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Underuse of modern methods of contraception: underlying causes and consequent undesired pregnancies in 35 low- and middle-income countries

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STUDY QUESTION: What is the contribution of the underuse of modern methods (MM) of contraception to the annual undesired pregnancies in 35 low- and middle-income countries?

SUMMARY ANSWER: Fifteen million out of 16.7 million undesired pregnancies occurring annually in 35 countries could have been prevented with the optimal use of MM of contraception.

WHAT IS KNOWN ALREADY: Every year, 87 million women worldwide become pregnant unintentionally because of the underuse of MM of contraception.

STUDY DESIGN, SIZE, DURATION: Demographic and health surveys (DHS) of 35 countries, conducted between 2005 and 2012, were analysed.

PARTICIPANTS/MATERIALS, SETTING, METHODS: Contraceptive use of 12 874 unintentionally pregnant women was compared with 111 301 sexually active women who were neither pregnant nor desiring pregnancy.

MAIN RESULTS AND THE ROLE OF CHANCE: An average of 96% of 15- to 49-year-old eligible women took part in the survey. When adjusted for covariates and compared with the use of MM of contraception, the use of traditional methods was associated with a 2.7 [95% confidence interval (CI): 2.3–3.4] times increase in odds of an undesired pregnancy, while non-use of any method was associated with a 14.3 (95% CI, 12.3–16.7) times increase. This corresponded to an estimated 16.7 million undesired pregnancies occurring annually in the 35 countries, of which 15.0 million could have been prevented with the optimal use of MM of contraception (13.5 million women did not use MM whilst 1.5 million women utilized MM incorrectly). Women with the lowest educational attainment and wealth quintile were 8.6 (95% CI: 8.2–9.1) and 2.6 (95% CI: 2.4–2.9) times less likely to use contraceptives compared with those with the highest level of each, respectively. Of the 14 893 women who neither desired pregnancy nor used contraception, 5559 (37.3%) cited fear of side effects and health concerns as the reason for non-use, 3331 (22.4%) cited they or their partner's opposition to contraception or religious prohibition and 2620 (17.6%) underestimated the risk of pregnancy.

LIMITATIONS, REASONS FOR CAUTION: Despite the fact that DHS are considered high-quality studies, we should not underestimate the role played by recall bias for past pregnancies. Few women report a current pregnancy in the first trimester and undesired pregnancies at that time are probably prone to under-reporting. Some terminated pregnancies may not be included in the current pregnancy group. Furthermore, covariates measured at the time of the survey may not have reflected the same covariates at the time the currently pregnant women became pregnant.

WIDER IMPLICATIONS OF THE FINDINGS: Underuse of MM of contraception burdens especially the poor and the less educated. National strategies should address unfounded health concerns, fear of side effects, opposition and underestimated risk of pregnancy, which are major contributors to undesired pregnancies.

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Key words: unwanted pregnancies / family planning / demographic health surveys / side effects / low- and middle-income countries

Introduction

Every year, when 123 million women experience pregnancy as a harbinger of happiness, many of the remaining 87 million face it with dismay. The World Health Organization (WHO) reports that, after becoming pregnant without intention, many of these women are presented with a stark set of scenarios: risk of death, disability and lower educational and employment potential (WHO, 2005). Reducing the number of unintended pregnancies could avert 60% of maternal deaths and 57% of the child deaths (WHO, 2014). As undesired pregnancies affect poor and vulnerable populations disproportionately, access to essential contraceptive commodities remains a great concern to redress global inequity. Furthermore, many undesired pregnancies end in induced abortion (Cleland and Ali, 2004).

In 2000, 189 nations, by adopting the United Nations Millennium Declaration, pledged to free people from extreme poverty and multiple deprivations. From this declaration emerged eight Millennium Development Goals (MDGs) (United Nations, 2000). It was agreed that family planning contributes to sustainable development, health and well-being of mothers, their children and gender equity (Van Braeckel *et al.*, 2012). In 2005, the Member States added 'achieve universal access to reproductive health' to MDG 5 (WHO, 2014); despite pledges, MDG-5 is the most off-track MDG of all (WHO, 2013a,b). Although contraceptive prevalence shows an upward trend and unmet needs show a downward trend globally, the absolute number of married women who either do not use contraception or who have an unmet need for family planning is projected to grow. This indicates that increased investment is necessary to meet the demand for contraceptive methods worldwide (Alkema *et al.*, 2013; Darroch and Singh, 2013). To accelerate the achievement of MDG 5 by expanding access to contraceptives, global initiatives have been revitalized (e.g. Family Planning 2020, International Conference on Family Planning, ICPD beyond 2014), which aim to improve the political and funding climate. This intensified global momentum to expand access to contraceptives could be an opportunity for reproductive health programmes in resource-limited settings.

Method failure leading to pregnancy is common among reversible methods of contraception. During the first year of contraceptive use, 25–27% women stop using 'calendar' and 'withdrawal' methods due to unintended pregnancy, 15% stop using male condoms, 8% oral contraceptives, 3% injectable, 2% lactational amenorrhea method (LAM) and 0.2% intrauterine devices (IUDs) (Trussell, 2007). Women, especially those with low education, often switch to less-effective traditional methods of contraception (Ali and Cleland, 2010). This has slowed progress in attaining MDG 5 (Ali *et al.*, 2012).

This study quantifies the relationship between undesired pregnancies and contraception: effectiveness of modern methods (MM) of contraception compared with traditional methods, non-use of contraception and the underlying reasons for not using contraceptives. The study results aim to target actions to improve utilization of effective contraceptive methodologies.

Materials and Methods

Data sources

DHS measure indicators of population and health using nationally representative multistage stratified probabilistic household sample surveys (Macro International Inc., 1996; Rustein and Rojas, 2003). DHS use extensive interviewer training and field monitoring, standardized variables and measurement tools and techniques to ensure standardization and comparability across diverse sites and time periods (Vaessen, 1996; Macro, 2006; Wirth *et al.*, 2006; Pullum, 2008).

The method-specific contraceptive use in the month before the current pregnancy was obtained from the monthly calendar of births, pregnancies and episodes of use and was validated against the variable concerning contraceptive failure to differentiate from contraception discontinuation followed by early conception.

The variables 'not desiring pregnancy' and 'desire, or not, to use contraception' were, respectively, derived from the DHS form questions 'wanting to have no more children' or 'wanting to postpone for two years or more' and from 'intention to use contraception in the future'.

DHS were conducted in 49 low- and middle-income countries between 2005 and 2012 (Demographic and Health Survey, 2012). The most recent survey was used. For the initial analysis, 14 countries did not have the complete set of variables needed and were excluded. Country-specific analysis for Albania, Azerbaijan and Swaziland was not possible because the sample had no cases using MM of contraception amongst women immediately before the current pregnancy; nevertheless, these data sets were incorporated in the pooled analysis. Namibia and Timor-Leste did not present any individual in the category of user of traditional methods of contraception immediately before the current pregnancy. Thus, the country-specific analysis was limited to MM of contraception versus non-users of contraception.

