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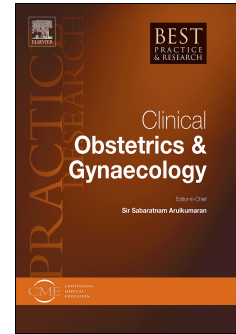
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**Abstract**

The incidence of abortion is determined by the incidence of unwelcome, or unintended, pregnancies and the propensity to terminate rather than take them to term. Exposure to the risk of unintended pregnancy rises as the desired family sizes fall, because fewer years of reproductive life are taken up with desired pregnancies. Increases in contraceptive use over recent decades has reduced the risk of unintended pregnancies but this effect has been moderated in many regions of the world by increased propensity to terminate such pregnancies. Globally, a large majority of abortions are still the direct consequence of non-use of any contraceptive precautions among women or couples not wishing to conceive. Reasons for non-use vary but side effects and health concerns figure prominently. As overall contraceptive use increases, choice of methods becomes a more important influence on the likelihood of unintended pregnancies and abortions. Sterilization, implants and IUDs are more effective at pregnancy-prevention than methods requiring skill, discipline, memory and frequent re-supply. Effective promotion of these methods, however, is difficult once other methods have become entrenched.

Key words: abortion, contraception, unintended pregnancy, contraceptive failure, fertility desires.

### **The complex relationship between contraception and abortion**

Contraception and abortion are alternative means of preventing unwelcome pregnancies and births. Thus it seems obvious at first glance that populations with high levels of contraceptive use will have a low incidence of abortion and vice versa. However, the truth is more complex and interesting. For a start not all abortions are performed on unwelcome, or unintended, pregnancies. Terminations may be motivated by the detection of fetal abnormalities or risk to the life of the woman. They may be forced on women by relatives or even by government officials, as has been documented in China [1]. Circumstances may change, for instance by the loss of a partner or a job, which convert a welcome conception into an unwelcome pregnancy. But these circumstances contribute little to the overall number of abortions. In USA, for instance, it is estimated that less than 5% of abortions are performed on intended pregnancies [2].

A more important consideration is sex-selective abortion, particularly in some Asian populations when the desire for a small family clashes with the desire for a son. An intended conception may become an unwanted pregnancy depending on fetal sex. Bongaarts and Guilimoto estimated the global number of female feticides to be 1.6 million per year for the period 2005-10, with China and India accounting for 90% [3]. For the same period Sedgh and colleagues estimated an overall annual total of 52.4 million abortions, suggesting that sex-selective abortion accounts for about 3% of the global total [4].

These special reasons for termination will not be discussed further. Instead, it will be taken as self-evident that all but a small fraction of abortions are the result of unplanned and unwelcome pregnancies. Thus an understanding of trends and variations in abortion has to start with a

consideration of unintended pregnancies resulting from non-use of any method among women desiring to avoid pregnancy or from accidental pregnancy while using contraception.

The central complexity or puzzle about the contraception-abortion link is the lack of a strong cross-sectional association between the prevalence of contraceptive practice and abortion incidence. For instance, in 2010, the prevalence of contraceptive use in married women in Europe was 71.5 % (and even higher among sexually active single women) compared with 15% in Western Africa but the abortion rates per thousand women in 2010-14 were not much different: 29 and 36, respectively [5,6]. Moreover in 2012, it was estimated that the percentage of all pregnancies that were unintended in Europe was nearly double that in Western Africa: 45% versus 26% [7]. Clearly, the relationship between contraception, unintended pregnancy and abortion is not straightforward and the aim of this paper is to clarify the role of other factors that mediate the relationship.

The paper starts with a consideration of measurement problems followed by an account of a model of abortion determinants that goes far in explaining the puzzle outlined above. The next three sections are more empirical. Evidence on the contribution of contraceptive failure and non-use to unintended pregnancies and abortions is summarised. Finally, variations and trends in the propensity to terminate unintended pregnancies are discussed.

