Redefining Contraceptive Prevalence

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ABSTRACT (136 words)

The contraceptive prevalence rate (CPR) is one of the most widely used family planning (FP) metrics, tracked and reported around the world by low-, middle-, and high-income countries alike. As the FP field evolves and calls grow for enhanced FP measurement, we question—can the metric be improved? Using data from the 2011-2013 National Survey of Family Growth, we reexamine both the CPR numerator and denominator and develop a new measure, contraceptive prevalence among the sexually active (CPSA), which reflects contraceptive use among women at risk of pregnancy. We compare CPSA estimates with conventional CPR estimates using NSFG and Demographic and Health Survey data. Findings indicate that women at risk of pregnancy report higher levels of contraceptive use than conventional CPR shows; CPSA gives a more accurate picture of the use of contraception than does CPR.

BACKGROUND

The contraceptive prevalence rate (CPR) is one of the oldest and most widely used family planning (FP) metrics. Since the World Fertility Surveys began capturing CPR data in the early 1970s (Kendall, 1979), it has been reported through virtually every large scale, international, population-based health survey—e.g. Contraceptive Prevalence Surveys, Reproductive Health Surveys, Demographic and Health Surveys (DHS), and Multiple Indicator Cluster Surveys. Moreover, it is tracked and reported around the world by low-, middle-, and high-income countries alike (United Nations, 2014). With its strong relationship to the total fertility rate and hence, population growth, it is one the few reproductive health indicators that the United Nations Population Division estimates and projects on an annual basis (United Nations, 2015). In short, it is a measure firmly rooted and widely employed. Yet as the FP field evolves, as sexual behavior outside of marriage increases, and as calls for improved FP measurement grow, we question—can the measurement of the rate of contraceptive use be improved?

CPR is defined as "the percent of women of reproductive age who are using (or whose partner is using) a contraceptive method at a particular point in time" (MEASURE/Evaluation, 2015). It generally includes all contraceptive methods, both modern and traditional, and is calculated as follows: (# of women age 15-49 using a contraceptive method / total # of women age 15-49) x 100. Based on data availability, it is often reported only for married or cohabitating (i.e. in-union) women. Additionally, CPR is frequently reported for modern methods only, under the term modern contraceptive prevalence rate (mCPR).

The contraceptive prevalence rate itself is a bit of a misnomer since it is not an actual rate with events measured over a time interval among a population at risk, but is instead a point prevalence with events measured at a specific time among all persons in the population at that time (Gordis, 2014). With its denominator of all women of reproductive age, the conventional CPR estimate is quite crude as it equates belonging to the female sex and the age group 15-49 years with pregnancy risk. Limiting the measure to married or in-union women, as is often done, begins to address the imprecise nature of conventional CPR by equating marital status among women age 15-49 years with pregnancy risk. However, restricting the CPR calculation to women in-union is increasingly problematic as demographic patterns and cultural norms shift—in many parts of the world marriage is occurring later, sexual activity within non-union relationships is increasing, and male economic migration is reducing coital frequency of some in-union partners (Wellings et al., 2006; Agadjanian et al., 2011; Ghimire and Axinn, 2013; United Nations, 2013). Furthermore, as funders and providers strive to meet the FP needs of everyone, regardless of marital status, wealth, or other factors, restricting the CPR calculation to women in-union disregards women not in-union, thereby undermining the rights-based approach to meet the needs of all.

We therefore argue for the adoption of an additional, new measure of FP use– contraceptive prevalence among women at risk of pregnancy, which we call Contraceptive Prevalence among the Sexually Active (CPSA). Using data from the 2011-2013 National Survey of Family Growth (NSFG), we reexamine both the CPR numerator and denominator to develop this new measure. We then use NSFG and Demographic and Health Survey data to compare CPSA

estimates with conventional CPR estimates. Finally, we discuss benefits and limitations of the new measure and suggest how it could be employed to inform FP decision-making.

METHODS

To understand contraceptive use among women at risk of pregnancy, we must first limit our population of interest to said group. Instead of a denominator encompassing all women of reproductive age as is used in conventional CPR estimation, our denominator becomes all women of reproductive age who are: a) sexually active within a specified recent time interval; b) not currently pregnant; and c) fecund. The numerator then becomes those sexually active within that specified time interval, not currently pregnant, and fecund women of reproductive age who report current contraceptive use or contraceptive use at last sex. In essence,

Number of women at risk of pregnancy who report contraceptive use

CPSA=

-x100

Number of fecund, non-pregnant women who recently had sex (women at risk of pregnancy)

These data are captured in both international (e.g. DHS) and national (e.g. NSFG) householdbased surveys (Alkema *et al.*, 2013), though of DHS and NSFG, only NSFG collects information on women's report of contraceptive use at last sex (International, 2011; National Survey of Family Growth Staff, 2011). We use NSFG data to test and refine our CPSA measure and DHS data to explore how our measure performs across multiple country settings.

