion (hereafter referred to as abortion) are needed to monitor progress towards reducing the unmet need for effective contraception and the incidence of unintended pregnancy. These estimates can also motivate investments in helping women avoid the recourse to and consequences of unsafe abortion where safe abortion is not available.

However, reliable data for abortion incidence are not consistently available across countries. Past estimates of global abortion incidence relied on available abortion data and on qualitative assessments of exchangeability to make inference to countries and territories lacking data.[1–3] After the last global estimates were made, country-specific estimates of the level of contraceptive use and unmet need for contraception among married women, and the proportions of women who are married,

were published.[4–6] These estimates, and their association with abortion incidence,[7,8] make possible a systematic, model-based approach to estimating abortion incidence. This is in line with methods used recently to estimate other global health indicators, such as causes of maternal death[9] and the incidence of anaemia[10] and maternal and child mortality.[11–13]

In this analysis, we aimed to estimate subregional, regional, and global levels and trends in abortion incidence for 1990 to 2014.

Methods
Framework

We developed a theoretical framework in which abortion incidence is estimated as the sum of abortions in subgroups of women of reproductive age defined by their marital status and contraceptive need and use. Separately

Research in context

Evidence before this study
Previous estimates of global abortion incidence were made for 1995, 2003, and 2008. These estimates relied on abortion data from various sources and qualitative assessments of exchangeability to make inference from existing data to countries and territories lacking data.

Added value of this study
We use an updated database of abortion incidence estimates and newly available annual estimates of factors associated with abortion incidence across all countries to develop model-based estimates of abortion incidence for 1990–2014.

We compiled a database on abortion incidence for the period 1990 to 2014 from official statistics and nationally representative studies. The Guttmacher Institute updated its database with information from official statistics obtained from countries with liberal abortion laws, United Nations Demographic Yearbook reports for countries with liberal and restrictive laws, and searches of published and unpublished reports based on nationally representative studies in countries with restrictive abortion laws. PubMed and Google searches were carried out with keywords "abortion incidence" followed, one by one, by the name of each country with a restrictive abortion law.

We also examined the results from an ongoing systematic review with a primary focus on abortion safety at WHO for additional evidence on incidence. This review entailed searches of PubMed, POPLINE, and Embase without language restrictions; Lilacs and Scielo to identify Spanish and Portuguese language literature; and BDSP and Inedoc to identify French-language literature.

The data collection effort resulted in abortion incidence data for 1069 country-years. We also compiled estimates made by the UNPD on the proportion of women of reproductive age who are married, and of contraceptive need and use among married women of reproductive age. These factors are known to be associated with abortion incidence.

We developed a Bayesian hierarchical time series model to construct country-year-specific estimates for 184 countries from 1990 to 2014, using all available data and information on marital status and contraceptive use among women of reproductive age. We used the country-period estimates to produce abortion incidence estimates for 5-year periods globally and for all world regions and subregions.

We estimate that the abortion rate declined significantly in the developed world from 46 (41–59) per 1000 women aged 15–44 years in 1990–94 to 27 (24–37) in 2010–14. The abortion rate in 2010–14 was higher in the developing world than in the developed world at 37 (34–46), and the decline in the developing world from 39 (37–47) in 1990–94 was not significant.

Implications of all the available evidence
The findings underscore that investments are needed to meet women's and couples' contraceptive needs and ensure access to safe abortion care, especially in the developing world, where abortion rates are high and many abortions are unsafe. Reliable estimates of abortion incidence in the developing world are scarce and additional research in this area is needed to improve our ability to monitor and more accurately estimate trends in this region.

for married and unmarried women, these subgroups are women with an unmet need for any contraception, those using a contraceptive method and expected to experience a method failure, and those classified as not needing contraception (either because they wish to have a child or because they are infecund). Because of data constraints, we examined abortion incidence in four subgroups of women: married women with unmet need, those with met need, and those with no need for contraception; and all unmarried women (panel). Married women are defined as women in formal marriages or in non-marital cohabiting unions. Abortion incidence in the subgroups might vary with coital frequency, fecundity, the strength of motivation to avoid carrying an unintended pregnancy to term, and a woman's ability to act on her preferences. Proxies for these measures were considered for inclusion in the model, as described below. A detailed technical explanation of the model is in the appendix (pp 2–8).

Abortion incidence data

We searched for abortion incidence data for every country and major territory in the world for 1990–2014. Data were obtained from official statistics and published or unpublished national studies.

We obtained data for abortion for 962 country-years from official statistics compiled by country agencies. For 527 of these observations, key informants, including contact persons at relevant agencies, indicated that reports were incomplete (appendix p 6); for these observations, we treated the reported numbers as the minimum numbers of abortions performed. For observations in eight countries or territories where the extent of under-reporting could be quantified, statistics were adjusted accordingly (appendix p 55).

For 26 country-years, we obtained abortion estimates from nationally representative surveys of women in countries with liberal abortion laws. Women are known to under-report their abortions in surveys, and a review of validation studies indicated that reported abortions in countries with liberal abortion laws represent 30–80% of true incidence.[14] We used the mean level of reporting observed in the review (55%) to adjust the survey-based estimates.

