Chapter 15

Non-use and use of ineffective methods of contraception

Martine Collumbien, Makeda Gerressu and John Cleland

Summary

This chapter estimates the burden of disease attributable to non-use of contraception and use of ineffective methods. The health outcomes include obstetric complications and abortion-related morbidity and mortality associated with unintended pregnancies (unwanted and mistimed). We have presented a model for linking data on contraceptive use and fertility preferences to unwanted births and unsafe abortions as intermediate outcomes, which were then related to the maternal disease burden.

The health outcomes considered were the conditions associated with unsafe abortion and unwanted births. The abortion-related conditions are a separate subcategory and the risk of abortion-related consequences is directly proportional to the risk of an unsafe abortion. The obstetric conditions linked to unwanted births are maternal haemorrhage, maternal sepsis, hypertensive disorders of pregnancy, obstructed labour and other maternal conditions. The burden of these obstetric complications attributable to non-use of contraception was assumed to be proportional to the percentage of unwanted births among all births.

Contraceptive use reduces the risk of unintended conception but does not altogether eliminate it, and failure rates are higher for traditional methods than for modern methods. The categorical variable "contraceptive use" has three levels of exposure: non-use, use of traditional methods and use of modern methods. Non-users experience the highest conception rates. The modern method category was used as the reference category for calculating the relative risk of having an abortion and an unwanted birth.

Not all conceptions lead to an avoidable burden, since many pregnancies are desired. We calculated how many unintended pregnancies are expected in one year by first estimating the proportion of women who would become pregnant and combining this with the probability that the

pregnancy would be unwanted or mistimed, based on current reproductive intentions. The proportion of women becoming pregnant was derived from contraceptive failure rates among modern and traditional method users and biological expectations of the number of conceptions among non-users. Within the non-users, conception rates were applied to the fecund women only, excluding those who would not be exposed to pregnancy for biological or behavioural reasons. Abortion probabilities were applied to determine how many of the mistimed and unwanted pregnancies would end as abortions and unwanted births. Unwanted pregnancies would contribute to both abortion-related burden and the obstetric burden of maternal complications. Mistimed pregnancies only contribute to the abortion-related burden since preventing mistimed births by use of more effective contraception does not avert—only delay—any potential associated obstetric burden.

As theoretical minimum exposure we have simulated the contraceptive distribution which would prevail if all women with a desire to either stop childbearing or postpone the next birth for at least another two years, adopt an effective modern method of contraception. All traditional method users and fecund non-users consist of women who want a birth in the next two years. At this theoretical minimum level, the relative risk of an unwanted birth and abortion becomes zero because only the reference category, modern method users, is at risk of unintended pregnancy. Counterfactual levels of relative risk were calculated to take account of the changing distributions of fertility desires within each exposure category.

Subregional[1] levels of distribution of contraceptive use and the relative risk levels of abortions and unwanted births were derived by aggregating country estimates based on data from 58 Demographic and Health Surveys (DHS). This source includes data on childbearing intentions and contraceptive use at the time of survey. Average method-specific and duration-specific failure rates were calculated from 18 countries with DHS calendar data on contraceptive use. In each country, the method–duration-specific failure rates were combined with the method mix and data on duration of use of current methods. Abortion probabilities were derived from the World Health Organization (WHO) estimates of incidence ratios (unsafe abortions per 100 live births).

It was estimated that globally 89% of the disease burden due to abortion complications is attributable to unprotected sex or use of less effective traditional methods. This amounted to 51 000 deaths and 4.4 million disability-adjusted life years (DALYs), with 82% of the burden falling on women aged <30 years. The highest absolute burden is experienced in South Asia (35% of the total abortion burden) while in relative terms women in the two African subregions are the worst effected. The burden of disease attributable to maternal conditions arising from unwanted births was 98 000 deaths and 4.5 million DALYs. In contrast to abortion, the largest part of the burden befalls women over 30 (74%) since a higher proportion of all births is unwanted among older women. For women aged <30 years, about 7% of all births could be averted if all women who wished to stop childbearing used a modern method. This proportion is as high as 40% for the older age group.

1. Introduction

Sexual intercourse contributes positively to health and general well-being in both men and women; it leads to increased intimacy in relationships. Sexual intercourse is also an important risk factor for disease and disability. The most important negative consequence of sex is the risk of contracting a sexually transmitted infection, including HIV, through unprotected intercourse. HIV and sexually transmitted infections (STIs) are discussed in chapter 14. In this chapter we have concentrated on the reproductive consequences of sexual intercourse. Notwithstanding recent developments in assisted reproduction, sexual intercourse is a requirement for reproduction for the overwhelming majority of couples. Motherhood is highly valued in most societies, but each pregnancy and childbirth carries a health risk for the woman, and where obstetric services are poor, maternal mortality is still very high. The most recent estimates show that, of the global 515 000 maternal deaths in 1995, more than 99% occurred in Africa, Asia, Latin America and the Caribbean (Hill et al. 2001).

Reduction of maternal mortality and morbidity can be achieved by more effective treatment of pregnancy-related complications. The disease burden can also be reduced by avoiding pregnancies through adoption of effective contraception. Not all pregnancies and births are intended: many are either mistimed or unwanted at any time. Worldwide it is estimated that about 210 million recognizable pregnancies occur every year (The Alan Guttmacher Institute 1999)—of which about 15% end in spontaneous miscarriage or stillbirth. Another 22% are terminated by induced abortion and thus can be classified unambiguously as unintended. The remainder—some 133 million—result in the birth of a baby. Evidence from DHS and similar surveys has suggested that, globally, some 20% of all births are unintended (The Alan Guttmacher Institute 1999). Adding together unintended births and induced abortions, it may be concluded that about 40% of all pregnancies are unintended.

This chapter is concerned with estimating the burden of maternal complications and abortions that could be avoided if couples increased their use of effective contraception. We have presented a model for linking data on contraceptive use and fertility preferences to unwanted births and unsafe abortions. DHS data for 58 countries were used to calculate attributable fractions: what proportion of these unwanted births and unsafe abortions could be averted by perfect implementation of fertility preference through increased use of effective contraception. These intermediate outcomes were then linked to estimates of the burden of maternal complications in pregnancy.

2. Risk factor definition and health outcomes

2.1 Health outcomes

The health outcomes considered for assessing disease burden due to lack of use of effective contraception are the conditions associated with unsafe abortion and unwanted births. The abortion-related conditions are a subcategory under the Global Burden of Disease (GBD) study's causes of maternal conditions. The main causes of mortality and morbidity associated with unsafe abortion are sepsis, following incomplete removal of the fetus, and perforation of the uterus. Based on the International Statistical Classification of Diseases and Related Health Problems (ICD-10), the obstetric conditions other than the abortion-related include maternal haemorrhage, maternal sepsis and obstructed labour. Other complications include hypertensive disorders of pregnancy, and the category of "other maternal conditions". These maternal complications were the causes considered in attributing the burden of disease to unwanted births.

Some other conditions are exacerbated by pregnancy. Indirect obstetric complications result from existing disease (malaria, anaemia, hepatitis, cardiovascular disease, tuberculosis and hypertension) but are aggravated by the physiological effects of pregnancies (AbouZahr and Vaughan 2000). Suicide and violence may be pregnancy related, and other forms of psychological morbidity are associated with childbirth and unintended pregnancies. Since the magnitude and the strength of these relationships are largely unknown, none of these conditions have been included in the burden attributable to non-use of contraception.

The morbidity related to use of contraception has been excluded for this exercise. Those conditions include allergic reactions to barrier methods, intrauterine device (IUD)-associated bleeding, and wounds from surgical procedures. Morbidity associated with systemic contraceptive such as the oral contraceptive pill, includes the impact on cardiovascular and hormonal systems and carcinogenicity (AbouZahr and Vaughan 2000).

The burden of obstetric complications attributable to non-use of (or use of less effective) contraceptive methods is proportional to the percentage of all births that are unwanted. Intergenerational effects of contraceptive use on the health of offspring have not been considered, nor has the burden of perinatal outcomes associated with the delivery of unwanted births been taken into account. It is clear that by averting unwanted pregnancies, a proportion of perinatal deaths can be avoided. However, by averting unwanted births the disease burden throughout infancy and beyond can be reduced. The potential contribution of contraception to infant survival through better birth spacing is also well known. Babies born within 24 months of an elder sibling are at elevated risk of dying in infancy (Trussell and Pebley 1984). Mistimed births may therefore be associated with higher disease burden in childhood. Because of the conceptual problems of considering health impact in the next generation, the outcomes have been restricted to maternal ones.

2.2 Intermediate outcomes: unwanted births and unsafe abortions

In the "perfect contracepting society", all women, or couples, who do not wish to have a baby within the next year or so would use effective contraception. Under these circumstances, a small residue of unintended pregnancies would remain because of contraceptive failure but the overwhelming majority of births would be intended. In the real world, however, large discrepancies exist between reproductive wishes and contraception protection. These discrepancies arise for myriad reasons. In developing countries the main direct cause is lack of any contraceptive precautions despite the desire to delay the next child or have no more children. In the demographic literature, non-use of contraception among women desiring to space or limit childbearing is termed "unmet need" for contraception. Estimates of the prevalence of such unmet need in 55 developing countries in the 1990s ranged from 6% to 40% of all currently married women (Westoff 2000). The main underlying causes of unmet need in developing countries include a perception that risk of pregnancy is low, opposition to the use of contraception, stemming from the husband's attitude or religious considerations, and concerns about the safety or side-effects of methods. Lack of knowledge about contraceptive methods, or how to access them, are also important contributory causes in some countries.

In industrialized countries, contraceptive practice tends to be higher than in most developing countries. Nevertheless appreciable discrepancies between reproductive motivation and behaviour are also apparent. Contraceptive failure and irregular use of methods are more important direct causes of unintended pregnancies than in developing countries. For instance, in the United States of America about half of all unintended pregnancies are the result of failure or irregular use (Henshaw 1998). Unanticipated sexual intercourse no doubt represents a further risk factor, particularly for single women.

Attitudes towards becoming pregnant are complex and often ambivalent. Typically, two persons are involved, the woman and her husband or partner, whose views do not necessarily coincide. Attitudes may also change over time, particularly between the time before conception and the time following recognition of the pregnancy. For instance, a couple may have no fixed intention to have a baby but nevertheless be delighted when conception occurs. No unambiguous and generally agreed definition of unintended pregnancy exists. Rather researchers have used a variety of indirect and direct methods of measurement.

The most commonly available and used measure is that employed by the DHS. In this approach women are asked the following question about recent live births and the current pregnancy (if any): "At the time you became pregnant with (NAME OF CHILD) did you want to become pregnant then, did you want to wait until later, or did you want no more children at all?" This question leads to a three-way classification: births wanted at that time; birth not wanted then but later; birth not wanted at any future time. The latter two categories—mistimed and unwanted births—are often grouped together and defined as unintended births or pregnancies. Some authors use the terms unintended and unplanned interchangeably. However the concept of planning implies active preparation for pregnancy (e.g. cessation of contraceptive use, possible dietary changes, etc.) that makes it inappropriate for the large number of countries where contraception is still uncommon.

Unintended pregnancies may be subdivided into those that are unwanted at any time and those that are mistimed. Both categories may lead to induced abortion although in most settings it can be expected that unwanted pregnancies are more likely to be terminated than mistimed ones (Bankole et al. 1999). In 1995, it was estimated that approximately 26 million legal and 20 million illegal abortions occurred worldwide (Henshaw et al. 1999). The legality and safety of abortion are strongly correlated (Rahman et al. 1998). In the developed world where abortion is generally legal, abortion mortality is as low as 0.2 to 1.2 deaths per 100 000 procedures. In non-legal settings, when an unskilled provider, using hazardous techniques, terminates the pregnancy—often in unsanitary conditions—complications for the woman are likely. Of the 20 million illegal abortions globally, 19 million happen in developing countries (Henshaw et al. 1999). Where abortion is either illegal or highly restrictive, abortion mortality averages 390 deaths per 100 000 procedures (but as high as 680 in Africa) (WHO 1998). WHO defines an "unsafe abortion" as a procedure for terminating an unintended pregnancy either by persons lacking the necessary skills or in an environment lacking the minimal medical standards or both (WHO 1998). About a third of unsafe abortions lead to serious complications, and about 13% of the pregnancy-related deaths worldwide are related to complications of unsafe abortion (The Alan Guttmacher Institute 1999).

When unintended pregnancies are not aborted, and no miscarriage or stillbirth occurs, the pregnancy results in a live birth. As mentioned before, in developing countries, the mortality and morbidity risk associated with complications during childbirth is substantial for any birth, whether intended or unintended.

Part of the total burden of obstetric complications during childbirth can, however, be avoided by preventing the unwanted pregnancies (i.e.

those not wanted at any time) through use of effective contraception (Fortney 1987; Winikoff and Sullivan 1987). Avoiding unwanted pregnancies will reduce maternal mortality in two ways: by reducing the number of pregnancies and by reducing obstetric risk (i.e. the risk per pregnancy). Unwanted births tend to occur when women are relatively old and already have several children. Risks to the mother's health of pregnancy and childbirth are higher at older ages. Hence, the obstetric risk as measured by the maternal mortality ratio (maternal deaths per 100 000 live births), is reduced by averting high-risk births based on maternal age and parity but the effect is relatively small (Trussell and Pebley 1984; Winikoff and Sullivan 1987).

In many countries unwanted births are particularly likely to occur to women who have low education, poor nutrition and poor access to health services—all conditions associated with a higher maternal complication rate (Berkley 1998). However, this link between socioeconomic conditions and unwanted births is not universal. In countries with low levels of contraceptive practice, as in much of sub-Saharan Africa, educated women are as likely to report unwanted births as uneducated women (Adetunji 1998). However, these effects of obstetric risk (averting high-risk births), are dwarfed by the impact of reducing the overall incidence of pregnancies through the elimination of unwanted births (Fortney 1987). This elimination will have a huge impact on the maternal mortality rate (maternal deaths per 100 000 women of reproductive age), and the lifetime risk of dying in childbirth or pregnancy.

So is it reasonable to assume that delivery complications associated with unwanted births are the same as those associated with wanted births? Apart from considerations of maternal age and socioeconomic status, another possibility is that mothers neglect unintended pregnancies in ways that put the mother herself at greater risk. The evidence is meagre but a recent analysis using five DHS concluded that unintended pregnancies are not selectively discriminated against in terms of obstetric care and thus probably did not represent excess risk to mother's health and survival (Marston and Cleland 2003a). As these five surveys include enquiries from Africa, Asia and Latin America, it is reasonable to generalize results, at least to developing regions. On balance, therefore, it is justifiable to assume that obstetric complications are the same for wanted and unwanted births.

How should *mistimed* (in distinction to unwanted) births be regarded in relation to delivery complications? Births may be classified as mistimed when the woman is too young and wants to delay the first birth, or when she feels births are too closely spaced or when other conditions are not yet conducive to childbearing. Births to very young women (aged <18 years) do carry a higher risk, and delaying some of those may therefore avert some obstetric risk, although the effect will be small (Trussell and Pebley 1984). However, reducing mistimed births by contraceptive practice will have little influence on the incidence of pregnancies as the births will merely be delayed rather than averted. Such delay or postponement will thus not reduce the burden of delivery complications. As discussed earlier, the potential contribution of contraception to infant survival through better birth spacing is well known, with babies born within 24 months of an elder sibling being at elevated risk of dying in infancy (Trussell and Pebley 1984). In contrast to the strong evidence regarding childhood risks, it is uncertain whether shorter birth intervals are associated with an increased risk of maternal mortality or morbidity. The only two published studies give conflicting results (Conde et al. 2000; Ronsmans and Campbell 1998). It is therefore not justified to regard short intervals as a risk factor for obstetric complications. It may be concluded, therefore, that prevention of mistimed births through contraceptive use will make no contribution to the reduction of delivery complications.