To explore the components of CPR, we chose the most recent NSFG survey round as our starting point. We made this decision due to data availability; compared with DHS, NSFG offers more information related to sexual recency and contraceptive use at last sex necessary for examining contraceptive prevalence estimation. We utilized data from the women's sample of the NSFG round of 2011-2013. Details of the survey methodology are published elsewhere (Groves *et al.*, 2009). Briefly, NSFG is a population-based household survey that collects information from men and women of reproductive age on fertility, family planning, pregnancy, health, marriage, and divorce. The response rate for women in the 2011-2013 survey round was 73.4%, resulting in a sample of 5601 women ages 15-44 that, after adjusting sampling weights for the nonresponse, is a nationally representative sample. The women were interviewed during the September 2011 to September 2013 period. The sample was a multi-stage design with oversampling of minorities. The National Center for Health Statistics has edited the data for valid and consistent responses and made the data freely available to researchers.

At its simplest, women potentially at risk of pregnancy are those women of reproductive age who have been sexually active in a recent period. With NSFG data, one can choose between at least three possible recent periods of sexual activity: women who have had sexual intercourse in the last 4 weeks; the last 3 months; or the last 12 months. We took advantage of this survey feature to explore the impact of different definitions of recent sexual activity on our new estimates of contraceptive prevalence, CPSA. We also excluded from our CPSA measurement women who were pregnant at the time of survey and those who reported sterility or their partner's sterility due to non-contraceptive reasons. Note that these two groups are included in the conventional

CPR calculation even though they are not at risk of pregnancy. We considered excluding postpartum amenorrheic women as well since they may not currently be at risk of pregnancy, but decided to leave them in our calculations with the recognition that ovulation typically returns before menses resume, meaning that some post-partum amenorrheic women may actually be at risk. We also briefly considered excluding women who are at risk of pregnancy but desire to become pregnant. We include them in our calculations because our primary interest is in measuring the rate of contraceptive use among all women at risk of pregnancy; removing those at risk who desire to become pregnant would move toward an alternative measure of met need for contraception rather than a measure of contraceptive use. Ultimately, we created three new denominators that included non-pregnant, fecund women who reported having sexual intercourse (henceforth "having sex"): a) within the last 4 weeks; b) within the last 3 months; and c) within the last 12 months. We estimated CPSA among all three groups and also explored differences in CPSA among women who reported having sex within the last 3 months but not the last 4 weeks or having sex within the last 12 months but not the last 3 months.¹

In terms of the numerator, NSFG collects two relevant pieces of information-contraceptive use at last sex among women who reported one or more sexual partners in the 12 months prior to the survey (use at last sex), and contraceptive method used, if any, during the month of the interview among all women regardless of recent sexual activity (current use). We took advantage of both pieces of data to explore CPSA, first using reported contraceptive use at last sex as the numerator and then using current contraceptive use as the numerator, again among women at risk of pregnancy. For the former we utilized the original data collected from women who had sex in the last 12 months on methods used at last sex.² To arrive at the latter, we used NSFG recode variable CONSTAT1, which has information for all 5,601 respondents. As NSFG documentation states, "[CONSTAT1] refers to the method used in the month of interview, or 'current month.' In cases where multiple methods were used in the current month, CONSTAT1 codes the highest priority method reported, according to a predetermined ranking of useeffectiveness, as used in earlier NSFG cycles" (National Survey of Family Growth Staff, 2014). The same variable has codes for women who reported that they were pregnant or sterile due to non-contraceptive reasons, which we employed to identify said women and remove them from the CPSA calculation. We utilized data collected from both questions to compare differences in self-report between use at last sex and current contraceptive use in the aggregate and by method type.³ We disaggregate our CPSA measure by union status (married, cohabitating, in-union (i.e. married or cohabitating), and non-cohabitating) and age (<25, 25-39, 40+ years of age). We describe differences in our CPSA estimates by union status and age and also between our CPSA estimates and the conventional CPR estimates.

To explore the impact of our new measure on contraceptive prevalence estimates in low- and middle-income countries, we utilized Demographic and Health Survey data. Details on DHS methodology are published elsewhere (Rutstein, 2006; Short Fabic *et al.*, 2012). Briefly, like NSFG, DHS is a population-based household survey designed to collect nationally representative data on population and health, including fertility, contraceptive use, sexual activity, child health and many other topics. DHS is also designed to be cross-nationally comparable, with a common survey methodology and core questionnaires utilized in every country that conducts a DHS. For our purposes, we selected the most recent DHS since 2000 in each country with such data available. The survey had to include both married and unmarried women and both groups had to

be asked questions about pregnancy, fecundity status, post-partum amenorrhea, recent sexual activity, and contraceptive use. These criteria yielded 48 surveys with 30 in Africa, 11 in Asia or Eastern Europe, and 7 in Latin America. A full list is given in Appendix A.