### **Measurement issues**

*Termination of pregnancy* is conceptually simple but in practice extremely difficult to measure at a population level, except in the minority of countries where registration is legally required and complete,

because of severe underreporting in surveys. Indirect methods of estimation and modelling have been developed by staff at the Alan Guttmacher Institute for sub-regions [4].

*Contraceptive practice* is routinely measured in many countries by the Demographic and Health Surveys (DHSs) and similar enquiries of women. Data are generally considered reliable though the so called traditional methods, such as coitus interruptus and periodic abstinence, may be underreported [8,9,10]. The United Nations Population Division has developed models to estimate family planning indicators among married women to complement gaps in survey data, including contraceptive use by region, and have compiled a data base of national survey estimates [5,11]. Contraceptive failure rates are well established, both under conditions of perfect and imperfect real life use.

*Need, or unmet need, for contraception* is primarily based on a simple prospective survey question on whether a, or another, child is wanted and, if so, how soon. Women who want to avoid childbearing for at least two years but are using no (or alternatively no “modern”) method of contraception to achieve this desire are defined as having an unmet need. This definition is applied to married women on the assumption that they are sexually active and, less frequently, to sexually active unmarried women. In practice measurement of unmet need is complicated by the necessity to consider women who are currently pregnant or protected by lactational amenorrhea because of a prior unmet need but we need not dwell on this complexity here [12]. The main limitation of the unmet need concept is that it takes no account of the wishes of the partner. The evidence from longitudinal studies in which the reproductive wishes of both wife and husband have been independently ascertained suggests that, when spouses disagree, their influence on contraceptive use and future reproduction is typically equal [13,14]. It should also be stressed that unmet need does not equate to active demand for contraceptive services; typically about half of those with unmet need state no intention to adopt a method.

*The intention status or wantedness of births* is conceptually complex and no consensus has been reached on how best it can be measured. Of necessity, unintended pregnancies that are not terminated can only be identified by surveys in which women are asked relevant questions. The main approach uses a variety of retrospective questions on recent births to ascertain whether they were wanted or planned at the time of conception. Most such estimates are derived from DHSs which pose a single question to ascertain whether a birth, at time of conception, was wanted, came earlier than desired (ie mistimed) or whether it was not wanted at all (ie unwanted). The limitations of these retrospective data are well recognised. The question may be inherently difficult to understand and requires mothers to be willing to report young children, no doubt much loved, to have been unwanted or mistimed at conception. Unsurprisingly therefore, answers have low test-retest reliability and are subject to rationalization [15,16]. Despite its drawbacks, the retrospective method provides the major source of information on unintended births and has the advantage of including mistimed as well as unwanted events.

In sum, the nexus of topics considered here (abortion, contraception, unmet need and unintended pregnancy) bristles with measurement problems. Though skilful modelling can mitigate these problems many of the numbers and rates discussed below should be regarded as approximations rather than precise estimates.

#### **A model of abortion determinants**

In 2000 Bongaarts and Westoff proposed a formal model of abortion determinants [17]. The essential components are as follows: (1) the number of years that a woman is sexually active and still able to bear children, which reflects age at sexual debut, marital dissolution, age at permanent sterility and in some societies the prevalence of pathological infertility; (2) the desired number of children, noting that each child “consumes” two to three years of reproductive life: six months on average to conceive, a small allowance for miscarriages, nine months gestation, and a period of temporary infecundity following

childbirth, the length of which depends largely on the intensity and duration of breastfeeding; (3) the level of contraceptive use and the effectiveness of methods used under real life conditions of human fallibility; (4) the probability that an unintended pregnancy will be terminated rather than taken to term. Factors 1 and 2 determine the number of years that a woman is exposed to the risk of an unintended pregnancy and factor 3, her use of contraception, together with method used, determine the rate of unintended pregnancy. Finally factor 4, the propensity to terminate an unintended pregnancy, will define the abortion rate.

