Explaining Inconsistencies Between Data on Condom Use and Condom Sales

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Abstract

This study uses data from six Demographic and Health Surveys (DHS) to estimate the total annual number of sex acts and condoms used and compares these totals with reported data on condom sales and distribution. The ability to estimate the number of condoms used from survey data would be a useful tool for program managers, as it would enable estimation of the number of condoms needed for different target groups.

Analyses of data on the annual number of condoms sold and distributed reveals very erratic patterns. The fluctuations appear to reflect stock-ups at various levels in the distribution chain. Consequently, available data on the number of condoms sold and distributed yield a very poor indicator of the actual number of condoms sold to consumers and the level of condom use.

The results of our survey analyses show that estimates of both the number of sexual acts and number of condoms used varied greatly based on the estimation method used. For several surveys, the highest estimate of the annual number of condoms used is tenfold that of the lowest estimate. While some estimation methods can be disregarded because the results obtained are clearly not plausible, it is impossible to determine which of the remaining methods yield the most accurate results. Until the reliability of these various estimation methods can be established, estimating the annual number of condoms used from survey data will not be feasible.

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Explaining Inconsistencies Between Data on Condom Use and Condom Sales

Programs that promote condom use for HIV prevention typically monitor their progress through survey-based indicators, such as the percentage of the population who ever used a condom or the percentage who used a condom in their last sex act with a casual or regular partner (UNAIDS, 2000; United Nations General Assembly Special Session on HIV/AIDS, 2002). Such information is routinely collected in national surveys such as the Demographic and Health Surveys (DHS) and the CDC Reproductive Health Surveys (Centers for Disease Control, 2003; Demographic and Health Surveys, 1995). In addition, HIV prevention programs often monitor the number of condoms sold or the number distributed free of charge.

The purpose of this study is to explain inconsistencies between information on reported levels of condom use and data on the number of condoms sold and distributed. Understanding the apparent inconsistencies between sales and survey data will help clarify to what extent the concerns about condom wastage, misreporting, and other related problems are founded. It will also provide guidance for improving the monitoring of condom sales and distribution and for improving survey questionnaires. To achieve these objectives, we used survey data from six DHS to estimate the total annual number of sex acts in a country, the total number of condoms used in those sex acts, and we then compared the totals with reported data on condom sales and distribution.

Background

At least in some instances, survey information on condom use and condom sales records appears to be inconsistent (Boerma, s.d.; Meekers & Van Rossem, 2001). For example, in some countries we observe steady increases in reported condom sales while survey indicators suggest that there had been no significant increase in the percentage of condom use in last sex across survey rounds. In Zimbabwe, sales of socially marketed *Protector Plus* condoms increased from 1.9 million in 1997 to 4.8 million in 1998 and to 8.9 million in 1999. Data on public sector condom distribution, which we discuss later in this paper, suggest that public sector sales also increased substantially. Yet nationally representative surveys indicate that condom use during

last sex remained constant between 1996 and 1999, at roughly 34% for males and 17% for females (Meekers, 2001; Meekers & Van Rossem, 2001). Similarly, in Tanzania, sales of socially marketed *Salama* condoms increased steadily between 1995 and 2000, as did condom distribution by the Ministry of Health. However, survey data indicate that condom use during last intercourse remained roughly constant between 1996 and 1999 for both men and women (Boerma, s.d.). These discrepancies suggest that the data on reported levels of condom use, the data on condom sales and distribution, or possibly that both are inaccurate.

Inaccuracies in the number of condoms sold or distributed are likely because sales figures typically represent sales to the trade (i.e., sales to wholesalers and distributors) rather than sales to consumers. Consequently, the recorded sales numbers included condoms that were being stocked at various levels of the distribution chain. In addition, some of the condoms that were sold or distributed may have been wasted or smuggled to other countries.