Because this study is descriptive, we simply present results without testing of hypotheses. Sample weights and correction for clustered data are used in the analyses; all numbers and percentages presented are weighted values unless otherwise stated. We used STATA 13.0 statistical software for all analyses (Stata Corporation, 2013, College Station, TX. USA).

We first explore estimates of contraceptive prevalence given varying reports of sexual frequency (ever; 4 weeks; 3 months; 12 months) and two assessments of contraceptive use (current use; use at last sex) utilizing NSFG data. From these analyses we then identify the preferred CPSA calculation. Finally, we compare the contraceptive prevalence estimates of CPSA and the conventional CPR using both NSFG and DHS data.

RESULTS

Alternative estimates of contraceptive prevalence using NSFG

Among all women, 86.5% had ever had sexual intercourse, 77.3% had been sexually active in the 12 months preceding the interview and 62.8% had been sexually active in the 4 weeks preceding the interview. For the women who had ever had sexual intercourse, recent sexual intercourse (i.e. within 4 weeks preceding the interview) was reported by 89.5% of married women, 90.6% of cohabitating women, and 48.3% of non-cohabitating women. By age, reports of sex in the last 4 weeks ranged from a low of 68.5% among women <25 years of age to a high of 75.2% among women ages 25-39 (Table 1). This age differential is to be expected since proportionally more women <25 years of age are in non-cohabitating relationships, which represents the group of sexually active women least likely to have had recent sexual intercourse. Exploring further the relationship between age and sexual frequency, we find that among women who have ever had sex, more women in the 25-39 and 40+ age groups reported no sex in the last 12 months (10.8% and 13.0%, respectively) compared with women <25 years of age (8.3%) (Table 1). These age differentials are also to be expected since sexual frequency is known decline with age (Eisenberg *et al.*, 2010; Karraker *et al.*, 2011).

Of the women who had ever had sex, 4.3% were pregnant at the time of interview and 2.8% declared themselves or their partners to be non-contraceptively sterile. Since these women were not at risk of pregnancy, we removed them from our CPSA calculations. With our calculation consisting of a universe of non-pregnant, fecund women who ever had sex, we find that contraceptive prevalence is 75%, regardless of whether the contraceptive use is based on self-reported current use or use at last sex (Table 2). Women in-union reported current contraceptive use slightly more than use at last sex (82% vs. 79%). In contrast, women not in-union reported current contraceptive use slightly less than use at last sex (65% vs. 69%). Restricting our denominator to those with sexual intercourse in the 4 weeks prior to interview, contraceptive prevalence rises to approximately 86% regardless of whether the numerator is based on use at last sex or current use. Expanding to 3 months, contraceptive prevalence changes very little from the 4 week estimate— 83% based on current use, 84% based on use at last sex. Further expanding to 12 months, contraceptive prevalence declines to 79% based on self-reported current

use, but based on use at last sex is nearly equal to the 4-week and 3-month estimates at 84% (Table 2). This five percentage point difference under the 12-month scenario is likely due to reporting differentials for use of coital-dependent methods among women who report less recent sex, as further elaborated below.

For women who report less recent sex—e.g. those who have had sex in the last 3 months but not the last 4 weeks—reported contraceptive use at last sex (79%) is much higher than reported current use (54%). This differential does not, however, persist across union status. Compared with women not in-union, women in-union who report less recent sex are more likely to report low levels of contraceptive use, regardless of whether the question is posed as current use or use at last sex (Table 1). Infrequent sex is a known risk factor for inconsistent contraceptive behavior, including non-use (Frost *et al.*, 2007); these data reveal that in-union women who experience less recent sex represent the group most likely to report contraceptive non-use. Meanwhile, for women not in-union who experience less recent sex, it is unclear whether they have an existing unmet need for contraception or whether they simply use contraception when the need arises.

To further understand whether the CPSA numerator choice—i.e. current use or use at last sex among women at risk of pregnancy-impacts contraceptive prevalence estimates, we examined similarities and differences in method report by question asked. Specifically, we used unweighted data to compare highest use-effective contraceptive method reported to the question on current contraceptive use and to the question on use at last sex among all women who reported sex within the 12 months preceding the interview (Figure 1). Several differences are noteworthy. First, female sterilization is under-reported in response to the use at last sex question-among the 771 women who reported use of female sterilization in response to either or both questions, 142 (18.4%) women reported it for current use only. By contrast, withdrawal and male condom use are probably under-reported in reports of current use-among the 262 women who reported use of withdrawal in response to either or both questions, 79 (30.2%) reported it for use at last sex only; among the 741 women who reported use of male condom in response to either or both questions, 260 (35.1%) reported it for use at last sex only. Similarly, emergency contraception was reported by only 10 women, the majority of whom (6) reported it only in response to use at last sex question. For nonuse, 748 women reported no contraceptive use in one, but not both questions. It is unclear whether this difference in nonuse report by question type is due to reporting error, new method adoption (i.e. since last sex), method discontinuation, or poor contraceptive adherence. Finally, 117 women reported two different methods for current use and use at last sex and were excluded from the above tallies. The differences in method report account for the five percentage point difference in contraceptive prevalence observed between reports of current contraceptive use and use at last sex among women who had sex in the last 12 months (Table 1).