Two examples will illustrate the implications of the model. Consider a low fertility European society in which two children are desired. Set age at sexual debut at 16 years and average age at permanent sterility at 45, and assume short breastfeeding durations of three months. Under these assumptions the two desired births will account for about three years of reproductive life (six months each to conceive, nine months gestation, and three months of postpartum infecundity), leaving a long span of nearly 26 years between age 16 and 45 during which women must either abstain from sex or correctly use highly effective contraceptive methods to avoid unintended pregnancies, a daunting proposition.

Compare this situation with a West African population where age at sexual debut is 18 years, five children are desired, and lactational protection following childbirth lasts on average for 12 months. Each wanted child now accounts for 27 months of reproductive life, so five of them sum to over 11 years. Under these perfectly realistic assumptions, a West African woman is faced with a span of 16 years in which protection against unintended pregnancy is needed, much shorter than her European counterpart.

The initially puzzling lack of correspondence between overall levels of contraceptive use and abortion incidence is thus largely attributable to differences in desired childbearing and resulting differences in exposure to risk of experiencing an unintended pregnancy. A further reason is that unintended



pregnancies may be less tolerated and more likely to be terminated in a high contraceptive use with low desired family sizes than in a low use society with higher desired family sizes. Yet another relevant difference is that the gap in Europe between sexual debut and first marriage or cohabitation is much longer than in West Africa. To the extent that single women face more obstacles in using effective contraception than married women, unintended pregnancies and abortions will be raised in Europe relative to West Africa.

Using their model Bongaarts and Westoff illustrate the trade-off between contraception and number of life time abortions per woman in achieving different desired family sizes. In the absence of either contraception or abortion and assuming a reproductive span of 20 years, women would have an average of eight births, which is close to the highest fertility observed in a national population. A two-child family could be achieved by 12 lifetime abortions per woman and no contraception, or by a contraceptive prevalence of 75% with a zero failure rate and no abortion, or by any combination lying between these two extremes, for instance a contraceptive prevalence of 50% and five abortions. A four-child family could be achieved by a contraceptive prevalence of 50% and no abortions or by eight abortions and no contraception.

While this model underscores the central role of effective contraceptive use in reducing abortion it also highlights the importance of other, often offsetting, influences, namely the number of children desired, the propensity to terminate unwanted pregnancies, the length of sexually active reproductive life and the length of lactational protection.

#### **The contribution of contraceptive failure to unintended pregnancy and abortion**

Under conditions of perfect adherence, all commonly used methods of contraception, including withdrawal and periodic abstinence, have low or modest failure rates [18]. Under real life conditions, failure rates are much higher for methods requiring memory, skill and discipline, such as oral

contraceptives, condoms, periodic abstinence and withdrawal (table 1). Using information from 15 DHSs with high quality data, it was estimated that 19% of periodic abstinence users, 17% of withdrawal users, 9% of condom users and 6% of pill users will become pregnant by month 12 of use [19].

Table 1 also shows the average percentage of women still using specified methods 12 months after starting, estimated from DHSs [20,21]. Continuation is much higher (at around 90%) for implants and IUDs than for other methods (50-60%), and thus the label “long-acting reversible methods (LARCs)” is frequently applied to them. Their low failure rate combined with high continuation underscores the superiority of LARCs in terms of effectiveness at preventing pregnancy. Note also that, while the failure rate for injectables is low, continuation is also low. A randomized control trial in USA confirms the observational evidence on the superiority of LARCs. Women who were randomly allocated to a LARC had higher continuation and lower pregnancy rates than women allocated to other methods [22].

Table 1 here

The major source of information on the consequences of contraceptive failure is the retrospective data from DHS calendars in which monthly information on episodes of contraceptive use and reasons for stopping are linked to women’s classifications of the intendedness of recent births. Accidental pregnancies while using a method have four possible outcomes: (a) reported fetal loss, mainly induced terminations though most surveys do not attempt to distinguish between spontaneous and induced loss; a live birth or continuing pregnancy which is reported by the mother as (b) unwanted, (c) mistimed, or (d) wanted.