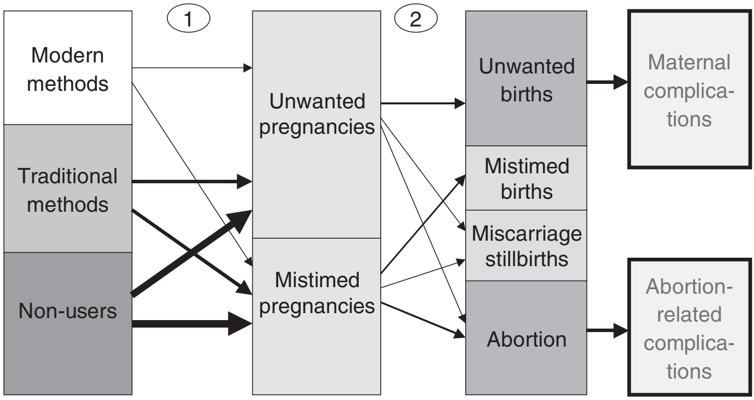
2.3 The pathway from exposure to health outcomes

When assessing the 1990 disease burden attributable to unsafe sex, Berkley (1998) estimated the percentage of women with an unmet need for family planning and attributed an equivalent proportion of the obstetric and abortion burden to non-use or inappropriate use of contraception (Berkley 1998). In order to follow the comparative risk assessment (CRA) methodology, we have modelled the outcomes (intermediate outcome in terms of unwanted births and unsafe abortion and health outcome in terms of obstetric and abortion-related burden) from exposure (i.e. contraceptive behaviour).

The definition of exposure has to take into account the fact that contraceptive use reduces the risk of conception but does not altogether eliminate it. The probability of accidental pregnancy while using a method depends on the intrinsic or theoretical effectiveness of the method itself (method failure) and on whether it is used consistently and correctly (user failure). Some methods (e.g. condoms, oral contraceptives, withdrawal and periodic abstinence) are much more prone to user error than other methods (e.g. contraceptive sterilization, intrauterine devices). Withdrawal, or coitus interruptus, and periodic abstinence are distinguished from all other commonly used methods by their exceptionally high failure rates. In the family planning literature these two methods are often given the label "traditional" because they are not the product of advanced techniques of biochemistry or engineering. To capture this variability by method, exposure was divided into three levels: non-use, use of traditional methods and use of modern methods. The pathway from exposure to intermediate and health outcome is depicted in Figure 15.1. The diagram relates to sexually active women (non-virgins), and for clarity the categories of wanted pregnancies and births are omitted.

All three levels of exposure will lead to both unwanted and mistimed pregnancies, but the probability is lowest for the modern method users.

Figure 15.1 Pathway from exposure to outcome



Failure rates for traditional methods are higher and no protection carries the highest risk. Modern methods have been used as the theoretical-minimum-risk reference category for calculating the relative risks of having an unintended pregnancy (subdivided into unwanted and mistimed) among traditional method users and non-users.

The next step in the model was to examine the reproductive outcomes of these unintended pregnancies: spontaneous fetal loss and stillbirths, abortions, mistimed and unwanted births. Both unwanted and mistimed pregnancies may end in miscarriage or stillbirth, and such events may cause obstetric complications. No evidence exists to suggest that the probability of miscarriage or stillbirth for unintended pregnancies differs from that of intended pregnancies (i.e. the ratio of unwanted over all stillbirths is the same as the ratio of unwanted births over all births). Therefore, these events have been excluded from the calculations of the attributable risk. Since the total burden of maternal complications is a separate input provided by WHO (independent from our model), and complications due to in utero loss are an integral part of this burden, the attributable burden of maternal complications associated with in utero loss has been accounted for. Both unwanted and mistimed pregnancies may be aborted. In terms of ultimate outcome or disease burden, the risk of abortion-related consequences is directly proportional to the risk of an unsafe abortion. Unwanted pregnancies may be carried to term and the burden of maternal complications will be proportional to the percentage of unwanted births among all births. As discussed earlier, mistimed pregnancies carried to term do not contribute to an attributable burden of disease, because this proportion of disease burden would only have been delayed if the pregnancy were not mistimed.

The model in Figure 15.1 was applied to data from 58 DHS to obtain subregional levels of exposure and the relative risk of having unwanted births and unsafe abortions.

3. Data and methods for exposure and hazard

3.1 Data sources

In the analysis, we drew heavily on DHS data on childbearing intentions and contraceptive use at the time of survey. DHS were used for several reasons. First, they are the dominant source of information on fertility intentions and contraceptive use in developing countries, with good representation in all highly populated regions. Most of the most populous developing countries have conducted a recent Demographic and Health Survey: Bangladesh, India, Indonesia and Pakistan in Asia; Brazil and Mexico in Latin America; and Ethiopia and Nigeria in sub-Saharan Africa. Indeed China is the only conspicuous absentee but, as will be shown later, this omission is relatively unimportant because the attributable burden is small in this country.

A further reason for reliance on DHS is that all surveys are nationally representative and executed to a high standard, with abundant technical assistance where needed. Surveys are also highly standardized in content, with the important implication that measures of fertility intentions and contraceptive use are comparable across countries. A final pragmatic reason for using DHS is that well-documented, clean data files are available for public use. Other data, especially the reproductive health surveys by the Centers for Disease Control and Prevention (CDC) were considered, since they cover countries mainly in Latin America and eastern Europe. Because of restricted availability, different age ranges and inadequate detail to make analytically important distinctions, we chose to use DHS data only. Similarly, the use of the National Survey of Family Growth (United States) was briefly considered, but the very small overall burden of maternal complication and the different questions used did not warrant the considerable effort that would have been required.

The surveys used in these calculations were those available at the time of calculation in 2001. Table 15.1 lists the countries by subregion, giving the date of survey, whether the sample was restricted to ever-married women (those who are or have been married) or all women, and the legal status of abortion in each country. The table also indicates what proportion of the total female population aged 15–44 years in the subregion is represented by the country and the weights used for aggregating country-specific data into subregional estimates. Ten of the 58 surveys were done before 1990. Although fertility levels and preferences may have changed considerably in the last decade, these surveys were retained

Table 15.1 DHS used in estimating exposure and relative risks

Subregion	*Country*	*Year*	*Sample (All or ever-married)*	*Legal status of abortion*[a]	*Proportion of subregional total of 15–44*[b] *(%)*	*Weight in subregional estimate*[b] *(%)*
AFR-D	Burkina Faso	1999	All	II	3.9	4.9
	Benin	1996	All	I	2.1	2.6
	Cameroon	1998	All	II	5.0	6.3
	Ghana	1998	All	III	6.9	8.6
	Guinea	1999	All	II	2.5	3.1
	Comoros	1996	All	II	0.2	0.3
	Liberia	1986	All	III	1.1	1.4
	Madagascar	1997	All	I	5.3	6.7
	Mali	1996	All	I	3.6	4.5
	Nigeria	1990	All	I	38.4	48.2
	Niger	1998	All	I	3.4	4.3
	Senegal	1997	All	I	3.2	4.0
	Chad	1997	All	I	2.5	3.1
	Togo	1998	All	I	1.5	1.9
AFR-E	Botswana	1988	All	III	0.5	0.7
	Burundi	1987	All	II	2.0	2.9
	Central African Republic	1994	All	I	1.1	1.6
	Côte d'Ivoire	1994	All	I	4.4	6.3
	Ethiopia	2000	All	II	17.5	25.2
	Kenya	1998	All	I	9.4	13.6

continued

Table 15.1 DHS used in estimating exposure and relative risks (*continued*)

Subregion	*Country*	*Year*	*Sample (All or ever-married)*	*Legal status of abortion*[a]	*Proportion of subregional total of 15–44*[b] *(%)*	*Weight in subregional estimate*[b] *(%)*
	Malawi	1992	All	I	3.1	4.5
	Mozambique	1997	All	II	5.7	8.2
	Namibia	1992	All	III	0.5	0.7
	Rwanda	1992	All	II	2.4	3.4
	United Republic of Tanzania	1996	All	I	10.0	14.4
	Uganda	1995	All	I	6.2	8.9
	Zambia	1996	All	IV	2.8	4.0
	Zimbabwe	1994	All	II	3.8	5.5
AMR-B	Brazil	1996	All	I	40.9	51.8
	Colombia	1995	All	I	9.9	12.5
	Dominican Republic	1996	All	I	1.9	2.4
	El Salvador	1985	All	I	1.4	1.8
	Mexico	1987	All	I	23.3	29.5
	Paraguay	1990	All	I	1.2	1.5
	Trinidad and Tobago	1987	All	III	0.3	0.4
	Bolivia	1998	All	II	11.2	11.2
AMR-D	Ecuador	1987	All	II	18.3	18.3
	Guatemala	1995	All	I	14.7	14.7
	Haiti	1994	All	I	11.3	11.3

	Nicaragua	1997	All	I	6.9	6.9
	Peru	1996	All	II	37.7	37.7
EMR-B	Tunisia	1988	EM	V	7.5	100.0
EMR-D	Egypt	1995	EM	I	20.0	23.7
	Morocco	1992	All	II	9.1	10.7
	Pakistan	1990	EM	II	42.4	50.0
	Sudan	1989	EM	I	8.6	10.1
	Yemen	1997	EM	I	4.6	5.5
EUR-B	Kyrgyzstan	1997	All	V	2.2	4.7
	Turkey	1998	EM	V	32.7	70.8
	Uzbekistan	1996	All	V	11.3	24.5
EUR-C	Kazakhstan	1995	All	V	6.9	100.0
SEAR-B	Indonesia	1997	EM	I	71.8	71.8
	Sri Lanka	1987	EM	I	6.4	6.4
	Thailand	1987	EM	II	21.8	21.8
SEAR-D	Bangladesh	1997	EM	I	11.1	11.9
	India	1993	EM	IV	80.4	86.1
	Nepal	1996	EM	I	1.8	2.0
WPR-B	Philippines	1998	All	I	4.8	100.0

[a] Legal status of abortion: I, permitted only to save the woman's life or prohibited altogether; II, physical health (also to save the woman's life); III, mental health (also to save the woman's life and physical health); IV, socioeconomic grounds (also to save the woman's life, physical health and mental health); V, without restriction as to reason (Source: Center for Reproductive Rights [formerly Center for Reproductive Law and Policy] 1999).

[b] These weights represent the fraction of the total population (of women aged 15–44 years) of countries with data.

in the analysis since the differences in fertility levels within subregions are even wider.

DHS directly provide most of the information needed for the calculation of attributable risk ratios. This includes information on sexual activity (needed to define exposure), fertility intentions, type of contraceptive method used and probability of contraceptive failure. These are discussed below. However, DHS have one important defect: most do not collect information on induced abortion and those that do yield severe underestimates. The difficulty of obtaining reliable information on induced abortion is the most intractable problem in the study of human reproduction, perhaps not surprisingly in view of the fact that abortion is both illegal and stigmatized in many societies.

In this chapter, we have used unpublished 1995 national estimates of unsafe abortions compiled by WHO. These estimates were made indirectly from data on hospital admissions for abortion complications, weighted by the proportion of abortions that are thought to result in complications requiring admission. Information from community surveys and to a lesser extent from abortion providers' surveys and mortality studies have also been used to derive best possible estimates (WHO 1998). While this is the main base of data used to calculate abortion probabilities, DHS data have also been used for three central Asian republics (Kazakhstan, Kyrgyzstan and Uzbekistan) where abortion is legal and survey estimates are considered reliable (Westoff et al. 1998). In addition, data on legal rates of abortion were used to make adjustments in some countries (Henshaw et al. 1999).

The only other non-DHS data source used in the calculations were biological in nature. Monthly probabilities of conception among nonusers of contraception (i.e. fecundability) and intrauterine mortality were taken from the published literature (Bongaarts and Potter 1983; Leridon 1977).

3.2 Defining exposure and fertility preferences

Women who do not have sexual intercourse are obviously not at risk of complications of abortion or childbirth. Virgins and others need to be distinguished. Virgins are excluded from exposure and they do not affect the relative risk calculations. The proportions of virgins have been given as a separate input for each subregion. In 12 surveys (Table 15.1), mainly in Asia where premarital sex is relatively uncommon, only ever-married women were interviewed. For these countries never-married women have been categorized as virgins. All non-virgins were included in the appropriate category of exposure variable "contraceptive status". A large proportion of non-users is not exposed to risk of pregnancy for either biological or behavioural reasons. As the calculations involved estimating births over a 12-month period, it was decided to classify women who reported no intercourse in the past 12 months as behaviourally unexposed.

Fertility surveys like the DHS include several questions on fertility intentions: total desired family size, whether more children are wanted, the number of additional children wanted and the intended status of recent births and current pregnancy. Retrospective data on recent births could not be used for our purposes of examining the relationship between unwanted births and contraceptive use, since the women were not asked whether they were using a method of contraception at the time of conception. Instead, we needed to use a forward-looking measure on desirability and timing of any future births. Women's response to the questions "Would you like to have a/another child or would you prefer not to have any (more) children?" and "How long would you like to wait from now before the birth of a/another child?" are considered to be relatively unbiased. Women have no reason to misreport their preference for more children (Bongaarts 1990). Moreover, these future childbearing wishes or intentions are predictive of subsequent childbearing (Westoff 1990).

The data used to link contraception with childbearing intentions are the same that provide the input for calculating the now ubiquitous measure of unmet need for family planning, routinely reported from fertility surveys (Dixon-Mueller et al. 1992; Robey et al. 1996). A woman has an unmet need for birth spacing when she wants to postpone the next birth for at least two years, she is not using contraception and is exposed to risk of conception (i.e. sexually active and menstruating). Similarly, women who want no more children and are not current users are defined to have an unmet need for limiting family size. Unmet need refers to the current status (at the time of interview), but we need to assume a steady state for one year in order to project the fertility implications over the next year for each combined level of exposure and fertility preference.

Since we wanted to estimate the yearly number of expected pregnancies, was this assumption that childbearing intentions stay constant for one year valid? Unless the women are re-interviewed the next year there is no way of knowing the exact fertility implications of the stated preferences and whether these preferences remain constant over a one-year span. Over long periods, childbearing intentions can change substantially, especially in countries progressing through a secular decline in fertility (Freedman et al. 1980). A woman's economic and social circumstances, health status and current marriage/partnership will influence her response about childbearing intentions. As these individual personal circumstances change so may her desire for more children. In the shorter term, however, stability of intentions is reasonably high. For instance, in a prospective study in Peru, aggregate levels of fertility preferences were shown to be consistent over a three-year period (Mensch et al. 1995). Even if circumstances and preferences change for individual women, at the aggregate level the changes are likely to be offset by other women whose life circumstances may change in the opposite direction.

3.3 Estimating the expected number of unintended pregnancies

Referring back to Figure 15.1, the first stage was to estimate how many unintended pregnancies we expected in one year. This was done by first estimating the proportion of women who would become pregnant and combining this with the probability that the pregnancy was unwanted or mistimed. The proportion of women becoming pregnant was based on contraceptive failures among modern and traditional method users and on biological expectations of the number of conceptions among non-users.

Contraceptive failure

Most enquiries of DHS do not collect information that permit the calculation of contraceptive failure rates. However in a subset of 18 developing countries where levels of contraceptive practice are high, the necessary data have been collected in the form of month-by-month calendars of contraceptive use spanning a 60-month period prior to date of interview. The type of methods used, dates of starting and ending episodes of use together with main reason for stopping (including failure) are ascertained. Failure rates can be calculated by application of life table techniques to these data. Though this retrospective method of measurement makes heavy demands on the memory of respondents, recall is aided by prior entry into the calendar of live births, ascertained earlier in the interview, and the contraceptive data appear to be of high quality (Curtis and Blanc 1997).

We used an unpublished analysis of failure rates for all 18 countries where calendar data have been collected. Despite considerable intercountry variability, the ranking of methods according to failure rates is clear-cut and accords with other evidence (Trussell 1998). Failure rates are low for methods requiring no memory or skill from users (sterilization, IUD, implant, injectable), intermediate for theoretically effective methods that do require inputs from users (oral contraceptives, condoms) and high for periodic abstinence and withdrawal.