Calculating CPSA

Based on these results, we recommend the following metric for CPSA:

Number of women at risk of pregnancy who report current contraceptive use

CPSA=

Number of fecund, non-pregnant women who had sex in the previous 4 weeks (women at risk of pregnancy)

-x100

Comparing CPSA and Conventional CPR Estimates

Utilizing the new CPSA calculation, we compare CPSA estimates with conventional CPR estimates in the United States and 48 low- and middle- income countries. In the U.S.A. we find that limiting our denominator to fecund, non-pregnant women who had sex in the last 4 weeks increases the contraceptive prevalence estimate in the U.S.A. from 62% (Daniels *et al.*, 2014) to 86%. That is, 86% of women at risk of pregnancy are using contraception. Among the 14% who are not using contraception, a cross tabulation shows that half report a desire to become pregnant; the remaining 50%, however, do not desire to become pregnant but are at risk of pregnancy (not shown). This group of at-risk contraceptive non-users represents 10.1% of all women age 15-44. This percentage closely aligns with the 2010 pregnancy rate for US women, which was 98.7 per 1,000 women age 15-44 (Curtin SC, 2015).

A similar, expected pattern emerges from DHS data—limiting the calculation to women at risk of pregnancy increases contraceptive prevalence estimates in all 48 survey countries (Figure 2). The difference is greatest among women not in-union (mean difference of 42.6 percentage points), since the majority of women not in-union in the conventional CPR estimate are not exposed to the risk of pregnancy as they are not sexually active. The difference is smallest among married women, where CPSA and CPR calculations are most closely aligned. Across the 48 countries, the CPSA estimate among in-union women is on average 13.0 percentage points higher than the CPR (unweighted average of national-level values across countries; 11.6 percentage points higher in Sub-Saharan African, 13.4 percentage points higher in Asian/Eastern European, and 14.0 percentage points higher in Latin American/Caribbean countries). With an average of 10.3% of in-union women currently pregnant across the 48 countries (range: 3.0%-17.5%, not shown), this contraceptive prevalence increase is largely the result of omission of pregnant women from our denominator. Among all women, the CPSA estimate is on average 23.3 percentage points higher than the CPR, ranging from 5-36 percentage points higher in sub-Saharan African countries, 18-39 percentage points higher in Asian/Eastern European countries, and 21-38 percentage points higher in Latin American/Caribbean countries (Appendix A). The smallest observed percentage point difference in contraceptive prevalence among all women is in Mali, where contraceptive prevalence increases from 11% to 17%. The largest observed difference is in the Philippines, where contraceptive prevalence among all women rises from 34% to 73%. Among women in-union, the smallest difference is also in Mali (12% to 16%), while the largest is in Central African Republic (43% to 65%). In Mali, a high percentage of women ages 15-49 are in-union (85%) and very few women outside of union partnerships report recent sex (12.9%), thereby minimizing the difference in contraceptive prevalence between all women and women in-union (Cellule de Planification et de Statistique, 2014).

Since CPR among women in-union (married or cohabitating) is the most commonly reported CPR measure, we plotted CPSA and CPR values among in-union women across the 48 countries (Figure 3). As the quadratic fit reveals, the differences are largest when conventional CPR is between 40%-65% and smaller when CPR is <20% or close to 80%.⁴ Just as CPR never reaches 100% since some women will intend to become pregnant and others will choose not to contracept for additional reasons, neither will CPSA reach 100%.

DISCUSSION

Measurement of global family planning progress is in the spotlight given the agendas of FP2020 and the post-2015 Sustainable Development Goals, both of which have contributed to the establishment of two specific and complementary FP aims—FP access for an additional 120 million women by 2020 (FP2020, 2015), and at least 75 percent demand for FP met with modern contraceptive methods in all countries by 2030 (Fabic *et al.*, 2015; FP2020, 2015). With these aims comes the imperative to measure progress and identify a set of key indicators and data sources. This imperative has spawned discussions about updating FP indicators and improving FP data collection. Authors of a recent paper capture the tenor of the conversation with their argument for "re-examining the traditional metrics used to monitor our family planning programs" (Cates *et al.*, 2014).