An analysis of a large number of DHSs showed that in the majority of countries between 5% and 20% of accidental pregnancies ended in fetal loss, though in Armenia, Ukraine and Vietnam, this proportion was well over half [20]. The majority of pregnancies carried to term were classified by mothers as unwanted or mistimed but a minority of up to 20% were classified as wanted. To regard a pregnancy resulting

from contraceptive failure as wanted seems illogical but similar findings have been reported in USA; 25% of women with an accidental pregnancy reported that they were happy or very happy [23]. Clearly unplanned pregnancies can be greeted positively.

The contribution of contraceptive failure to the overall number of unintended pregnancies in a population will be heavily influenced by the prevalence of contraceptive practice and the types of method used. For developing countries as a whole, it is estimated that 74% of the 89 million unintended pregnancies in 2017 were the result of non-use of any contraceptive method, 16% from contraceptive failure of a modern method and 10% from failure of a traditional method [24]. Wide variation between countries has been documented in a report on 20 DHSs [25]. The contribution of contraceptive failure to unintended births was typically low, at around 10% in sub-Saharan Africa where the prevalence of contraceptive use is lower than elsewhere. It was also low (11%) in India where contraceptive use is high and dominated by sterilization, but much higher (33%) in neighbouring Bangladesh where oral contraception is the dominant method. The contribution was much higher in Morocco (58%) than in Egypt (25%) because contraceptive use in Egypt is dominated by the highly effective IUD while in Morocco the most commonly used method is the pill. Large contributions of method failure to unintended births were found in countries where traditional method use is common, such as Vietnam, Armenia, Moldova and Turkey.

Similarly, the proportion of pregnancy terminations attributable to method failure range widely from 10% or less in the sub-Saharan African countries, India, Indonesia, and Egypt to over 40% in Vietnam, Armenia, Moldova, Turkey and Ukraine. The contribution of failure to unintended pregnancies and abortion is also high in USA and France [2,26]. One particularly detailed nationally representative study in USA found that 54% of abortions were the result of failure, mainly from inconsistent use of condoms and pills [27].

Numerous trend analyses have confirmed that the displacement of use of traditional methods of contraception by more effective ones typically results in a fall in unintended pregnancies and abortions. The evidence is particularly striking for countries of the former Soviet Union whose citizens were historically deprived of access to most effective methods but had ready access to abortion. After the collapse of the Soviet Union, access and uptake of effective methods improved and abortion incidence declined in many of these countries. For instance over six years in the 1990s, use of IUDs, pills or injectables increased by 8% in Kazakhstan, by about 10% in Uzbekistan and Kyrgyz Republic [28]. Between the late 1980s and the mid-1990s, the abortion rate per thousand women fell by 20%, 31% and 6% in these three countries.

Using data from six national surveys between 1978 and 2010 and abortion statistics, Bajos and colleagues analysed trends in contraceptive use, pregnancy wantedness and abortions in France [26]. Over this period fertility and overall use of contraception remained stable but the use of highly effective methods rose from 35% to 59%. Consistent with this change in methods, the unwanted fertility rate (ie unwanted pregnancies carried to term) fell by 49% but the abortion rate by only 23%. The reason for the moderate effect on the abortion rate was that the proportion of unwanted pregnancies that were terminated increased from 44% to 60%. As access to abortion changed little over this period, it is clear that French women were becoming less tolerant of bearing children resulting from unwanted conceptions. This is one of the best examples of how trends in behaviour can have offsetting consequences that attenuate the expected relationship between increased use of methods with low failure rates and resort to abortion.

The initial fertility decline in Europe and its overseas populations occurred before the advent of highly effective methods and withdrawal was the main mechanism. The development of the IUD, hormonal methods and improved techniques of sterilization in the 1950s and 1960s largely displaced less effective methods in European populations with market economies and in USA and were already available when

the need arose in Asia, Africa and Latin America. The global percentage of married women using a traditional method fell from 11% in 1970 to 5% in 2015, though, as noted earlier, these may be underestimates [5]. Nevertheless there remain 19 countries, with recent survey data, where 20% or more of women use traditional methods. Half belong to the former Soviet Union or were under communist regimes in Europe where withdrawal is still commonly used [11]. In these countries, persistent defects in access to modern methods is implicated. The remainder include Bolivia, Peru, Turkey, Greece and Congo. Nor is the fall in traditional method use ubiquitous. Sustained increased use has been recorded in Jordan, Syria, Oman, Iraq, Philippines, Cambodia, Guatemala and Bolivia [11]. In these settings lack of access to modern methods is probably not the main reason but rather distrust of service providers, intolerance of side effects from modern methods and fears about damage to health, which have been widely documented in many countries. In some countries, including India, Pakistan, Ghana and Indonesia it is the most educated who are choosing traditional over modern methods [29,30].