Failure rates not only vary by method and by type of user but also by duration of use. They tend to be higher during the initial period of use and subsequently decline. The reason for this trend concerns selectivity. Inefficient users of a method have a high probability of an early failure. With the passage of time, continuing users are increasingly selected for their proficiency of use and thus failure rates fall. This tendency is more marked for methods requiring skill or memory than for other methods. We have used the mean method-specific and duration-specific failure rates for these 18 countries to calculate country-specific aggregate failure rates for all 58 countries. In the left-hand panel of Table 15.2 we have presented the yearly probabilities of experiencing failure by duration of use for each method. These were calculated from the single-decrement

Table 15.2 Calculation of average method-specific failure rates from yearly probability of failure by duration of use for women aged 30–44 years, all countries combined

Contraception method	*Yearly probability of experiencing contraceptive failure by duration of use (%)*				*Duration of use in completed years (proportional distribution)*				*Average failure rate (%)*
Year of use	1st	2nd	3rd	4+	0	1st	2nd	3rd	
Pill	5.4	6.1	4.6	4.0	0.43	0.17	0.10	0.30	5.0
IUD	1.4	1.7	1.3	1.4	0.26	0.16	0.14	0.45	1.4
Injections	2.4	2.4	2.1	1.7	0.57	0.17	0.08	0.17	2.2
Diaphragm/foam	20.8	17.9	7.7	5.0	0.44	0.09	0.10	0.37	13.3
Condom	9.6	8.3	7.1	2.7	0.45	0.15	0.10	0.30	7.1
Norplant	0.1	0.2	0.1	0.0	0.37	0.23	0.11	0.30	0.1
Female sterilization	0.1	0.0	0.0	0.2	0.12	0.11	0.10	0.67	0.1
Male sterilization	0.9	0.7	1.8	0.0	0.09	0.10	0.10	0.70	0.3
Periodic abstinence	21.0	19.5	12.7	10.1	0.34	0.09	0.14	0.43	14.9
Withdrawal	17.4	18.2	15.8	10.7	0.41	0.16	0.13	0.30	15.3
Other traditional	16.0	24.0	15.5	8.5	0.37	0.20	0.10	0.33	15.1

life table estimates of failure. The estimates should be interpreted as the cumulated percentage of couples who would experience failure by the end of the 12th month of use, in the absence of other reasons for stopping use. As can be seen, failure rates generally decline by duration of use, although the second-year failure rates are higher than the first year ones for pill, IUD, withdrawal and "other traditional" methods.

For each of the 58 countries, these method–duration-specific failure rates were then combined with data on duration of use of current methods. The resulting country-specific failure rates for each method were calculated separately for the two age groups. Table 15.2 shows the calculation of these method-specific failure rates for women aged 30–44 years (all countries combined).

The final step was to obtain aggregate failure rates for modern and traditional methods by taking into account the relative contribution of the different modern and traditional methods (method-mix) in each country. The country–method-specific failure rates (calculated as in Table 15.2) have been combined with the relative method mix, as shown in Table 15.3. For women aged 30–44 years, the average failure rate experienced by modern method users is 2.3%, while 15.1% of the traditional method users will conceive in a year. For the younger age group these failure rates are higher at 4% and 17.3%, respectively, due to their greater reliance on less effective reversible methods, and a shorter length of time for which current users have been using the methods (calculations not shown).

Table 15.3 Aggregate failure rates, calculated from method-specific failure rates and method mix for women aged 30–44 years, all countries combined

	Average method-specific failure (%)	*Method mix relative distribution*	*Aggregate failure rate (%)*
Modern methods			2.3
Pill	5.0	0.21	
IUD	1.4	0.22	
Injections	2.2	0.11	
Diaphragm/foam/jelly	13.3	0.01	
Condom	7.1	0.06	
Norplant	0.1	0.01	
Female sterilization	0.1	0.36	
Male sterilization	0.3	0.02	
Traditional methods			15.1
Periodic abstinence	14.9	0.60	
Withdrawal	15.3	0.32	
Other traditional	15.1	0.08	

Conception rates

The estimation of the expected conceptions among the non-users was based on fecundability, which is defined as the probability of conceiving in a month among fecundable women (Bongaarts and Potter 1983). Fecundable women are those capable of conceiving. Conception refers to recognizable conception signified by the delay of first menses after fertilization. Some non-users have obvious biological or behavioural characteristics that make them temporarily unexposed to the chance of conceiving: the currently pregnant, amenorrhoeic women, women who have not resumed sex since the most recent childbirth and women who reported no sex in the past year. Other non-users, such as those who have reached menopause or know themselves to be infecund, are permanently unexposed to the risk of conception. These women have thus been excluded and the conception rates applied to fecundable women who have been sexually active over the past year.

Fecundability is difficult to assess empirically and it is usually estimated from waiting times to conception. Most reliable estimates are available from measuring the length of interval between marriage to first birth among couples using no contraception. Coital frequency is the dominant behavioural determinant of fecundability and most of the variation of fecundability by age can be attributed to a decline in intercourse (James 1979). Fecundability has been tabulated either by age or by coital frequency, but not by both (Bongaarts and Potter 1983; Leridon 1977).

Without sex there can be no conception but there are other biological requirements: the woman needs to ovulate, and insemination must lead to a successful fertilization, which then has to result in a recognizable conception. Mathematical modelling of age-specific fecundability shows that the ability to conceive is quite constant between ages 25 and 40, while the ability to maintain a pregnancy starts to decline much earlier (Weinstein et al. 1990; Wood and Weinstein 1988). In our calculations intrauterine mortality was accounted for in the second step (Figure 15.1) when we estimated how many of the unintended pregnancies resulted in unwanted births and unsafe abortions.

While biological determinants of fecundability are fairly constant across populations, differences in frequency of sexual intercourse do have a substantial impact on fertility (Brown 2000; Weinstein et al. 1993). Increased frequencies of sexual intercourse raise fecundability, but the relationship is not linear. When coital frequency is low, the chance of conceiving is proportional to the frequency, but, at higher levels of monthly frequency, further increases are minimal (Potter and Millman 1986; Weinstein et al. 1990).

Should age-based or coitus-based estimates of fecundability be used? DHS data allow the calculation of both. Most surveys enquire about the most recent date of last sexual intercourse and frequency in the last month. We have used the data on the most recent date of the last intercourse to infer coital frequency, because it is less prone to recall error and normative responses than the question on coital frequency in the last month (Becker and Begum 1994). It is also available for more surveys included in our calculations. When the individual probability of coitus is constant throughout the month, the interval between two acts of intercourse is the reciprocal of the frequency. It has been shown—mathematically and empirically—that the distributions of the time since last sex and the interval between two acts have the same mean and variance (Leridon 1993). We could therefore estimate the coital frequency from the mean time since last sex. Our calculations were based on women who have been sexually active in the past year. Among these women, a large proportion did not have sex during the last month. Therefore, the average time since last sex was converted into monthly coital frequency for those who did have sex within the last month, while the others were given the value of 0 in order to derive the average monthly frequency among all women sexually active during the past year. Twelve countries lacked data on time since last sex, and for those we imputed frequencies taking the average values estimated from other countries for the three levels of fertility intention. The calculation of mean coital frequencies was done separately for samples of ever-married and samples that included all women. The frequencies for all women typically give lower values, especially among women who want to space their births (hereafter referred to as "spacers"), which include many women who may not have a regular partner, or not live with a partner.

Since the frequency of intercourse varies considerably according to childbearing intentions, with spacers and women who want to limit their births (hereafter referred to as “limiters”) having less frequent sex than women who want a birth within the next two years, we have calculated expected pregnancies in two ways. The first uses model estimates of fecundability based on coital frequency (Bongaarts and Potter 1983), allowing different conception rates by fertility intention, while the second uses simple age-specific fecundability estimates, with monthly fecundability declining from 0.25 in the early 20s to 0 by age 45 years (Leridon 1977).

Table 15.4 shows the differentials in monthly coital frequencies by fertility desire and its impact on fecundability for the two age groups. Fecundability was expressed as the number of women expected to become pregnant at the end of one year, and this was contrasted with the age-specific fecundability as calculated from the monthly model estimates (Leridon 1977).

Overall, the mean coital frequencies derived from data on duration since last sexual intercourse seem very low, but reflect the fact that these are based on all women who had sex during the past year (rather than on those in stable cohabiting relationships). The effect of including unmarried, non-cohabiting women is especially evident among the spacers aged 15–29 years, a group which includes 25% of never-married women, compared with 13% among the limiters and 7% among those who desire a child soon. Single women have sex less frequently—and are likely to underreport sexual activity. For the 12 countries with ever-married samples, higher levels of coital frequency result in higher expected fecundability. But in most societies, sexual intercourse and therefore risk of pregnancy is not restricted to marriage. A study among nine African countries has shown that the time spent in marriage is not always a good proxy for sexual activity either, with high levels of inac-

Table 15.4 Mean monthly coital frequency by age and fertility preference for fecund non-users, and estimates of coitus-based and age-based fecundability

	15–29 years	*30–44 years*
Mean coital frequency		
Want children soon	4.4	3.9
Spacers	2.1	3.0
Limiters	3.5	2.0
Coitus-based fecundability (proportion pregnant in a year)		
Want children soon	0.82	0.78
Spacers	0.54	0.71
Limiters	0.72	0.54
Age-based fecundability (proportion pregnant in a year)	0.97	0.75

tivity recorded by married women, especially in West Africa (Brown 2000). The differential in fecundability according to fertility preference persists when the analysis is restricted to married women only and remains important.

Guided by consistency checks on internal validity of the data (discussed below), the relative risk estimates presented in this chapter were calculated using *age-based* fecundability estimates. Because of the importance of the effect, however, we will return to this topic in the section on uncertainty of estimates at the end of the chapter.

3.4 Combining exposure and fertility intention

The expected number of unwanted pregnancies was calculated separately from mistimed pregnancies. In fact, pregnancies were estimated for all nine combinations of exposure (modern method use, traditional method use, no use) and fertility intention (want birth soon, later, never). As shown schematically in Figure 15.2, contraceptive failures can thus result in pregnancies that are classified as intended. They occur among women who want a birth within the next two years.

More detail is provided in Figure 15.3 showing the calculation of the expected proportion of women having an unwanted pregnancy in the next year for each level of exposure, using data for women aged 30–44 years (all surveys combined).

Among the non-users, 11% were currently pregnant, 19% were amenorrhoeic or had not resumed sex since last birth, 21% were infecund or menopausal and another 10% had not had sex in the past year, leaving

Figure 15.2 Combining data on exposure and fertility intention to estimate pregnancies

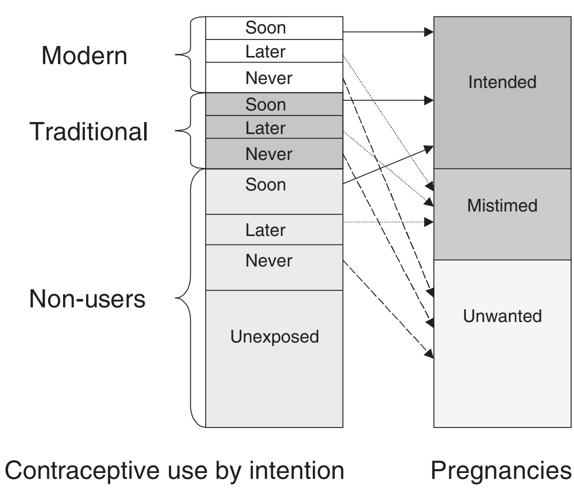
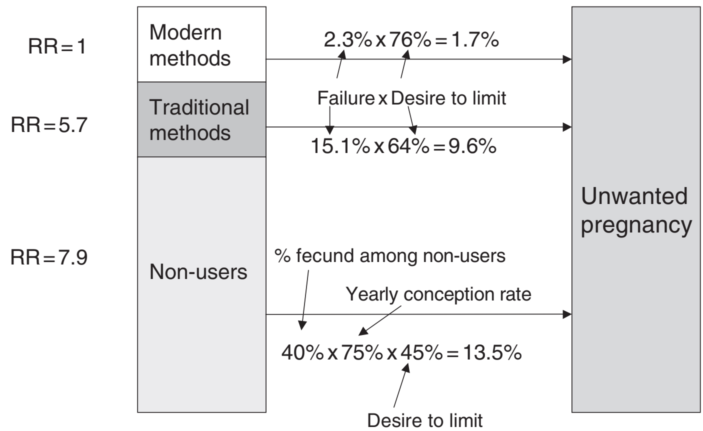


Figure 15.3 Expected proportion of women having an unwanted pregnancy in the next year, by exposure



only 40% of the non-users exposed to the risk of conception. Forty-five per cent of these fecundable women wanted to limit their families (i.e. have no more children) and, based on their coital frequency, they had a 75% probability of conceiving in a 12-month period. The product of these three numbers (40% × 45% × 75%) gave the proportion of all non-users who were expected to have an unwanted pregnancy in the next 12 months, namely 13.5%.

Among traditional (and modern) method users there may also be women who are biologically or behaviourally unexposed, but they are implicit in the failure rates (in contrast to conception rates). In other words, the presence of unexposed women among users will depress failure rates and thus obviate the need to take further account of such women. The calculation of the expected number of unwanted births was simply the product of the 12-month failure probability and the percentage of those who wanted no more children. For all surveys combined, the failure rates for modern and traditional methods were 2.3% and 15.1%, respectively, and the percentage wanting no more children was 76% among modern method users and 64% among traditional method users. The calculations in Figure 15.3 show that a non-user is 7.9 times (13.5% / 1.7%) more likely than a modern method user to have an unwanted pregnancy in the next year.

Table 15.5 illustrates the calculation of the distribution of expected pregnancies in the next year, according to fertility intention. The right-hand panel shows that among the modern method users, 1.7% will experience an "unwanted" failure, while 0.1% will have an "intended" failure. Among 100 non-users, 13.5 will have an unwanted pregnancy and there will be 9.6 intended pregnancies. The last row gives the

Table 15.5 Distribution of expected pregnancies estimated from contraceptive use by fertility intention (women 30–44, all surveys combined)

	Level of exposure: Contraceptive use (%)	Fertility intention:[a] want birth			Percentage of women expected to have intended, mistimed and unwanted pregnancies (within level of exposure		
		Soon[b]	Later	Never	Intended	Mistimed	Unwanted
Modern users	28.2	5	18	76	0.1	0.4	1.7
Traditional users	8.1	11	25	64	1.7	3.8	9.6
Non-users	63.8	32	22	46	9.6	6.5	13.5
Total	100				6.3	4.6	9.9

[a] Per cent distribution with % wanting birth soon + % wanting birth later + % never wanting birth adding to 100%.

[b] Soon means a birth within the next 2 years.

expected pregnancies, weighted by the contraceptive distribution. In total, 21% of women aged 30–44 years are expected to get pregnant at current levels of contraceptive use. According to prevailing fertility intentions, 10% of women will have an unwanted pregnancy.

3.5 Estimating pregnancy outcomes

This section refers to the second step in Figure 15.1, estimating unwanted births and unsafe abortions from unwanted and mistimed pregnancies.

Spontaneous pregnancy loss

Before applying abortion probabilities to unwanted and mistimed pregnancies, we allowed for miscarriages and stillbirths. Recognizable intrauterine mortality is lowest in the early twenties (16%), but reaches double this rate by age 45 years (Bongaarts and Potter 1983). From these tabulated data we calculated the average spontaneous pregnancy loss as 17% and 27% for the younger and older women, respectively. Pregnancy loss does not vary by fertility intention, and the expected pregnancies in Table 15.5 need to be reduced by 27%, leaving 15.3% of women aged 30–44 years pregnant. Thus after accounting for pregnancy loss, 7.2% of women have an unwanted pregnancy and 3.4% have a mistimed pregnancy. A proportion of these will be aborted while the rest will result in a live birth.

Abortion probabilities

Abortion probabilities have been derived by converting the WHO country estimates of incidence ratios (unsafe abortions per 100 live births) to abortion probabilities (ratio of abortions to abortions plus births). For countries without estimates ($n=10$) we took the WHO regional abortion estimate (WHO 1998). The average abortion incidence ratio of 17.5 abortions per 100 live births translates into an overall abortion probability per pregnancy of 0.15 (= 17.5/(100 + 17.5)). Because intended pregnancies are most unlikely to be aborted, this probability needs to be converted to relate to unintended pregnancies only, while keeping the overall abortion ratios constant.

The main reason stated by women for having an abortion is to stop bearing children; following this is the wish to postpone pregnancy (Bankole et al. 1999). Other reasons included disruption of education and the belief that they were too young to have children, especially in Africa where single women are sexually active, all adding to the postponement component of abortion. An in-depth study in Maharashtra, showed that 54% of aborted pregnancies among married women were defined as unwanted and 42% as mistimed at the time of conception (Ganatra et al. 2000). In three central Asian republics, the proportion of unwanted pregnancies that were aborted ranged from 74% to 86%, while two-thirds of all mistimed pregnancies were aborted (Westoff et al. 1998).