In addition to these potential problems with condom sales data, there are concerns that reported condom use in surveys was inaccurate. For example, there are concerns that respondents may have overreported condom use because they did not want to admit to the interviewer that they were engaging in risky sexual behavior. There are also concerns that condom use may have been underreported because condoms are frequently used with sex workers, which stigmatizes condom use. Women may have also underreported condom use because it is a male method.[1]

Methods

Data

This study uses two types of data: data on condom sales and distribution, and survey data on self-reported condom use. We restricted our analysis to data from four countries in sub-Saharan Africa (Kenya, Tanzania, Nigeria, and Zimbabwe), mainly because these countries have strong condom social marketing programs and therefore have relatively good data on condom sales and distribution. In addition, Tanzania and Zimbabwe are two of the countries where discrepancies between condom distribution and condom use have been noted.

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[1] Questionnaires try to overcome this by asking "The last time you had intercourse, was a condom used?" rather than "The last time you had intercourse, did you use a condom?" (Demographic and Health Surveys, 1995).

Data on sales of socially marketed condoms were obtained from DKT International's Social Marketing Statistics (DKT International, 1995; DKT International, 1996; DKT International, 1997; DKT International, 1998; DKT International, 1999; DKT International, 2000; DKT International, 2001), while data on donor-supplied public sector condoms were obtained from UNFPA and USAID (Johnston & Shelton, 2002; Shelton & Johnston, 2001). Data on commercial condom sales were not readily available, but very rough estimates were obtained for recent years from Population Services International's MIS database (Population Services International [PSI], 1989-2002).[2] As commercial sales tend to be negligible in the countries under consideration, the lack of accurate data on commercial sales is unlikely to have a significant effect on our findings.

The survey data used in this study include the following DHS: Kenya, 1998; Nigeria, 1999; Tanzania, 1996 and 1999; and Zimbabwe, 1994 and 1999. Each of the six surveys comprised a representative sample of females aged 15–49 and of males 15–54.[3] For more detailed information on the sampling methods and the data collection, we refer the reader to the DHS reports for these surveys (Bureau of Statistics [Tanzania] & Macro International Inc., 1997; Central Statistical Office [Zimbabwe] & Macro International Inc., 1995; Central Statistical Office [Zimbabwe] & Macro International Inc., 2000; National Bureau of Statistics [Tanzania] & Macro International Inc., 2000; National Council for Population and Development [Kenya], Central Bureau of Statistics, Office of the Vice President, Ministry of Planning and National Development, & Macro International Inc., 1999; National Population Commission [Nigeria], 2000).

Determining the total annual number of condoms used in a population requires information on the frequency of intercourse. Unfortunately, recent sexual behavior surveys typically do not allow the quantification of the number of sex acts (Collumbien, Das, & Campbell, 2001).

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[2] We tried to obtain data on commercial condom sales from the IMS Health database. However, this database includes very few developing countries and none of the countries considered here (see http://www.ims-global.com).

[3] For men, the upper age limit varies across surveys. See Table 1 for details. Note that excluding younger and older age groups is not expected to have a major effect on the estimated number of sex acts and number of condoms used.

While some of the DHS from the late 1980s and early 1990s did ask respondents about the frequency of intercourse in a fixed time interval (i.e., frequency of intercourse in the previous month),[4] such a question has not been included in recent surveys (Blanc & Rutenberg, 1991). For example, the standard questionnaire for DHS implemented since 1997 does not include a question on the frequency of intercourse. In the surveys included in our study, the 1994 Zimbabwe survey was the only one that included a question on the self-reported frequency of intercourse (see Table 1). However, the DHS do ask respondents about the time since they last had intercourse (Demographic and Health Surveys, 1995; ORC Macro, 2002). Hence, our analysis estimates the total annual number of sex acts based on reported data of time since last intercourse (Boerma, s.d.; Leridon, 1993; Slaymaker & Zaba, 2003). Depending on the survey, it may or may not be possible to differentiate the frequency of intercourse by partner type. Differentiation by partner type may be important, as it is believed that men who admit to having a nonmarital partner are unlikely to underreport the frequency of intercourse (Collumbien et al., 2001).

All DHS asked whether respondents used a condom in their last sex act. We use this information to estimate the probability of condom use, and, subsequently, to estimate the total annual number of condoms used in the country.

[4] For example, such a question was included in Burundi, 1987; Ghana, 1988; Kenya, 1993; and Zimbabwe, 1994, as well as in a large number of Latin American DHS (Blanc & Rutenberg, 1991).

