

# Global changes in contraceptive method-mix and outlook to 2030

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## Introduction

The landmark 1994 International Conference on Population and Development (ICPD) asserted the importance of availing women and their partners of the full range of safe, affordable and effective family planning methods. Despite the emergence of an emphasis on increasing availability and agency, method-specific contraceptive prevalence continues to vary widely across the world (United Nations 2019). The patterns currently observed are a result of a combination of long-term changes in the contraceptive choice set and the motivations for using contraception. The set of choices of methods has been influenced by changes in methods themselves (including their variety, availability, and acceptability), shifts in healthcare policy, institutional transformation (e.g. changes in secularization and democratization), and global economic integration and aid. At the population level, the patterns of method use have been and continue to be influenced by demographic dynamics, such as changes in childbearing desires, fertility trends, marriage and union formation patterns and the age structure of women of reproductive age.

A population's method-mix serves as an indicator of how effectively women and couples can avoid unintended pregnancies, an important factor for enabling women and their partners to exercise their reproductive rights. This is because contraceptive failure rates are known to vary widely across methods (Hatcher et al, 2011; Ali et al. 2012, Bradley et al. 2019, Polis et al. 2016). As a result, variation in the types of specific methods used across populations – despite similarities in the overall level of contraceptive use – can lead to inequalities in the propensity for high-risk births, unsafe abortions, and unwanted pregnancies.

Previous comparative studies on contraceptive method-mix looked at the situation at one point in time or a change over two points in time (United Nations 2015 and 2019, Ross et al 2002, Ross et al 2015). In this paper, we track the development of the contraceptive method-mix across three points in time covering the period 1995 to 2015 and by marital status. First, we will describe trends in the contraceptive methods used by women and their partners since 1995. Then, we describe changes in the effectiveness of method-mix for pregnancy prevention. Finally, we estimate how the global method-mix will change under different scenarios.

## Data

There are two main data sources used to produce the method-specific estimates of contraceptive use: survey estimates and model-based estimates.

### *Survey Estimates*

We identified 1,376 survey observations across 196 countries for the period 1950-2020 which were nationally representative and reported data on the prevalence of individual contraceptive methods (i.e. the percentage of women of reproductive age using a specific method). (United Nations, 2021a). Of these, we included one survey observation from each country (where possible) for each of the following periods: 1990-1999, 2000-2009 and 2010-2019. When countries had multiple surveys in a period, the survey closest to the midpoint of the decade (i.e. 1995, 2005, 2015) was selected. Surveys prior to 1990 were excluded as the quality of the data and the geographical coverage tended to be worse. After imposing these restrictions, we include data from a total of 516 unique surveys. There was generally better coverage for the contraceptive behavior of married/in-union women than for unmarried/not-in-union women. For married women, estimates could be calculated at least one period for 188 countries and for all three periods for 114 countries; for unmarried women, an estimate could be calculated for at least one period for 134 countries and for all three periods for 45 countries. Most countries with missing data on method use among unmarried women are located in Northern Africa, Western Asia, and other parts of Asia, where the use of contraceptive methods is estimated to be low among unmarried women due to lower levels of sexual activity in this population and generally low acceptance of sex for unmarried women (Ueffing et al, 2019)

### *Modelled Estimates*

To construct the method-specific prevalence at the national, regional and global levels, we made use of the model-based estimates of the use of modern and traditional methods generated by Bayesian hierarchical models (Alkema et al., 2013; Kantorova et al. 2020). This model is fitted to the survey data in *World Contraceptive Use 2021* (United Nations, 2021a) and used to generate estimates of the numbers of users and contraceptive prevalence rates for the period 1990 to 2030 for all women of reproductive age (15-49 years) and by marital status, for 186 countries (United Nations, 2021b). These estimates of family planning indicators are comparable across place and time as they take into account all available data and make adjustments for their various biases.

## **Methods**

### *Generating estimates for 1995, 2005 and 2015*

Estimate the use of individual methods requires two steps. First, one must calculate the distribution of method use among all women who use any form of contraception. Then, one must translate these distributions into prevalence rates by multiplying them by the total contraceptive prevalence rate.

For the first step, we calculate the distribution of contraceptive users among 14 categories of contraceptive methods: for modern methods, female sterilization, male sterilization, IUD, implant, injectables, pill, male condom, female condom, vaginal barrier methods, lactational amenorrhea method (LAM), emergency contraception and other modern methods; and for traditional methods, rhythm (and other fertility awareness-based methods), withdrawal and other

traditional methods. We then calculate the proportion of individual use of modern (or traditional) methods among all modern (or traditional) method use from survey observations as an estimate of the combined method-mix.

Missing data was a common problem of varying complexity when constructing estimates of the method-mix. In the simplest cases of missing data, when a country had no data on contraceptive use for a single period, estimates of contraceptive prevalence were generated using sub-regional and regional averages. Other cases could be more complex, for instance if a survey only reported the use of some methods or if a survey categorized methods in an unconventional way. For example, male and female sterilization are often not reported separately, and to generate an estimate of their probable contributions to the method-mix, the sub-regional ratio of male to female sterilization is used to separate the combined figure into two. Analogous adjustments are made for the traditional methods withdrawal and rhythm methods, which are also often reported together in surveys. In cases where a country only has survey data available for the first and last period, linear interpolation is used to fill in missing data.

In the second step, to estimate the contraceptive prevalence of the individual methods, the method-mix is then multiplied by the model-based estimates of contraceptive prevalence of modern and traditional methods from model-based estimates (United Nations, 2021b). This procedure is done separately for each marital status. To produce estimates for all women of reproductive age, estimates for married and unmarried women are weighted by the proportion of women aged 15-49 who are married or in-union (United Nations 2020).