Consistent with the limited evidence available, our calculations assumed that the abortion probability of a mistimed pregnancy was half that of an unwanted pregnancy. Though this assumption is essentially arbitrary, it is consistent with the judgements of experts. It can be regarded as reasonable but nevertheless must be viewed with caution.

The relative distribution of mistimed, unwanted and planned pregnancies expected for 100 women (at the current contraceptive prevalence and childbearing intentions) was used to relate abortions to mistimed and unwanted births only. Of the 15.3 pregnancies among 30–44-year olds (after spontaneous pregnancy loss), 3.4 are expected to be mistimed and 7.2 unwanted. So the abortion probability of unintended pregnancies is calculated as $0.15 \times 15.3/(7.2 + 3.4/2) = 0.25$. This probability implies that one in four unwanted pregnancies will be aborted compared with one in eight of mistimed pregnancies. Although we started from the same incidence ratio for both age groups, the fact that only unintended pregnancies are aborted leads to different abortion probabilities for the two age groups. In the countries with high rates of unsafe abortion and lack of systematic data, we know little about how abortions vary by age. Where official statistics are more complete, there are generally two age patterns of abortion ratios (Bankole et al. 1999). The first takes a U-shape, where abortion is high both among unmarried young women and older women who have reached their desired family size. The second pattern is a steady increase in the abortion ratio with age. As default we have chosen to use the same ratio for both age groups. Where consistency checks indicated negative levels of unwanted births in the younger age group (Guinea, Indonesia and Thailand) or where data on age patterns were available (Kazakhstan, Kyrgyzstan, Uzbekistan) the ratio was adjusted by age. For countries that needed correction, the abortion probability of (any) pregnancy to women aged 30–44 years was assumed to be three times the probability for pregnancies to younger women (estimate based on the data provided for the latter three countries in the article by Bankole et al. 1999).

We have implicitly assumed that abortion probabilities of unwanted (and mistimed) pregnancies are the same regardless of whether they resulted from method failure or non-use. Common sense suggests that women who act on their intention to prevent an unwanted pregnancy by adoption of contraception are more determined to regulate fertility than other women and thus more likely to seek a termination when pregnant. Very limited empirical evidence on differential abortion probabilities supports this expectation. In Turkey, for instance, 28.5% of unintended pregnancies in 1998 resulting from non-use were aborted, compared with 38.1% and 35.2% of pregnancies resulting from modern and traditional method failure, respectively (Senlet et al. 2000). In Kazakhstan, 51% of unintended pregnancies among non-users were aborted compared with 67% of (all) contraceptive failures (Westoff 2000). The inferred differences are relatively small and their generalizability is unknown. Hence, it was decided to apply the same abortion probabilities for all three contraceptive use categories. Nevertheless, since the desire to discontinue childbearing altogether is highest among modern method users, our simulations did result in higher abortion probability for all modern method failures relative to traditional method failures and conceptions among non-users.

Probability and relative risk of having an abortion

Abortion probabilities have been combined with expected proportions of women who have unwanted and mistimed pregnancies in each exposure category. Table 15.6 provides the worked example of the expected proportion of women aged 30–44 years (all surveys averaged) having an abortion. The expected percentages of women having pregnancies are 27% lower than in Table 15.5, since they are adjusted for spontaneous pregnancy loss.

The abortion probability of 0.25 for unwanted births results in an expected proportion of 3.1% of non-users having an abortion in the next

Table 15.6 Probability of having an abortion in each exposure category and the resulting relative risk ratios

	Expected % of women having pregnancies			*Expected % of women having an abortion*	*RR of having an abortion*
	Intended	*Mistimed*	*Unwanted*		
Modern users	0.1	0.3	1.3	0.4	1.0
Traditional users	1.2	2.8	7.1	2.2	6.0
Non-users	7.1	4.9	9.9	3.1	8.7

year ($0.25 \times 9.9\%$ [unwanted pregnancies] $+ 0.25/2 \times 4.9\%$ [mistimed pregnancies]). Following the same logic, only 0.4% of modern method users are expected to have an abortion. Using the modern method users as the reference category the relative risk was derived as the ratio of expected proportion of women having an abortion among non-users compared with modern method users (RR=8.7). Similarly, traditional method users were projected to be six times more likely to have an abortion than modern method users.

PROBABILITIES OF WOMEN IN EACH EXPOSURE CATEGORY OF HAVING AN UNWANTED BIRTH

The proportions of modern and traditional method users and of non-users who are expected to deliver an unwanted birth were calculated by applying the complement of the abortion probability to the unwanted pregnancies. Mistimed pregnancies that end as live births do not contribute to the burden of maternal outcomes. The worked example in Table 15.7 shows that with an abortion probability of 0.25, three-quarters of the 9.9% of non-users with an unwanted pregnancy are expected to carry it to term. With 7.4% of non-users having an unwanted birth in the next year, compared with 0.9% of modern method users, the relative risk is 7.8.

Since the WHO abortion estimates relate to unsafe abortions only (which is required for the calculation of relative risk to have an unsafe abortion), we have potentially overestimated the expected number of unwanted births in countries where legal abortions are common. This does not affect the relative risk of unwanted birth, but it does affect the proportion unwanted among all births. As can be seen from Table 15.1, most surveys were done in countries with highly restrictive abortion laws, and therefore most abortions will be unsafe. For the countries with available data on legal abortions (Henshaw et al. 1999), the proportions of unwanted births among all births were calculated using legal abortion rates. The legal abortion ratio was used for Turkey. For Bangladesh and India, the official legal rates are very low and are underestimates of actual procedures performed (Henshaw et al. 1999). In India, abortion

Table 15.7 Probability of having an unwanted birth in each exposure category and the resulting relative risk ratios

	Expected % of women having pregnancies			*Expected % of women having an unwanted birth*	*RR of having an unwanted birth*
	Planned	*Mistimed*	*Unwanted*		
Modern users	0.1	0.3	1.3	0.9	1.0
Traditional users	1.2	2.8	7.1	5.3	5.6
Non-users	7.1	4.9	9.9	7.4	7.8

has been legal for 30 years, but abortion services by authorized facilities are inadequate, especially in rural areas. Many women are even not aware that abortion is legal and resort to abortions from both unskilled and skilled providers (Ganatra et al. 2000). In Bangladesh, with highly restrictive abortion laws, the legal rate refers to menstrual regulation services (manual aspiration evacuation of the uterus without prior confirmation of pregnancy). They are widely available, effectively providing abortion up to eight weeks of a woman's last menstrual period (Rahman et al. 1998). For India and Bangladesh we used the WHO estimates on unsafe abortions.

3.6 Consistency checks

Two basic consistency checks guided the assessment of the plausibility of the data inputs and the method assumptions, and informed the adjustments done for a few individual countries. We compared both the total numbers of projected births and the proportion of unwanted births among all births with retrospective estimates based on the question "At the time you became pregnant with (NAME OF CHILD) did you want to become pregnant then, did you want to wait until later or did you want no more children at all?" Age-specific fertility rates published by DHS allowed the calculation of the yearly number of births in each age group. These rates were averaged for a period of three or five years prior to survey data in order to reduce sampling error. The number of recent births per year should agree with our expected number of births per 1000 women in each age group, after adjusting for the proportions of women who never had sex. Exact matches for each survey are not expected, but systematic patterns of excess or shortfall of births may imply regional biases.

Compared with the current births calculated from the age-specific fertility rates, the projection using age-based fecundability estimates (averaging the outcomes for all surveys) results in a 15% shortfall of expected births for the younger age group, and 2% excess for the older age group. What may contribute to the underestimation of expected births? A minor factor may be that we discount miscarriages and stillbirths before calculating abortions. Since some of the aborted pregnancies might have resulted in a spontaneous intrauterine death, we may have underestimated the pregnancies carried to term. A second factor may be abortion probabilities that are too high. While this is unlikely overall, the assumption of constant incidence ratios by age may contribute to the shortfall of expected births in the youngest age group. Continuing fertility decline would also contribute to the discrepancy between projected and retrospective fertility levels. Finally, underreporting of sexual exposure (both overstating virginity and time since last sex) may well be a major cause of the deficit of births to young women.

It should be pointed out that in terms of estimating the relative risk ratios of having an unwanted birth or an abortion, overall numbers of births are less important than the relative distribution of births across fertility intention. As we indicated before, frequency of sexual intercourse is not the same for women who want a birth soon and those who either want to space or stop childbearing. Moreover, there is no reason to doubt the validity of these *relative* differences. This is an important factor contributing to the uncertainty around the estimates (discussed later).

This leads us into the second consistency check, the comparison of projected and retrospective estimates of the proportion of births that are unwanted. Compared with the proportion of the most recent births that were reported as unwanted, serious discrepancy was apparent with projected proportions of unwanted births: they were 63% and 143% higher for the 15–29-year olds and the 30–44-year olds, respectively. We discuss below potential biases that may account for the discrepancy.

The proportion unwanted among most recent births is available if this birth occurred within the last five, or in some surveys, three years. It is derived from the question "At the time you became pregnant with (NAME OF CHILD), did you want to have more children then, did you want to wait until later, or did you want no more children?" The question is meant to draw on the memory of the feelings that were held at the time of conception. Though little evidence exists to evaluate to what extent respondents later report as being wanted those children whose conception was initially unwanted, the most important reason why the "wantedness" of the most recent birth may not agree with our projected number of unwanted births is undoubtedly ex-post rationalization (Bongaarts 1990; Westoff 1981). Panel data in Morocco allowed the comparison of reports on the "wantedness" of 0–2-year-old children in 1992 with reports on the same births three years later (Westoff and Bankole 1998). Whereas 6% of children reported in 1992 as wanted at the time of conception were later described as unwanted, as many as 62% of the unwanted pregnancies in the first round were reported as wanted in 1995. The older the child, the more likely reports on the feelings or intentions had changed from unwanted to wanted. A comparison among five DHS confirms the result from Morocco. The percentage unwanted declines as the age of children increased, though the trend was less pronounced than in the Morocco data (Montgomery et al. 1997). Data on change in perception before and after a baby is born are not available. However, in a recent qualitative study in the United Kingdom of Great Britain and Northern Ireland among pregnant women and those who recently aborted, women generally agreed that conceptions which were initially "unplanned" or "unintended" could become "wanted", a term many women associated with the decision to carry the pregnancy to term (Barrett and Wellings 2002). Since we do not know how these concepts are translated and understood by different cultures, the magnitude of the rationalization bias cannot be quantified.

An additional explanation is that the most recent birth refers to a child of lower birth order than the projected next birth. Calculating order-specific estimates on the "wantedness" of the last child and applying these to the birth order distribution shifted by one child allows assessment of the magnitude of this order effect on fertility preferences. The average effect is surprisingly low: 9% of women aged <30 years report their most recent birth as being unwanted, while this would be raised to only 11% by shifting the order by one child. For the older women the effect was equally small.

A last potential factor contributing to the discrepancy might be the underestimation of the proportion of unwanted pregnancies that are terminated. By considering unsafe abortions, rather than all abortions, we may have overestimated the expected unwanted pregnancies carried to term. When the relative abortion probability of unwanted over mistimed pregnancies is lower than two, then we could again overestimate the number of unwanted births.

Given the considerable differences between the various measures of preferred fertility and the known bias in underreporting of unwanted births (Bongaarts 1990; Westoff 1981), we have to tolerate a level of inconsistency between projected and retrospective estimates of "wantedness". Important biases other than our model assumptions are operating and this precludes the use of the extent of discrepancy as a guide to make adjustments. Nevertheless, for selected countries with available data on legal rates and age pattern of abortion, adjustments were done (as explained above). We have been guided more by disparity between the age groups, than any discrepancy in expected level of fertility. While the abortion adjustments do not affect relative risk ratios, they do lower the proportion of unwanted among all births, which is used in projecting how much of the obstetric burden can be avoided by reducing unwanted births.

3.7 Counterfactual scenario

Counterfactual distribution of contraceptive use

The burden of maternal outcomes, including abortion, attributable to lack of effective modern contraception was calculated as the reduction in current burden that would be observed if levels of exposure were reduced to a counterfactual distribution of contraceptive use. Theoretical-minimum-risk distribution of contraception does not mean 100% modern use, but rather that all women with a desire to either stop or postpone childbearing for at least another two years, adopt an effective modern method of contraception. Perfect implementation of fertility preferences among limiters and spacers obviously results in a higher proportion of modern method users and fewer women using traditional contraception or no contraception at all. All traditional method users and fecund non-users now consist of women who want a birth in the next two years. This theoretical minimum level of exposure was thus simply calculated by shifting all spacers and limiters into modern method use.

The potential impact fractions were used to estimate the proportional reduction in the total number of unwanted births and unsafe abortions by a change in contraceptive prevalence. Potential impact fractions generally assume that only exposure changes, while the relative risk of the outcome for each level of exposure stays the same. However, as we demonstrated in the previous section, the relative risk of an abortion (or unwanted birth) among the traditional method users not only depends on the failure rates, but also on the fertility preference among these users. The factors determining the relative risk among non-users are conception rates, fertility preferences and the proportion fecund among the non-users. While both the failure and conception rates remain constant, the relative fertility preferences in each exposure category and the proportion of women who are fecund among non-users will change with a change in contraceptive distribution.

COUNTERFACTUAL RELATIVE RISK RATIOS

How do we expect the relative risk to vary with a change in exposure? Under the scenario of theoretical-minimum-risk, all women with a desire to stop or space childbearing will adopt modern methods and all expected conceptions in traditional method users and non-users will now be intended pregnancies. Because only the reference group (modern users) is at risk of an unintended pregnancy, the relative risk of unwanted births and abortions will be 0 in other groups. For intermediate levels of shifting the counterfactual relative risk will be between 0 and the current level of relative risk.

In deriving these counterfactual levels of relative risk, the degree of shifting was assumed to be the same for spacers and limiters. The calculation involved computing counterfactual proportions of fecundable women among the non-users, and counterfactual fertility preferences in all three categories of exposure.

For each level of shifting, the counterfactual distribution of contraceptive use was determined by subtracting the number of women using traditional methods and no contraception at all and adding that to those using modern methods. The distribution of non-users was recalculated by keeping the number of infecund/menopausal women and those that were not sexually active in the past year constant; the number of fecundable women changed by subtracting the number of limiters and spacers who shifted to using modern methods; the number of pregnant and amenorrhoeic women changed since more effective contraception implies a reduction in the number of births, with at any one time a smaller proportion of women pregnant or in the amenorrhoeic state. Through a process of iteration we imputed the ratio of births in the counterfactual over current population and assumed that the number of pregnant and amenorrhoeic change to the same extent. These numbers were combined in the counterfactual proportion of fecund women among non-users. The counterfactual distribution of fertility desires among the three categories of exposure was calculated taking account of the level of shifting and counterfactual proportion of fecundity among the non-users. Table 15.8 compares current with counterfactual exposure and fertility intentions, calculated for women aged 30–44 years, all countries combined, assuming 50% shifting.

These counterfactual contraceptive distributions, fertility desires and proportion fecund among non-users were then combined to obtain relative risks in the same way as explained in the previous section for the "current" relative risk levels. Table 15.9 contrasts the counterfactual relative risk for the same scenario of 50% shifting, among women aged 15–29 years and 30–44 years, with the relative risk levels under current exposure.