Table 1. Data Available in Selected DHS on Frequency of Intercourse and Probability of Condom Use

Country	Year	Sex	Age Range	Time Since Last Intercourse	Frequency of Intercourse	Condom Use During Last Intercourse	Frequency of Condom Use
Kenya	1998	Men	15–54	✓		✓	
		Women	15–49	✓		✓	
Nigeria	1999	Men	15–64	✓		✓	
		Women	15–49[1]	✓		✓	
Tanzania	1996	Men	15–54	✓		✓	
		Women	15–49	✓		✓	
	1999	Men	15–59	✓		✓	
		Women	15–49	✓		✓	
Zimbabwe	1994	Men	15–54	✓	✓	✓	✓
		Women	15–49	✓	✓	✓	✓
	1999	Men	15–54	✓		✓	
		Women	15–49	✓		✓	

[1] The age range for women in the 1999 NDHS was 10 to 49. To enhance comparability, we restricted our analysis to women ages 15–49.

General Estimation Procedure

In theory, estimating the total number of condoms used in a population is straightforward. The estimated mean number of condoms used per sexually active person (C) equals the product of the frequency of intercourse, or the number of sex acts (F), and of the probability of condom use (p):

$$C = F \times p \tag{1}$$

The total number of condoms used (C^T) then can be calculated by multiplying C with the proportion of individuals who are sexually active (s) in the population at risk and with size of the population at risk (N):

$$C^T = N \times s \times C \tag{2}$$

Since the frequency of intercourse and the probability of condom use are known to vary by age and marital status (Adetunji & Meekers, 2001; Agha, Escudero, Keating, & Meekers, 2003; Blanc & Rutenberg, 1991; Gage & Meekers, 1994; Leridon, 1993; Van Rossem, Meekers, & Akinyemi, 2001), it is advisable to estimate these coefficients separately for various

subpopulations and subsequently to calculate a weighted average for the entire population. In this analysis, we stratified our estimates by the respondents' age and marital status. The formula to calculate the mean annual number of condoms used per sexually active respondent is:

$$C_{ij} = \frac{\sum_a w_a \left(m_a s_{am} F_{iam} p_{jam} + (1 - m_a) s_{au} F_{iau} p_{jau} \right)}{\sum_a w_a \left(m_a s_{am} + (1 - m_a) s_{au} \right)} \quad (3)$$

where w_a is the weight for age group a, m_a and (1-m_a) are the proportion of married and unmarried respondents in age category a, and s_{am} and s_{au} are the proportion of sexually actives where the subscripts *am* and *au* refer to the rates for married and unmarried respondents in age category a, respectively.

We used five-year age categories[5] and based the age weights on the age distribution within the household file of the DHS, as no other reliable data on the age structure of the population in these countries were available. Marital status and the marital status weights were derived from the individual respondent files of the DHS. Following the DHS definition, we define marriage as formal marriage or living together. Information on current sexual activity, defined as having had sex at least once in the previous year, was also obtained from the individual respondent files of the DHS. Data on the countries' population size were obtained from the 2003 World Bank World Development Indicators.

Although the above procedure is simple, data on the two main components F and p are not readily available and need to be estimated. The following sections describe the procedures for estimating them.

Methods for Estimating Frequency of Intercourse

This section describes methods to estimate frequency of intercourse. Three types of estimation methods are presented: 1) estimation based on the reported frequency of intercourse

[5] We also conducted analyses using one-year age groups with similar results. However, as the sample size for the one-year age groups was often quite small, the age-specific estimates of the frequency of intercourse, *F,* and the probability of condom use, *p,* will be less reliable.

during a four-week period; 2) methods based on the proportion of respondents reporting intercourse the day before the interview; and 3) survival analyses based on the time since last intercourse.

All methods follow a similar strategy: 1) estimate the mean likelihood or frequency of intercourse for a specific time unit (i.e., for a day, one week, or four weeks) for each of the subpopulations; and 2) estimate the mean frequency of intercourse per year for the entire population by calculating a weighted average of the subpopulation results. The general formula is:

$$F_i = n_i \frac{\sum_a w_a \left(m_a s_{am} f_{iam} + (1 - m_a) s_{au} f_{iau} \right)}{\sum_a w_a \left(m_a s_{am} + (1 - m_a) s_{au} \right)} \tag{4}$$

where F_i stands for the annual frequency of intercourse estimated by method i, f_{iam} and f_{iau} are the estimated mean likelihood or frequency of intercourse per time unit using method i for married and unmarried persons in age category a, respectively, and n_i is the number of time units for this method in a year.