Sexually active single women often face particularly severe barriers to modern method use, partly because of stigma attached to seeking clinical services but also because of fear that future fertility may be threatened [31]. However, among both married and single women, traditional method use is not always motivated by dislike of alternatives. They may be regarded positively because they involve no cost or physiological interference and require discipline and self-restraint [32].

#### **The contribution of non-use of contraception to unintended pregnancies and abortions**

The percentage of all married or cohabiting women who use no method despite wishing to avoid pregnancy and who are thus defined as having an unmet need for any family planning method, was estimated in 2015 to be 9.7% in developed regions and 11.8% in developing regions [5]. The lowest

prevalence of unmet need is in East Asia dominated numerically by China (4.6%), followed by Northern America and Northern Europe, at just under 8%. In 1970 unmet need was around 30% in Asia, North Africa, sub-Saharan Africa, and Latin America. With the world wide spread of contraception, by 2015 the level had fallen to 10% in Asia and Latin America, to 14% in North Africa but only to 23% in sub-Saharan Africa. While there is much variation between countries within region, it is clear that the scope for further large reductions in unmet need is limited except in the latter two regions.

These UN estimates are restricted to married women. Unmet need tends to be higher in sexually active unmarried women, because, with the exception of sub-Saharan Africa, contraceptive use is lower and the desire to avoid pregnancy higher. It is estimated that 27% of all unmet need in Africa is contributed by this segment of the population, 23% in Latin America and 13% in Asia [33].

Staff at the Guttmacher Institute have estimated the number of unintended births, abortions and still births/miscarriages in developing countries that are being prevented by levels of contraceptive use in 2017 and how many more would be prevented if unmet need among women, including sexually active unmarried women, were to be eliminated by use of modern methods and if all traditional method users switched to modern ones [24]. Table 2 summarises the results of this exercise. Under the hypothetical scenario of no use of modern methods, the number of abortions would be 248 million; current levels of contraceptive use have reduced this number to 48 million and, if all 214 million women with unmet need or using a traditional method used a modern method, the number of abortions would fall by 75% to 12 million.

Table 2 here

These calculations are useful in demonstrating that unintended births and abortions can never be eliminated because of accidental conceptions while using modern methods. However, they are less useful in predicting the impact of increases in modern method use because they do not take into

account possible future falls in family size desires, which would elevate exposure to unintended pregnancies, nor changes in the propensity to terminate such pregnancies. An analysis of 11 countries with reliable abortion data showed that increases in contraceptive use do not always result in declining abortion rates [34]. While in some countries (Bulgaria, Tunisia) the expected rise in contraceptive use resulted in a decline in abortions, a more common pattern observed in Denmark, Netherlands, USA and Singapore was that initial simultaneous increases in contraceptive use and abortions occurred, followed by a decline in abortions as contraceptive use rose further. The abortion decline started in the 1970s in Denmark and Netherlands, in the early 1980s in USA and the mid-1980s in Singapore. The explanation for the initial simultaneous increases is that childbearing desires and fertility itself were declining and that resort to abortion as well as increased contraception was needed to achieve this reduction. The subsequent fall in abortion rates occurred once fertility levels stabilised. The lesson is that when reproductive desires and behaviour are shifting, the relationship between contraception and abortion can take several forms but, when reproduction is stable, rises in modern method use will bring about a decline in the incidence of abortion, unless offset by increases in the probability of terminating unintended pregnancies.