The relative risks among non-users initially decline faster with the degree of shifting, compared with levels among traditional method users. When half of all non-users and traditional users who currently have an unmet need for spacing or limiting have adopted a modern method, the relative risk for a non-user to have an unwanted birth has decreased from 7.8 to 5.0. The relative risk for traditional users drops to a lesser extent (from 5.6 to 5.2). The steeper decline among the non-users can be explained mainly by the fact that the infecund, the menopausal and the sexually inactive women gradually become a larger proportion of all non-users. The pattern of the counterfactual relative risk levels by degree of shifting varies across countries. The average pattern (for all surveys combined, women aged 30–44 years) shows the most common pattern as depicted in Figures 15.4 and 15.5 of a near-linear decline for

Table 15.8 Current and counterfactual contraceptive distribution and fertility preferences among women aged 30–44 years, all surveys combined

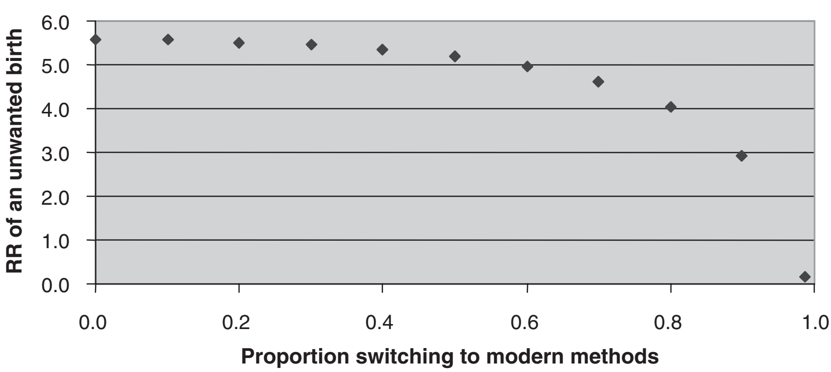
	Current exposure and intention			
	Contraceptive use	*Want birth soon*	*Want to space*	*Want to limit*
Modern	28.2	0.05	0.18	0.76
Traditional	8.1	0.11	0.25	0.64
Non-use[a]	63.8	0.32	0.22	0.46
	Counterfactual exposure and intention (50% shifting)			
Modern	37.4	0.04	0.22	0.74
Traditional	4.6	0.20	0.22	0.58
Non-use[a]	58.1	0.49	0.17	0.34

[a] The percentage fecund among the non-users decreases from 40% to 32%.

Table 15.9 Relative risk ratios for unsafe abortions and unwanted births under current and counterfactual exposure, both age groups, all surveys combined

	RR under current exposure		*RR under counterfactual exposure assuming 50% shifting*	
Abortions	15–29 years	30–44 years	15–29 years	30–44 years
Modern	1.0	1.0	1.0	1.0
Traditional	3.8	6.0	3.2	5.4
Non-use	6.2	8.7	3.8	5.4
Unwanted birth				
Modern	1.0	1.0	1.0	1.0
Traditional	2.9	5.6	2.7	5.2
Non-use	4.5	7.8	3.1	5.0

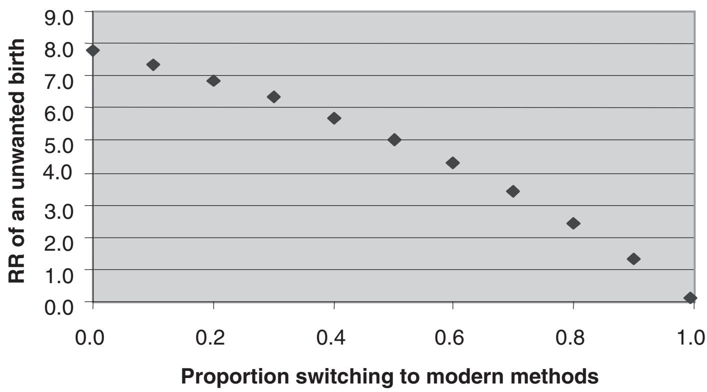
Figure 15.4 Pattern of change in relative risk of an unwanted birth by level of switching for traditional method users, women aged 30–44 years



non-users, while the relative risks for traditional method users tend to stay relatively constant up to 50–60% shifting, declining rapidly to 0 thereafter.

For traditional use the relative risk of unwanted births and abortions sometimes increases initially at lower levels of shifting. This seems to happen when more spacers than limiters move into the modern method users, which has little effect on the distribution of fertility preferences among the traditional users, but affects the expected proportion of modern users who will be having relatively more "mistimed failures"

Figure 15.5 Pattern of change in relative risk of an unwanted birth by level of switching for non-users, women aged 30–44 years



rather than "unwanted failures". Thus the expected proportion of modern method users having unwanted births actually decreases slightly. Since the expected proportion of unwanted births among the non-users changes much faster, this pattern of an initial relative risk rise is not detected so much among the non-users.

3.8 Aggregating country-specific estimates into subregions

The country level results in terms of contraceptive exposure, relative risks of unsafe abortions and unwanted births were aggregated into subregional averages, weighting each country according to the size of the population (see Table 15.1 for weighting factors). The derived estimate was then taken as subregional average, assuming that the countries were reasonably representative of the whole subregion. Table 15.10 presents the coverage of subregional population by countries with data.

As can be seen from the subregional coverage presented in Table 15.10, the African, Latin American and some of the Asian subregions are well represented. The three subregions where relevant data are totally lacking are AMR-A, EUR-A and WPR-A, which mainly consist of industrialized low-fertility countries with small burdens of maternal mortality or unsafe abortion. The exposure distributions for these subregions were imputed from data provided in the United Nations (UN) report on levels and trends in contraceptive use (UN 1999). As the UN data were for married women aged 15–49 years, we assumed 90% of total estimate for the age group 15–29 years and 110% of estimate for 30–44-year olds. Since safe abortion is widely available in most of these countries, the relative risk levels were arbitrarily set at 1.5 for unwanted births (both for traditional users and non-users). For abortion we took relative

Table 15.10 Coverage of subregional population by countries with data from DHS

Subregion	*Number of DHS per subregion*	*Percentage of the subregional population covered by countries with DHS data*
AFR-D	9	80
AFR-E	14	69
AMR-A	0	0
AMR-B	6	79
AMR-D	6	100
EMR-B	1	8
EMR-D	5	85
EUR-A	0	0
EUR-B	3	46
EUR-C	1	7
SEAR-B	3	100
SEAR-D	3	93
WPR-A	0	0
WPR-B	1	5

risks of 2 and 3, respectively, for traditional method users and non-users. It matters little what the real risks are since the burden of obstetric and abortion complications is negligible. Subregions that are cause for greater concern are EMR-B, EUR-C and WPR-B. Tunisia is the only country representing EMR-B and Kazakhstan the only one in EUR-C. Most worrying is that WPR-B, a subregion in which 83.5% of the population live in China, is represented solely by the Philippines. In China, because of the strict anti-natal policies, there will be very few unwanted births and most abortions are legal and safe. Therefore an adjustment was needed for WPR-B, which is discussed in the next section on deriving attributable burden.

3.9 Subregional estimates of input parameters

The inputs provided for calculating the attributable burden are the contraceptive distributions and relative risks under the current situation and counterfactual (theoretical minimum) scenario, and the proportion of all births that are unwanted.

We first estimated the proportions of women who were excluded from the analysis because they never had sex and were therefore not exposed to the possibility of pregnancies (i.e. virgins). Table 15.11 gives the proportion of the female population that is presumed to be virgins. Our method overestimates virginity in two ways. In the countries with ever-married samples, single women do not enter the analysis and are assumed to be virgins. Clearly, this assumption is not entirely valid. In the other

Table 15.11 Average proportion of women who are virgins, by subregion

Subregion	*15–29 years*	*30–44 years*
AFR-D	23.6	0.5
AFR-E	26.1	0.5
AMR-A	15.0	1.5
AMR-B	39.4	4.1
AMR-D	43.0	3.7
EMR-B	65.1	7.4
EMR-D	48.8	4.2
EUR-A	15.0	1.5
EUR-B	46.5	3.1
EUR-C	42.1	2.1
SEAR-B	45.8	5.6
SEAR-D	27.6	1.2
WPR-A	15.0	1.5
WPR-B	59.8	8.7

countries virginity may be overstated to the extent that single women underreport sexual activity. The estimates for the three subregions where we lacked data, AMR-A, EUR-A and WPR-A, were informed by data from the British Sex Survey in 1990/91 (Johnson et al. 1994).

Current contraceptive use, averaged for each subregion, is shown in Table 15.12 and the counterfactual scenario in Table 15.13. The second table thus provides the contraceptive status that would have been observed if all women with a current need for spacing and limiting were to adopt a modern method. Note that a small residue of traditional method users remains; these are women who want a child within the next two years. The subregional variation in *current* contraceptive use is thus explained by variations in desired family size and extent of implementation of these desires through contraception (and abortion). Subregional variations in *counterfactual* contraceptive use reflect differences in desired family sizes and use of abortion as alternative means to implement fertility intentions.

Tables 15.14 and 15.15 show the relative risk estimates for having an unwanted birth and an unsafe abortion, respectively, under the current regime of contraceptive practice and fertility preferences. The levels for the counterfactual minimum risk have not been provided since they are all 0, as explained earlier. As can be seen, there is wide subregional variation in relative risks, both for traditional method users and non-users. The subregion that stands out is SEAR-D, where India represents a large part of the population. Modern contraception in India (and

Table 15.12 Averages of current contraceptive distribution among women who ever had sex, by subregion

	15–29 years			*30–44 years*		
Subregion	*Modern method*	*Traditional method*	*Non-use*	*Modern method*	*Traditional method*	*Non-use*
AFR-D	8.0	9.1	82.9	10.7	7.7	81.6
AFR-E	13.0	5.4	81.6	15.6	5.6	78.8
AMR-A	60.6	2.6	26.8	74.1	3.2	32.8
AMR-B	48.1	6.9	45.0	62.1	6.8	31.1
AMR-D	27.9	11.6	60.5	36.2	14.6	49.2
EMR-B	30.4	7.7	61.9	44.8	10.8	44.5
EMR-D	14.9	2.6	82.4	23.5	4.1	72.4
EUR-A	62.1	5.2	22.7	75.9	6.4	27.7
EUR-B	36.0	16.6	47.4	46.9	21.8	31.3
EUR-C	42.4	12.4	45.2	55.5	12.2	32.3
SEAR-B	54.4	2.6	43.0	55.9	4.1	40.0
SEAR-D	23.5	4.0	72.5	48.3	5.3	46.4
WPR-A	48.7	5.0	36.3	59.5	6.1	44.4
WPR-B	24.1	18.0	57.9	29.5	20.3	50.2

Table 15.13 Averages of counterfactual contraceptive distribution (theoretical minimum) among women who ever had sex, by subregion

	15–29 years			*30–44 years*		
Subregion	*Modern method*	*Traditional method*	*Non-use*	*Modern method*	*Traditional method*	*Non-use*
AFR-D	43.1	2.5	54.4	42.5	1.8	55.8
AFR-E	47.7	1.5	50.8	49.9	0.8	49.4
AMR-A	60.6	2.6	26.8	74.1	3.2	32.8
AMR-B	84.7	1.1	14.3	84.4	0.7	14.9
AMR-D	72.9	2.0	25.1	72.8	1.7	25.5
EMR-B	66.2	1.4	32.5	82.6	1.0	16.4
EMR-D	48.6	0.4	51.0	62.3	0.4	37.4
EUR-A	62.1	5.2	22.7	75.9	6.4	27.7
EUR-B	70.3	2.7	27.0	82.4	0.8	16.8
EUR-C	76.1	2.0	21.9	79.5	0.9	19.6
SEAR-B	71.2	0.3	28.5	73.0	0.5	26.6
SEAR-D	60.7	0.9	38.4	74.0	0.2	25.8
WPR-A	48.7	5.0	36.3	59.5	6.1	44.4
WPR-B	72.7	1.2	26.1	70.0	1.0	28.9

Table 15.14 Average relative risk of having an unwanted birth under the current contraceptive scenario, by subregion

	Traditional method users		*Non-users*	
Subregion	*15–29 years*	*30–44 years*	*15–29 years*	*30–44 years*
AFR-D	2.3	3.2	2.8	3.5
AFR-E	1.6	4.4	3.0	4.9
AMR-A	1.5	1.5	1.5	1.5
AMR-B	3.2	7.9	8.3	14.3
AMR-D	4.1	6.4	6.2	9.8
EMR-B	3.2	5.9	3.9	8.4
EMR-D	3.2	5.1	3.4	6.8
EUR-A	1.5	1.5	1.5	1.5
EUR-B	4.0	6.3	5.1	11.1
EUR-C	5.1	8.6	6.9	12.7
SEAR-B	4.1	6.1	4.3	8.0
SEAR-D	4.6	22.2	4.6	27.8
WPR-A	1.5	1.5	1.5	1.5
WPR-B	3.7	5.9	5.8	7.7

Table 15.15 Average relative risk of having an unsafe abortion under the current contraceptive scenario, by subregion

	Traditional method users		*Non-users*	
Subregion	*15–29 years*	*30–44 years*	*15–29 years*	*30–44 years*
AFR-D	2.6	3.5	3.9	4.2
AFR-E	3.0	4.7	4.7	5.4
AMR-A	2.0	2.0	3.0	3.0
AMR-B	4.1	8.4	10.6	16.2
AMR-D	4.3	6.8	7.6	10.6
EMR-B	4.6	6.0	6.4	10.0
EMR-D	3.9	5.2	5.0	7.7
EUR-A	2.0	2.0	3.0	3.0
EUR-B	4.9	6.3	7.5	11.5
EUR-C	5.0	8.3	10.5	13.3
SEAR-B	5.5	6.4	6.4	9.2
SEAR-D	6.6	22.7	10.9	30.9
WPR-A	2.0	2.0	3.0	3.0
WPR-B	4.1	6.2	6.6	8.5

Nepal) is dominated by sterilization, which has a very low failure rate. As very few modern method users become pregnant, the relative risks for the other two categories are raised. This observation has complicated the interpretation of the counterfactual relative risks for abortions, as one of our model assumptions has obviously been violated. Keeping failure rates and contraceptive method mix constant with an increase in contraceptive prevalence has become internally inconsistent with the fertility preferences. Where sterilization is the dominant modern contraceptive method, it is impossible to accommodate the needs of spacers at the current method mix. Increased contraceptive use among spacers in such settings would have to involve uptake of reversible methods but this trend would reduce the average effectiveness of modern method use, because reversible methods have higher failure rates than sterilization. And this, in turn, would reduce the relative risk of an abortion for traditional method users and non-users. The attributable fractions derived from these relative risks of unsafe abortions for these countries with high use of sterilization will thus be a slight overestimate. However, since spacers do not contribute to unwanted births, the relative risks for unwanted births remain unaffected. Only when limiters adopt methods other than sterilization, as method choice widens, would the relative risks for unwanted births be affected.

4. Attributable burden

By combining the relative risk values for an unsafe abortion (Table 15.15) with the data on current and counterfactual distributions of contraceptive use (Table 15.12 and Table 15.13), we have derived the attributable fractions for unsafe abortions (Table 15.16). These estimates show that a very large proportion of the disease burden due to abortion complications is attributable to unprotected sex or use of less effective traditional methods. The residual is the "unavoidable" burden associated with modern method failure.

Table 15.17 gives the estimated burden of disease attributable to unsafe abortions by subregion. Both deaths and total DALYs have been presented as well as the relative burden in each subregion, expressed as DALYs per 1000 women, to allow better comparison between the subregions. The estimated burden of abortion attributable to non-use and use of ineffective methods of contraception is 4.4 million DALYs, with 82% of the burden falling on women aged <30 years. South Asia with its large population (SEAR-D) has the highest abortion burden at about 35% of the total abortion burden in both age groups. Although AFR-D and AFR-E include smaller populations than SEAR-D, women in these subregions have the highest relative burden.

The calculation of attributable burden for unwanted births is slightly more complicated. The attributable fraction for unwanted births could not be applied to the total burden of obstetric complications in

Table 15.16 Estimates of attributable fraction for unsafe abortions, by subregion

	Attributable fraction (%)	
Subregion	*15–29 years*	*30–44 years*
AFR-D	88	89
AFR-E	88	90
AMR-A	59	59
AMR-B	85	87
AMR-D	87	89
EMR-B	86	85
EMR-D	90	90
EUR-A	56	56
EUR-B	86	85
EUR-C	87	86
SEAR-B	79	84
SEAR-D	93	95
WPR-A	68	71
WPR-B	85	88

childbirth, since the many wanted births also contribute to maternal deaths and morbidity. We thus had to restrict the burden to that proportion of all births that was unwanted as simulated from contraceptive failure, conception rates and fertility preferences. These proportions are presented in Table 15.18, together with the unadjusted attributable fractions. These fractions express what proportion of unwanted births can be avoided by perfect implementation of fertility preferences. The proportion of unwanted among all births is much higher for the older age group, as the desire to limit family size is much more prevalent than among younger women. The negative values for women aged 15–29 years in EUR-C and SEAR-B reflect the fact that the abortion probabilities assumed for these women were probably still too high. In calculations the proportion was set to 0, and in the subregions concerned we may have slightly underestimated the burden of maternal complications in childbirth for the younger age group while overestimating it for older women. Finally, these proportions have been combined with the unadjusted attributable fractions (unwanted births only), to give the attributable fractions of all births that could be averted if all women who wish to stop childbearing used a modern method.