Outcomes, exposure and covariates

An undesired pregnancy was a pregnancy (at the time of the survey) desired later after occurrence, or not desired at all.

Status of contraceptive usage was at the time of the survey. For pregnant women, contraceptive usage indicates its use immediately prior to knowledge of pregnancy, representing contraceptive failures.

The use of contraception was classified under MM, traditional methods and non-use. MM include combined oral contraceptives, progestogen-only pills, implants, injectable contraceptives, IUDs, male and female condoms, sterilization and LAM (WHO, 2013a,b). Traditional methods include withdrawal and fertility-awareness methods (WHO, 2013a,b).

Each person was able to select one primary reason for not using contraception; reasons were subdivided into six categories. 'Fear of side-effects/health concerns' included fear of side effects or health concerns or belief of interference with normal body processes. 'Opposition' included the woman's, her husband's or other's opposition to contraception use or religious prohibition. 'Lack of knowledge' included not knowing where to buy contraceptives or the types of methods available. 'Method related reasons' included 'cost too much' or 'provider too far'. 'Underestimated risk of pregnancy' included 'husband away', 'infrequent sex' and 'marital separation'. 'Other' included 'fatalism' (i.e. an event predetermined by fate and therefore unalterable) and 'other'.

DHS defined 'sexually active' as one engaging in sexual intercourse within 30 days of the interview.

Study population and sample size

The pooled analysis exploring the risk of undesired pregnancy included undesired pregnancies (*n* = 12 874) and sexually active, currently not pregnant 15- to 49-year-old women who did not desire pregnancy (those known to be infertile and unable to conceive were excluded from the analysis) (*n* = 111 301). Eight hundred and seventy-five (0.7%) women were missing values for 'desiring pregnancies' leaving 124 175 (99.3%) included in the analysis.

A total of 78 784 (70.8%) out of 111 301 non-pregnant sexually active women who did not want any future pregnancy were making use of contraception; 17 474 (15.7%) women were not using any form of contraception but expressed the desire to use it and 15 043 (13.5%) did not desire contraception at all. The pooled analysis exploring reasons for not using a method

of contraception included all non-pregnant ($n = 15\,043$), sexually active women who neither desired children nor have the intention to use a method of contraception in the future. The reason for not using methods of contraception was not reported by 150 (1.0%) women, leaving 14 893 (99.0%) included in the analysis. The response rate for fertility preference and intention to use contraception in the non-pregnant women population was above 97.0% for all DHS countries under study.

Statistical analysis

The pooled analysis was performed after merging all the latest DHS country files for the 2005–2012 time period. STATA 10 SE (StataCorp LP, USA) was used for statistical analysis (Stata Corp., 2008). To weight data, we accounted for clustering of women by primary sampling units and included country fixed effect in the pooled analysis.

For each country and the pooled analysis, odds ratio (OR) and adjusted OR (using multiple logistic regression analysis) between undesired pregnancy and the type of contraception were determined. P-values of <0.05 were considered significant. Logistic regression included education, occupation (working/not working), marital status, wealth quintiles and urban or rural residence as covariates.

Population and crude birth rates (CBR) by country were obtained from the World Health Statistics 2012 (WHO, 2012) to determine annual expected pregnancies. The estimated number of annual expected pregnancies was calculated as the number of population multiplied by CBR and then by 1.15 to adjust for miscarriages and terminations (estimated to be 15%; Garcia-Enguidanos et al., 2002; Inter-agency field manual on reproductive health in humanitarian settings, 2010), as it is not possible to calculate the exact number of miscarriages and terminations of pregnancy for each country. Expected undesired pregnancies and population attributable fraction (PAF) of undesired pregnancies attributable to not using MM of contraception were calculated for each country: $P(E)(OR-1)/[1+P(E)(OR-1)]$, where $P(E)$ was the proportion of undesired pregnancies due to non-use of MM of contraception and OR the odds ratio of pregnancy and the use of MM of contraception.

The PAF would give us proportional reduction in undesired pregnancies if traditional methods of contraception and non-use of contraception at all were replaced by the use of MM of contraception.

Ethical approval

The institutional review board of ORC Macro (Calverton, MD, USA) and of each country approved the DHS data collection procedures including informed consent. This study used existing data obtained from ORC Macro through formal request mechanisms. As no direct interviews or identifying information were included, additional ethical review for the secondary analysis was not required.

Results

Undesired pregnancies

Of the 111 301 not pregnant women who did not desire pregnancy, Ghana contributed the smallest number, 447 (0.4%), and India the largest, 19 056 (17.1%). Of the 12 874 (10.4%) undesired pregnancies, Albania contributed the smallest number, 15 (0.1%), and India contributed the largest, 1407 (10.9%) (Table I).

For Honduras and India, there were significantly fewer women not wanting the current pregnancy if the last child was a girl, whilst for Peru, this was the opposite; for all other countries, there was no significant variation. In all countries, the tendency of not wanting the current pregnancy increased significantly with parity.

Table I Data on conception obtained from demographic and health surveys in 35 low- and middle-income countries between 2005 and 2012.

Country, survey years	Current undesired pregnancies, n (%)	Currently non-pregnant, women not desiring pregnancy, n (%)
Pooled	12 874 (100.0)	111 301 (100.0)
Albania 2008/2009	15 (0.1)	2845 (2.6)
Armenia 2010	18 (0.1)	1516 (1.4)
Azerbaijan 2006	51 (0.4)	2682 (2.4)
Bolivia 2008	612 (4.7)	4116 (3.7)
Burkina Faso 2010	199 (1.5)	1469 (1.3)
Burundi 2010	395 (3.1)	1109 (1.0)
Cambodia 2010	135 (1.0)	4621 (4.1)
Colombia 2010	1230 (9.6)	7813 (7.0)
Ethiopia 2011	305 (2.4)	1993 (1.8)
Ghana 2008	137 (1.1)	447 (0.4)
Guyana 2009	113 (0.9)	1265 (1.1)
Honduras 2005/06	564 (4.4)	2968 (2.7)
India 2005/06	1407 (10.9)	19 056 (17.1)
Indonesia 2007	376 (2.9)	10 500 (9.4)
Jordan 2009	357 (2.8)	3062 (2.7)
Kenya 2008/2009	257 (2.0)	1493 (1.3)
Lesotho 2009	167 (1.3)	1366 (1.3)
Madagascar 2008/2009	273 (2.1)	3540 (3.2)
Malawi 2010	1140 (8.8)	3393 (3.0)
Moldova 2005	45 (0.3)	2079 (1.9)
Namibia 2006/2007	334 (2.6)	1527 (1.4)
Nepal 2011	214 (1.7)	2767 (2.5)
Nigeria 2008	430 (3.3)	2410 (2.2)
Peru 2007/2008	1162 (9.0)	9992 (9.1)
Philippines 2008	225 (1.8)	2976 (2.7)
Rwanda 2010	432 (3.4)	2732 (2.4)
Senegal 2010/2011	336 (2.6)	1233 (1.1)
Sierra Leone 2008	174 (1.3)	729 (0.6)
Swaziland 2006/2007	164 (1.3)	1052 (0.9)
Tanzania 2010[a]	334 (2.6)	1212 (1.1)
Timor-Leste 2009/10	114 (0.9)	1874 (1.7)
Uganda 2011	435 (3.5)	1147 (1.0)
Ukraine 2007	31 (0.2)	2007 (1.8)
Zambia 2007	395 (3.1)	845 (0.8)
Zimbabwe 2010/2011	298 (2.3)	1465 (1.3)