As a contribution in this area, we have herein proposed a refined measure of contraceptive prevalence. To arrive at our proposed CPSA measure, we explored multiple denominators and numerators vis-a-vis several possible reference time intervals before the survey. Our basic premise is that contraceptive prevalence is more meaningfully calculated among women at risk of pregnancy.

Deriving the CPSA yielded important insights when compared with the conventional CPR. First, as shown in Table 1, among women who ever had sexual intercourse, reported recent sexual activity is high (~90%) among in-union women regardless of marital status (i.e. married or cohabitating). It is, however, far less likely among women who are not in-union, with only 48.3% reporting sex in the 4 weeks preceding interview and more than a fifth (21.4%) reporting last sex more than 12 months before the interview. As would be expected, higher proportions of married and cohabitating women report recent sex compared with non-cohabitating women. This is in keeping with the evidence stemming not just from the United States, but from countries around the world (Westoff, 2007; Kaida et al., 2008; Mathur et al., 2015). It is also an important difference to track over time. As age at marriage increases and age at sexual debut remains relatively constant, more women will be sexually active and not in-union (Wellings et al., 2006). These women typically have less frequent sex, and are less likely to report themselves as current contraceptive users, even if they report contraceptive use at last sex. This has implications for measurement. Specifically, coital- and male- specific methods are likely to be under-reported with the conventional CPR. Furthermore, unmet need calculations may be inflated since women who are using contraception when they have sex, albeit infrequently, may not be captured as current users and instead be captured as having an unmet need for contraception. NSFG data reveal that many of these women are instead meeting their contraceptive needs on an episodic basis.

Clearly, additional programmatic effort must be expended towards meeting the family planning needs of women not in-union. Compared with other women, women not in-union tend to experience higher levels of infrequent sex, which is associated with inconsistent contraceptive behavior (Glei, 1999; Frost *et al.*, 2007), and increased reliance on coital-dependent methods, which have relatively high failure rates (Trussell, 2011). Family planning programs and providers would serve these women well by inquiring about sexual intercourse recency and frequency, counseling about fertility intentions and pregnancy risk, promoting long acting contraception alongside short term methods, and discussing benefits and limitations of coital-

dependent methods. Given the high rates of unintended pregnancy experienced in the U.S.A. and around the world, such interventions could help women better meet their childbearing intentions by expanding and improving effective contraceptive use.

With regard to women in-union, our exploration of CPSA with NSFG data reveals an unexpected difference in contraceptive prevalence. Specifically, women who are in-union but experience infrequent sex reported lower levels of contraceptive use at last sex than women not in-union (Table 2). Based on use at last sex data, it appears that in-union women with infrequent sex have the lowest levels of contraceptive use among all groups in our analysis. In terms of programming, this analysis highlights a new target population—women in-union who have infrequent (non-recent) sex—for focused FP interventions. These interventions would be similar to those described in the preceding paragraph, focusing on provider-initiated discussion about the woman's fertility intentions, her sexual intercourse recency and frequency, and her pregnancy risk perceptions, followed by counseling on a wide range of methods, including long acting contraceptives. Using market segmentation strategies to tailor family planning messaging and broader programming efforts towards this little known subgroup could also help to reduce unintended pregnancy.

The difference between reports of current contraceptive use and contraceptive use at last sex is minimal overall in NSFG, but differences emerge when examining method mentioned. Female sterilization is reported more in response to the current contraceptive use question than in response to the use at last sex question. Conversely, coital- and male- dependent methods (e.g. male condoms, withdrawal, and emergency contraception) are more likely to be reported in response to the use at last sex question than to the current contraceptive use question. These method-specific reporting differences are logical; when one asks about contraception used at last sex, it makes sense that coital-dependent methods would be better recalled as they are associated with the act, just as it makes sense that female sterilization would be better recalled in response to the current use question since it is not associated with a specific sexual encounter. Thus the conventional CPR based on current use questions probably underestimates male- and coitaldependent method use. This finding is largely in keeping with previous evidence, which shows that survey questionnaire design does not appear to impact contraceptive prevalence estimates for modern methods, but does impact estimates of withdrawal, rhythm, and other traditional methods (Anderson, 1984b; Anderson, 1984a; Mauldin and Segal, 1988). Of course, neither current use nor use at last sex questions speak to effective use; compared with frequency measures of use (always, sometimes, never), use at last sex may, for example, overestimate effective condom use (Reynolds et al., 2012; Reynolds et al., 2013). On the other hand, if one were to calculate the conventional CPR based on use at last sex, our analysis indicates that permanent method use may be underestimated. These findings in method report differences are mitigated when restricting our denominator to women who had sex in the four weeks preceding the interview, though they do not entirely vanish (not shown).