#### *Calculating Effective Contraceptive Prevalence Rate*

To assess the effectiveness of a country's method-mix, we calculate the effective contraceptive prevalence rate. The standard CPR can be thought of as the sum of method-specific contraceptive prevalence rates. If one intends to interpret the standard CPR as a measure of protection from unwanted pregnancy, one must assume that all methods offer equal and perfect protection. It is known, however, that the risk of contraceptive failure is not equal across methods. We may estimate the effective CPR for a country  $c$  in year  $i$  as the sum of the users of individual methods  $j$  multiplied by one minus the method-specific probability of contraceptive failure  $p$  and divided by the number of women of reproductive age.

$$Effective\ CPR_{c,i} = \sum \frac{M_{j,c,i}(1 - p_j)}{N_{c,i}}$$

This quantity can now be interpreted as the percentage of women protected against unintended pregnancy given the risk of contraceptive failure. For the estimation of method-mix efficacy, method-specific failure rates are based on estimates in Bradley et al (2019) for implant, IUD, injectable, pill, condom, withdrawal, periodic abstinence and Trussell (2011) (in Hatcher et al. 2011) for female and male sterilization and vaginal barriers methods.

#### *Generating scenarios for 2030*

To understand how future changes in population structures and contraceptive use may change the global estimates of the method-mix by 2030, estimates were generated for two scenarios:

### Constant Method-mix Scenario

In the first scenario, we assume that the method-mix in all countries in 2015 will remain constant, but we allow the number of women of reproductive ages (15-49) to continue to change as projected up to 2030 (equation 1). Using the projections of the total number of contraceptive users in 2030 from the model-based estimates, we first estimated the number of users of method  $j$  of method-mix  $M$  in 2030 for country  $c$ . This was done by multiplying the country-specific proportion of contraceptive users for method  $j$  for 2015 by the country-specific total projected number of users in 2030 and then summing across all countries of the world. These were then divided by the sum of the projected number of women of reproductive age in 2030 from the *World Population Prospects* to obtain the global method-specific prevalence rates.

$$M_{j,c,2030} = \frac{\sum M_{j,c,2015} U_{2030}}{\sum W_{2030}} \quad (1)$$

### Changing Method-Mix Scenario

In the second scenario, we assume that – in addition to the changing population structure – the country-specific method-mix will also change over time. In this scenario, we assume that the method-mix of countries which have relatively lower *total contraceptive prevalence rates* in 2015 will increasingly resemble the method-mix of countries which have relatively higher rates by 2030. Furthermore, we assume that there will not be a widespread adoption of a new method not included in the current categorization.

Estimates of a country's method-mix in 2030 are generated using a two-step procedure. First, we calculate the quantiles of the total contraceptive prevalence rate in 2015 from the population of countries. Each country is then assigned its percentile rank according to where it is located in the distribution. For example, a country which had a total contraceptive prevalence rate equal to the median would be assigned a rank of 50.

In the second step, we calculate the method-mix of a country in 2030 as an average of two components: (1) the country's method-mix in 2015 and (2) the mean of the method-mix for countries whose total contraceptive prevalence rate was between 10 and 20 percentage points above the index percentile in 2015. The estimated value for method  $j$  of method-mix  $M$  for country  $c$  would therefore be calculated as:

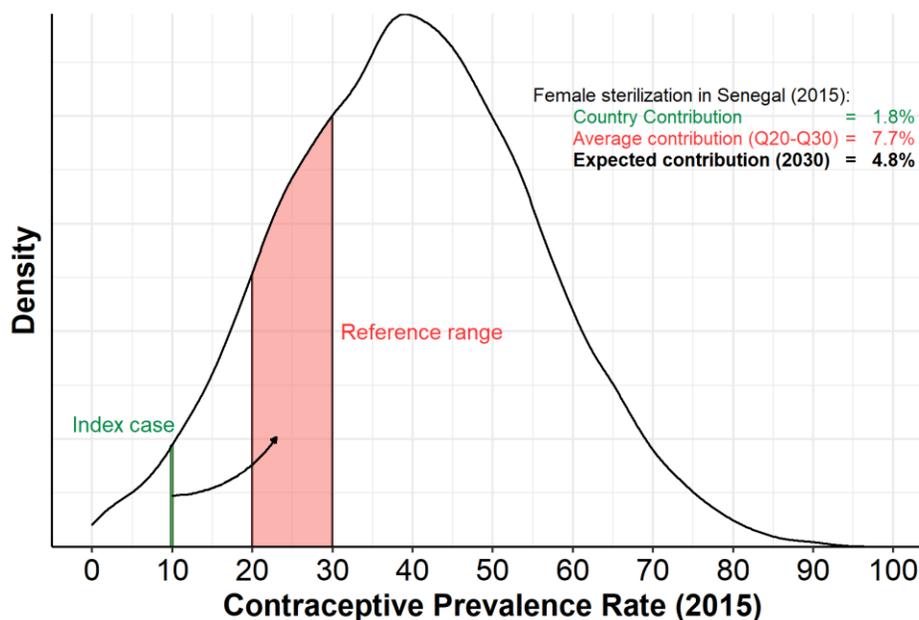
$$M_{j,c,2030} = \begin{cases} \frac{M_{j,c,2015} + \left( \sum_{CPR_{Q_{n+20}}}^{CPR_{Q_{n+10}}} \frac{M_{j,c,2015}}{N_{c,2015}} \right)}{2}, & n < 80 \\ \frac{M_{j,c,2015} + M_{j,Q_{95},2015}}{2}, & n \geq 80 \end{cases} \quad (2)$$

Here,  $Q_n$  refers to the quantile at which the index population's contraceptive prevalence rate (CPR) was located in the distribution. For all countries at or above the 80<sup>th</sup> percentile in the distribution of CPR, it was assumed that they would progress towards the method-mix at the 95<sup>th</sup> percentile. The rationale behind this approach is that the estimated change will be informed by both a country's current level of contraceptive use and a range of plausible levels of future use

by 2030. Furthermore, the expected changes are defined uniformly for all countries, rather than defined using a single reference value (e.g. assuming that method-mix will converge towards that found in countries with a CPR equal to some specific value). As a result, countries' method-mixes are expected to become more similar to those found in countries which had similar levels of contraceptive use more recently rather than more similar to countries which have long had high rates of use.