[a]Tanzania refers to the United Republic of Tanzania.

In the pooled analysis, the use of traditional methods was associated with a 2.2 [95% confidence interval (CI): 2.1–2.9] times increased odds of having an undesired pregnancy compared with the use of MM of contraception (Table II, Fig. 1). Adjusted for covariates, this increased to 2.7 (2.3–3.4) times increased odds. Not using any method of contraception was associated with a 12.4 (95% CI, 11.7–13.1) times increased odds of

Table II OR by method of contraception for undesired pregnancies, and PAF of undesired pregnancies for women not using MM of contraception in 35 low- and middle-income countries between 2005 and 2012.

	PAF undesired pregnancies of non-use of MMs[a]	OR (95% CI) unadjusted	OR (95% CI) adjusted[b]
Pooled	16 749 753 (100%)		
Traditional methods	13 517 051 (80.7%)	2.2 (2.1–2.9)	2.7 (2.3–3.4)
Not using contraceptives		12.4 (11.7–13.1)	14.3 (12.3–16.7)
Armenia	5603 (100%)		
Traditional methods	4466 (79.7%)	1.9 (0.4–10.1)	2.3 (0.4–11.9)
Not using contraceptives		16.1 (3.5–73.1)	18.1 (3.9–83.2)
Bolivia	199 958 (100%)		
Traditional methods	171 190 (86.0%)	3.9 (2.7–5.7)	4.4 (3.0–6.5)
Not using contraceptives		21.6 (15.3–30.5)	32.8 (22.6–47.7)
Burkina Faso	96 545 (100%)		
Traditional methods	83 898 (86.9%)	4.2 (1.4–12.1)	3.8 (1.3–11.2)
Not using contraceptives		7.0 (4.1–11.9)	8.6 (4.9–15.1)
Burundi	139 632 (100%)		
Traditional methods	122 876 (88.0%)	1.9 (0.8–4.7)	2.9 (1.2–6.7)
Not using contraceptives		10.3 (6.2–17.1)	13.9 (8.1–24.1)
Cambodia	53 410 (100%)		
Traditional methods	45 772 (85.7%)	4.4 (2.1–9.3)	2.5 (1.1–5.8)
Not using contraceptives		15.3 (8.1–28.9)	11.9 (8.1–29.3)
Colombia	645 020 (100%)		
Traditional methods	556 007 (86.2%)	2.4 (1.9–3.0)	2.6 (2.1–3.2)
Not using contraceptives		15.2 (13.1–17.7)	15.9 (13.7–18.6)
Ethiopia	715 882 (100%)		
Traditional methods	650 737 (90.9%)	–	–
Not using contraceptives		10.8 (6.9–17.)	13.9 (8.6–22.5)
Ghana	330 127 (100%)		
Traditional methods	282 589 (85.6%)	1.3 (0.4–4.2)	1.8 (0.5–5.9)
Not using contraceptives		7.7 (3.8–15.6)	7.8 (3.8–16.0)
Guyana	6771 (100%)		
Traditional methods	6229 (92.0%)	1.9 (0.3–15.7)	1.8 (0.2–15.4)
Not using contraceptives		15.1 (6.9–32.7)	14.2 (6.5–31.0)
Honduras	104 688 (100%)		
Traditional methods	90 346 (86.3%)	2.3 (1.6–3.2)	2.4 (1.7–3.4)
Not using contraceptives		12.5 (9.8–16.1)	15.2 (11.7–19.)
India	7 440 925 (100%)		
Traditional methods	5 878 331 (79.0%)	1.5 (1.2–2.0)	1.4 (1.1–1.9)
Not using contraceptives		11.8 (9.7–14.5)	12.1 (9.8–14.7)
Indonesia	968 955 (100%)		
Traditional methods	540 677 (55.8%)	3.1 (2.1–4.8)	2.2 (1.4–3.5)
Not using contraceptives		6.0 (4.7–7.7)	8.4 (6.7–10.7)
Jordan	50 592 (100%)		
Traditional methods	32 379 (64.0%)	2.6 (1.9–3.5)	3.2 (2.3–4.4)
Not using contraceptives		12.2 (9.1–16.3)	13.2 (9.8–17.9)
Kenya	722 648 (100%)		
Traditional methods	581 732 (80.5%)	4.4 (2.4–8.1)	5.9 (3.0–11.8)
Not using contraceptives		16.8 (10.5–26.8)	14.8 (9.2–23.9)