As mentioned earlier, the estimate for WPR-B needed adjusting since China, with very low rates of unwanted births, dominates the subregion. The easiest adjustment procedure was to keep the relative risk and contraceptive prevalence estimates for the Philippines, and adjust the

Table 15.17 Estimated burden of disease attributable to unsafe abortions (due to non-use of contraception), by subregion and age group in 2000

	Women 15–29 years				*Women 30–44 years*			
Subregion	*Attributable fractions (%)*	*Deaths*	*DALYs*	*DALYs per 1000 women*	*Attributable fractions (%)*	*Deaths*	*DALYs*	*DALYs per 1000 women*
AFR-D	88	5 437	604 075	14 944	89	2 671	91 241	4 062
AFR-E	88	10 133	895 872	18 686	90	3 717	124 403	4 741
AMR-A	59	12	496	15	59	14	370	10
AMR-B	85	808	69 473	1 151	87	435	13 608	297
AMR-D	87	461	42 841	4 197	89	393	11 887	1 843
EMR-B	86	65	36 873	1 880	85	180	7 894	680
EMR-D	90	2 976	385 594	8 468	90	3601	115 620	4 018
EUR-A	56	8	1 466	37	56	10	363	8
EUR-B	86	79	16 217	574	85	37	1 980	87
EUR-C	87	117	21 562	788	86	103	4 014	144
SEAR-B	79	1 009	196 086	4 714	84	1 745	62 122	1 952
SEAR-D	93	6 445	1 230 514	7 549	95	8 507	310 247	2 647
WPR-A	68	0	31	2	71	2	49	3
WPR-B	85	834	86 591	456	88	999	31 689	176
World	89	28 383	3 587 692	4 710	91	22 413	775 486	1 247

Table 15.18 Derivation of attributable fractions for unwanted births, proportions of unwanted births and attributable fraction for all births, by subregion and age

	Women 15–29 years			*Women 30–44 years*		
Subregion	*Attributable fraction (unwanted)*	*Unwanted births (%)*	*Attributable fraction (all)*	*Attributable fraction (unwanted)*	*Unwanted births (%)*	*Attributable fraction (all)*
AFR-D	84%	2.4	2%	87%	23.7	21%
AFR-E	82%	6.8	6%	88%	34.6	31%
AMR-A	42%	2.0	1%	42%	2.0	1%
AMR-B	81%	23.5	19%	85%	58.0	49%
AMR-D	84%	27.3	23%	88%	61.7	54%
EMR-B	78%	9.5	7%	83%	51.8	43%
EMR-D	85%	11.9	10%	89%	53.3	47%
EUR-A	40%	2.0	1%	40%	2.0	1%
EUR-B	79%	11.6	9%	85%	67.9	58%
EUR-C	82%	–0.8	0%	86%	38.5	33%
SEAR-B	71%	–0.7	0%	82%	39.9	33%
SEAR-D	84%	9.6	8%	95%	67.2	64%
WPR-A	56%	2.0	1%	56%	2.0	1%
WPR-B	83%	21.7	5%	87%	53.6	12%

proportion of all births that are unwanted. The whole subregion has an average total fertility rate (TFR) of 2, and we can therefore calculate that 75% of the subregional births occur in China (with a TFR of 1.8), all of them assumed as wanted. Of course, this assumption cannot be totally correct nor can it be verified, but it is likely to be a close approximation to the truth because of the strict birth control policies that have been applied in China since 1979.

The burden of disease attributable to unwanted births totals 4.6 million DALYs (see Table 15.19). In contrast to abortion, the largest part of the burden befalls women aged >30 years (75%). It is again the same subregions that are most affected, with those in Africa having the highest relative burden.

5. Sources of uncertainty

The calculation of aggregate level attributable fractions inevitably involves numerous uncertainties. One of the most serious concerns is the limited availability of data and the need to extrapolate results for a few countries to an entire subregion. Others relate to the quality of the input data, and to the method for simulating the expected numbers of

Table 15.19 Estimated burden of disease attributable to unwanted births (due to non-use of contraception), by subregion and age group in 2000

	Women 15–29 years				*Women 30–44 years*			
Subregion	*Attributable fractions (%)*	*Deaths*	*DALYs*	*DALYs per 1000 women*	*Attributable fractions (%)*	*Deaths*	*DALYs*	*DALYs per 1000 women*
AFR-D	2	938	53 279	1 318	21	7 284	248 587	11 068
AFR-E	6	3 527	188 279	3 927	31	15 812	523 605	19 957
AMR-A	1	2	1 092	34	1	2	481	13
AMR-B	19	1 231	139 381	2 308	49	2 512	152 705	3 338
AMR-D	23	814	60 070	5 884	54	1 916	88 018	13 647
EMR-B	7	91	18 566	946	43	835	56 151	4 839
EMR-D	10	2 719	194 874	4 280	47	13 663	513 596	17 849
EUR-A	1	1	760	19	1	1	479	10
EUR-B	9	86	20 887	740	58	214	44 212	1 942
EUR-C	0	0	0	0	33	146	21 774	782
SEAR-B	0	0	0	0	33	3 827	138 968	4 368
SEAR-D	8	4 491	369 244	2 265	64	36 894	1 443 505	12 314
WPR-A	1	0	396	25	1	1	270	17
WPR-B	5	446	86 893	457	12	997	84 396	469
World	7	14 346	1 133 721	1 488	40	84 106	3 316 749	5 335

unwanted births and unsafe abortions. Finally, the counterfactual estimates involved further assumptions.

While it was not possible, with one exception, to quantify the magnitude of the effect caused by the nature of the empirical data and assumptions, we can predict the direction in which they operate: whether they lead to an overestimation or an underestimation of the burden of maternal ill-health attributable to lack of effective contraceptive use. We have briefly reviewed the most important uncertainties and their likely effect on our estimates of relative risk and attributable fractions.

5.1 Robustness of data

Current contraceptive use

Survey data on current contraceptive use have been routinely collected by means of national surveys for 30 years. Their quality is considered high. Trends over time are plausible and the relationship between contraceptive prevalence and fertility rates is strong. Measurement error, where it exists, is likely to take the form of underreporting. In some societies, clandestine use by women occurs (Biddlecom and Fapohunda 1998; Castle et al. 1999) and this is likely to be concealed in conventional surveys. Moreover, some evidence exists to suggest that women underreport male methods, such as condoms, because of shyness and embarrassment (Koenig et al. 1984). Thus some users may be misclassified as non-users, and exposure may be slightly overestimated. The effect on relative risk estimates of such errors will be in the direction of underestimation but is likely to be small compared with other errors.

Contraceptive failure rates

Contraceptive failure rates were derived from enquiries of 18 DHS where detailed month-by-month information on contraceptive use episodes had been collected. Although this data source is undoubtedly the most appropriate, two types of uncertainty apply: the accuracy of the information and their representativeness. With regard to accuracy, the estimates (Table 15.2) are in general consistent with evidence from more carefully controlled prospective studies, with the exception of the condom where rates were lower than expected (Trussell 1998). However condoms are not a common method of contraception in most developing countries and any error is of minor significance. There are also doubts about representativeness. Calendar data are collected only in countries with high prevalence of use but the average results have been applied to all 58 countries. The validity of the underlying assumption—that failure rates are unrelated to overall levels of use—is unknown, but, again, the error is unlikely to be serious.

Induced abortion

In countries where abortion is illegal, or highly restricted and heavily stigmatized, it is impossible to obtain reliable information on incidence by means of conventional direct questioning. Hence, in this chapter, we have had to rely on WHO's indirect estimates of unsafe abortion (WHO 1998). While these estimates are widely accepted and cited at global level, a very considerable band of uncertainty surrounds them. However, no means exist of assessing the possible magnitude, or even direction, of error. In a few countries, the number of legal terminations could be taken into account when estimating the projected number of unwanted births. In yet other countries, legal terminations are carried out but no information was available on their number and therefore no allowance could be made. This gap in data leads to an overestimate of relative risks of unwanted births.

Fertility preferences

The method used to derive attributable and avoidable burden of disease depends heavily on women's statements about their future fertility desires or intentions. While experts agree that this way of measuring preferences is the least problematic of the several alternatives, interpretation is far from straightforward. For instance, attitudes toward future childbearing may be weakly held and ambivalent. Moreover, the attitude of the spouse, or male partner, is not taken into account. These considerations may partly explain why projected estimates of unwanted and mistimed pregnancies based on the pair of questions "Would you like to have a/another child or would you prefer not to have (more) children?" and "How long would you like to wait from now before the birth of a/another child?" are much larger than retrospective estimates of the "wantedness" of recent births and current pregnancies. While there is good reason—and some empirical evidence—to believe that the retrospective estimates are biased downwards by post facto rationalization, the size of the discrepancy between the prospective and retrospective estimates (63% and 143% for younger and older age groups, respectively) is a matter of concern. The direction of potential bias is clear. To the extent that preferences for future childbearing do not translate into unwanted and mistimed pregnancies, we will have overestimated relative risks as well as exposure.

Sexual exposure

The method of estimating attributable burden involved the exclusion of virgins from the calculations and the classification of women who report no sexual intercourse in the past 12 months as behaviourally not at risk of pregnancy. In countries with a strong traditional emphasis on pre-marital chastity for women, it is to be expected that single women will underreport sexual activity, which would lead to an underestimate of expected birth among non-users, thereby underestimating relative risks.

In countries where DHS field staff interviewed ever-married women only, the single women were implicitly categorized as virgins. Countries with no data on single women are typically those where it would be socially unacceptable to ask young unmarried women about sex and reproduction. Although levels of sexual activity will no doubt be low in these countries, the resulting pregnancies are very likely to be unwanted. Most of them will be terminated, often clandestinely and thus most probably "unsafe". Insofar that the WHO estimates on unsafe abortion include procedures to unmarried girls (as estimates are based to a large extent on hospital admissions for abortion complications), these abortions have been attributed to the married women. However, since the exposure for single women is more skewed towards non-users we will have underestimated the attributable burden.

Fecundability

A major dilemma arose in the estimation of projected pregnancies among non-users of contraception. We had to choose biological estimates of the monthly probability of conceiving based on woman's age or on reported coital frequency. The reason for preferring age-based estimates was that they gave a closer fit between expected overall births and observed births in the recent past. The deficit in births was much bigger when estimates of fecundability were based on coital frequency, with expected births 39% and 11% lower than recent observed births for the 15–29 and 30–44 group, respectively. At low levels of intercourse, the impact of frequency of intercourse on fecundability is substantial with coitus-based conception rates well below the age-based rates, as shown in Table 15.4. The large shortfall in expected births compared with recent age-specific fertility does cast doubt on the reliability of sexual activity data, which appear to be too low to explain current fertility. Brown (2000) in his comparative study in Africa used the same Bongaarts and Potter model estimates of coitus-dependent fecundability with reported coital frequencies in the last month, and came to the same conclusion. However, in defence of the data he has shown good internal consistency between reported monthly frequency and time since last sex. Of course, at low frequencies, sex could be targeted to coincide with ovulation, increasing the probability of a pregnancy, although this would only affect women who desire a pregnancy soon and who are knowledgeable about the timing of ovulation.

The use of fecundability based on reported coital frequency would make a substantial difference to relative risks, reducing them by about a quarter. The relative risk of having an abortion for non-users would decrease from 8.7 to 6.7, while the relative risk of an unwanted birth would decrease from 7.8 to 5.7. This is explained by the fact women aged 30–44 years who say they want to have no more children have less sex (two times a month) than those who want to space (three times) or those who desire a child within the next two years (3.9 times).

Whereas coital frequency among contraceptive users also varies with fertility intention, failure rates were kept constant regardless of preference. For modern methods, the most important determinant of failure is imperfect use. However, among perfect users, frequency of intercourse is the most important characteristic determining method failure (Trussell 1995). Traditional method failure is likely to be more dependent on coital frequency. This assumption, though far less important than the choice of age-based rather than coitally-based estimates of fecundability for non-users, will act to bias relative risks upwardly.

5.2 Assumptions in the basic model

In addition to concerns about the robustness of the empirical data, we had to make several assumptions in the basic model that links exposure to outcomes. The most important of these were:

- The burden is limited to direct obstetric events.
- Obstetric morbidity and mortality are the same for wanted and unwanted births.
- Abortion probabilities are zero for those who want another child in the next two years and are twice as high for limiters than spacers; probabilities are not affected by the proximate cause (failure vs non-use) and are the same for the two age groups.

Choice of outcomes

The crucial dilemma in defining the burden was whether or not to include perinatal mortality, much of which stems from unwanted pregnancies. Expert opinion was divided. The final decision to exclude perinatal mortality was based on the judgement that its inclusion would open up a Pandora's box of other intergenerational effects, going well beyond the perinatal period into infancy and childhood. Beyond the mortality of the unwanted children, short interbirth intervals are known to be a major risk factor for infant mortality and can be prevented by contraceptive use to cause better child spacing.

Obstetric burden is the same for wanted and unwanted births

The evidence base for judging whether the obstetric burden is the same for wanted and unwanted birth was meagre. To the extent that unwanted births are concentrated among older women of low socioeconomic status, it would have been justifiable to assume a higher risk. However, because births at late maternal ages constitute a small fraction of all births and because the link between socioeconomic status and unwanted childbearing varies between subregions, it was decided, by default, to assume no difference. The effect of errors in this assumption would be to raise relative risks and the attributable burden.

Abortion probabilities

Several potential biases stem from assumptions that had to be made about the distribution of abortions by age group and exposure status. We made the simplifying assumption that no pregnancies occurring to women who report the desire for a child in the next two years are aborted. Because life circumstances change, this is no more than a close approximation to the truth and a small upward bias on relative risks is possible. A more important possible form of bias operating in the same direction is the assumption that abortion probabilities for unintended pregnancies are the same for non-users and for users who experience contraceptive failure. The available empirical evidence on this matter was insufficient to propose differing probabilities but it is nevertheless likely that modern method users do have a greater propensity to seek terminations than traditional method users and non-users, in which case relative risks would be overestimated. This bias may be offset to the extent that modern method users are more likely than others to seek safe abortions rather than unsafe, illicit abortions.

A bias operating in the opposite direction arises from the assumption that women who experience an unintended pregnancy when they want no more children are twice as likely to seek an abortion than those who wish to postpone the next pregnancy. Such a differential accords with common sense, at least for married women, and is consistent with the available shreds of evidence, but the size of the assumed difference is essentially arbitrary and may be too high. Because modern method users contain a disproportionately large number of limiters, relative risks may be underestimated.

The age pattern of abortion is known to vary between countries as a reflection of large differences in the proportion of young single women who are exposed to the risk of unintended pregnancy and differences in age at marriage. The simplifying assumption that abortion probabilities were constant by age may have led to an overestimation of abortion in the younger age group and an underestimation among older women. This will not affect the relative risks of unsafe abortion or unwanted birth by contraceptive use status but for the younger age group we may have underestimated the proportion of all births that are unwanted and thus the burden of obstetric complications.

5.3 Summary of uncertainty

Table 15.20 attempts to summarize in a necessarily crude manner the possible magnitude and direction of data defects and model assumptions on relative risks. A positive symbol (+) indicates that the effect may be to bias risks upwardly and a negative symbol (–) the opposite. A zero

Table 15.20 Possible effects of data limitations and assumptions on relative risks

	RRs Abortion	*RRs Unwanted births*
Robustness of empirical data		
• Contraceptive use	–	–
• Failure rates	–	–
• Induced abortion	0	+
• Fertility preferences	+++	+++
• Sexual exposure	––	––
• Fecundability	+++	+++
Assumptions in the model		
• Definition of burden	0	0
• Obstetric burden is same for unwanted and wanted births	––	––
• Abortion probabilities		
— No abortions among those who want birth soon	–	0
— Same for failure and non-use	++	0
— Twice as high for limiters than spacers	––	0
— No age pattern	0	0

(0) denotes that the direction of the uncertainty, or possible bias, cannot be established. The number of symbols represents our judgement on the magnitude of the possible bias. As may be seen, positive biases are broadly balanced by negative biases.

Quantifying a range around our estimates is not an easy task, and beyond the scope of this exercise. Varying fecundability by fertility desire alone could lead to a 25% reduction in relative risk levels. Allowing for other biases that work in the same direction we may set 25% as a minimum range of uncertainty around the estimates at country level. The extrapolation to subregional level may well introduce the biggest cause of uncertainty. Given these inherent limitations in the data and in the complexity of the various assumptions adopted to apply the methodology, the subregional estimates presented are approximate and reflect actual disease burden in general terms.