For 81 country-years, abortion estimates were based on other types of nationally representative studies. The most common of these were censuses of abortion providers in the USA[15] and studies that use an indirect approach to estimate abortion incidence in developing countries (as

See **Online** for appendix

Panel: Definitions of women as classified into groups used by the United Nations Population Division (UNPD)

- Unmarried women: women who are neither formally married nor living in a cohabiting union.
- Married women: comprised of (1) women who have been married and are not divorced, widowed, or separated and (2) women who are living in a cohabiting union. Women in "visiting partnerships" in the Caribbean region are also classified by the UNPD as married.
- Married women of reproductive age with no need: this group includes married women who want to be pregnant soon (in the next 2 years) and those who are currently pregnant with an intended pregnancy, have recently had an intended birth, or are infecund.
- Married women of reproductive age who use contraception but become pregnant: this is the sum of the number of women using a specific method × method-specific failure rate, for all methods, including traditional methods.
- Married women of reproductive age with unmet need for contraception: this group is comprised of married women who are fecund and who do not want a child soon (in the next 2 years) or at all and are not using a modern or traditional method of contraception. Pregnant women who identify their current pregnancy as unintended, and women experiencing post-partum amenorrhoea after an unintended pregnancy, are included in this group.

defined by the United Nations Population Division).[16] The censuses are deemed to include all abortions. The net direction of the potential sources of bias in the other nationally representative studies is not known, therefore no adjustment was made to these estimates.

We obtained data for 1069 country-years. Of these, 625 were for countries in Europe, 239 for Asia, 74 for Latin America and the Caribbean, 40 for North America, 40 for Oceania, and 51 for Africa (appendix p 56). Data were available for 92 countries and territories, and data for 2 or more years were available for 74 countries. The proportions of countries and territories with at least one estimate of abortion incidence, by geographic area and time period, are in the appendix (p 57). The proportion of women of reproductive age represented by at least one observation of abortion incidence are in the appendix (p 58).

We assessed the likely random error associated with the abortion data that were used as inputs, based on information in reports and input from key informants. Expected SEs ranged from 2·5% to 20% (appendix p 59). Sensitivity tests show that the main findings are robust to the SEs assumed around the abortion data (appendix pp 15–16).

To aid in the estimation of abortion rates in subgroups of women by marital status, information about the proportion of all abortions obtained by unmarried women was collected from official statistics and nationally representative surveys (appendix pp 60–63). We obtained 177 observations for 35 countries. Because of differences in the definition of marital status, we treated 162 of the observations as minimum or maximum estimates of the percent of abortions to unmarried

women. Additionally, estimates were available from the USA of the proportion of abortions obtained by married women with unmet need, met need, and no need for contraception and these were treated as data inputs.[17,18] The numbers and distributions of observations related to abortion by type of observation and data source are summarised in the appendix p 64).

Sizes of subgroups
Estimates of the number of women of reproductive age, the percent of these women who are married, and the percent of married women with unmet need for contraception, no contraceptive need, and met need, by country and year for 1990–2014, for women aged 15–49 years for 184 countries, were taken from the United Nations Population Division (UNDP).[4,19] Distributions of women across the subgroups are shown in the appendix (p 65).

To estimate the proportion of married contraceptive users expected to experience contraceptive failure, we computed the sum of the percent of women using a method × the failure rate for that method, for all methods. We used method-specific contraceptive prevalence data from the UNPD[20] and published method-specific user failure rates.[21] We used a hierarchical regression model to estimate method-specific contraceptive prevalence for country-years without information on the basis of data from other years for that country and data from other countries in the subregion (appendix p 9).

Potential predictors of abortion rates (covariates)
We explored whether proxies for coital frequency, fecundity, the strength of women's motivation to avoid carrying an unintended pregnancy to term, and their ability to act on their preferences, predict the estimated abortion rates in the subgroups of women. For coital frequency and fecundity, we used the age distribution of women of reproductive age[22,23] (including the average age of married and unmarried women separately, as well as the percent of women in 5-year age groups).[24] For women's motivation and ability to act on their fertility intentions, we used female education (the percent of women who completed primary or secondary school)[25–27] and national wealth (gross domesic product [GDP] per capita).

Statistical analysis
We developed a Bayesian hierarchical time series model in which the dependent variable was the number of abortions in a country-year. The predictors were the number of women of reproductive age in each of the four subgroups described above. The model did not include an intercept, and coefficients were constrained to be positive; thus, the coefficients represent abortion rates in population subgroups. The model was used to estimate country-period-specific subgroup abortion rates, using the constraint that married women with no need for