As noted earlier, globally about three-quarters of unintended pregnancies and a similar proportion of abortions are the consequence of non-use of any method of contraception among women who state in surveys that they wish to avoid pregnancy for at least two years, in other words women with an unmet need. The search for explanations of this inconsistency between wishes and behaviour has generated a huge literature. Reasons fall into four broad categories. First, desires to avoid pregnancy may be weakly held, ambivalent or unstable, or may differ between spouses, and thus may be insufficient to motivate the necessary behaviour to prevent conception. Second, barriers may prevent women or couples from adopting a method. Third, women may try a modern method but suffer from side effects and become concerned about damage to health and abandon use. Fourth, couples may believe that they have a low

risk of pregnancy, because of low coital frequency or other reasons. The relative importance of these three categories changes over time. At the initial stage of the transition to lower fertility, lack of knowledge and moral or social disapproval of the idea of deliberately preventing pregnancy are prominent. Motivation may also be weak. As contraceptive knowledge and practice spreads, fear of side effects and health become more important [35]. Discontinuation of use for these reasons becomes an expanding component of unmet need [36]. In 21 countries of sub-Saharan Africa, 25%, on average, of unintended births occurred to past users of contraception and this figure rises to 41% in 15 countries from other developing regions [37]. Even in settings with high contraceptive use, negative perceptions about specific contraceptive methods are common [38].

#### **The relationship between unintended pregnancy and termination**

Using survey data on the intendedness of births for 105 countries, estimates of abortion, and Bayesian modelling, Bearak and colleagues recently derived sub-regional levels and trends in unintended fertility rates, abortion rates and the percentage of unintended pregnancies that are terminated [39]. A summary of results is shown in table 3. In 2010-2014, the global unintended pregnancy rate (including abortions) per 1000 women aged 15-44 years was estimated to be 62. This rate is highest at over 100 in East and Middle Africa, and also in the Caribbean, and lowest in Northern and Western Europe at 27-28. Since 1990-1994, all but one sub-region (Western Europe) have experienced a decline. This decline is small in North America, Latin America, and Northern Europe where the level of contraceptive use and method-mix have changed little. It is large, over 20%, in Central, Southeast and West Asia, North Africa and Southern Europe where appreciable increases in modern method use have taken place. The largest fall (48%) is recorded in East Europe where, as discussed earlier, modern contraception has been displacing traditional methods.

Table 3 here



Globally, it is estimated that 56% of unintended pregnancies are terminated with little change since the early 1990s. This proportion is highest (over 70%) in East and Central Asia, and in Eastern Europe and lowest (below 40%) in sub-Saharan Africa, Central and North America, and Oceania. Abortion probabilities between 1990-4 and 2010-4 fell by 26% in North America and by about 10% in Eastern and Southern Europe but rose in most other sub-regions, particularly in Africa, South Asia, and Central and South America.

Variations in the probability of terminating an unintended pregnancy are best understood in terms of the intensity of the desire to avoid a birth, taking into account the financial, social, and other consequences of childbirth, and access to abortion, broadly defined to encompass information, financial costs, perceived health hazard, and social and moral considerations. Disentangling the relative influence of these two types of factors is extremely difficult. Termination probabilities are higher in countries where abortion laws are most liberal, suggesting that access is key, but this association may also reflect the likelihood that countries with liberal laws are also characterised by a greater intensity to avert unintended childbearing [39]. Evidence on the effect of legal changes is conflicting. The partial decriminalisation of abortion in 1985 in Spain appears to have had no effect on abortion incidence [40]. Conversely, one analysis found that Nepal's 2004 legalisation of abortion and scale-up of abortion services did increase abortion incidence and also resulted in a slight fall in contraceptive use [41].