Continued

Table II *Continued*

	PAF undesired pregnancies of non-use of MMs[a]	OR (95% CI) unadjusted	OR (95% CI) adjusted[b]
Lesotho	34 495 (100%)		
Traditional methods	32 736 (94.9%)	2.6 (0.3–20.3)	2.4 (0.3–19.5)
Not using contraceptives		22.9 (12.6–41.6)	22.2 (12.1–40.8)
Madagascar	158 086 (100%)		
Traditional methods	151 763 (96.0%)	4.8 (1.9–12.2)	6.1 (2.3–16.4)
Not using contraceptives		41.2 (19.4–87.6)	37.7 (17.7–80.3)
Malawi	75 776 (100%)		
Traditional methods	68 198 (90.0%)	2.7 (1.3–6.5)	2.7 (1.8–4.1)
Not using contraceptives		17.9 (14.2–22.6)	19.5 (15.5–24.9)
Moldova	12 827 (100%)		
Traditional methods	10 544 (82.2%)	2.5 (0.9–6.5)	2.5 (0.9–6.6)
Not using contraceptives		16.5 (7.1–38.3)	18.1 (7.7–42.4)
Namibia	40 186 (100%)		
Traditional methods	37 413 (93.1%)	–	–
Not using contraceptives		16.7 (12.0–23.4)	18.1 (12.8–25.5)
Nepal	288 949 (100%)		
Traditional methods	257 165 (89.0%)	2.7 (1.2–6.3)	3.2 (1.5–6.7)
Not using contraceptives		28.3 (14.6–40.6)	26.6 (15.5–45.6)
Nigeria	879 368 (100%)		
Traditional methods	738 669 (84.0%)	1.3 (0.7–2.5)	1.4 (0.6–2.9)
Not using contraceptives		7.7 (5.1–11.7)	11.3 (6.9–18.3)
Peru	446 061 (100%)		
Traditional methods	386 735 (86.7%)	4.6 (3.8–5.5)	4.8 (3.9–5.9)
Not using contraceptives		21.5 (17.7–26.1)	25.4 (20.6–31.3)
Philippines	722 484 (100%)		
Traditional methods	574 375 (79.5%)	5.3 (3.2–8.9)	5.4 (3.3–8.9)
Not using contraceptives		8.9 (5.4–14.6)	8.7 (5.4–14.0)
Rwanda	231 398 (100%)		
Traditional methods	185 350 (80.1%)	2.9 (1.8–4.7)	3.3 (2.1–5.3)
Not using contraceptives		11.4 (8.4–15.4)	12.6 (9.3–17.0)
Senegal	138 561 (100%)		
Traditional methods	125 398 (90.5%)	2.3 (0.5–11.2)	2.4 (0.5–12.5)
Not using contraceptives		8.9 (4.8–16.4)	11.4 (6.0–21.6)
Sierra Leone	79 040 (100%)		
Traditional methods	70 346 (89.0%)	1.3 (0.3–6.5)	1.0 (0.2–5.4)
Not using contraceptives		8.0 (3.7–17.4)	10.1 (4.5–22.3)
Tanzania	758 833 (100%)		
Traditional methods	660 185 (87.0%)	2.5 (1.2–5.1)	4.0 (1.9–8.5)
Not using contraceptives		14.3 (8.4–24.3)	14.3 (8.3–24.9)
Timor-Leste	6270 (100%)		
Traditional methods	6151 (98.1%)	–	–
Not using contraceptives		53.7 (7.5–385.4)	56.2 (7.8–404.2)
Uganda	782 193 (100%)		
Traditional methods	657 042 (84.0%)	2.6 (1.4–4.7)	2.3 (1.2–4.5)
Not using contraceptives		10.6 (7.2–15.5)	12.6 (8.4–18.9)

Continued

Table II *Continued*

	PAF undesired pregnancies of non-use of MMs[a]	OR (95% CI) unadjusted	OR (95% CI) adjusted[b]
Ukraine	92 008 (100%)		
Traditional methods	76 275 (82.9%)	1.5 (0.4–5.4)	1.5 (0.4–5.4)
Not using contraceptives		24.2 (9.6–60.8)	24.3 (9.5–61.9)
Zambia	352 166 (100%)		
Traditional methods	299 299 (85.0%)	1.3 (0.7–2.4)	1.2 (0.6–2.3)
Not using contraceptives		9.0 (6.5–12.5)	9.7 (6.9–13.7)
Zimbabwe	173 918 (100%)		
Traditional methods	132 178 (76.0%)	3.4 (1.6–7.1)	3.3 (1.5–6.9)
Not using contraceptives		6.4 (4.8–8.3)	6.5 (4.9–8.6)

Albania, Azerbaijan and Swaziland not reported as no women utilizing MM of contraception prior current pregnancy.

Ethiopia, Namibia and Timor-Leste datasets do not contain any Traditional methods amongst the currently pregnant women.

CI, confidence interval.

[a]The PAF of undesired pregnancies attributable to not using MM of contraception were calculated using $P(E)(OR-1)/[1+P(E)(OR-1)]$, where $P(E)$ was the proportion of undesired pregnancies due to non-use of MM of contraception and OR the odds ratio of pregnancy and use of MM of contraception.

[b]Adjusted for household income, urban/rural, education, marital status and occupation.

having an undesired pregnancy. Adjusted for covariates, this increased to 14.3 (95% CI, 12.3–16.7) times increased odds (Table II, Fig. 2).

Country-specific OR of undesired pregnancy associated with using traditional methods ranged from 1.0 (95% CI, 0.2–5.4) for Sierra Leone to 6.1 (95% CI, 2.3–16.4) for Madagascar and was statistically significant for all but 10 countries. Country-specific OR of undesired pregnancy because of not using any contraception methods ranged from 6.5 (95% CI, 4.9–8.6; $P < 0.001$) for Zimbabwe to 56.2 (95% CI, 7.8–404.2; $P < 0.001$) for Timor-Leste and was statistically significant for all countries.

The PAF of not using MM accounted for 80.7% (13 517 051) of the estimated undesired pregnancies (16 751 374) in the pooled analysis. The PAF ranged from 55.8% (540 677) for Indonesia to 98.1% (6151) for Timor-Leste and the estimated number of undesired pregnancies because of the use of traditional methods or non-use of contraception ranged from 4466 in Armenia to 5 878 331 in India.

Indonesia had the lowest PAF (55.8%) contributing to undesired pregnancies due to not using MM in large part due to extremely high failure rates among those using MM. A total of 105 of 376 women (28%) were using MM prior to having an unwanted pregnancy (Table III). A high proportion of women becoming pregnant, despite the usage of MM of contraception was also found in four other countries: Zimbabwe 37.9% (113/298), Colombia 24.1% (297/1237), Jordan 19.3% (69/357) and Ukraine 19.4% (6/31). Another 20 countries had failure rates between 5 and 15% and the remaining 10 countries had rates below 5%. If all countries could achieve a failure rate for MM of <5%, 1 553 735 (9.3% of all) unwanted pregnancies could be prevented.

Women not desiring a pregnancy with the lowest education level and poorest quintile were 8.6 (95% CI, 8.2–9.1) and 2.6 (95% CI: 2.4–2.9) times less likely to use any contraception method compared with women with the highest educational level and quintile, respectively.

Reasons for not using contraception

Of the 14 893 sexually active, not pregnant women who neither desired pregnancy nor used contraception, country-specific sample sizes varied from 132 for Armenia to 2476 for India.

Of the total, 5559 (37.3%) did not use any contraceptive methods because of fear of side effects/health concerns; 2620 (17.6%) did not use it because they underestimated the risk of pregnancy; 3331 (22.4%) women indicated they or their partner's opposition to contraception or religious prohibition as the reason; 1055 (7.1%) mentioned other related methods reasons, such as the cost, which alone accounted for 2.4% of the total. Some 516 (2.4%) women were not aware of the availability and/or source of contraception and 1812 (12.1%) women indicated other reasons (Table IV).