Figure 1 provides an illustrative example of how the percentage of users relying on female sterilization would be calculated for Senegal using this approach. In 2015, Senegal's total CPR for all women of reproductive age was 17%. This value was located at the 10<sup>th</sup> percentile of the distribution of all CPRs for that year. Among contraceptive users in Senegal, 1.8% used female sterilization. To create an estimate for the share of users relying on female sterilization in 2030, this approach assumes that the percentage of users relying on female sterilization in Senegal would become more similar to the average share using sterilization in countries whose CPR was between the 20<sup>th</sup> and 30<sup>th</sup> percentile (i.e. CPR between 23.4% and 31.2%). This leads to the estimate that 4.8% of contraceptive users in Senegal in 2030 will rely on female sterilization. The same procedure is then applied to all methods and for both married and unmarried women to obtain the complete method-mix for 2030.

**Figure 1.** Example of calculation of changing method-mix scenario: female sterilization in Senegal.



## Results

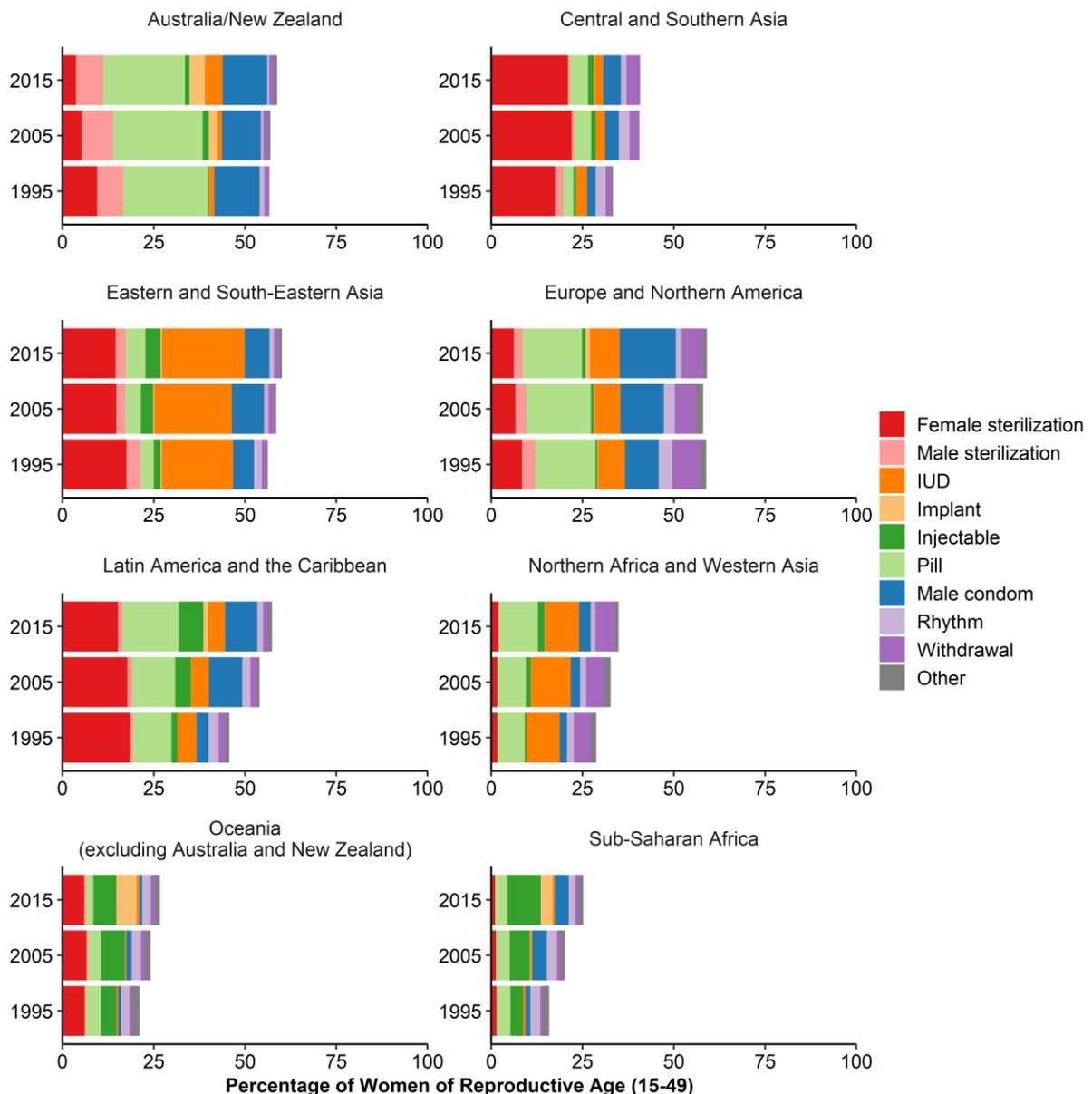
### *Changes in method-mix: 1995 – 2015*

Figure 2 shows how the method-specific and total contraceptive prevalence rates have changed within regions between 1995 and 2015. The overall use of contraception has increased in all world regions since 1995, with the largest increases occurring in Latin America and the

Caribbean, Sub-Saharan Africa, and Northern Africa and Western Asia. Other regions have only witnessed small increases during the same period, including Australia/New Zealand, Europe and Northern America, and Eastern- and South-Eastern Asia.

Method-mix has varied significantly over time and between regions. In Central and Southern Asia, Eastern and South-Eastern Asia, Oceania, and Latin America and the Caribbean, female sterilization plays a prominent role in the method-mix, while this method only plays a minor and shrinking role in Australia/New Zealand, Europe and Northern America, Northern Africa and Western Asia, and Sub-Saharan Africa.

**Figure 2.** Total and method-specific contraceptive prevalence rate for all women by SDG region, 1995-2015.



The contraceptive pill has consistently been an important part of the method-mix found in Europe and Northern America and in Australia/New Zealand. The pill's importance has also been growing over the past two decades in Latin America and the Caribbean as well as in Northern Africa and Western Asia. It only plays a relatively small role in regions with low contraceptive prevalence, however, such as Oceania and Sub-Saharan Africa.