Some surveys asked married respondents separate questions about the time since last intercourse with the respondents' spouse and with the respondents' other partners. Such questions were included in the 1998 Kenya and 1996 Tanzania DHS surveys. For these surveys, the formula becomes:

$$F_{ib} = n_i \frac{\sum_a w_a \left(m_a s_{am} \left(f_{iam,p} + f_{iam,o} \right) + (1 - m_a) s_{au} f_{iau} \right)}{\sum_a w_a \left(m_a s_{am} + (1 - m_a) s_{au} \right)} \tag{5}$$

where the b subscript in F_{ib} indicates that for married respondents, marital and extramarital sex were included separately.

METHOD F_1

When self-reported data on the frequency of intercourse during the previous four weeks are available, such as in the 1994 Zimbabwe DHS, the annual number of sex acts can be estimated by extrapolation. Assuming the previous four weeks are representative of the respondents' behavior, the mean annual number of sex acts can be estimated by multiplying this four-week frequency with 13 ($n_1 = 13$). However, because few recent surveys contain this type of information, it is generally necessary to use other estimation methods.

METHOD F_2

The frequency of intercourse can be estimated on the basis of the proportion of respondents reporting intercourse the day before the interview (Boerma, s.d.). Assume each of a group of individuals has 104 sex acts per calendar year (i.e., two sex acts per week). Assuming one sex act per day that intercourse occurs, the probability of intercourse on any given day during the calendar year would equal 104/365, or 0.285. Hence, it is expected that, on average, 28.5% of the population will have intercourse on any given day.

In other words, the proportion of the population reporting intercourse on any given day equals the daily probability of intercourse. Therefore, the annual number of sex acts can be estimated by multiplying the proportion of respondents who had intercourse the day before the interview by 365.

The advantage of this method is that it is simple to calculate and that use of data that refer to the day before the interview minimizes recall problems. The disadvantage is that the method does not take into account that some people may have more than one sex act in a day (i.e., only one of those sex acts will be counted), so that the frequency of intercourse may be slightly underestimated. In turn, the impact of this more frequent intercourse on condom use may be somewhat greater than results would indicate, as the uncounted numbers may represent commercial sex workers with a relatively high condom use.

Another problem with this method is that for some surveys the percentage of respondents reporting last having intercourse the day before the survey does not appear to be reliable. For example, in the 1998 Kenya survey the percentage of respondents reported last having sex one

day before the survey was smaller than the percentage last having sex two days before the survey (4.1% vs. 8.9%). Similarly, in the 1999 Nigeria survey 0.7% reported last having intercourse one day before the survey, compared to 10.0% who reported having sex two days before the survey. In the other surveys, the percentage reporting last having sex the day before the survey was slightly higher than the percentage last having sex two days before the survey. While it is unclear why so few respondents in the Kenya and Nigeria surveys reported last having intercourse the day before the survey, the implication is that the F_2 estimates for these surveys appear to be unrealistically low.

METHOD F_3

A third alternative is to estimate frequency of intercourse based on data on the duration since last intercourse, which is collected in all DHS (Leridon, 1993; Slaymaker & Zaba, 2003). This group of techniques is based on the fact that mean duration between two successive acts of intercourse provides an estimate of the frequency of intercourse. The major difficulty with this approach is that the duration between two successive sex acts is a closed interval, while the available data — duration since last intercourse — is an open interval.

Slaymaker and Zaba (2003) deal with this inconsistency by using survival analyses with an exponential decay function. The survival analysis estimates the daily probability of intercourse. The estimated annual number of sex acts is obtained by multiplying the average daily probability of intercourse by 365.

One of the main weaknesses of this approach is the assumption that daily probability of intercourse is constant and can be estimated with an exponential decay function. Since data on the actual distribution of the intervals between two successive sex acts are not available in DHS, one cannot determine whether the exponential decay function provides a good fit for the data. Using a function that does not match the data well would introduce a very large error in the estimated annual number sex acts (and consequently in the estimated number of condoms used), rendering the results meaningless.