The prevalence of women not using contraceptives, citing fear of side effects/health concerns varied from 9.0% in Armenia to 61.0% in Kenya; 3717 (66.9%) of them did not complete secondary school education, but the response was evenly distributed among wealth categories. The prevalence of those underestimating risk for pregnancy varied from 2.0% for Timor-Leste to 40.7% for Ukraine; 1875 (71.6%) had not completed secondary school education and again the response was evenly distributed among wealth categories. Opposition and lack of knowledge increased with decreasing wealth quintile. Cost was only cited by 2.4% of the total as a reason for non-use. Even among the poorest, only 3.3% cited costs.

Discussion

Analysis of 35 low- and middle-income countries revealed that four out of five undesired pregnancies could have been prevented if MM were used. The use of traditional methods and not using any method of contraception increased the odds of an undesired pregnancy by 3 and 14 times, respectively. Of the sexually active women who did not desire pregnancy, non-use of contraceptives was mostly reported due to fear of side effects/health concerns, religious opposition to use and underestimated risk of pregnancy. Consistent with other studies, women with the lowest education level and poorest quintile were least likely to use any contraception method (Byrne et al., 2012; Mostafa Kamal, 2012). The lack of knowledge about contraceptives was rarely cited as a reason for non-use. Cost was not even commonly cited among the poor as a hindrance to contraception access.
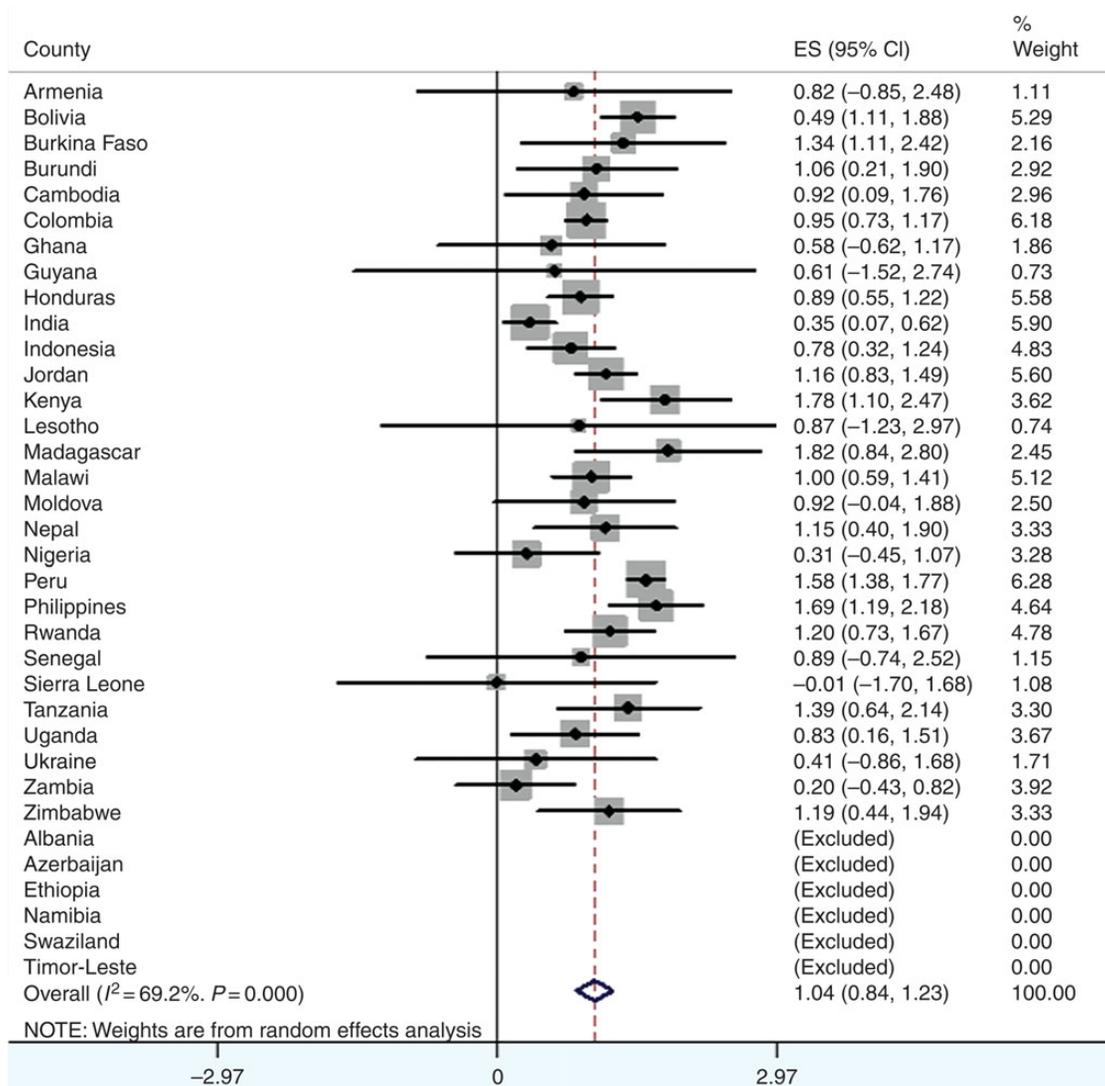
Figure 1 Forest plot showing the relation between undesired pregnancy in women using traditional methods of contraception and women using MM of contraception in all 35 low- and middle-income countries in the survey between 2005 and 2012. This relation is expressed by the effect size (ES), or Log OR, with relative CI and shows significant association between the use of traditional methods of contraception and undesired pregnancies for 19 countries. Plotted on log scale; error bars are 95% CIs. Wald test for equivalence of coefficient rejected ($\chi^2 = 90.9$, $P < 0.001$). See Table II for OR and CIs by country. Tanzania refers to the United Republic of Tanzania.

Together, these 35 countries have 2.4 billion persons, 33.6% of the global population. Most countries had significant ORs of undesired pregnancy associated with the use of traditional methods. The 10 countries that did not have significant differences had samples with <10 subjects in at least one of the comparison categories. Four additional countries had significant ORs despite having <10 subjects in one of the comparison categories.

More than one in four women in Indonesia, Jordan and Colombia had become pregnant despite using MM. This is vastly higher than other countries and needs specific attention.

DHS are generally considered high-quality surveys and are sometimes the only source of maternal and child health information available in developing countries (Johnson *et al.*, 2009). However, one must consider that DHS were compared across 35 countries at various times after 2005. The surveys used standardized questionnaires, which minimizes the risk of variation that would significantly affect the results (Johnson *et al.*, 2009).

An average of 96% of 15–49 years age eligible women took part in the survey. Guyana had the lowest participation rates (90%) and Rwanda and Burundi the highest (99%). Recall bias in reporting the use of contraception prior to the current pregnancy could potentially affect the results (Boerma and Sommerfelt, 1993): women who experienced an undesired pregnancy may be more likely to recall and report their sexual behaviours compared with those who did not have any undesired pregnancy. Missing data were minimal in the examined data sets.