Intrauterine devices (IUDs) also show strong regional variation, playing a prominent role in the method-mix of Eastern and South-Eastern Asia as well as Northern Africa and Western Asia. IUDs also make up a non-negligible share of the contraceptive users in Europe and Northern America and Latin America and the Caribbean and increasingly in Australia/New Zealand.

Injectables and implants are uncommon in much of the world, but are crucial to the method-mix of sub-Saharan Africa and Oceania. After 2005, implants became far more prevalent in these regions. Injectables, while only playing a minor role in many populations' method-mix, have been increasingly adopted in other world regions, particularly Latin America and the Caribbean and South-Eastern Asia.

In all regions, a minority of women rely exclusively on traditional methods, such as rhythm methods and withdrawal. Nevertheless, traditional method use accounts for a significant share of total contraceptive use in Central and Southern Asia (13% in 2015), Europe and Northern America (14%), and in Northern Africa and Western Asia (21%), Oceania (16%), and sub-Saharan Africa (14%). Even in these regions, however, the share of traditional use has declined since 1995.

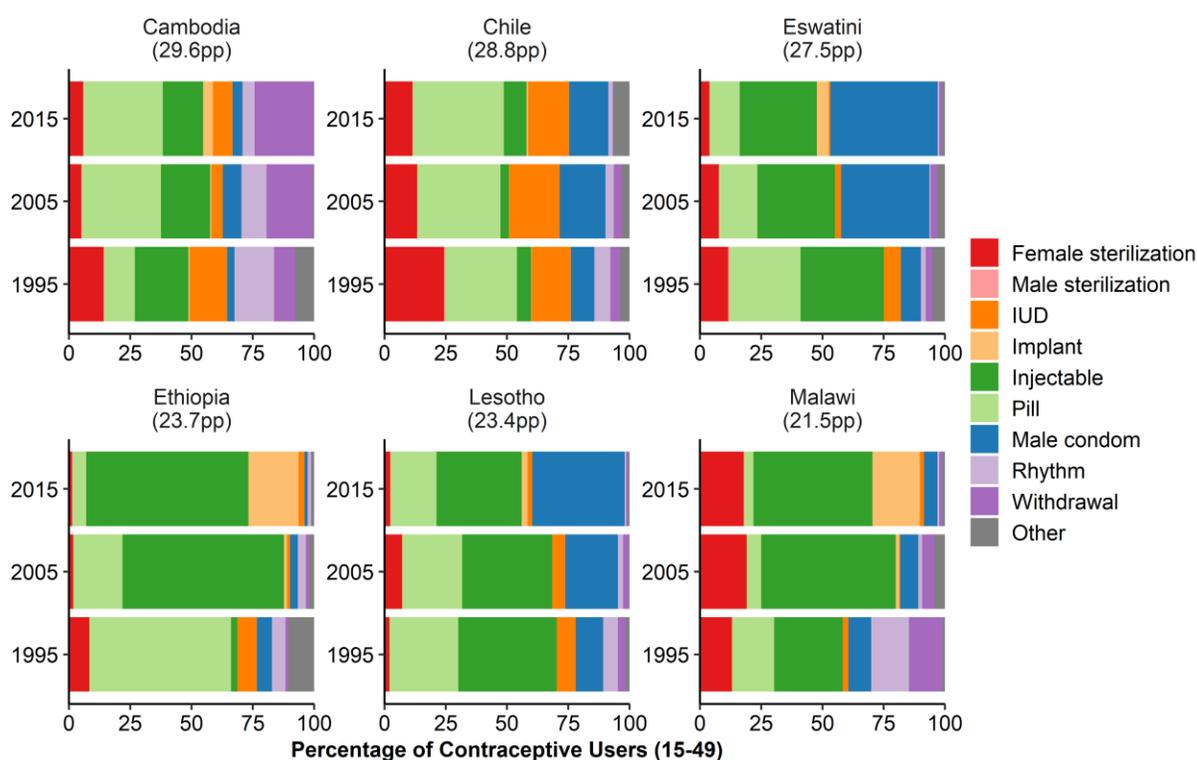
The variation found at the regional level is also reflected at the national level. Figure 3 presents the method-mixes for the six countries experiencing the largest percentage point increase in the contraceptive prevalence rate between 1995 and 2015. All of these countries have shown dramatic increases in the use of contraception since 1995, but the evolution of their method-mixes has varied significantly.

A common trend across these countries is the decline of the prominence of traditional methods over time. This decrease is clearest in Malawi, where traditional methods accounted for over 25% of all method use in 1995, but less than 2% by 2015. In Cambodia, on the other hand, traditional methods have continued to play a prominent role in the method-mix, despite declining slightly. Similarly, the share of users relying on female sterilization has generally declined over time as overall contraceptive use has increased. The exception to this is Malawi, where female sterilization has come to make up a larger share of contraceptive use over time.

In sub-Saharan Africa (Eswatini, Ethiopia, Lesotho, Malawi), implants and injectables have emerged as a major component of the method-mix and the pill has become less prominent. In 1995, injectables were nearly non-existent in Ethiopia's method-mix, but have come to account for nearly two-thirds of use by 2015. In Malawi, the method-mix has similarly shifted towards the use of injectables, where it accounted for 28% of use in 1995 and 49% in 2015. Implants are used less widely, but also have become important components of the method-mix in these countries. In both Ethiopia and Malawi, implant use increased from about 1% in 2005 to 20% in 2015. As implants and injectables have become more commonly used in these countries, the

birth control pill has become less commonly used. In the most extreme case, the pill was used by 58% of contraceptive users in 1995 but only 6% in 2015. These methods have been less prominent outside of sub-Saharan Africa, but they contribute significantly to the method-mixes of countries in other regions. In Cambodia, injectables and implants account for a combined 20% of method use, for example. In contrast to the sub-Saharan African countries, however, pill use has increased in Cambodia and Chile since 1995 and made up about one-third of total use in 2015.