Methods for Estimating the Probability of Condom Use

As most DHS only contain data on whether a condom was used in the respondent's last intercourse, we must assume that condom use at last sex is typical for the likelihood of condom use for a given subpopulation. Three different estimations for the likelihood of condom use are explored in this paper, two of which are based on data on condom use at last intercourse and one of which is based on the self-reported frequency of condom use.

METHOD p_1

For surveys that collected information on the frequency of condom use, this information can also be used to estimate the probability of condom use. Unfortunately, none of the DHS asked direct questions about either the number of sex acts and the number of condoms used (for an example of a survey that collects such data, see Muhwava, Kusanthan, & Sachingongu, s.d. However, some DHS did ask respondents how frequently they used condoms. For example, the 1994 Zimbabwe DHS first established how often respondents had sex with their spouse and other partners in the previous four weeks. Next, respondents were asked "Was a condom used on any of these occasions?" Respondents who answered that a condom was used were asked "Was it each time or sometimes?" Hence the frequency of condom use was coded as "Yes, each time," "Yes, sometimes," or "Never." To obtain an estimate for the probability of condom use for each of these categories, we cross-tabulated this reported frequency of condom use against condom use in last intercourse. The results showed that 93% of men claiming to always use condoms reported using a condom in last intercourse. Similarly, 44% of those claiming to sometimes use condoms and 2% of those claiming to never use condoms reported that they had used a condom in last intercourse. Thus, we recoded the three categories for frequency of condom use among men as 0.93, 0.44, and 0.02. For women, the values were 0.94, 0.47, and 0.01, respectively. The probability of condom use was then calculated as the mean value for each of the sub-samples.

METHOD p_2

The second estimate of the probability of condom use simply equals the proportion of a sub-sample (by age and marital status) who reported using a condom at last intercourse. This estimate was also used by Collumbien et al. (2001). Information on condom use in last intercourse is available in all DHS. For surveys that collected data on condom use at last

intercourse by partner type, such as the 1998 Kenya DHS and 1996 Tanzania DHS, taking this information into account can refine the estimate of the probability of condom use.

METHOD p_3

Another alternative measure of the probability of condom use equals the proportion of respondents who reported using a condom at last sex among those who had sex the previous day. This indicator has the advantage that it is less likely to be subject to recall errors. It also avoids the problem that condom use at last intercourse may be dependent on the time since last intercourse. However, this measure has the disadvantage that it tends to be less reliable because it is based on information from a much smaller number of observations (those reporting intercourse the day before the interview).

Estimating the Annual Number of Condoms Used

We estimate the annual number of condoms used by multiplying the annual number of sex acts with the probability of condom use for each of the strata by age and marital status, as described in Equation 3. Because we have three different methods to estimate the annual number of sex acts and three methods to estimate the probability of condom use, up to nine estimates of the annual number of condoms used are provided, depending on the available data. Moreover, separate estimates were calculated using data from the female and male DHS, as there are known gender differences in the reported frequency of intercourse and levels of condom use (Adetunji & Meekers, 2001; Anarfi, 1990; Van Rossem et al., 2001).

Results

Reported Condom Sales and Distribution

Figure 1 shows trends in the annual number of condoms sold or distributed in Kenya, Nigeria, Tanzania, and Zimbabwe. Although these statistics represent the number of condoms sold or distributed to the trade (i.e., to distributors, wholesalers, and retailers), it is often assumed that they mimicked sales to consumers because the trade was unlikely to restock unless there was sufficient consumer demand.