	1990–94 (90% UI)	1995–99 (90% UI)	2000–04 (90% UI)	2005–09 (90% UI)	2010–14 (90% UI)	Difference (90% UI)*
World	40 (39 to 48)	37 (35 to 44)	35 (33 to 41)	34 (32 to 41)	35 (33 to 44)	–5·0 (–11 to 0)
Developed countries	46 (41 to 59)	40 (36 to 52)	34 (31 to 45)	31 (28 to 40)	27 (24 to 37)	–19·0 (–26 to –14)
Developing countries	39 (37 to 47)	36 (34 to 43)	35 (33 to 42)	35 (32 to 43)	37 (34 to 46)	–2·0 (–9 to 4)
Africa	33 (28 to 51)	33 (29 to 48)	33 (29 to 47)	33 (29 to 45)	34 (31 to 47)	1·0 (–8 to 8)
Eastern Africa	32 (26 to 47)	33 (27 to 45)	34 (30 to 43)	33 (29 to 41)	34 (31 to 41)	2·0 (–10 to 9)
Middle Africa	32 (21 to 65)	33 (22 to 64)	35 (23 to 66)	34 (23 to 63)	35 (24 to 66)	3·0 (–11 to 16)
Northern Africa	40 (25 to 94)	38 (24 to 84)	37 (23 to 76)	37 (22 to 77)	38 (22 to 80)	–2·0 (–25 to 13)
Southern Africa	32 (17 to 68)	32 (17 to 66)	34 (19 to 66)	33 (19 to 65)	35 (20 to 70)	3·0 (–14 to 22)
Western Africa	28 (23 to 41)	29 (24 to 39)	29 (25 to 39)	29 (25 to 38)	31 (28 to 39)	3·0 (–6 to 10)
Asia	41 (38 to 51)	37 (34 to 46)	34 (31 to 43)	34 (30 to 44)	36 (31 to 48)	–5·0 (–14 to 4)
Eastern Asia	44 (38 to 56)	38 (32 to 50)	34 (27 to 48)	34 (26 to 49)	36 (26 to 55)	–8·0 (–22 to 8)
South and central Asia	36 (28 to 48)	33 (27 to 42)	32 (29 to 39)	33 (27 to 42)	37 (30 to 51)	1·0 (–12 to 16)
Southeastern Asia	46 (35 to 76)	42 (32 to 69)	38 (28 to 65)	36 (26 to 61)	35 (25 to 64)	–11·0 (–26 to 2)
Western Asia	46 (38 to 70)	45 (38 to 70)	43 (35 to 65)	37 (29 to 61)	35 (26 to 61)	–11·0 (–23 to 2)
Latin America region	40 (37 to 47)	40 (36 to 50)	41 (36 to 52)	44 (37 to 58)	44 (36 to 62)	4·0 (–6 to 20)
Caribbean	60 (48 to 97)	60 (49 to 97)	59 (46 to 95)	65 (50 to 104)	65 (48 to 107)	5·0 (–14 to 25)
Central America	27 (24 to 34)	28 (23 to 38)	29 (24 to 38)	32 (29 to 38)	33 (25 to 46)	6·0 (–4 to 17)
South America	43 (38 to 52)	43 (36 to 55)	44 (36 to 58)	46 (36 to 66)	47 (35 to 72)	4·0 (–10 to 27)
Northern America	25 (24 to 26)	22 (21 to 22)	20 (20 to 21)	19 (18 to 20)	17 (16 to 18)	–7·0 (–9 to –6)
Europe	52 (48 to 64)	45 (42 to 56)	38 (35 to 48)	34 (31 to 43)	30 (27 to 38)	–22·0 (–29 to –17)
Eastern Europe	88 (80 to 107)	75 (69 to 92)	61 (56 to 74)	51 (47 to 62)	42 (38 to 51)	–46·0 (–60 to –38)
Northern Europe	22 (20 to 25)	20 (19 to 24)	19 (18 to 22)	19 (18 to 21)	18 (17 to 20)	–4·0 (–7 to –3)
Southern Europe	38 (27 to 76)	34 (24 to 69)	29 (21 to 60)	27 (19 to 56)	26 (18 to 57)	–12·0 (–31 to 1)
Western Europe	13 (10 to 23)	13 (10 to 23)	15 (12 to 26)	18 (14 to 30)	18 (14 to 31)	5·0 (1 to 11)
Oceania	20 (18 to 28)	21 (19 to 30)	21 (18 to 30)	20 (17 to 29)	19 (15 to 29)	–1·0 (–5 to 3)

UI=uncertainty interval. *Based on comparison of 2010–14 with 1990–94.

Table 1: Estimated abortion rates per 1000 women 15–44 years old, by geographic area and time period

contraception would experience the lowest abortion rates and married women who experienced method failures would exhibit the highest rates of the four subgroups. The hierarchical aspect of the model allowed for exchange of information on the rates, as well as on changes in rates, between countries within subregions. By estimating subgroup rates, we were able to fit the model to data for the percent distribution of abortions by subgroup, in addition to the data for overall abortion incidence. We estimated abortion incidence for each subgroup for each country for each 5-year period (1990–94, etc), and the number of abortions as the sum of abortions in these subgroups. The model-based abortion estimates in countries change over time if subgroup-specific rates change and as the sizes of the subgroups change. Additional details about the analyses are in the appendix (pp 2–7).

In the hierarchical model, we used the UNPD classification of subregions. Because of data constraints, a few countries or subregions were merged with other subregions with similar measures on demographic and family planning indicators for the analysis (appendix p 66). Western Asia was divided into two regions because of heterogeneity on relevant factors. Final results are shown with original UNPD classifications of subregions.

Model choice, validation, and sensitivity analysis

We used in-sample and out-of-sample validation exercises to check model performance (appendix pp 10–14). In brief, we did validation exercises whereby 20% of the data were left out at random and ran simulations. The simulation results approximated the results that would be obtained if we treated each country as a random country without abortion data, given its subregion and its country-period-specific values for population composition and potential predictors of subgroup abortion rates (covariates). We noted that the hierarchical time series model did well in both sets of validation exercises.

We used statistical and theoretical criteria to assess the potential covariates (appendix p 10). Analyses showed that none of the covariates meaningfully improved upon the no-covariate model. Moreover, the implied associations between abortion rates and GDP per capita were not in the direction that we expected. We also observed that the no-covariate model yielded the most conservative (widest) uncertainty intervals and the most conservative (lowest) point estimates for developing countries (appendix p 14). Based on these findings, we chose the no-covariate model as the basis for the model-based estimates.