6. Discussion of attributable burden

The calculation of the burden of disease attributable to non-use of modern contraception methods has required a long and complicated series of steps, mainly arising from the fact that exposure has two dimensions: a behavioural one (use or non-use of contraception) and an attitudinal one (the desire to avoid or delay childbearing). Despite the inevitable degree of uncertainty surrounding estimates, some stemming from inadequacies of empirical evidence and others from necessary assumptions, the key results make good intuitive sense and certainly provide a reliable basis for setting priorities at global and regional levels.

It is estimated that about 57 000 women die each year and that 4.9 million healthy life years (measured in DALYs) are lost because of abortions. Globally, about 90% of this burden is attributable to non-use of modern contraception. Regional differences in the attributable burden are strikingly large. In east and southern Africa (AFR-E), the estimated annual attributable burden exceeds 18 500 DALYs per 1000 women aged 15–29 years, and is also high in West Africa, South Asia and some Middle Eastern countries (AFR-D, SEAR-D and EMR-D). By comparison, it is under 40 per 1000 women aged 15–29 years in the industrialized low-fertility subregions AMR-A, EUR-A and WPR-A. Of course, one reason stems from differences in exposure: variations in the propensity of women who want to delay or avoid pregnancy to use modern contraception. But the more important reason concerns differences in access to legal and safe abortion services. Regions with high attributable burden of abortion-related mortality and morbidity are characterized by restrictive abortion laws, and vice versa. From a public health perspective, both issues (low contraception access and use and restrictive abortions) have important policy implications.

The magnitude of abortion-related mortality and morbidity is dwarfed by the obstetric burden stemming from complications of pregnancy and childbirth. It is estimated that about 415 000 women die each year from obstetric causes and that about 25 million healthy life years (measured in DALYs) are lost to these conditions. However, only a minority of these pregnancies are unwanted and hence the proportion of this overall disease burden attributable to non-use of modern methods is much lower than for the abortion-related burden: 7% among younger women rising to 40% in older women, among whom the desire to avoid all further childbearing is much more common. For both age groups combined, the estimates suggest that 98 000 obstetric deaths, representing nearly 20% of all such deaths, could be prevented each year if all women who desire no more children were to use modern contraceptives. The attributable burden is thus appreciably larger than the attributable abortion-related burden. Huge subregional differences are again apparent. In five subregions (AFR-D, AFR-E, AMR-D, EMR-D and SEAR-D) over 10 000 healthy life years are lost per year per 1000 women aged 30–44 years. The equivalent figure for the industrialized subregions (AMR-A, EUR-A and WPR-A) is below 20. In addition to access to and the use of modern contraception, these stark contrasts stem largely from variations in the coverage and quality of obstetric services.

7. Avoidable burden

There is little time lag between a change in contraception and the effect on burden of maternal complications. Current abortions and unwanted births are due primarily to non-use of contraception in the previous year. Thus, determining avoidable risk is very much like calculating attributable risk, but for "exposure in the future". Since fertility in today's medium- and high-fertility subregions is expected to drop in the future, the risk for each woman of death from an obstetric complication is also expected to decrease. However, the total burden of abortion-related complications and maternal outcomes may continue to increase in the next three decades, because the absolute number of women of reproductive age and the total number of births will continue to increase in the high-fertility subregions with the highest burden of maternal mortality.

In calculating counterfactual scenarios and attributable burden, the level of obstetric care and the quality of abortion services available were assumed to remain constant at current levels. Only the numbers of unwanted births and abortions determine the potential decrease in burden by uptake of contraception. However a reduction in unintended pregnancies is not the only pathway to lower levels of disease burden. In industrialized countries, there are still high levels of unintended pregnancies and abortions, but the disease burden associated with these is minimal because of the high quality of obstetric and abortion services. Indeed, the avoidable burden in absolute numbers may change more through a decline in the risk attributed to each pregnancy—by improvements in quality and provision of safe obstetric and abortion services—than through a decline in unintended pregnancies resulting from the use of effective contraception. It should be emphasized that improvement in risks related to abortions in many low-income countries requires above all a political will to change restrictive laws. Whatever the future may hold in terms of the risk attached to a single pregnancy or birth, it remains relevant and valid to estimate the proportion of the burden avoidable by increased effective use of contraception to avert unwanted births and abortions.

How should future attributable fractions be calculated and what are the necessary assumptions about fertility decline and levels of exposure? Fertility is expected to vary over the next three decades according to the UN medium-variant projections. Specifically all developing countries are now projected to reach replacement level fertility of 2.1 births per woman in the course of this century. Indeed the next UN projection will assume declines to 1.85 births per woman (UN 2002). These projections are rooted in evidence from the past 100 years that suggests that, once fertility has started to decline, it continues to fall until the achievement of low levels. This process of fertility transition appears to be relatively impervious to socioeconomic development. For instance, fertility has declined under conditions of rapidly improving standards of living, as in many east Asian countries. It has also declined under conditions of economic stagnation or decline, as in Europe in the 1930s and much of east Africa in the past 20 years. Whatever the underlying forces of change, these fertility declines will be achieved primarily through increased levels of contraceptive use (and perhaps abortion), accompanied in some countries by rising age at marriage.

We thus need to project a future contraceptive distribution based on expected declines in fertility in the next three decades. Cross-country comparisons show that a fall in TFR of one child roughly corresponds to an increase in contraceptive prevalence of 15 percentage points (Ross and Frankenberg 1993). However, inferring contraceptive use from future fertility is complicated by the fact that abortion is an alternative means to regulate fertility. In countries experiencing simultaneous fertility decline and rapid changes in desired family sizes, unwanted births, abortion and contraception levels may all rise in parallel. This counterintuitive trend reflects the fact that in societies where couples want large families of, say, five or six children, exposure to the risk of an unwanted pregnancy is bound to be low. As fertility desires fall, the risk increases. For instance, in a society where couples want two children and women marry at 20 years of age, the desired family size will typically be achieved when the wife is in her mid-20s, leaving her exposed to the potential risk of unwanted pregnancy for the next 20 years. Thus it is not surprising that rapid declines in desired fertility can give rise to situations where increased contraceptive practice is unable to meet the growing need for fertility regulation.

One of the clearest examples is the Republic of Korea. As documented from longitudinal data in this country (Bongaarts and Westoff 2000), early on in the fertility transition, both levels of contraceptive use and the incidence of abortion rose in parallel, which in itself provides evidence for a growing unmet need for contraception. While abortion levels reached a peak and declined, contraceptive prevalence continued to rise, as the Republic of Korea progressed through the fertility transition.

The sequence of events in the Republic of Korea is not inevitable. In countries where effective contraception has not been promoted, and is thus relatively inaccessible, heavy reliance on abortion may persist. This is true in Japan and much of eastern Europe and central Asia (Henshaw et al. 1999). But in countries where abortion is very common, evidence suggests that improved availability of family planning services and wider choice of effective contraception can cause a rapid decline in abortion (Henshaw et al. 1999). This is the trend observed in central Asia, where abortion is being replaced by contraceptive use (Westoff et al. 1998). Thus widely varying patterns of change in population levels of contraception and abortion levels are evident in different populations (Marston and Cleland 2003b).

We therefore needed to make assumptions about the level of unmet need at future expected levels of TFR and contraceptive use. What change in unmet need is to be expected from recent trends? There has been a steady increasing potential need for limiting births (adding the met need and unmet need), in the 1980s and the 1990s in developing countries (Westoff and Bankole 2000). Whereas the average proportion of women using contraception for limiting births increased faster than the potential need in Latin America, Asia and north Africa, this was not true for sub-Saharan Africa, where the proportion of women with an unmet need for limiting increased during the past two decades (Westoff and Bankole 2000).

As explained before, with rapid rates of social change, the need for contraception can grow faster than contraceptive use itself, resulting in rising incidence of unintended pregnancies, unwanted births and unsafe abortions. This implies that at the same levels of future fertility (TFR), populations could have different levels of unmet need, and that women will make trade-offs between abortion and contraception, depending on the legality, availability and perceived quality of services. However, the prediction of changes in unmet need (reductions in Asia and Latin America vs increases in Africa) made the calculation of avoidable risk too complex to operationalize.

The most effective and practical means of obtaining estimates of future exposure levels was to start from the relationship between fertility desires and TFR, and then to infer future contraceptive levels from the projected fertility desires. Fertility changes because of a decline in fertility desires and/or a better implementation of fertility preferences by couples. Future exposure to the risk factor considered here will depend on both. Therefore, the decrease in the maternal burden of disease (linked to a decline in pregnancies) can be split in two components: a reduction due to a lower desired family size and one due to a better implementation of fertility desires. Subregions with a high burden of maternal complications are going through a fertility transition and the desire for smaller families will continue to increase.

We have thus inferred the change in family size desires from the expected decline in TFR. Whereas the fertility preferences within each category of exposure will shift to higher proportions of women with an intention to stop or postpone childbearing, we can keep the propensity to translate desire into effective contraceptive protection constant. We have assumed that within each level of fertility intention (want children now, spacers, limiters), the relative distribution of non-users, traditional and modern method users stays the same, providing us with an estimate of future exposure. The future levels of contraceptive use implicit in the lower family size desires can be taken as the "business-as-usual" exposure. This reflects a rise in use expected from declines in desired family sizes, but is obviously dependent to a large extent on continued or increased investment in subsidized contraceptive services.

Based on this business-as-usual scenario, the avoidable burden then refers to the burden associated with unwanted births and unsafe abortions that could be avoided through perfect implementation of future fertility preferences, over and above the burden that is avoided by the general trend towards lower fertility and the desire to have smaller family sizes. Simulating business-as-usual exposure levels for different time points in the future also requires associated business-as-usual relative risk levels and proportions unwanted among all births.

The step-by-step derivation of all the input data needed for the calculation of avoidable risk is given, followed by a discussion of the trends in input data. Avoidable risk was calculated for 2001, 2005, 2010, 2020 and 2030. For 2001, the 2000 input levels have been used.

7.1 Business-as-usual exposure and other inputs to calculate avoidable burden

Establishing the association between fertility desire and TFR

We have related the levels of fertility intention (want more children soon, spacing and limiting) aggregated across the three levels of exposure (modern methods, traditional methods, fecund non-users) to the TFR in the following way. Using the data from the 58 DHS, the cross-sectional linear associations between each of the current aggregate levels of fertility preference and the TFR were assumed to represent rates of change in the fertility desire for a one-unit change of TFR. Among the non-users, the proportions of women that are not currently exposed to the risk of pregnancy, either behaviourally or biologically, were also correlated to the TFR. With a fall in fertility there will also be a decline in aggregate levels of women who are pregnant and amenorrhoeic at any point in time; these were regressed as one category against the TFR. Amenorrhoeic women include those who abstain sexually after childbirth. Since both the numbers of women who did not have sex in the past 12 months (other than those who are also amenorrhoeic) and menopausal or infecund women are expected to change little with levels of TFR they were combined and then regressed together against the TFR. The regression coefficients were calculated separately for the 15–29- and 30–44-year age groups. Table 15.21 shows the results in terms of the slopes (rate of change along the regression line) and also the R-squared values.

Projected fertility decline

The expected decline in fertility was calculated from current TFRs and projected TFR levels using the UN projections (medium-variant) for each time point in future. Table 15.22 shows the subregional average TFR—current and projected—and the resulting projected decline at each time point. For 2001, the current levels were kept at calculated 2000 levels.

The sudden drop in fertility from current levels of 4.2 to 2.1 in 2005 in the EMR-B subregion is spurious and explained by the fact that

Table 15.21 Association of fertility intentions by TFR

Age group (years)	Want birth soon	Want to space	Want to limit	Pregnant and amenorrhoeic	Infecund + no sex in past year
	% change for 1 unit change in TFR: regression coefficients (R-squared values)				
15–29	1.42 (0.14)	–2.87 (0.24)	–6.56 (0.60)	7.16 (0.69)	0.85 (0.12)
30–44	2.38 (0.30)	1.34 (0.16)	–13.4 (0.73)	8.39 (0.83)	1.28 (0.09)

Table 15.22 Current and projected future levels of TFR, by subregion

Subregion	Current TFR	Projected future TFR UN median variant				Projected change in TFR			
		2005	2010	2020	2030	2005	2010	2020	2030
AFR-D	5.9	5.4	4.9	4.0	3.1	–0.5	–0.9	–1.9	–2.8
AFR-E	5.7	5.5	5.1	4.2	3.4	–0.2	–0.6	–1.5	–2.3
AMR-A	—	—	—	—	—	—	—	—	—
AMR-B	3.1	2.3	2.2	2.1	2.1	–0.8	–0.9	–0.9	–1.0
AMR-D	4.1	3.1	2.8	2.4	2.2	–0.9	–1.2	–1.7	–1.9
EMR-B	4.2	2.1	2.1	2.1	2.1	–2.1	–2.1	–2.1	–2.1
EMR-D	4.6	4.2	3.8	3.1	2.5	–0.4	–0.8	–1.5	–2.1
EUR-A	—	—	—	—	—	—	—	—	—
EUR-B	2.8	2.2	2.1	2.1	2.1	–0.6	–0.7	–0.7	–0.7
EUR-C	2.5	1.9	1.9	1.9	1.9	–0.6	–0.6	–0.6	–0.6
SEAR-B	2.7	2.1	2.0	2.0	2.0	–0.5	–0.6	–0.6	–0.6
SEAR-D	3.4	2.9	2.5	2.2	2.1	–0.5	–0.9	–1.2	–1.3
WPR-A	—	—	—	—	—	—	—	—	—
WPR-B	3.7	3.0	2.6	2.1	2.1	–0.7	–1.1	–1.6	–1.6

— No data.

Tunisia is the only country represented. Fertility has changed dramatically since the last Demographic and Health Survey in 1988.

Projected levels of fertility preferences

The calculation involved different steps, explained here in detail for women who want to limit family size, using Ghana for illustrative purposes.

1. *The current overall percentage of women who want to limit childbearing:* This was calculated from the distribution of fertility preferences within each level of exposure. For example, in Ghana, 11.4% of women aged 15–29 years are modern method users, 10.1% use tra-

ditional methods and 78.5% are not using any contraception at all. Among the modern method users, 11% want to limit their family size. So 1.2% (= 11.4% × 11%) of all women aged 15–29 years are modern method users with a desire to limit family size. Since 7% of traditional method users want no more children, 0.7% of all women are traditional method users with desire to limit family size. Among the non-users 47% are currently fecund and, among these, 6% want to stop childbearing. This gives 2.2% (= 78.5% × 47% × 6%) fecund non-users with a desire to limit family size. Adding all limiters together gives an aggregate percentage of 4.1% (= 1.2% + 0.7% + 2.2%) of all 15–29-year olds who want no more children.

2. *Projected decline in fertility*: Fertility in Ghana is projected by the UN to fall by 0.4 children from a current TFR of 4.4 to 4.0 in 2005.
3. *Future overall percentage of women who want to limit childbearing in 2005*: The projected fertility decline (0.4) was multiplied by the coefficient representing the change in the percentage of limiters (see Table 15.21: –6.56) and added to the current percentage (4.2%). So in 2005, 4.2 + 6.56 × 0.4 = 6.6% of 15–29-year olds are projected to want to limit their family size.
4. Steps 1 to 3 were repeated for the four other variables, using the appropriate coefficients in Table 15.21. By 2005, the percentage of women who want more children is projected to decline from 12.9% to 12.4% and women who want to space to increase from 41% to 42.1%. The percentage pregnant and amenorrhoeic would decline from 29% to 26.3%, while the percentage of infecund and not sexually active women would change from 13% to 12.7%.

Projected business-as-usual levels of contraceptive use

Having calculated the new overall distribution of fertility preferences in the population, we used the relative distribution of modern method users, traditional method users and fecund non-users within each level of fertility desire (current scenario), to estimate our business-as-usual exposure variable. For example, 29% of the limiters were modern method users, 17% used traditional methods and 54% were fecund non-users. Keeping the propensity to translate fertility intention into contraceptive practice constant, we have 29% of the 6.6% limiters aged 15–29 years, i.e. 1.9% using modern methods in 2005. Adding this to the 12% of the 12.4% women who want a child soon and the 21% of the aggregate 42.1% spacers who are using a modern method, we have derived an aggregate percentage of 12.3% modern method users in 2005 (= 1.9% + 1.4% + 8.9%). In total, 10.7% are traditional method users and 77.1% are non-users (this last category includes the 26.3% pregnant and amenorrhoeic and 12.7% infecund and not sexually active).