Another limitation might be that few women report a current pregnancy in the first trimester and undesired pregnancies at that time are probably prone to under-reporting. Some terminated pregnancies may not be included in the current pregnancy group. Also, covariates measured at
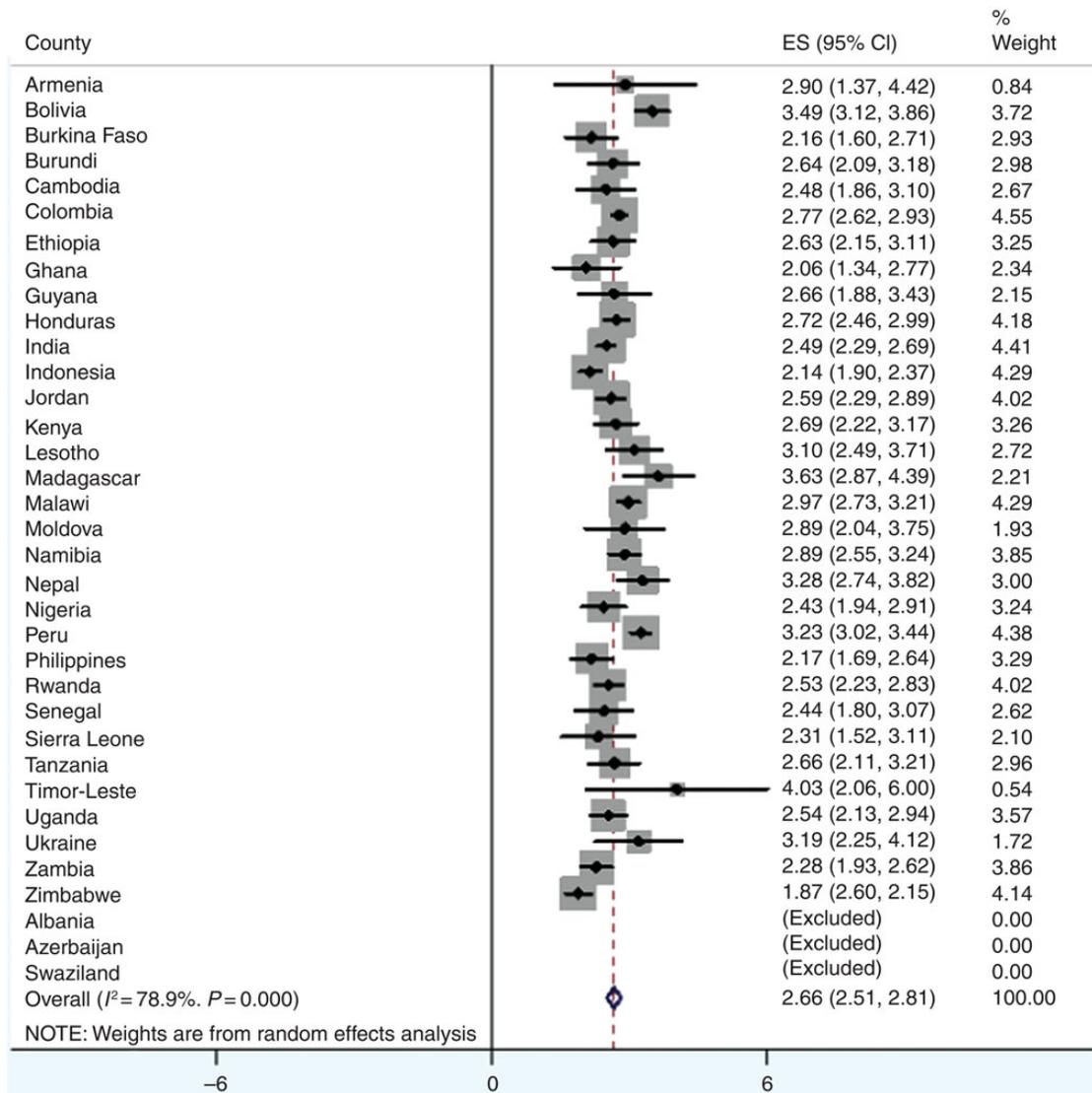
Figure 2 Forest plot showing the relation between undesired pregnancy in women not using contraception and women using MM of contraception in all 35 low- and middle-income countries in the survey between 2005 and 2012. This relation is expressed by the ES, or Log OR, with relative CI and shows significant association between the non-use of traditional methods of contraception and undesired pregnancies for all countries for which the analysis could be performed; for Albania, Azerbaijan and Swaziland, no women were utilizing MM of contraception prior to the current pregnancy. Plotted on log scale; error bars are 95% CIs. Wald test for equivalence of coefficient rejected ($\chi^2 = 500.6$, $P < 0.001$). See Table II for OR and CIs by country. Tanzania refers to the United Republic of Tanzania.

the time of the survey may not have reflected the same covariates at the time the currently pregnant women became pregnant. The DHS did not include questions on reason for not using among the women who desired to use contraception.

This study has many implications. Health concerns commonly result in women not using modern contraceptives; yet most health concerns are not backed by evidence. For example, scientific studies and systematic reviews have found no associations between any of the following: oral contraception and fractures (Lopez et al., 2012a,b); progestin contraception and thromboembolism (Mantha et al., 2012); combined oral contraception (COC) and increase weight gain (Gallo et al., 2011a,b); progesterone-only methods and breastfeeding performances, infant

growth, health or development (Kapp and Curtis, 2010; Kapp et al., 2010); hormonal contraceptives and carbohydrate metabolism in women without diabetes (Lopez et al., 2009); COC and the course of acute or chronic hepatitis including progression or severity of cirrhotic fibrosis, the risk of hepatocellular carcinoma in women with chronic hepatitis or the risk of liver dysfunction in hepatitis B virus carriers (Kapp and Curtis, 2009a,b, Kapp et al., 2009); and oral contraceptive formulation and increase in breast cancer risk (Marchbanks, 2012). Oral contraception reduces the risk of death from ovarian and endometrial cancer (Maquire and Westhoff, 2011).

While many women discontinue contraceptives because of side effects, most of these diminish within a few months. Health worker

Table III Distribution of methods of contraception among women who are sexually active, currently not pregnant and not desiring a child and women with a current undesired pregnancy in 35 low- and middle-income countries between 2005 and 2012.