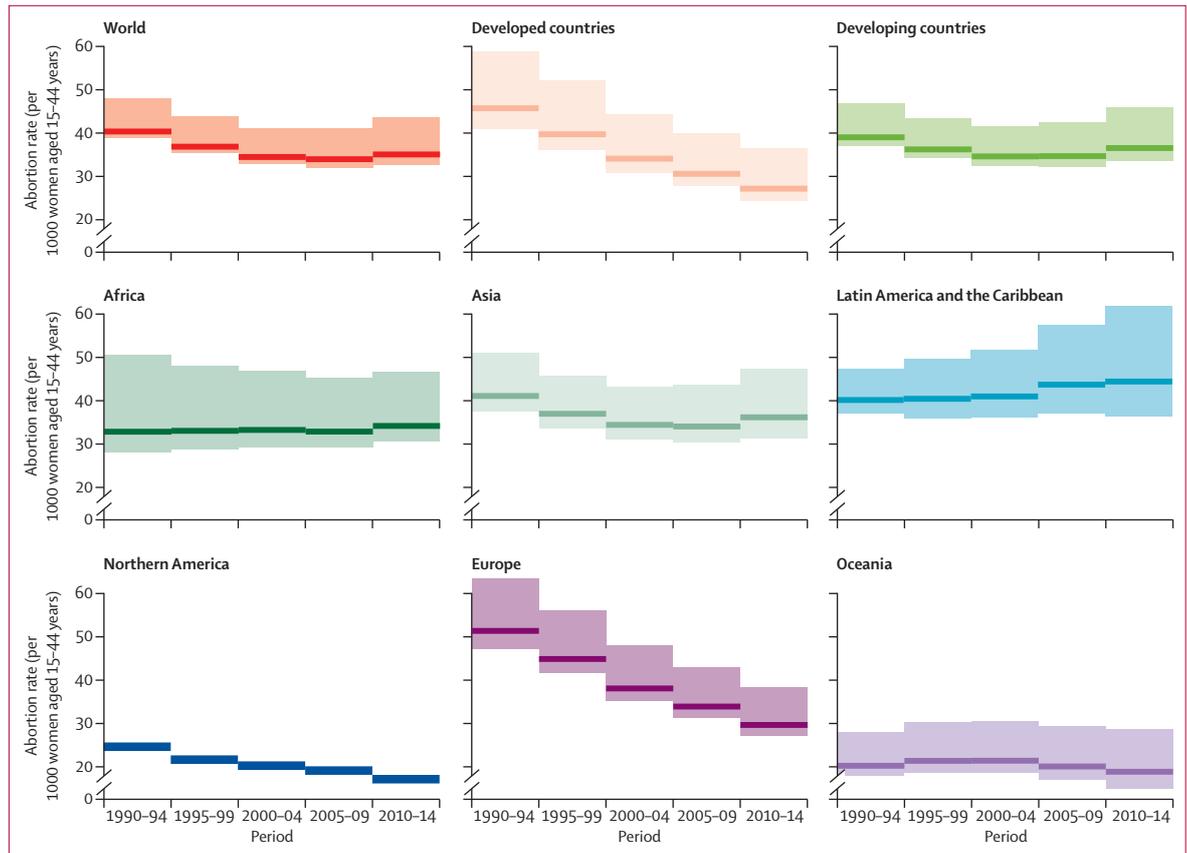We investigated the sensitivity of the model-based estimates to various model assumptions (appendix

Figure 1: **Global and regional abortion incidence rate estimates (per 1000 women aged 15–44 years), 1990–94 to 2010–14**
Shaded areas are 90% uncertainty intervals.

pp 15–27). We noted that estimated overall abortion rates varied little between models with different assumptions, but estimated rates for subgroups of married women varied more substantially and were very uncertain. Hence, we focus the discussion of the results on the overall abortion rates and rates for married and unmarried women, which are deemed to be less sensitive to model assumptions.

Because the evidence base of abortion rates is scarce, we present abortion incidence for 5-year periods rather than for each year, and we present rates for subregions rather than for countries. Abortion rates are presented as the total number of estimated abortions per 1000 women aged 15–44 years. We defined differences as statistically significant at α of 0·9, two-tailed; that is, if the posterior probability of a difference in the estimated direction was at least 95%. Details regarding computation of point estimates and uncertainty intervals are in the appendix (p 8).

Using the results, we calculated total pregnancy incidence and the percent of all pregnancies that end in abortion. The total number of pregnancies is the sum of all livebirths, abortions, and miscarriages (spontaneous fetal losses at 5 or more weeks of gestation). We used the UN Population Prospects' estimates of livebirths[19] and model-based estimates of abortions. To estimate miscarriages, we

used an approach derived from life tables of pregnancy loss by gestational age based on clinical studies,[23] which indicates that these events are equal to about 20% of births plus 10% of induced abortions.

We also used the results to examine how the estimated abortion rates in 2010–14 varied across groups of countries classified according to the grounds under which abortion is legal, as categorised by the US Center for Reproductive Rights.[28]

Role of funding source
The funders had no role in the study design, data collection and analysis, the writing of the report, or the decision to submit the paper for publication. The corresponding author (GS) has had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results
We estimated that there were 35 abortions per 1000 women (90% UI 33–44) aged 15–44 years worldwide each year in 2010–14 (table 1; figure 1). This represents a non-significant 5 point decline (–11 to 0) since 1990–94, when the estimated rate was 40 abortions per 1000 women (90% UI 39–48). Because of population growth, the absolute number of