One potential limitation of our analysis is comparability between NSFG and DHS current use questions. Specifically, NSFG and DHS use different questions to elicit information on current contraceptive use. NSFG assesses current use based on self-reported contraceptive use in the current month while DHS assesses it based on self-reports of "currently doing something or using any method to delay or avoid getting pregnant" (International, 2011). These questionnaire

differences could make our findings from our derivation of CPSA less applicable in the context of DHS. Other research, however, has found that contraceptive prevalence estimates based on use in the current month and current use are comparable (Anderson, 1984b; Anderson, 1984a). Given these findings, we believe that the NSFG and DHS current use questionnaire differences are inconsequential.

Another limitation of our exploration of various potential CPSA numerators and denominators is data availability, particularly with regard to data on contraceptive use at last sex and contraceptive use and sexual history of women not in-union. Compared to other population-based household surveys that collect contraceptive prevalence data, NSFG offers more data on sexual recency and contraceptive use at last sex. Because these data are U.S.A,-specific, however, generalizing our findings is less straightforward. We can plausibly expect the pattern of differences in CPSA calculation by 4-week, 3-month, and 12-month sexual recency definitions to follow in other countries. Differences in method report by current use/use at last sex, however, may or may not arise across other survey instruments and other country contexts. The method report differences we observed via NSFG would be interesting to research further in other contexts. With regard to data for women not in-union, we find that a large proportion of DHS conducted in Asia and the Middle East collect data only from women in-union. The lack of data from women not in-union in these countries clearly limits our ability to estimate CPSA for all women. Of course, in the absence of large-scale household surveys, CPSA estimates are not possible.

Data quality is another limitation of our analysis. In particular, data quality is more suspect for sensitive topics, especially sexual behavior, due to social desirability bias/response bias (Dare, 1994; Cleland, 2004; Poulin, 2010). DHS interviewers are extensively trained to build rapport and minimize bias. Additionally, the sexual behavior questions come later in the course of the questionnaire, after discussing myriad topics, including experience of child's death. Through the course of the questionnaire, the interviewer has time and opportunity to build rapport with the respondent, thereby mitigating potential response bias for sensitive topics (ICF International, 2015). Moreover, incomplete and inconsistent reporting of events is captured and addressed during both the interview and data processing phases of the survey. Data quality assessments of timing of first intercourse data reveal that women are willing and able to answer questions on sexual activity (Gage, 1995). Recent methodological work reveals that questionnaire modifications to enhance sexual activity reporting have little substantial impact on the quality of sexual behavior reporting (Fishel, 2014).

Though we were limited by data availability in our exploration of alternative CPSA measures, we believe our proposed CPSA measure is the strongest of all options explored. First, it relies on data already collected via NSFG and DHS, so there is no need for additional data collection. This is especially relevant with regard to DHS, which does not ask women about contraceptive use at last sex. Second, the sexual activity component corresponds closely in time with current contraceptive use, thereby minimizing recall bias. Limiting the sexual activity component to sex in the last four weeks appears especially important because it helps to overcome the problem of underreporting of coital- dependent methods among women who last had sex more than four weeks prior to the interview. Third, the choice of denominator between women with sex in the last 4 weeks, the last 3 months, and the last 12 months matters little for women in-union, but

makes a major difference for women not in-union. This is largely because women not in-union are less likely to have had sex recently, and are therefore less likely to report themselves as current contraceptive users, even if they report contraceptive use at last sex (Table 2). Since CPSA is intended to capture contraceptive use among all women at risk, regardless of union status, it is important to use the denominator that works best for both union scenarios. Finally, asking about current contraceptive use rather than use at last sex helps to ensure that female sterilization is accurately reported. Given these results, it is clear that CPSA is best defined as the proportion of women at risk of pregnancy who report current contraceptive use among those women who are fecund, non-pregnant, and sexually active within the last four weeks (i.e. women at risk). Unlike the conventional CPR, CPSA presents a true contraceptive use rate (i.e. events among population at risk within a specified time period).

With CPSA, we now know the percentage of women at risk who are using contraception (Figures 2 and 3). This percentage varies dramatically from a low of 15% to a high of 90% among the countries included in our analysis. Clearly, this huge variation represents a major disparity in meeting family planning needs. Our measure alone, however, cannot quantify that disparity. Indeed, a key limitation of CPSA is that it does not provide information on the proportion of women at risk who intend to become pregnant. Data from the 48 DHS included in our analysis show that an average of 14% of women ages 15-49 desire to give birth within the next 2 years (range: 5% - 29%, not shown). For family planning programming to reach those women at risk who desire to avoid or delay pregnancy, CPSA must be used in conjunction with other key FP measures, especially proportions desiring pregnancy and proportions with unmet need.