**Figure 3.** Method-mix of countries experiencing the largest increases in total contraceptive prevalence since 1995.



*Notes:* Percentage point change in contraceptive prevalence rate among women of reproductive age between 1995 and 2015 in parentheses. 'Other' includes various modern and traditional methods that did not fit into the major categories.

The role of condoms in national method-mixes has varied over time and across countries. Lesotho and Eswatini, in particular, have seen condom use increase from about 10% of total use in 1995 to 40% in 2015. In Chile, the share of condom use has increased from 9% in 1995 to 16% in 2015. In Ethiopia, on the other hand, condom use was a minor component in 1995, accounting for 6% of use, and this share has only decreased, reaching 1% in 2015. In Cambodia, condom use has generally remained low throughout the coverage period.

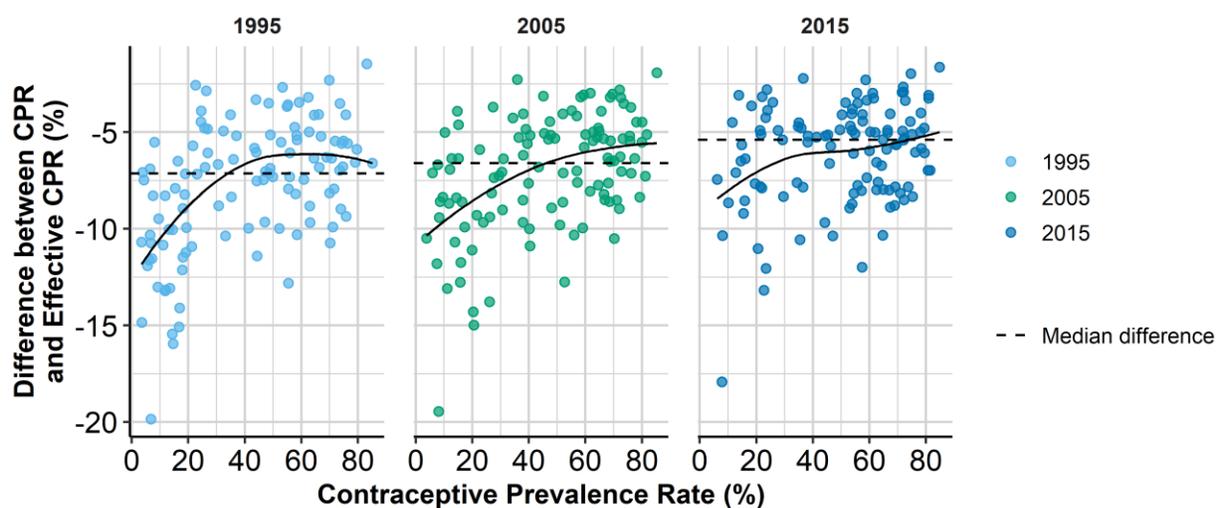
IUDs were not widely used in most of these countries, except for Chile, where it made up 17% of use in 2015. In Cambodia, IUDs were more widely used in 1995 (15%) but have made up a smaller and smaller share of the total method-mix over time; by 2015, IUDs were used by 8% of

contraceptive users. In the sub-Saharan African countries, IUDs only accounted for a less than 1% of the method-mix.

### *Changes in method-mix effectiveness*

As the prevalence of specific methods has evolved over time, there has consequently been an improvement in the overall effectiveness of method-mixes throughout the world. Figure 4 shows the difference in contraceptive prevalence when comparing the total CPR and the effective CPR. Effective CPR represents the total CPR adjusted for the average effectiveness of each of the components of the method-mix. Effective CPR will always be less than the total CPR. This metric provides an illustration of how well a current method-mix protects against unwanted pregnancy at a given level of CPR. The larger the difference between the CPR and effective CPR, the more the CPR overestimates the level of protection from unwanted pregnancy.

**Figure 4.** Percentage difference between CPR and Effective CPR for married/in-union women, 1995 to 2015.



*Notes:* Figures represent contraceptive use for married/in-union women. Only countries having a survey observation in each period were included. Y-axis refers to the relative percentage difference between the CPR and the effective CPR, i.e.  $(\text{CPR} - \text{Effective CPR}) / \text{CPR} * 100$ . Trend line estimated using a locally weighted regression.

In 1995, the median difference between CPR and effective CPR was 7.1%. In other words, the percentage of women of reproductive age who had actual protection from unwanted pregnancy was at least 7.1% lower than suggested by the standard CPR in half of the countries observed. The gap between effective and total CPR was largest, however, in countries in which the total CPR was already low. That is, countries that already had the lowest use of contraception were also using less effective method-mixes.

Differences in the effectiveness of the various method-mixes have continued to vary according to the level of CPR. In all years, countries with the lowest level of contraceptive use tended to have less effective method-mixes. Noteworthy progress has taken place, however. The median difference in effective CPR vs total CPR has continued to diminish, decreasing to 6.4% in 2005 and 5.4% in 2015. Furthermore, countries with low levels of contraceptive use have increasingly

gained access to highly effective methods, leading to smaller differences between total CPR and effective CPR. For countries with a total CPR below 20%, the mean difference between effective and total CPR was 10.9% in 1995 and decreased to 7.6% by 2015. For comparison, countries with a CPR between 20 and 40% only saw a reduction in the method-mix effectiveness gap from 5.7% to 5.1% over the same period.

#### *Differences in method use by marital status*

The overall level of contraceptive use tends to be lower among unmarried/not-in-union women than among married/in-union in a given population. This difference is due to several factors, including lower mean age of unmarried vs married women, less frequent sexual activity, and cultural norms against non-marital sexual activity, among others. Among women who do use contraception, however, there are clear differences in the methods used by married/in-union women and unmarried/not-in-union women.