	Pregnant women (n, %)[a]	Non-pregnant women (n, %)
Pooled	12 874 (100%)	111 301 (100%)
MM	1455 (11.3)	56 173 (50.5)
Traditional methods	1324 (10.3)	23 315 (20.9)
Not using contraceptives	10 095 (78.4)	31 813 (28.6)
Albania	15 (100%)	2845 (100%)
MM	0 (−)	262 (9.3)
Traditional methods	4 (27.7)	2152 (75.6)
Not using contraceptives	11 (72.3)	431 (15.1)
Armenia	18 (100%)	1516 (100%)
MM	2 (11.1)	578 (38.1)
Traditional methods	5 (27.8)	740 (48.8)
Not using contraceptives	11 (61.1)	198 (13.1)
Azerbaijan	51 (100%)	2682 (100%)
MM	0 (−)	559 (20.8)
Traditional methods	15 (29.4)	1585 (59.1)
Not using contraceptives	36 (70.6)	538 (20.1)
Bolivia	612 (100%)	4116 (100%)
MM	35 (5.7)	1759 (42.7)
Traditional methods	121 (19.8)	1401 (34.0)
Not using contraceptives	456 (74.5)	956 (23.3)
Burkina Faso	199 (100%)	1469 (100%)
MM	15 (7.5)	528 (35.9)
Traditional methods	5 (3.3)	42 (2.9)
Not using contraceptives	179 (89.2)	899 (61.2)
Burundi	395 (100%)	1109 (100%)
MM	15 (3.8)	335 (30.2)
Traditional methods	10 (2.5)	79 (7.1)
Not using contraceptives	370 (93.7)	695 (62.7)
Cambodia	134 (100%)	4621 (100%)
MM	11 (8.2)	2046 (44.3)
Traditional methods	13 (9.7)	922 (19.9)
Not using contraceptives	110 (82.1)	1653 (35.8)
Colombia	1230 (100%)	7813 (100%)
MM	297 (24.1)	5748 (73.6)
Traditional methods	132 (10.7)	1049 (13.4)
Not using contraceptives	801 (65.2)	1016 (13.0)
Ethiopia	304 (100%)	1993 (100%)
MM	21 (6.9)	870 (43.6)
Traditional methods	0 (—)	40 (2.0)
Not using contraceptives	283 (93.1)	1083 (54.4)
Ghana	137 (100%)	447 (100%)
MM	9 (6.6)	140 (31.3)
Traditional methods	5 (3.6)	58 (13.0)
Not using contraceptives	123 (89.8)	249 (55.7)

Continued

Table III *Continued*

	Pregnant women (*n*, %)[a]	Non-pregnant women (*n*, %)
Guyana	113 (100%)	1265 (100%)
MM	7 (6.2)	611 (48.3)
Traditional methods	1 (0.9)	46 (3.6)
Not using contraceptives	105 (92.9)	608 (48.1)
Honduras	564 (100%)	2968 (100%)
MM	85 (15.1)	1707 (57.5)
Traditional methods	68 (12.1)	604 (20.4)
Not using contraceptives	411 (72.8)	657 (22.1)
India	1407 (100%)	19 056 (100%)
MM	113 (8.0)	7734 (40.6)
Traditional methods	102 (7.2)	4587 (24.1)
Not using contraceptives	1192 (84.8)	6735 (35.3)
Indonesia	376 (100%)	10 500 (100%)
MM	105 (28.0)	7567 (72.1)
Traditional methods	23 (6.1)	721 (6.8)
Not using contraceptives	248 (65.9)	2212 (21.1)
Jordan	357 (100%)	3062 (100%)
MM	69 (19.3)	1860 (60.7)
Traditional methods	89 (24.9)	762 (24.9)
Not using contraceptives	199 (55.8)	440 (14.4)
Kenya	257 (100%)	1493 (100%)
MM	20 (7.8)	828 (55.4)
Traditional methods	17 (6.6)	122 (8.2)
Not using contraceptives	220 (85.6)	543 (36.4)
Lesotho	167 (100%)	1366 (100%)
MM	12 (7.2)	857 (62.7)
Traditional methods	1 (0.6)	28 (2.0)
Not using contraceptives	154 (92.2)	481 (35.3)
Madagascar	271 (100%)	3540 (100%)
MM	7 (2.6)	1585 (44.8)
Traditional methods	12 (4.4)	570 (16.1)
Not using contraceptives	252 (93.0)	1385 (39.1)
Malawi	1140 (100%)	3393 (100%)
MM	86 (7.5)	1868 (55.1)
Traditional methods	36 (3.1)	292 (8.6)
Not using contraceptives	1018 (89.4)	1233 (36.3)
Moldova	45 (100%)	2079 (100%)
MM	7 (15.6)	1116 (53.7)
Traditional methods	11 (24.4)	702 (33.8)
Not using contraceptives	27 (60.0)	261 (12.5)
Namibia	334 (100%)	1527 (100%)
MM	45 (13.5)	1085 (71.0)
Traditional methods	0 (—)	26 (1.7)
Not using contraceptives	289 (86.5)	416 (27.3)
Nepal	214 (100%)	2767 (100%)
MM	15 (7.0)	1565 (56.6)

Continued

Table III *Continued*

	Pregnant women (n, %)ᵃ	Non-pregnant women (n, %)
Traditional methods	14 (6.5)	446 (16.1)
Not using contraceptives	185 (86.5)	756 (27.3)
Nigeria	430 (100%)	2410 (100%)
MM	19 (4.4)	610 (25.3)
Traditional methods	11 (2.6)	256 (10.6)
Not using contraceptives	400 (93.0)	1544 (64.1)
Peru	1161 (100%)	9992 (100%)
MM	145 (12.5)	5362 (53.7)
Traditional methods	453 (39.0)	3661 (36.6)
Not using contraceptives	563 (48.5)	969 (9.7)
Philippines	225 (100%)	2976 (100%)
MM	21 (9.3)	1225 (41.2)
Traditional methods	72 (32.0)	800 (26.9)
Not using contraceptives	132 (58.7)	951 (31.9)
Rwanda	432 (100%)	2732 (100%)
MM	54 (12.5)	1565 (57.3)
Traditional methods	29 (6.7)	286 (10.5)
Not using contraceptives	349 (80.8)	881 (32.2)
Senegal	335 (100%)	1233 (100%)
MM	11 (3.3)	282 (22.9)
Traditional methods	2 (0.6)	22 (1.8)
Not using contraceptives	322 (96.1)	929 (75.3)
Sierra Leone	172 (100%)	729 (100%)
MM	7 (4.0)	177 (24.3)
Traditional methods	2 (1.2)	39 (5.3)
Not using contraceptives	163 (94.8)	513 (70.4)
Swaziland	162 (100%)	1052 (100%)
MM	0 (−)	694 (66.0)
Traditional methods	0 (−)	44 (4.2)
Not using contraceptives	162 (100)	314 (29.8)
Tanzania	334 (100%)	1212 (100%)
MM	14 (4.2)	388 (32.0)
Traditional methods	18 (5.4)	178 (14.7)
Not using contraceptives	302 (90.4)	646 (53.3)
Timor-Leste	114 (100%)	1874 (100%)
MM	1 (0.9)	592 (31.6)
Traditional methods	0 (−)	36 (1.9)
Not using contraceptives	113 (99.1)	1246 (66.5)
Uganda	435 (100%)	1147 (100%)
MM	31 (7.1)	481 (41.9)
Traditional methods	14 (3.2)	93 (8.1)
Not using contraceptives	390 (89.7)	573 (50.0)
Ukraine	31 (100%)	2007 (100%)
MM	6 (19.4)	1266 (63.1)
Traditional methods	4 (12.9)	558 (27.8)
Not using contraceptives	21 (67.7)	183 (9.1)