Figure 1. Annual Number of Condoms Sold and Distributed by Country

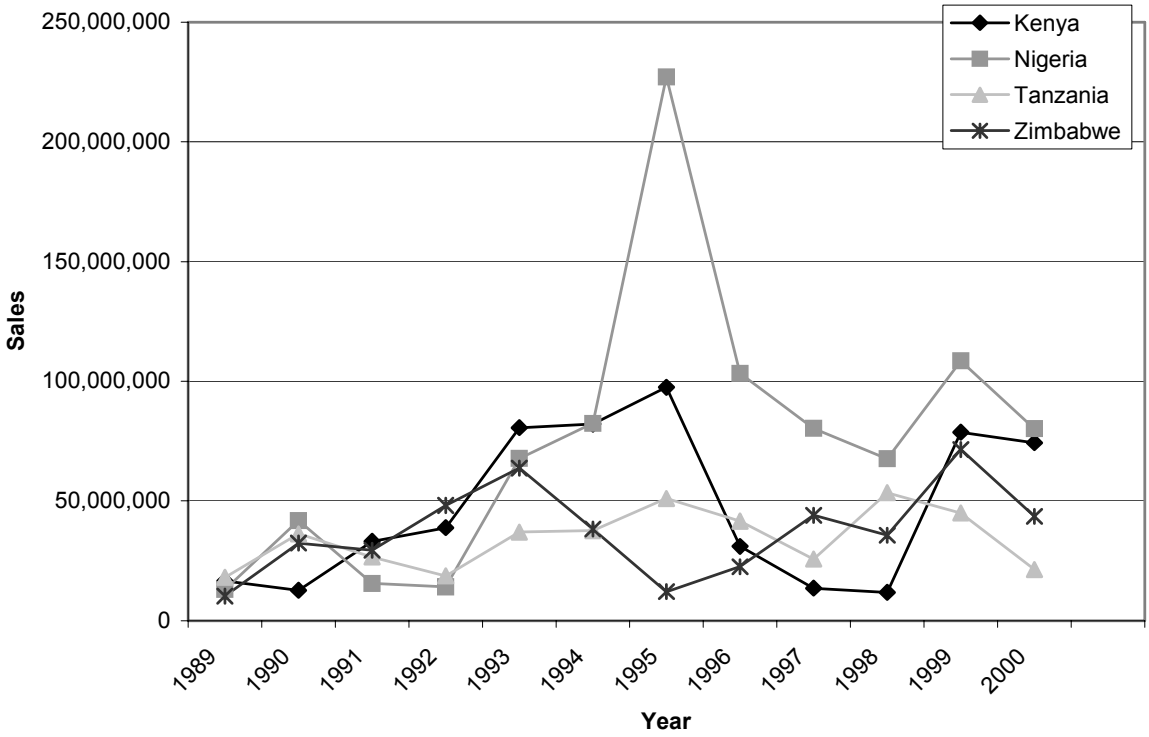

Figure 1 reveals very erratic patterns in the number of condoms sold or distributed in each of the four countries. The most dramatic pattern is observed for Nigeria. The total number of condoms distributed in Nigeria increased from 13 million in 1989 to 42 million in 1990, but then fell to 14 million in 1992. Between 1992 and 1994, condom distribution increased rapidly to 83 million, and by 1995, Nigerian condom sales jumped to 227 million. However, the very next year the number of condoms distributed dropped back to 103 million and continued to decrease to 68 million in 1998. In 1999, condom sales rapidly increased to 108 million. The trend in the number of condoms distributed in Kenya is equally erratic. In Kenya, the total number of condoms distributed increased rapidly from 17 million in 1989 to 39 million in 1992 and to 97 million in 1995. However, from 1996 on, the number of condoms distributed dropped dramatically to only 12 million in 1998. By 1999, condom distribution jumped to 79 million. The number of condoms distributed in Tanzania and Zimbabwe is considerably lower, but also shows very large year-to-year fluctuations.

It is clear that these drastic fluctuations in the number of condoms sold or distributed do not reflect real differences in the level of condom use, as this would require major changes in behavior (which is known to change very slowly). Since statistics on the number of condoms

sold or distributed reflect sales to the trade and not consumers, it is highly likely that the observed fluctuations in the number of condoms distributed simply reflect a stocking up of condoms at one or more levels of the distribution system, the addition of new condom outlets, and so on. For example, data from condom distribution surveys in Kenya indicate that the percentage of retail outlets that were selling socially marketed *Trust* condoms increased from 25% in 1998 to 32% in 1999. Similarly, the percentage of retail outlets selling public sector condoms increased from 2% to 6%. The percentage of retail outlets selling other brands stayed constant at 3% (Kaai, 1998; Kaai, 1999). Assuming that outlets sell only one type of condom, the percentage of retail outlets selling any type of condom increased from 30% to 41%, which implies that that the total number of retail outlets that sell condoms may have increased by as much as 37% (= 41 / 30 x 100) in just one year. Such an increase in retail outlets that carry condoms would require a substantial increase in the number of condoms sold to the trade to fill the pipeline (i.e., to supply national and regional distributors, wholesalers, and retailers).