Explanation should also be sought in the diverse histories of fertility control. In many countries of Eastern Europe, Central Asia, and Japan the growing need to restrict childbearing came at a time when access to contraception was limited but abortion was legal and widely available. This gave rise to what has been termed an "abortion culture" in which pregnancy termination became a central and accepted method of fertility regulation, seen as complementary to contraception rather than a backup to it. Acceptance, however, does not imply approval. In Kazakhstan, approval of abortion was lower than that for contraception [42]. Similarly, in Armenia, negative views about abortion coexist with readiness to

use it but views about contraceptive methods are equally negative [43]. While in many of these countries, greater contraceptive access is displacing abortion, the historic legacy lives on and is reflected in the high probability of terminating unintended pregnancies.

Though direct evidence is sparse, another population group with high propensities to terminate unintended pregnancies comprises sexually active single non-cohabiting women, for whom the consequences of childbirth are likely to be more severe than for married women. In USA in 2011, 56% of unintended pregnancies were terminated by never married, non-cohabiting women compared to 23% among married women [44]. In 12 of 17 mainly European countries with reliable data, abortion rates peak at ages 20-24, an age group characterised by a large fraction of sexually active single women [6]. An extensive literature on young women in sub-Saharan Africa, particularly in West and Central Africa, suggests that a growing intolerance of premarital childbearing among increasingly educated, urban young women coexists with poor information about, and access to, modern contraceptive methods [45,46,47,48]. This combination has led to a high reliance on abortion, despite strong moral antipathy.

Perhaps the most important question regarding the future of abortion is whether the global proliferation of medication abortion, which represents a huge increase in access, will raise the propensity to terminate unintended pregnancies and/or raise willingness to use less effective methods.

### **Conclusions**

Contraception-abortion linkages are not straightforward because other factors may distort the expectation that rises in contraceptive use will be matched by declines in abortion. These factors include: the length of sexually active reproductive life; the number of these years that comprise desired childbearing and the number of remaining years in which women are exposed to the risk of unintended pregnancies; and the propensity to terminate unintended pregnancies.

As societies evolve from high to low fertility, these factors often influence abortion incidence in opposing ways. Falls in the desired number of children, accompanied sometimes by the wish for longer intervals between births, act to increase the span of time exposed to risk of unintended pregnancy. The behavioural response is a blend of contraception and abortion. Their relative contribution to regulating childbearing varies between countries and over time. Much depends on policies. The poorer the access to contraceptive methods, the greater the reliance on abortion is likely to be. But even in countries with good access to effective methods, rapid changes in desired childbearing may outstrip uptake of contraception, with the result that parallel increases in contraception and abortion occur. Only when desires have stabilised do further rises in contraceptive protection typically result in decreased abortion, though this effect may be attenuated by rises in termination of unintended pregnancies.

As the prevalence of contraceptive use evolves towards its upper limit of 70% or higher, the incidence of unintended pregnancies depends increasingly on contraceptive failure; and the unintended pregnancy rate, together with the degree of tolerance to take such pregnancies to term, determines the abortion rate. Method-choice is critical. Sterilization and LARCs are more effective than methods that require adherence or frequent re-supply. Accordingly, many family planning interventions place emphasis on these highly effective methods. However, once a particular method-mix has become entrenched, it is not easy to shift. Women, and couples, prefer methods that are familiar. Furthermore, most family planning services strive to offer choice of method and many women will choose alternatives to sterilization or LARCs. Nor are these highly effective methods suitable for all. In sub-Saharan Africa, for instance, young women still face considerable risks of infection with HIV or classical sexually transmitted diseases and, for them, condoms may still be the best option. The spread of emergency contraception and medication abortion increases the justification for use of methods for which 100% adherence is difficult.

## Summary

Contraception and abortion are alternative ways of avoiding unwanted childbearing and therefore it seems obvious that a rise of one will lead to a fall in the other. In other words the expectation is that countries with high levels of contraceptive use will have low abortion rates and vice versa. But this relationship is not so straightforward because of the intervening influence of other factors. These include the length of sexually active reproductive life; the number of desired children and thus the number of years that comprise welcome pregnancies, including time to conceive, gestation and lactational protection; and the propensity to terminate unwelcome pregnancies. As desired number of children falls, exposure to the risk of unwelcome pregnancies increases. All contraceptive methods reduce this risk but their effectiveness varies widely. Methods that require memory, discipline, skill, and frequent re-supply are all prone to higher failure probabilities than methods that do not make these demands, namely sterilization, IUDs, and implants. As countries progress towards high levels of contraceptive practice, method-choice and failure rates become increasingly important determinants of unwelcome pregnancies and abortions.