As demographic patterns and cultural norms shift and as FP funders and programmers embrace a rights-based approach, it is imperative to measure contraceptive use among all women at risk of pregnancy. Even the recent tune-up of the proximate determinants of fertility model has modified the "marriage index" to the "marriage/union/sexual exposure index" in recognition that the original model's assumption that sexual activity and childbearing only take place within in-union partnerships is "increasingly less tenable" (Bongaarts, 2015).⁵ Clearly, capturing CPR among in-union women is no longer sufficient. Reporting CPR among all women—CPR(all)— will not do either. Without knowing the proportion of women who are at risk of pregnancy, CPR(all) is not very informative. Adding CPSA to the FP measurement portfolio begins to address these challenges by providing a conceptually strong, data rich, and programmatically relevant indicator of the true rate of contraceptive use among those who are at risk.

CONCLUSIONS

If family planning programs are to make progress to better meet the contraceptive needs of women, men, and couples around the world, more precise measures are required. With our proposed CPSA one can know at a glance the percentage of at-risk women who are using contraception. Coupled with other key FP measures, including unmet need, percent of FP demand satisfied, and percent of women seeking pregnancy, we can have a fuller picture of risk, need, and priority populations for FP programming interventions. These more precise measures can also help policymakers decide on the best allocation of limited resources by better highlighting populations at risk of unintended pregnancy.

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Demographic group	Sexual activity							
	All women in category (weighted sample size)	in last 4 weeks	in last 3 months, not last 4 weeks	in last 12 months, not last 3 months	ever, but not in last 12 months			
All women	100.0 (4845)	72.6	6.9	9.9	10.6			
Marital status								
Married	100.0 (2040)	89.5	4.5	3.5	2.6			
Cohabiting	100.0 (795)	90.6	3.4	2.1	3.9			
Non-cohabiting	100.0 (2009)	48.3	10.8	19.5	21.4			
Age group								
< 25	100.0 (1214)	68.5	8.3	15.1	8.3			
25-39	100.0 (2704)	75.2	6.4	7.6	10.8			
40+	100.0 (928)	70.4	6.8	9.8	13.0			

Table 1: Percent distribution of sexual activity reports, by marital status and age group for women in NSFG 2011-13 age 15-44 who ever had sexual intercourse

Table 2: Estimates of contraceptive prevalence (percent) with different denominators (timing of last sex) and different numerators (current use or use at last sex) by marital status among women age 15-44, NSFG 2011-2013 (n=4,845)

Group of	Contraceptive	Marital status						
women	use report	All marital statuses	In- union	Married	Cohabiting	Not cohabiting		
All women	Currently	75	82	83	78	65		
who ever had sex	at last sex	75	79	80	74	69		
All fecund, n	ion-pregnant wome	n with sexual	l intercour	rse in:				
Last 4	Currently	86	85	85	82	89		
weeks n=3,517	at last sex	85	83	84	78	90		
Last 3 months n=3,852	Currently	83	83	84	80	82		
	at last sex	84	82	83	78	90		
Last 12 months n=4,332	Currently	79	82	84	80	74		
	at last sex	84	81	83	77	88		
Last 3	Currently	54	58	66		52		
months* n=336	at last sex	79	63	64		87		
Last 12 months** n=480	Currently	49	56	59		47		
	at last sex	81	66	68		85		
Not in last	Currently	40	61	69		36		
12 months*** n=513	at last sex	N/A	N/A	N/A	N/A	N/A		

*Not in last 4 weeks; **Not in last 3 months; ***No data collected on use at last sex among women who report no sexual intercourse in the 12 months preceding the interview; (--) fewer than 50 cases.

Figure 1: Comparison of contraceptive method reported by women to question on current use and contraceptive method reportedly used at last coitus by women who reported sexual intercourse in the last 12 months in NSFG 2011-13 (un-weighted).



Note: The above tallies exclude 117 women reported two different methods for current use and use at last sex respectively.

Figure 2. Box and whisker plots of conventional CPR and CPSA by union status for 48 recent DHS







Appendix A: Year of survey, number of women and estimated contraceptive prevalence by conventional CPR and CPSA, by country for all women and women in- and not in-union

	Year of survey	Number of women	Group of women and measure					
Region and			All women		In-union women		Not in union	
country			CPR	CPSA	CPR	CPSA	CPR	CPSA
SUB-SAHARAN AFRICA								
Benin	2011/12	16,599	15	25	14	23	18	38
Burkina Faso	2010	17,087	16	31	17	29	12	63
Cameroon	2011	15,426	24	41	23	36	24	63
CAR	2011/12	10,819	42	68	43	65	41	77
Comoros	2012	5,329	15	30	21	28	5	58
DRC	2013/14	18,827	17	30	17	30	16	45
Ethiopia	2011	16,515	18	37	26	35	5	67
Gabon	2012	8,422	29	47	28	43	31	58
Gambia	2013	10,233	7	15	8	14	3	53
Ghana	2008	4,916	19	41	23	39	13	52
Guinea	2012	9,142	8	18	6	11	16	55
Ivory Coast	2011/12	10,060	19	33	17	29	22	45
Kenya	2008/9	8,444	30	54	41	54	13	53
Lesotho	2009/10	7,624	34	61	44	61	22	62