	1990–94 (90% UI)	1995–99 (90% UI)	2000–04 (90% UI)	2005–09 (90% UI)	2010–14 (90% UI)	Difference (90% UI)*
World	50·4 (48·6 to 59·9)	49·7 (47·7 to 59·0)	49·9 (47·6 to 59·6)	52·4 (49·4 to 63·5)	56·3 (52·4 to 70·0)	5·9 (–1·3 to 15·4)
Developed countries	11·8 (10·5 to 15·1)	10·2 (9·3 to 13·4)	8·7 (7·9 to 11·4)	7·7 (7·0 to 10·1)	6·7 (6·0 to 8·9)	–5·1 (–7·0 to –4·0)
Developing countries	38·6 (36·7 to 46·5)	39·5 (37·3 to 47·2)	41·2 (38·7 to 49·6)	44·7 (41·5 to 54·9)	49·6 (45·6 to 62·4)	11·0 (4·3 to 20·4)
Africa	4·6 (3·9 to 7·1)	5·4 (4·7 to 7·8)	6·2 (5·5 to 8·8)	7·0 (6·2 to 9·7)	8·3 (7·4 to 11·4)	3·7 (2·6 to 5·3)
Eastern Africa	1·4 (1·1 to 2·0)	1·6 (1·4 to 2·3)	2·0 (1·7 to 2·5)	2·2 (2·0 to 2·7)	2·7 (2·4 to 3·3)	1·3 (0·8 to 1·8)
Middle Africa	0·5 (0·3 to 1·0)	0·6 (0·4 to 1·2)	0·7 (0·5 to 1·4)	0·8 (0·6 to 1·5)	1·0 (0·7 to 1·9)	0·5 (0·3 to 1·0)
Northern Africa	1·3 (0·8 to 3·0)	1·4 (0·9 to 3·1)	1·5 (1·0 to 3·2)	1·7 (1·0 to 3·6)	1·9 (1·1 to 4·0)	0·6 (0·0 to 1·6)
Southern Africa	0·3 (0·2 to 0·7)	0·4 (0·2 to 0·8)	0·4 (0·2 to 0·8)	0·5 (0·3 to 0·9)	0·5 (0·3 to 1·0)	0·2 (0·0 to 0·5)
Western Africa	1·1 (0·9 to 1·6)	1·3 (1·1 to 1·8)	1·5 (1·3 to 2·1)	1·8 (1·5 to 2·3)	2·2 (1·9 to 2·7)	1·1 (0·7 to 1·5)
Asia	31·5 (28·8 to 39·1)	30·7 (27·9 to 38·1)	30·8 (27·8 to 38·7)	32·7 (29·1 to 41·8)	35·8 (31·1 to 47·1)	4·3 (–2·9 to 13·1)
Eastern Asia	14·9 (13·0 to 19·1)	13·4 (11·2 to 17·5)	12·4 (9·8 to 17·2)	12·9 (9·8 to 18·5)	13·0 (9·3 to 19·8)	–1·9 (–6·9 to 3·6)
South and central Asia	9·9 (7·9 to 13·4)	10·4 (8·7 to 13·4)	11·5 (10·1 to 13·7)	12·9 (10·7 to 16·7)	15·7 (12·6 to 21·7)	5·7 (1·4 to 11·5)
Southeastern Asia	5·1 (3·9 to 8·3)	5·2 (3·9 to 8·5)	5·1 (3·7 to 8·7)	5·0 (3·6 to 8·7)	5·2 (3·6 to 9·4)	0·1 (–1·4 to 2·2)
Western Asia	1·5 (1·3 to 2·4)	1·8 (1·5 to 2·7)	1·9 (1·6 to 2·9)	1·8 (1·4 to 3·0)	1·9 (1·5 to 3·4)	0·4 (–0·1 to 1·3)
Latin America region	4·4 (4·0 to 5·2)	4·9 (4·4 to 6·0)	5·4 (4·7 to 6·8)	6·1 (5·2 to 8·0)	6·5 (5·3 to 9·1)	2·1 (0·8 to 4·5)
Caribbean	0·5 (0·4 to 0·8)	0·5 (0·4 to 0·8)	0·5 (0·4 to 0·9)	0·6 (0·5 to 1·0)	0·6 (0·5 to 1·0)	0·1 (–0·0 to 0·3)
Central America	0·8 (0·7 to 0·9)	0·9 (0·7 to 1·2)	1·0 (0·8 to 1·3)	1·2 (1·1 to 1·4)	1·3 (1·0 to 1·8)	0·6 (0·2 to 1·0)
South America	3·1 (2·8 to 3·8)	3·5 (2·9 to 4·5)	3·8 (3·2 to 5·1)	4·3 (3·4 to 6·1)	4·6 (3·3 to 7·0)	1·4 (0·1 to 3·7)
Northern America	1·6 (1·6 to 1·7)	1·5 (1·4 to 1·5)	1·4 (1·3 to 1·4)	1·3 (1·3 to 1·4)	1·2 (1·1 to 1·3)	–0·4 (–0·5 to –0·4)
Europe	8·2 (7·5 to 10·1)	7·1 (6·6 to 8·9)	6·0 (5·5 to 7·5)	5·2 (4·8 to 6·6)	4·4 (4·0 to 5·7)	–3·8 (–5·0 to –3·1)
Eastern Europe	6·0 (5·5 to 7·3)	5·2 (4·7 to 6·3)	4·1 (3·8 to 5·0)	3·4 (3·1 to 4·1)	2·6 (2·4 to 3·2)	–3·4 (–4·4 to –2·8)
Northern Europe	0·4 (0·4 to 0·5)	0·4 (0·4 to 0·5)	0·4 (0·3 to 0·4)	0·4 (0·4 to 0·4)	0·3 (0·3 to 0·4)	–0·1 (–0·1 to –0·1)
Southern Europe	1·2 (0·9 to 2·4)	1·1 (0·8 to 2·2)	0·9 (0·7 to 1·9)	0·8 (0·6 to 1·8)	0·8 (0·5 to 1·7)	–0·4 (–1·1 to –0·1)
Western Europe	0·5 (0·4 to 0·9)	0·5 (0·4 to 0·9)	0·6 (0·5 to 1·0)	0·6 (0·5 to 1·1)	0·6 (0·5 to 1·1)	0·1 (–0·0 to 0·3)
Oceania	0·1 (0·1 to 0·2)	0·1 (0·1 to 0·2)	0·1 (0·1 to 0·2)	0·1 (0·1 to 0·2)	0·1 (0·1 to 0·2)	0·0 (–0·0 to 0·1)

UI=uncertainty interval. *Based on comparison of 2010–14 with 1990–94.