## Research Agenda

- More research is needed on contraceptive method choices and how most effective method use can be encouraged without impugning freedoms
- Better measures of unwelcome pregnancy are needed
- The influences on the decision to terminate or carry to term an unwelcome pregnancy are poorly understood
- The effect of medication abortion on abortion and willingness to use less effective contraceptive methods needs to be monitored

## Conflict of interest

None

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Method	12 Month failure rates per 100 women		Percentage using at 12 months
	Perfect use	Typical use	
Implant	0.1	0.3	92
Copper IUD	0.6	1.2	87
Injectable	0.3	2.0	59
Combined pill	0.3	6.3	56
Condom	2.0	8.6	50
Withdrawal	4.0	17.3	60
Periodic abstinence (calendar)	5.0	19.0	60

Table 1 Twelve month failure rates for main reversible contraceptive methods under conditions of perfect and typical use and percentage still using at 12 months

Events (millions)	No modern method Use	Modern method use in 2017	All unmet need addressed
Unintended births	103	30	7
Abortions	248	48	12
Miscarriages/stillbirths	45	11	3
Number of modern method Users	0	671	885

Table 2 Estimated numbers of unintended births, abortions, and miscarriages/stillbirths under three scenarios: no modern method use, 2017 levels of use, and all unmet need addressed by modern method use



Region	Unintended pregnancies		Percentage aborted	
	Rate 2010-14	% decline since 1990-94	2010-14	% change since 1990-94
<b>World</b>	<b>62</b>	<b>17</b>	<b>56</b>	<b>4</b>
<b>Africa</b>	<b>89</b>	<b>17</b>	<b>38</b>	<b>23</b>
East	112	12	30	17
Middle	103	13	34	25
North	68	31	56	36
Southern	94	11	36	20
West	72	17	43	32
<b>Asia</b>	<b>54</b>	<b>20</b>	<b>65</b>	<b>10</b>
East	45	17	77	-2
South	59	22	61	36
Central	53	28	78	7
Southeast	58	31	59	9
West	70	28	48	13
<b>Latin America</b>	<b>96</b>	<b>7</b>	<b>46</b>	<b>18</b>
Caribbean	116	3	51	1
Central	82	9	39	33
South	99	6	47	18
<b>North America</b>	<b>47</b>	<b>6</b>	<b>36</b>	<b>-26</b>
<b>Europe</b>	<b>41</b>	<b>38</b>	<b>70</b>	<b>-10</b>
Eastern	54	48	77	-10
Northern	27	17	64	-4
Southern	40	25	64	-9
Western	28	0	56	12
<b>Oceania</b>	<b>48</b>	<b>2</b>	<b>38</b>	<b>-5</b>

Table 3 Unintended pregnancy rate in 2010-14 and percentage decline since 1990-94, and percentage of unintended pregnancies aborted in 2010-14 and percentage change since 1990-94

ACCEPTED MANUSCRIPT

## Highlights

- Over 90% of abortions are performed on pregnancies that are unwelcome or unintended.
- Globally about 70% of unintended pregnancies are the direct consequence of non-use of any method of contraception among women not wishing to conceive and about 30% from accidental pregnancy while using a method
- The reasons for non-use vary between countries and over time; they include lack of knowledge, social or moral disapproval, fear of side effects or damage to health, and perceived low risk of conceiving
- As the level of contraceptive use in a population rises, accidental pregnancy while using a method that requires discipline, memory, or skill becomes a more important cause of unintended pregnancies
- Globally, slightly over half of unintended pregnancies are terminated, ranging in sub-regions of the world from 30% to over 70%
- The relationship between the level of contraceptive use in a population and the incidence of abortion is not straightforward because exposure to risk of unintended pregnancy increases as the number of desired children falls and propensity to terminate varies