Figure 5 shows the percentage of contraceptive users by marital status relying on long-acting, short-acting, and traditional contraceptive methods in 1995, 2005, and 2015. The countries included in the graph were those which had survey data available for both marital status groups and in all three periods. These requirements led to the inclusion of 45 countries in this figure. Long-acting contraceptives include male and female sterilization, implants and IUDs; short-acting contraceptives include the pill, injectables, male condoms, vaginal barrier methods, the lactational amenorrhea method, emergency contraception, and other modern methods; traditional methods include withdrawal, rhythm methods, and other traditional methods. The diagonal line indicates that an equal proportion of married/in-union and unmarried/not-in-union women used a given method in a given year. A point located above the diagonal indicates that a given method made up a relatively larger share of the method-mix for unmarried/not-in-union women than for married/in-union women; the reverse is true if it is located below the diagonal.

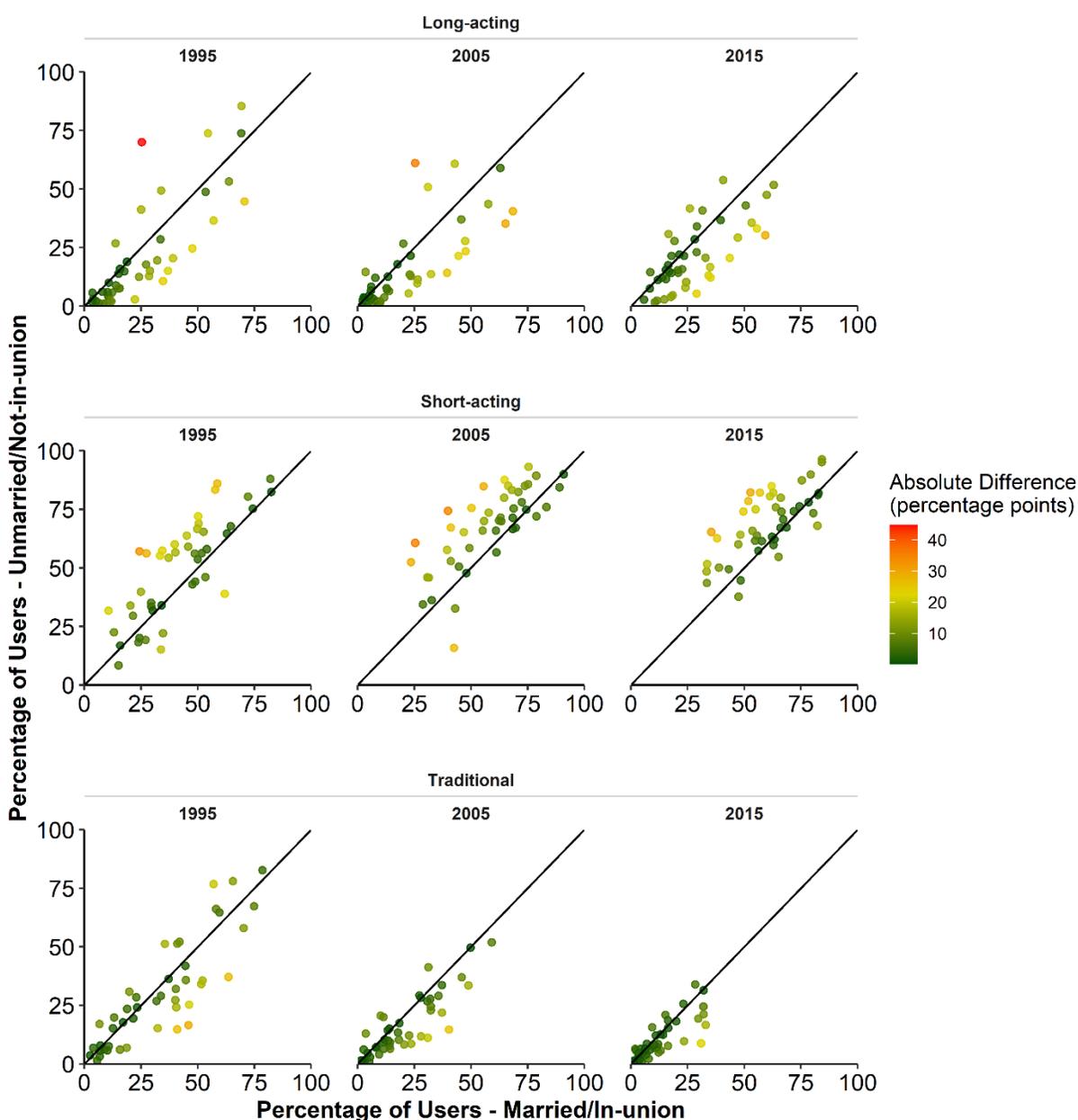
Between 1995 and 2015, long-acting methods made up an increasing proportion of the method-mix for both married/in-union and unmarried/not-in-union women, indicated by the cluster of points moving up along the diagonal. In general, long-acting methods have tended to make up a larger share of the method-mix of married/in-union women than of the method-mix of unmarried/not-in-union women. However, over time the number of points rising above the diagonal has increased, indicating that long-acting methods are playing an increasingly larger role in the method-mix of unmarried/not-in-union women.

Short-acting methods have made up the largest share of the method-mixes of both groups, and they have tended to be used more heavily by unmarried/not-in-union women. Since 1995, the share of women relying on short-acting modern methods has moved up the diagonal and become more concentrated, suggesting a general increase among all women in the share of use consisting of short-acting modern methods. In all periods, short-acting methods have accounted for a greater share of the method-mix for unmarried/not-in-union women.

Finally, the proportion of method-mixes consisting of traditional methods has declined for both groups since 1995, indicated by the movement of the points down the diagonal across years.

Furthermore, the share of the method-mix accounted for by traditional methods has generally become larger for married/in-union women than for unmarried/not-in-union women over time.

**Figure 5.** Method-specific use by marital status, 1995 to 2015.



*Notes:* Figures refer to data from 45 countries which had a survey available in each period (i.e. 1990-1999, 2000-2009, and 2010-2019) and for which contraceptive use data was collected for women who were married/in-union and unmarried/not-in-union. Diagonal line indicates the point at which a given method in a given year accounts for the same share of the method-mix for married/in-union women and unmarried/not-in-union women.