Table 2: Estimated annual numbers of abortions (in millions) by geographic area and time period

abortions increased by 5·9 million (90% UI –1·3 to 15·4), from 50·4 million per year (48·6 to 59·9) in 1990–94 to 56·3 million per year (52·4 to 70·0) in 2010–14 (table 2).

In the developed world, the annual abortion rate declined significantly and substantially by 19 points (–26 to –14) from 46 abortions per 1000 women (90% UI 41 to 59) in 1990–94 to 27 (24 to 37) in 2010–14. In the developing world, the 2 point decline (–9 to 4) in the abortion rate from 39 abortions per 1000 women (37 to 47) in 1990–94 to 37 (34 to 46) in 2010–14 was not significant.

Of the 16 world subregions, the highest estimated annual rate in 2010–14 was in the Caribbean at 65 abortions per 1000 women (90% UI 48–107) and the lowest were in Northern America at 17 (16–18) and western Europe at 18 (14–31). The largest observed reduction between the first and last time periods was in eastern Europe, where the rate fell from 88 abortions per 1000 women (90% UI 80–107) in 1990–94 to 42 (38–51) in 2010–14. The abortion rate also fell in northern America and all the European subregions, except western Europe. Non-significant declines were noted in all the Asian subregions and in Northern Africa. The abortion rate is estimated to have increased significantly in western Europe by 5 points (1–11) from 13 abortions per 1000 women (90% UI 10–23) to

18 (14–31). Non-significant increases were noted in western, middle, eastern, and southern Africa and in all the Latin American subregions.

Globally, 25% (23–29) of pregnancies ended in abortion in 2010–14 (table 3). In the developed world, the percent of pregnancies ending in abortion declined by 11 points (–15 to –9) from 39% (36 to 44) to 28% (26 to 33), whereas in the developing world, it increased significantly by 3 points (2 to 7) from 21% (20 to 24) to 24% (23 to 29). Pregnancy rates and numbers of pregnancies are shown in the appendix (pp 70–71).

When countries were grouped according to the grounds under which abortion was legal, we did not find evidence that abortion rates for 2010–14 were associated with the legal status of abortion (table 4). The rate was 37 abortions per 1000 women (34–51) where abortion is prohibited altogether or allowed only to save a woman's life, and 34 (29–46) where it is available on request.

The estimated annual abortion rate in 2010–14 was 36 (32–53) for all married women and 25 (20–42) for unmarried women (table 5). The UIs for the subgroup rates are wide, but married women have higher abortion rates than unmarried women in most subregions, and this difference is significant in Europe (posterior probability 98·5%). In sub-Saharan

	1990–94 (90% UI)	1995–99 (90% UI)	2000–04 (90% UI)	2005–09 (90% UI)	2010–14 (90% UI)	Difference* (90% UI)
World	23% (23 to 26)	24% (23 to 27)	24% (23 to 27)	24% (23 to 28)	25% (23 to 29)	2 (–0 to 5)
Developed countries	39% (36 to 44)	37% (35 to 43)	34% (32 to 40)	31% (29 to 36)	28% (26 to 33)	–11 (–15 to –9)
Developing countries	21% (20 to 24)	22% (21 to 25)	22% (21 to 26)	23% (22 to 27)	24% (23 to 29)	4 (2 to 7)
Africa	12% (11 to 18)	13% (12 to 18)	14% (12 to 18)	14% (13 to 18)	15% (14 to 19)	3 (4 to 8)
Eastern Africa	11% (9 to 15)	12% (10 to 15)	12% (11 to 15)	13% (11 to 15)	14% (13 to 16)	3 (4 to 8)
Middle Africa	10% (7 to 19)	11% (8 to 19)	12% (8 to 20)	12% (8 to 20)	13% (9 to 22)	3 (3 to 11)
Northern Africa	19% (13 to 34)	21% (15 to 36)	22% (15 to 37)	23% (15 to 37)	23% (15 to 38)	4 (0 to 13)
Southern Africa	17% (10 to 31)	20% (12 to 33)	21% (13 to 34)	22% (14 to 35)	24% (15 to 38)	7 (0 to 15)
Western Africa	10% (8 to 14)	10% (9 to 14)	11% (9 to 14)	11% (10 to 14)	12% (11 to 15)	2 (4 to 7)
Asia	23% (22 to 27)	25% (23 to 29)	25% (23 to 30)	26% (24 to 31)	28% (25 to 33)	4 (–2 to 7)
Eastern Asia	31% (28 to 36)	34% (31 to 40)	35% (30 to 42)	35% (29 to 42)	34% (27 to 43)	2 (–11 to 5)
South and central Asia	17% (14 to 21)	18% (15 to 21)	19% (17 to 22)	21% (18 to 26)	25% (21 to 31)	8 (2 to 14)
Southeastern Asia	26% (21 to 36)	27% (22 to 37)	26% (21 to 38)	26% (20 to 37)	27% (21 to 39)	1 (–5 to 7)
Western Asia	21% (18 to 29)	23% (20 to 31)	24% (21 to 32)	23% (19 to 32)	23% (18 to 34)	2 (–1 to 10)
Latin America region	23% (22 to 26)	25% (23 to 29)	27% (25 to 31)	30% (27 to 36)	32% (28 to 39)	9 (3 to 14)
Caribbean	32% (27 to 42)	34% (30 to 44)	35% (30 to 46)	39% (33 to 49)	39% (33 to 51)	8 (–2 to 11)
Central America	15% (13 to 18)	17% (14 to 21)	19% (16 to 23)	22% (20 to 25)	24% (20 to 30)	9 (4 to 14)
South America	25% (23 to 29)	27% (24 to 32)	29% (26 to 35)	32% (27 to 40)	34% (28 to 44)	9 (1 to 16)
Northern America	23% (22 to 24)	21% (21 to 22)	20% (20 to 21)	19% (18 to 19)	17% (17 to 18)	–6 (–6 to –4)
Europe	42% (41 to 47)	42% (41 to 47)	39% (37 to 44)	34% (33 to 40)	30% (29 to 36)	–12 (–16 to –10)
Eastern Europe	54% (52 to 58)	56% (54 to 61)	52% (50 to 56)	45% (43 to 49)	38% (36 to 43)	–16 (–21 to –15)
Northern Europe	22% (21 to 25)	22% (21 to 25)	21% (20 to 24)	20% (20 to 23)	19% (18 to 21)	–3 (–5 to –2)
Southern Europe	38% (31 to 54)	36% (30 to 52)	33% (26 to 49)	30% (24 to 47)	29% (22 to 46)	–9 (–17 to –1)
Western Europe	17% (13 to 26)	17% (14 to 26)	19% (16 to 28)	21% (17 to 31)	21% (17 to 31)	4 (–1 to 7)
Oceania	16% (15 to 21)	17% (16 to 23)	18% (16 to 23)	16% (14 to 22)	16% (13 to 22)	–1 (–0 to 5)