Liberia	2013	9,239	20	32	19	30	22	38
Mali	2012/13	10,424	11	17	12	16	9	40
Madagascar	2008/9	17,375	31	48	39	48	14	45
Malawi	2010	23,020	35	61	46	62	13	46
Mozambique	2011	13,745	16	25	15	21	18	39
Nigeria	2013	38,948	16	28	15	23	18	70
Rwanda	2010/11	13,671	29	64	52	64	5	47
Sao Tome + Principe	2008/9	2,615	32	50	40	50	17	50
Sierra Leone	2013	16,658	23	43	17	33	33	64
Swaziland	2006/7	4,987	39	65	51	63	30	69
Tanzania	2009/10	10,139	25	42	31	40	15	54
Tchad	2004	6,085	9	18	12	18	3	20
Togo	2013/14	9,480	19	34	20	32	18	48
Uganda	2011	8,674	23	43	29	41	13	56
Zimbabwe	2010/11	9,171	41	75	59	76	14	63
EASTERN EUROPE AND ASIA								
Albania	2008/9	7,584	48	82	70	83	6	74
Armenia	2010	5,922	33	68	53	68	1	53
Cambodia	2010/11	18,754	30	65	49	65	0	32

India	2005/6	124,385	42	74	58	74	5	53
Indonesia	2012	45,607	43	76	60	77	1	27
Kyrgzstan	2012	8,208	27	54	38	54	3	61
Moldova	2005	7,440	50	86	68	88	15	70
Nepal	2011	12,674	38	73	51	73	2	58
Philippines	2013	16,155	34	73	54	73	3	54
Tajikstan	2012	9,656	19	47	29	47	1	80
Timor-Leste	2009/10	13,137	14	32	22	32	0	24
Ukraine	2007	6,841	50	84	66	82	25	91
LATIN AMERICA								
Bolivia	2008	16,939	42	79	61	79	14	79
Colombia	2009/10	53,521	56	85	77	86	33	82
Guyana	2009	4,996	33	54	40	52	22	65
Haiti	2012	14,287	23	44	34	46	10	36
Honduras	2011/12	22,757	48	86	71	87	16	82
Nicaragua	2001	13,060	46	80	68	80	14	73
Peru	2012	23,888	52	90	75	90	19	89

Note: CPR calculations do not directly match to those presented in DHS Final Reports. This difference is because we omitted from the CPR and CPSA calculations women who did not answer the recent sexual activity question. These cases are few in number and their omission allows for direct comparison of the CPR and CPSA using the same universe of women.

NOTES

¹ To identify women with sexual activity in the last 3 months and 12 months, we utilized the NSFG recode variables SEX3MO and PARTS1YR, respectively. Since there is no standard recode variable for women who reported sex within the last four weeks, we developed a new variable based variable PST4WKSX, which is the number of times a woman reported sex with a male in the four weeks preceding the interview.

² We utilized variables LSTMTHP1, LSTMTHP2, and LSTMTHP3 to develop the use at last sex variable. NSFG does offer a recode variable for use at last sex, METH12MI. This recode variable reports first method mentioned, rather than method that is most effective. Since CPR by method is typically reported as most effective, we chose not to use the recode variable.

³ Since the woman could report up to three methods used in response to the use at last sex question, we also created a new variable to identify highest priority method she reported in order to align with the construction of CONSTAT1 for current use.

⁴ The curvilinear fit is due to simple math. To illustrate, suppose 80% of all in-union women age 15-49 are sexually active, fecund, and not pregnant. Assuming all contraceptive users are of this group, then CPSA = CPR/ $0.8 = 1.25 \times CPR$. Now consider three cases according to the level of conventional CPR:

- a) CPR = 10%. Then CPSA = 12.5% with a difference of only 2.5 percentage points
- b) CPR = 50%. Then CPSA = 62.5% with a difference of 12.5 percentage points
- c) CPR = 80%. Then CPSA would be 100%, which is virtually impossible since some women will be trying to become pregnant and some will choose not to use contraception for other reasons.

Thus, at the low end, the difference is minimal due to the small numerator, and at high end, the difference becomes small again because the maximum difference between CPSA and CPR is 100-CPR.

⁵ Of note, the Bongaarts "marriage/union/sexual exposure index" is slightly more inclusive in its definition of women who are exposed to the risk of pregnancy than our definition.