### *Scenarios for 2030*

Figure 6 presents method-specific contraceptive prevalence rates for the world from 1995 until 2015 and with two scenarios for 2030: a constant method-mix scenario and a changing method-

mix scenario. Between 1995 and 2015, female sterilization was the most widely used contraceptive method in the world, driven by its widespread use in the Indian subcontinent and in much of Latin America and the Caribbean. Despite modest decreases in the CPR for female sterilization over the period, it remained the most widely used method in 2015. Male sterilization, which is far less common than female sterilization, declined throughout the period.

The pill, male condom, and injectable have been seeing more widespread use since 1995. Pill use increased from 6.7 % to 7.9%, injectables from 1.4% to 3.7%, and male condom from 4.8% to 7.0%. The use of implants, while still low in relative terms, has increased by more than four times from 0.2% to 0.9% over the period. The CPR for IUDs remained virtually constant between 1995 and 2015, being used by about 10% of women of reproductive age worldwide. The use of traditional methods, particularly rhythm methods, has largely declined since 1995.

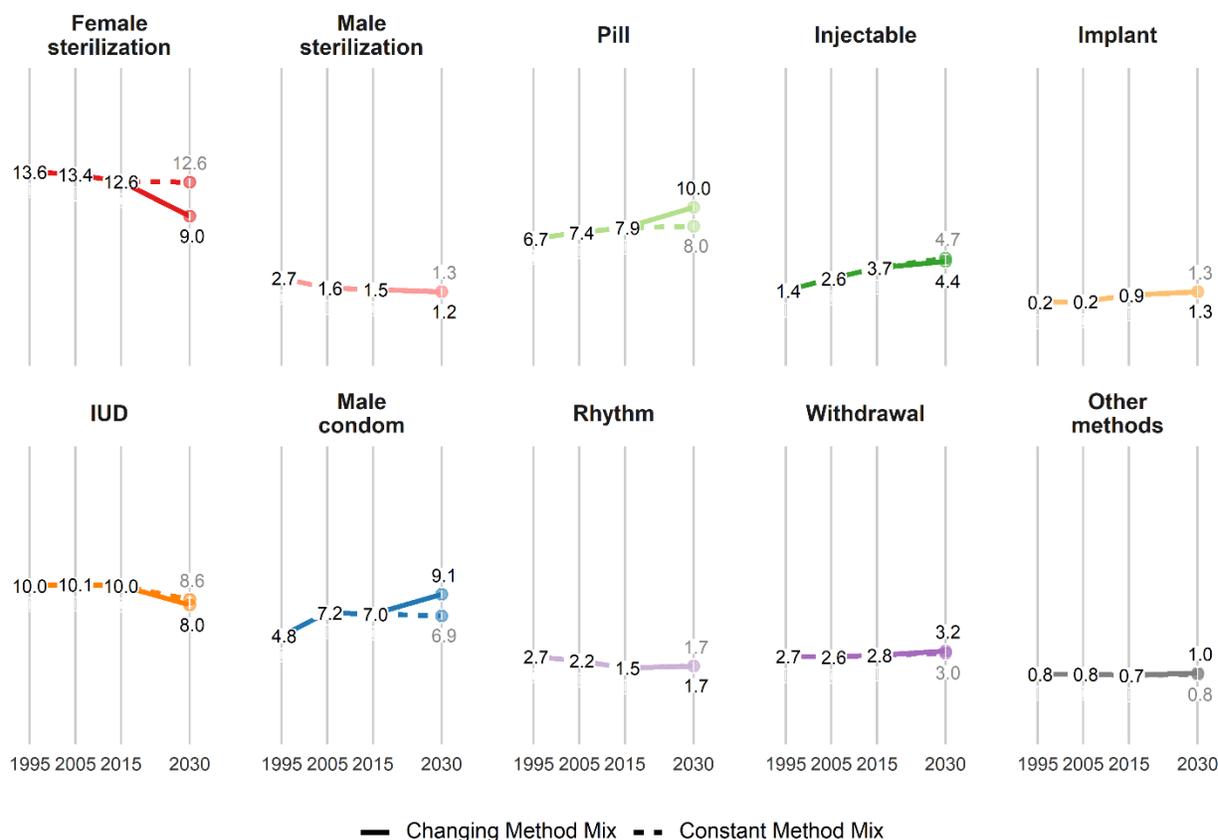
Looking towards 2030, we estimate that contraceptive prevalence of most methods would develop similarly, regardless of changes in countries' method-mix. Male sterilization is expected to continue its decline. As sub-Saharan Africa makes up a larger share of the world's population of women of reproductive age, injectables and implants are expected continue to become more prevalent and IUDs less widely used. Traditional methods are expected remain largely constant or slightly increase.

The scenarios provided divergent expectations for three methods: female sterilization, pill, and male condoms. Under the constant method-mix scenario, the percentage of the world's women of reproductive age using female sterilization is expected to remain virtually constant at 12.6% until 2030. Under the changing method-mix scenario, on the other hand, we would expect that female sterilization will continue its decline and reach 9% by 2030. Under the constant method-mix scenario, we would expect about 61 million more users of female sterilization worldwide.

Pill use would similarly be expected to remain virtually constant under the constant method-mix scenario at 8% of women of reproductive age. Under the changing method-mix scenario, however, the share of women of reproductive age using the pill would be expected to increase from 7.9 in 2015 to 10% 2030. The difference between the two scenarios is about 59 million users.

Finally, the two scenarios lead to different expectations for how the global use of male condoms may develop by 2030. Assuming countries' method-mixes remain constant, we would expect that the percentage of women of reproductive age using condoms would decline slightly from 7% to 6.9%. In the alternative case, in which method-mixes change, we would expect that condom use would increase to 9.1% by 2030. The difference between the two scenarios is equivalent to about 45 million users.

**Figure 6.** Global changes in method-specific contraceptive prevalence for all women from 1995 to 2015 with scenarios for 2030.