Other input for business-as-usual scenario

The relative distribution of fertility preference within each exposure level was calculated (e.g. 1.9 of the 12.3% or 16% of modern method users want no more children). The relative composition of the non-users in five categories of fecund, pregnant, amenorrhoeic, infecund/menopausal and no sex in the past year was also recalculated, and together with the projected contraceptive use levels used as input into the simulations. From this we derived the business-as-usual levels of the relative risk of having an abortion, the relative risk of having an unwanted birth as well as the proportions of unwanted among all births.

These calculations were done for each of the 58 countries at different time points (2005, 2010, 2020, 2030). For 2001, we used the current (2000) levels of contraceptive use and fertility desire. For each time point in the future we estimated five contraceptive prevalence distributions: business-as-usual exposure, theoretical minimum, and three other counterfactuals, shifting 10%, 20% and 30% of fecund non-users and traditional method users into the modern use category. For each of these we used the corresponding relative risks for abortions, unwanted births and proportion of unwanted births among all births.

7.2 Trends in business-as-usual exposure and relative risk levels

We have presented the trend in modern method use as derived through aggregating the country data into subregional estimates from 2001 (which was kept as the same as the 2000 level) to 2030. Table 15.23 shows these trends separately for the two age groups. For the three subregions with missing data, we kept the contraceptive distribution constant at the estimated 2000 level.

As expected from the fertility decline (Table 15.22), the contraceptive levels, reflecting the associated decline in fertility desire, are increasing steadily. As suggested by the regression coefficients (Table 15.21), the increase is more marked for the older age group. Since the expected fall in fertility by 2030 is largest for the two African subregions, the business-as-usual contraceptive levels are predicted to increase most steeply here.

In the business-as-usual scenario, the relative risk levels also varied from the current one, as shown in Tables 15.24 and 15.25 for unwanted births and abortions, respectively. The increase is more marked for non-users than it is for traditional method users. The increase is explained by the fact that the proportion of limiters increases among all three levels of exposure, but relatively more among the non-users.

Logically, as fertility desires are projected to go down with time, and keeping the propensity to translate desire into contraceptive behaviour at 2000 levels, the proportion of unwanted births among all births increases steadily, as can be seen from Table 15.26.

Table 15.23 Projected trends in the proportion of women using a modern method, business-as-usual scenario

	Women 15–29 years					*Women 30–44 years*				
Subregion	*2001*	*2005*	*2010*	*2020*	*2030*	*2001*	*2005*	*2010*	*2020*	*2030*
AFR-D	8.0	9.2	10.2	12.4	14.7	10.7	13.1	14.9	18.9	22.9
AFR-E	13.0	13.9	15.4	18.5	21.1	15.6	16.9	18.9	23.1	26.7
AMR-A	60.6	60.6	60.6	60.6	60.6	74.1	74.1	74.1	74.1	74.1
AMR-B	48.1	52.1	52.5	53.0	53.1	62.1	68.6	69.3	70.0	70.3
AMR-D	27.9	31.9	33.1	34.9	35.7	36.2	42.4	44.4	47.3	48.7
EMR-B	30.4	42.7	42.7	42.7	42.7	44.8	61.5	61.5	61.5	61.5
EMR-D	14.9	17.3	18.7	20.4	21.5	23.5	26.6	29.0	32.1	34.7
EUR-A	62.1	62.1	62.1	62.1	62.1	75.9	75.9	75.9	75.9	75.9
EUR-B	36.0	39.4	40.0	40.0	40.0	46.9	51.2	51.9	51.9	51.9
EUR-C	42.4	45.5	45.6	45.6	45.6	55.5	59.9	60.1	60.1	60.1
SEAR-B	54.4	58.5	59.1	59.1	59.1	55.9	60.9	61.7	61.8	61.7
SEAR-D	23.5	26.1	28.0	30.0	30.3	48.3	53.5	56.9	60.6	61.1
WPR-A	48.7	48.7	48.7	48.7	48.7	59.5	59.5	59.5	59.5	59.5
WPR-B	24.1	26.8	28.5	30.3	30.3	29.5	33.6	36.3	39.1	39.1

7.3 Business-as-usual and counterfactual scenarios

The main assumptions underlying the projected exposure and risk are as follows:

- Fertility in developing countries will fall in line with the UN median-variant projections.
- The cross-sectional relationship between fertility desires and fertility itself can be used to project future changes in fertility desires.
- In the business-as-usual scenario, the propensity to translate fertility desires into contraceptive use will remain unchanged.
- The relative popularity of different contraceptive methods and failure rates will remain unchanged.
- The proportion of infecund and sexually inactive non-users will remain constant.

Fertility trends

The UN medium-variant fertility projections are widely accepted as a reasonably dependable guide to the future. The UN's past record of successful projection over the short term of 20–30 years is impressive and no specific reason exists to doubt recent projections (Bongaarts and

Table 15.24 Projected trends in relative risk of having an unwanted birth, business-as-usual scenario

	Traditional method users 15–29 years					*Non-users 15–29 years*				
Subregion	*2001*	*2005*	*2010*	*2020*	*2030*	*2001*	*2005*	*2010*	*2020*	*2030*
AFR-D	2.3	2.3	2.3	2.4	2.4	2.8	3.3	3.8	4.8	6.0
AFR-E	1.6	1.6	1.7	1.8	1.9	3.0	3.2	3.7	4.9	6.0
AMR-A	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
AMR-B	3.2	3.3	3.3	3.3	3.3	8.3	10.4	10.6	10.9	11.0
AMR-D	4.1	4.1	4.2	4.2	4.2	6.2	7.9	8.5	9.4	9.9
EMR-B	3.2	3.5	3.5	3.5	3.5	3.9	7.2	7.2	7.2	7.2
EMR-D	3.2	3.2	3.3	3.4	3.4	3.4	4.0	4.6	5.4	6.1
EUR-A	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
EUR-B	4.0	4.1	4.1	4.1	4.1	5.1	6.3	6.5	6.5	6.5
EUR-C	5.1	5.1	5.1	5.1	5.1	6.9	8.1	8.1	8.1	8.1
SEAR-B	4.1	4.2	4.2	4.2	4.2	4.3	5.1	5.2	5.3	5.2
SEAR-D	4.6	4.9	5.0	5.1	5.1	4.6	5.4	5.9	6.6	6.7
WPR-A	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
WPR-B	3.7	3.7	3.7	3.7	3.7	5.8	6.9	7.8	8.8	8.8

	Traditional method users 30–44 years					*Non-users 30–44 years*				
	2001	*2005*	*2010*	*2020*	*2030*	*2001*	*2005*	*2010*	*2020*	*2030*
AFR-D	3.2	3.3	3.4	3.6	3.7	3.5	4.3	5.2	7.2	9.6
AFR-E	4.4	4.4	4.6	4.8	4.9	4.9	5.4	6.4	9.1	11.7
AMR-A	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
AMR-B	7.9	8.4	8.4	8.4	8.5	14.3	21.3	22.3	23.4	23.8
AMR-D	6.4	6.8	6.9	7.2	7.3	9.8	14.1	15.8	18.9	20.9
EMR-B	5.9	6.3	6.3	6.3	6.3	8.4	20.8	20.8	20.8	20.8
EMR-D	5.1	5.1	5.2	5.3	5.4	6.8	8.2	9.7	11.9	14.0
EUR-A	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
EUR-B	6.3	6.3	6.3	6.3	6.3	11.1	15.3	16.1	16.1	16.1
EUR-C	8.6	8.6	8.6	8.6	8.6	12.7	16.5	16.7	16.7	16.7
SEAR-B	6.1	6.3	6.3	6.3	6.3	8.0	10.0	10.3	10.4	10.4
SEAR-D	22.2	23.0	23.4	23.8	23.9	27.8	35.8	41.9	49.5	50.0
WPR-A	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
WPR-B	5.9	6.1	6.1	6.2	6.2	7.7	10.0	11.9	14.4	14.4

Table 15.25 Projected trends in relative risk of having an unsafe abortion, business-as-usual scenario

	Traditional method users 15–29 years					*Non-users 15–29 years*				
Subregion	*2001*	*2005*	*2010*	*2020*	*2030*	*2001*	*2005*	*2010*	*2020*	*2030*
AFR-D	2.6	2.6	2.7	2.6	2.6	3.9	4.3	4.8	5.8	7.1
AFR-E	3.0	3.2	3.0	2.9	2.9	4.7	5.0	5.4	6.7	8.0
AMR-A	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0
AMR-B	4.1	4.2	4.2	4.2	4.2	10.6	13.1	13.4	13.7	13.8
AMR-D	4.3	4.4	4.4	4.5	4.5	7.6	9.5	10.2	11.2	11.7
EMR-B	4.6	4.7	4.7	4.7	4.7	6.4	10.7	10.7	10.7	10.7
EMR-D	3.9	3.9	3.9	4.0	4.0	5.0	5.7	6.3	7.3	8.1
EUR-A	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0
EUR-B	4.9	4.9	4.9	4.9	4.9	7.5	9.1	9.3	9.3	9.3
EUR-C	5.0	5.0	5.0	5.0	5.0	10.5	12.1	12.1	12.1	12.1
SEAR-B	5.5	5.5	5.5	5.5	5.5	6.4	7.5	7.7	7.7	7.7
SEAR-D	6.6	6.8	6.9	7.0	7.0	10.9	12.5	13.5	14.7	14.8
WPR-A	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0
WPR-B	4.1	4.1	4.1	4.1	4.1	6.6	7.8	8.8	9.9	9.9
	Traditional method users 30–44 years					*Non-users 30–44 years*				
	2001	*2005*	*2010*	*2020*	*2030*	*2001*	*2005*	*2010*	*2020*	*2030*
AFR-D	3.5	3.6	3.7	3.8	3.8	4.2	5.0	5.7	7.7	10.2
AFR-E	4.7	4.7	4.8	4.9	5.0	5.4	5.9	7.0	9.6	12.1
AMR-A	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0
AMR-B	8.4	8.8	8.8	8.8	8.9	16.2	23.3	24.3	25.4	25.9
AMR-D	6.8	7.1	7.2	7.4	7.5	10.6	14.9	16.6	19.6	21.6
EMR-B	6.0	6.3	6.3	6.3	6.3	10.0	22.9	22.9	22.9	22.9
EMR-D	5.2	5.2	5.3	5.3	5.4	7.7	9.1	10.5	12.7	14.7
EUR-A	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0
EUR-B	6.3	6.2	6.2	6.2	6.2	11.5	15.7	16.5	16.5	16.5
EUR-C	8.3	8.3	8.3	8.3	8.3	13.3	17.1	17.3	17.3	17.3
SEAR-B	6.4	6.6	6.6	6.6	6.6	9.2	11.2	11.6	11.7	11.6
SEAR-D	22.7	23.4	23.7	24.0	24.1	30.9	38.5	44.2	51.4	51.9
WPR-A	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0
WPR-B	6.2	6.3	6.4	6.4	6.4	8.5	10.9	12.9	15.3	15.3

Table 15.26 Projected trends in the proportion of births that are unwanted among all births, business-as-usual scenario

	Women 15–29 years					*Women 30–44 years*				
Subregion	*2001*	*2005*	*2010*	*2020*	*2030*	*2001*	*2005*	*2010*	*2020*	*2030*
AFR-D	2.4	5.8	8.7	15.0	20.6	23.7	30.8	37.6	51.1	62.3
AFR-E	6.8	7.2	9.8	15.9	20.9	34.6	35.2	42.3	56.7	67.5
AMR-A	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
AMR-B	23.5	26.5	26.8	27.1	27.2	58.0	67.5	68.5	69.4	69.8
AMR-D	27.3	32.0	33.4	35.2	36.1	61.7	73.5	77.0	81.9	84.2
EMR-B	11.7	20.2	20.2	20.2	20.2	53.9	78.0	78.0	78.0	78.0
EMR-D	11.9	13.6	16.3	20.4	23.7	53.3	58.3	64.9	74.4	81.5
EUR-A	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
EUR-B	18.6	21.0	21.3	21.3	21.3	72.3	78.9	79.9	79.9	79.9
EUR-C	6.0	7.9	8.0	8.0	8.0	47.6	54.9	55.3	55.3	55.3
SEAR-B	0.4	0.6	0.7	0.7	0.7	39.9	48.6	50.0	50.1	49.9
SEAR-D	9.6	11.1	12.1	13.3	13.5	67.2	78.5	86.1	94.6	95.3
WPR-A	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
WPR-B	21.7	25.7	28.1	30.5	30.5	53.6	63.7	70.1	76.3	76.3

Butatao 2000). In our view, fertility projections are therefore not a major source of uncertainty, nor is it possible to conjecture about possible departures from projections and their effect on our estimates.

LINK BETWEEN FERTILITY AND FERTILITY DESIRES

The relationship between achieved and desired fertility is not straightforward. Nevertheless, over the longer term, they tend to move in parallel. To represent this link we calculated cross-sectional correlations in the 58 study countries between fertility rates and fertility intentions and then assumed that these relationships would remain constant over the next 30 years. While we accept that a degree of uncertainty surrounds this procedure, we doubt whether it represents a serious bias.

PROPENSITY TO TRANSLATE FERTILITY DESIRES INTO CONTRACEPTIVE PRACTICE

In the business-as-usual scenario it was assumed that the proportion of limiters and spacers who use contraception to achieve their intentions remains constant. This assumption was made in adherence to the business-as-usual concept that exposure changes with changing fertility desires, while the propensity to translate these into effective contraceptive use remains the same. Yet the empirical record of the past 40 years suggests that it is an artificial and unrealistic assumption. Fertility has declined in the past both because desired fertility has fallen and because desires have been better implemented (Feyisetan and Casterline 2000). A more realistic representation of business-as-usual, of course, would act to reduce the avoidable burden.

Method mix and failure rates

Estimation of future scenarios used the assumption that choice of methods—or the method mix—within each country would remain the same, as with failure rates. Several forms of uncertainty may be identified: the development and uptake of newly developed forms of contraception; the possibility of a drift towards more effective existing methods; and greater resort to barrier methods in response to the HIV pandemic. The development and widespread use of radically new methods of contraception seems increasingly unlikely in view of lack of major investment by the pharmaceutical industry (Hagenfeldt 1994). The development of a contraceptive vaccine, for instance, seems an increasingly remote possibility. More plausibly, general shifts from less to more effective methods might occur—and indeed are underway in the countries of the former Soviet Union. With the exception of these latter countries, where in the past, access to modern contraception was severely restricted, little evidence exists to support the view that the contraceptive method mix will change over the next 30 years. Contraception in developing countries, unlike Europe or North America, has always been dominated by effective methods: sterilization, intrauterine devices and hormonal methods. In our view, an increased dominance of these methods is possible but not particularly likely. Any such trend would increase relative risks. Offsetting this might be increased uptake of condoms, the only existing contraceptive method that offers protection against HIV and other STIs. So far, no tendency towards greater use of condoms for family planning (and dual protection) within marriage has been recorded (UN 1999). With regard to contraceptive failure for users of specific methods, the assumption of no change is reasonably robust. We are unaware of any evidence of secular trends in the probability of failure.

Infecundity and sexual inactivity among non-users

A final assumption in the estimation of future scenarios was that the projection of infecund and sexually inactive non-users would remain constant. As the general health of adults improves, physiological infecundity is more likely to decline than increase, and prolonged sexual abstinence may become less common for the same reason and because of the erosion of customs of postpartum abstinence in sub-Saharan Africa. Any such trend would probably serve to increase relative risks and increase exposure and the avoidable burden.

Table 15.27 summarizes effects of assumptions on estimates of avoidable risk. A positive symbol (+) indicates that the effect may be to bias risks upwardly and a negative symbol (–) the opposite. A zero (0)

Table 15.27 Possible effects of assumptions on estimates of avoidable risk

Future fertility trends	0
Future fertility desires	0
Translation of desires into contraceptive use	++
Method mix and failure rates	0
Infecundity and sexual inactivity	–

denotes that the direction of the uncertainty, or possible bias, cannot be established.

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Note

1 See preface for an explanation of this term.

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