UI=uncertainty interval. *Based on comparison of 2010–14 with 1990–94.

Table 3: **Percent of pregnancies ending in abortion, by geographical area and time period**

	Average number of countries per year	Abortion rate (90% UI)
Prohibited altogether or to save a woman's life†	58	37 (34–51)
Physical health	34	43 (40–53)
Woman's mental health	19	33 (27–49)
Socioeconomic grounds	10	31 (23–47)
On request	63	34 (29–46)

UI=uncertainty interval. *Gestational limits, authorisation requirements, waiting periods, and other conditions for legal abortions vary across countries in all categories. †Includes countries where abortion is also allowed in cases of rape or incest.

Table 4: **Abortion rate per 1000 women aged 15–44, by grounds under which abortion is legally allowed, 2010–14***

Africa and north America, unmarried women have higher abortion rates than do married women; this difference is significant in western Africa (posterior probability 99·6%; appendix pp 19, 22). In the developed world, the abortion rate declined more among married women than among unmarried women (posterior probability 98·4%; appendix pp 18–23). Globally, we estimate that for the period 2010–14, 27% (18–41) of abortions were obtained by unmarried women (who represent 35% of all women of reproductive age; figure 2).

Discussion

Our findings indicate the abortion rate declined significantly in the developed world, but not in the developing world, between 1990 and 2014. Although it is likely that current numbers and rates of abortion would be even higher in the absence of investments in family planning services in recent decades, the findings suggest that much more investment is needed to meet the demands of the growing population, the increasingly widespread desire for small families, and the growing strength of women's and couples' motivation to control family size and the timing of births.

We estimate that more than 15 million unmarried women obtained an abortion each year in 2010–14. The findings should motivate efforts to ensure that unmarried women and their partners have access to the reproductive health services they need to prevent and manage unintended pregnancies.[29]

Although the estimated rates for subgroups of married women were sensitive to model assumptions, we found that a non-trivial number of abortions occur in all

	Unmarried women (90% UI)	Married women (90% UI)
World	25 (20–42)	36 (32–53)
Developed countries	18 (15–25)	33 (29–51)
Developing countries	27 (21–48)	37 (32–55)
Africa	36 (30–55)	26 (25–50)
Asia	23 (14–50)	38 (29–59)
Latin America region	28 (16–59)	49 (34–89)
Northern America	20 (16–24)	14 (11–18)
Europe	16 (13–26)	38 (33–55)
Oceania	20 (11–33)	15 (9–35)

Table 5: Abortion rates per 1000 women aged 15–44 years in groups of women defined by marital status, 2010–14
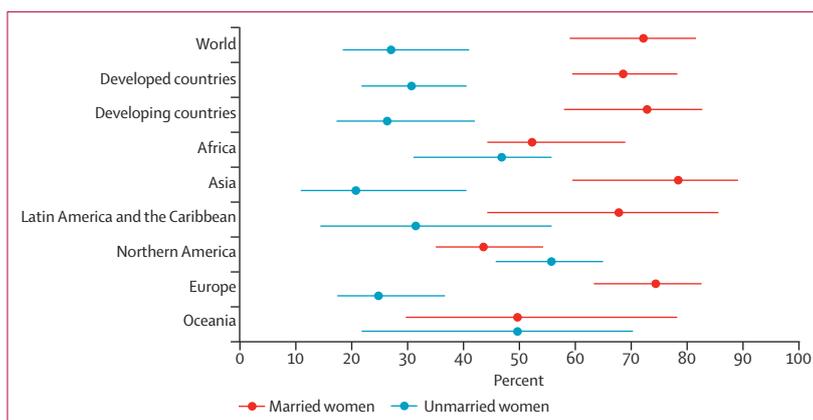
Figure 2: Global and regional percent of abortions obtained by married and unmarried women, 2010–14
Point estimates are represented by circles and 90% uncertainty intervals are represented by horizontal lines.

subgroups of married women, including women using a contraceptive method and those who had been classified as having no need for contraception. These findings suggest that some contraceptive users need more effective methods, methods better suited to their circumstances, more secure contraceptive supply, and information and counselling to help them use their methods more effectively and consistently. It is also the case that nearly all methods sometimes fail, even when used consistently and correctly.