*Notes:* Figures refer to the percentage of women of reproductive age (15-49) using a specific method. Constant method-mix scenario assumes that, among contraceptive users, the proportion using a given method will remain constant in all countries, but that the size, age distribution, and total contraceptive prevalence of populations will continue change. In the changing method-mix scenario, it is assumed that countries' method-mixes will increasingly resemble the method-mix of countries with higher levels of total CPR in 2015. In addition, it assumes continued changes in the size, age distribution, and total contraceptive prevalence in populations, as in the constant method-mix scenario. Labels colored in gray represent values from the constant method-mix scenario.

## Discussion

The analysis presented above has revealed several interesting patterns on the development of contraceptive method-mix over time and cross-sectionally.

First, method-mix only seems to be partially related to the overall level of contraceptive use in a population. Generally, as the level of contraceptive use increases, so does the share of use made accounted for by modern methods. Which modern methods are the most prevalent, however, tends to vary regionally and even within regions. Among countries which had the largest improvements in CPR since 1995, method-mixes continued to vary widely between countries. For example, the method-mixes found in Cambodia and Chile – after increasing the CPR by nearly 30 percentage points – continued to be quite different in 2015 from countries in sub-

Saharan Africa which had experienced similar success. Cambodia continued to rely disproportionately on traditional methods, while Chile had a more diverse method-mix. Even among regional neighbors in sub-Saharan Africa that experienced large increases in CPR, method-mixes continued to vary, especially concerning the respective roles of condoms or implants.

Second, there has been a widescale improvement in the overall effectiveness of contraceptive method-mixes since 1995. This is especially true for countries which have a low level of overall contraceptive prevalence. Some notable changes in regional method-mixes that have contributed to gains in contraceptive effectiveness include the expansion of injectables and implants in sub-Saharan Africa, growing pill use in Latin America and the Caribbean, and greater use of IUDs in Eastern and Southern-eastern Asia, in addition to a general decline in traditional method use worldwide.

Third, married/in-union and unmarried/not-in-union contraceptive users tend to adopt different method-mixes. For both groups, there has been a long-term trend in which long-acting and short-acting modern methods account for a greater share of the overall method-mix and traditional methods a smaller share. At the same time, unmarried/not-in-union users tend to rely on short-acting methods to a greater extent than married/in-union users. This is likely due to a combination of factors, including more sporadic sexual activity, lower likelihood of using a permanent method due to their younger mean age, and lower administrative barriers towards accessing of short-acting methods. Married/in-union users, on the other hand, tend to rely more on long-acting methods and traditional methods than unmarried/not-in-union women. The greater reliance on long-acting methods is likely due to a higher probability of having a need for spacing and limiting births because of more frequent sexual activity. For traditional methods, the disproportionate use among married/in-union women may be due to factors such as ambiguous childbearing desires, being less concerned about the transmission of sexually transmitted infections, and the fact that partners may also influence the choice of method, among other reasons.

Finally, the evolution of the global method-mix by 2030 will likely lead to a shift away from long-acting, non-reversible methods. In neither of the two scenarios presented above – both of which accounted for changes in the population age structure and geographical distribution of women of reproductive age – did the rate of female sterilization increase. In the constant method-mix scenario, the rate remained constant between 2015 and 2030 and in the changing method-mix scenario it declined by nearly 30%. Although we cannot be sure about the magnitude of the change, we can be fairly certain that the regional trends in which female sterilization made up a smaller and smaller share of the overall method-mix will continue. In sub-Saharan Africa, where we expect significant growth in the number of contraceptive users to occur, female sterilization is already generally low and declining. What is yet to be determined is which methods will be adopted in lieu of female sterilization. IUDs and implants offer a high level of protection against unwanted pregnancy and are reversible, but their use tends to be regionally concentrated. The pill and condom have accounted for larger and larger shares of method-mixes in many regions throughout the world, including sub-Saharan Africa, Northern African and Western Asia, Central

and Southern Asia, Oceania, and Latin America and the Caribbean. These methods come with other disadvantages, however, namely that they have higher risks of method failure and require greater stability in reproductive health care provision to continuously meet women and couples' contraceptive needs.

## **Conclusion**

This study has documented the development of the global and regional contraceptive method-mix between 1995 and 2015 and we believe it has made several important contributions to the current body of literature. Among its contributions are documenting changes in the global and regional method-mix at three points in time, illustrating how it has varied between married/in-union and unmarried/not-in-union users, identifying changes in the effective level of protection against unwanted pregnancy, and providing a set of plausible scenarios of the method-mix in the future.

Nevertheless, this study has its limitations. First, missing data is a common problem that is not easily overcome when studying how method-specific use changes over time and by region and marital status. There is only a relatively small number of surveys that can be used to calculate method-use for both married/in-union and unmarried/not-in-union women across three decades. Furthermore, the largest countries in regions are often not well represented in this regard. Missing data on method use also tends to be more serious an issue in countries with relatively high contraceptive prevalence, e.g. much of Europe, China, Japan.

Second, the estimation of the changing method-mix scenario can be improved to better incorporate regional clustering of certain methods. It is known that specific methods tend to be more widely used in some regions, e.g. IUDs in Eastern and Southeastern Asia or injectables in sub-Saharan Africa, and this information should ideally be incorporated into the calculation of a country's future method-mix.

Finally, this study only considered a maximum of three datapoints per country in order to improve the comparability of data over time and cross-sectionally. It would be beneficial, however, to incorporate all known data on contraceptive method-mix in order to improve our understanding of how method-mixes evolve over time and in relation to the level of CPR.

Despite these limitations, the present study raises new ideas worth exploring in the future about the dynamics of method-mixes. Will the use of female sterilization continue its decline worldwide? And if it does, which adjustments will countries need to plan for to continue to meet women's and couples' demand for family planning? Given the variation in method-mix by marital status, future work should also investigate how method-mixes vary along other dimensions, such as by urban-rural residence, socioeconomic status, age, minority status, and other relevant characteristics. This information will be crucial for monitoring the availability and accessibility of a complete range of contraceptives for all women and couples and for ensuring that women and couples may decide freely and responsibly the number and spacing of their children and have the information and means to do so.

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