Table III *Continued*

	Pregnant women (n, %)[a]	Non-pregnant women (n, %)
Zambia	395 (100%)	845 (100%)
MM	52 (13.2)	437 (51.7)
Traditional methods	16 (4.0)	103 (12.2)
Not using contraceptives	327 (82.8)	305 (36.1)
Zimbabwe	298 (100%)	1465 (100%)
MM	113 (37.9)	1154 (78.8)
Traditional methods	10 (3.3)	30 (2.0)
Not using contraceptives	175 (58.8)	281 (19.2)

[a]Method discontinued due to pregnancy.

Table IV Frequency by covariate of the reasons for not using any contraception in sexually active, non-pregnant women who do not desire children (n = 14 893) in 35 low- and middle-income countries between 2005 and 2012.

	Fear of side effects/ health concerns (n = 5559; 37.3%), n (%)	Underestimated risk of pregnancy (n = 2620; 17.6%), n (%)	Opposition (n = 3331; 22.4%), n (%)	Lack of knowledge (n = 516; 3.5%), n (%)	Other related methods reasons (n = 1055; 7.1%), n (%)	Other (n = 1812; 12.1%), n (%)
Education						
No education	1703 (30.7)	1049 (40.0)	1611 (48.4)	352 (68.2)	309 (29.3)	757 (41.8)
Primary	2014 (36.2)	826 (31.5)	950 (28.5)	122 (23.6)	382 (36.2)	570 (31.5)
Secondary	1497 (26.9)	630 (24.1)	635 (19.1)	40 (7.8)	279 (26.5)	377 (20.8)
Higher	345 (6.2)	115 (4.4)	135 (4.1)	2 (0.4)	85 (8.1)	108 (6.0)
Marital status						
Married	5492 (98.8)	2544 (97.1)	3304 (99.2)	511 (99.1)	1043 (98.9)	1741 (96.1)
Non married	67 (1.2)	76 (2.9)	27 (0.8)	5 (0.9)	12 (1.1)	71 (3.9)
Wealth quintile						
First, poorest	1158 (21.2)	523 (20.1)	864 (26.0)	224 (43.6)	266 (25.3)	440 (24.8)
Second	1061 (19.3)	505 (19.5)	709 (21.4)	130 (25.2)	208 (19.8)	361 (20.4)
Third	1011 (18.4)	464 (17.9)	664 (20.0)	99 (19.2)	210 (20.0)	336 (19.0)
Fourth	1077 (19.6)	545 (21.1)	572 (17.2)	44 (8.5)	201 (19.1)	311 (17.5)
Fifth, richest	1181 (21.5)	549 (21.2)	510 (15.4)	18 (3.5)	167 (15.8)	324 (18.3)
Location						
Rural	1784 (32.1)	778 (29.7)	846 (25.4)	56 (10.9)	341 (32.3)	627 (34.6)
Urban	3775 (67.9)	1842 (70.3)	2485 (74.6)	460 (89.1)	714 (67.7)	1185 (65.4)
Occupation						
Not working	1167 (21.0)	477 (18.2)	763 (22.9)	129 (25.1)	291 (27.6)	413 (22.8)
Working	4392 (79.0)	2143 (81.8)	2568 (77.1)	387 (74.9)	764 (72.4)	1399 (77.2)

reassurance, education regarding common adverse effects, judicious treatment of symptoms and changing of methods can enable women to remain protected by MM (Barr, 2010). Furthermore, discontinuation due to concerns about bleeding patterns appears to be lower with COC containing second-generation progestogens (Lawrie et al., 2011; Gallo et al., 2011a,b). Thus, programmes still using first-generation progestogens may consider changing to second-generation progestogens.

Most countries have high contraceptive failure rates. Counselling and increased use of long-term reversible and irreversible methods have been effective in reducing failure rates (Lee et al., 2011). Specific emphasis must be directed to women under 25 years of age who are more likely to request premature discontinuation of their IUDs and may benefit from additional counselling (Aoun et al., 2014); limited data suggest that the levonorgestrel intrauterine system may be an

acceptable alternative to the COC in this population (Tang et al., 2012). Additionally, community-based interventions and antenatal contraceptive counselling targeting an improved uptake of (copper) IUDs have proven effective (Arrowsmith et al., 2012). Furthermore, insertion of IUDs in the post-partum period has proven safe without increasing the risk of complications (Kapp and Curtis, 2009a,b). In contrast, post-natal contraceptive education appears to lack evidence of intervention effectiveness (Lopez et al., 2012a,b). Countries must determine interventions considering their setting and level of resources, and research needs to ensure high rates of long-term contraceptive continuation (Halpern et al., 2011).

Fertility-awareness-based methods for contraception were found to be inferior to the use of MM, which has been reported previously (Grimes et al., 2004).

In conclusion, our study estimated 13.5 million undesired pregnancies in 35 low- and middle-income countries could have been prevented annually if all women who did not desire pregnancy used MM of contraception. It is important to understand how underuse of MM of contraception translates into a burden of death and disease. Unfounded health concerns, fear of side effects, opposition to use and an underestimated risk of pregnancy affect all women, regardless of wealth and educational status. Systematic efforts are needed to address these issues. Routine client encounters, such as antenatal, immediate post-natal and post-abortive care visits, present opportunities for health workers to elicit concerns from sexually active clients about contraceptives and counsel accordingly. The use of modern media, such as push videos linked with websites containing accurate information, could help dispel myths, especially among the youth. These approaches could prove attractive for augmenting sexual education in schools. Many organized religions are neutral or supportive of family planning. National strategies need to consider how best to exploit these varied channels to improve the response to demand and the knowledge of clients. However, national strategies to increase the response to demand need to be coupled with an available, affordable and acceptable range of quality contraceptives.

Authors' roles

S.B. contributed to the conception and design of the study, the acquisition of data and the analysis/interpretation of data. He was also responsible for drafting and revising the manuscript. H.S., H.O. and M.T. contributed to the conception and design of the study, to the interpretation of data, drafting and revising the manuscript. All authors reviewed and approved the final manuscript. S.B. is the guarantor and takes full responsibility for the work as a whole.

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