Findings from the descriptive analysis presented here indicate that abortion rates are not substantially different across groups of countries classified according to the grounds under which abortion is legally allowed. The level of unmet need for contraception is higher in countries with the most restrictive abortion laws than in countries with the most liberal laws, and this contributes to the incidence of abortion in countries with restrictive laws. Additional research on women's and couples' decision making in the face of an unintended pregnancy in different legal settings and sociocultural contexts is needed to improve our understanding of the factors that influence the decision to have an abortion.

The estimates of abortion incidence for 1990–2014 are intended to override previously published estimates for 1995, 2003, and 2008.[1] Our results corroborate the previously published finding that abortion incidence declined more substantially in the developed world than in the developing world, and extend this finding to 2010–14. The model-based abortion rates presented here are higher than those previously published for many regions (appendix pp 28–53). We expect that the previously published estimates were based on conservative assumptions, including conservative adjustments for under-reporting. Moreover, the current estimates drew from a larger body of information, including abortion rates, information about the composition of populations, and relationships between these factors.

Our estimates have several limitations. Information about abortion incidence in the developing world is scarce. The quantity and precision of data in developing regions are reflected in the wide uncertainty intervals around estimates for these regions. Empirical evidence to inform and validate the estimated rates for subgroups of married women is also lacking, and research on abortion incidence in these subgroups is needed.

Only proxy information was available for the potential predictors of subgroup rates—namely, women's strength of motivation to resolve an unintended pregnancy through abortion, their ability to do so, their fecundity, and the frequency of their sexual activity. The proxies for these potential predictors of subgroup abortion rates did not improve overall model performance. More research is needed to better understand and capture the covariates and their relationships with abortion incidence.

To estimate the number of women experiencing contraceptive failure, we required estimates of method-specific contraceptive failure rates. Because of data constraints, we assumed that contraceptive failure rates are fixed across place and time, but user effectiveness rates vary across populations.[30–32] We might expect that method-specific failure rates, and therefore abortion rates among contraceptive users, are higher in developing countries with fairly weak family planning programmes than in developed countries. Sensitivity analyses indicate that the overall abortion rates in the subregions are not sensitive to assumptions about method failure rates (appendix pp 15–16).

Data limitations also required us to classify all unmarried women together rather than subdivide them according to whether they had an unmet or met need for contraception. Information about sexual activity, contraceptive need, and contraceptive use among unmarried women is available for a small proportion of all the countries and years in this analysis, and existing estimates can be compromised by under-reporting of sexual activity where premarital sex is stigmatised. It is also possible that the composition of the married subgroups varies across subregions and over time. For example, a larger share of women classified as having unmet need might be infecund or sexually inactive in some subregions than in others. However, the model's

ability to estimate different subgroup rates across countries, and different trends in rates across countries, provides one means to capture these differences. Validation exercises suggest that the model performs well for estimating overall abortion rates despite these limitations.

The availability of abortion data on which to base our estimates was also uneven across regions and time. As for any estimates based on inference, this approach relies on the assumption that abortion rates in countries without data are comparable to those in countries with similar characteristics but for which evidence is available.

This analysis represents a substantial improvement over approaches used previously to estimate abortion incidence. This undertaking brings formal model-based inference to worldwide abortion estimates for the first time. The modelling approach allowed us to make formal inference, present uncertainty intervals around the estimated abortion rates, and examine the robustness of the results with validation exercises and sensitivity analyses.

The increasingly widespread use of medical abortion (misoprostol with or without mifepristone) has made it more difficult to measure abortion incidence in many countries. To make these global estimates, we distinguished between data sources that are and are not likely to include all abortions, including medical abortions. Nevertheless, more rigorous data collection and estimation efforts are needed to ensure that medical abortions are not omitted from national statistics and studies of abortion incidence.

Although an induced abortion is a medically safe procedure when done in accordance with recommended guidelines,[33] many women undergo unsafe abortions that put them at risk of physical harm. It is estimated that 6·9 million women in the developing world were treated for complications from unsafe abortion in 2012,[34] and as many as 40% of women who need care do not obtain it.[35] Estimates of the proportion of abortions that are unsafe, ideally with a gradation by severity of risk associated with the procedure,[36] will help to bring attention to the magnitude of this public health problem and the need for policies and programmes to help to reduce the incidence and consequences of unsafe abortion.

The UN Sustainable Development Goals include the target of ensuring universal access to sexual and reproductive health-care services, including for contraceptive services. Achieving this goal would help millions of women to avoid unintended pregnancies and the need for abortion. But our findings indicate that, even if all couples who wished to avoid pregnancy used contraception, unintended pregnancies and abortions would occur because no method is perfect and methods are sometimes used imperfectly. Moreover, some women who want to have a child face circumstances that lead them to seek an abortion after they become pregnant. Access to safe abortion is necessary to help women seeking an abortion to avoid recourse to clandestine and unsafe procedures.

For more on **the UN SDG targets** see http://sustainable development.un.org/topics

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