In addition, our estimates of the number of public sector condoms are not the actual number of public sector condoms distributed to the population, but rather the total number of condoms provided to each country by international donors. It is possible that many of these condoms are still stocked at Ministry of Health warehouses and similar distribution hubs or at local health clinics. The actual number of public sector condoms that reach the hands of consumers is unknown. Therefore, the data that are available on the number of condoms that have been sold or distributed seem to provide an estimate of the total of number of condoms that were in circulation during the course of the year, rather than the number provided to consumers.

In other words, the current data on the number of condoms sold or distributed provide a very poor estimate of the actual number of condoms used. For example, as shown in Figure 1, condom distribution in Nigeria peaked at 227 million in 1995. However, condom distribution subsequently dropped to a level far below that of the period preceding the peak. This drop-off in sales to the trade between 1995 and 1997 suggests that some of the 227 million condoms sold to the trade in 1995 were not sold to consumers until 1996 or 1997, if not later. Hence, changes in condom sales do not necessarily indicate any changes in condom use. Measuring changes in the level of condom use requires either collecting data on retail sales, which is not feasible in most developing countries, or using sample surveys to measure the level of condom use.

Estimated Annual Number of Sex Acts

Table 2 summarizes the results of different estimates for the mean annual frequency of intercourse for both male and female samples in the six DHS used. We first discuss the results from the 1994 Zimbabwe DHS, for which all three methods for estimating the per capita annual number of sex acts could be calculated. Hence, these data were ideal for comparing the estimate based on self-reported data, F_1, with the two estimates based on the duration since last intercourse (F_2 and F_3). Next, we discuss the results for the other surveys, for which only methods F_2 and F_3 could be estimated.

The results from the 1994 Zimbabwe DHS show that the three estimation methods yielded very different estimates of the annual number of sex acts. Estimates based on the self-reported number of sex acts in the previous four weeks (F_1) gave the highest estimates. Using this method, it is estimated that in 1994, sexually active unmarried males in Zimbabwe had 21 sex acts per year, while sexually active married men had 82 sex acts per year. For females, the number of sex acts was estimated at 9 per year for unmarried females and 82 for married females. This latter finding is fairly consistent with Brown (2000), who estimated the coital frequency for sexually active married women at 7.9 acts per month (95 acts per year).

The second estimation method (F_2), which is based on the proportion of respondents who reported having intercourse the day before the interview, results in an estimate of 8 sex acts per year for unmarried males, 61 for married males, 9 for unmarried females, and 59 for married females. Thus, this estimate consistently yields a lower estimate of the number of sex acts than the estimate based on the self-reported frequency of intercourse. This difference appears to be especially large for unmarried males.

The third estimation method (F_3), which is based on a survival analysis using the assumption of a constant hazard, yielded substantially lower estimates of the per capita annual number of sex acts. For unmarried males, the annual number of sex acts was estimated at only 4, while for married males it was estimated at 17. For females, the corresponding numbers were 3 and 10 per year, respectively. These estimates do not appear to be realistic.

Table 2. Estimated Annual Number of Sex Acts (Mean per Sexually Experienced Respondent)

						Estimation Method		
Country	**Year**	**Sex**	**Marital Status**	**Number of Cases**	**Proportion Currently Sexually Active**	**Self-Reported Coital Frequency (F_1)**	**Proportion Having Sex Previous Day (F_2)**	**Survival Analysis, Constant Hazard (F_3)**
Kenya	1998	Men	Unmarried	1,644	66.1%	-. -	4.8	6.2
			Married	1,763	98.2%	-. -	22.4	16.3
			All	3,407	82.7%	-. -	15.8	12.4
		Women	Unmarried	3,034	40.3%	-. -	0.9	2.6
			Married	4,847	93.5%	-. -	16.5	9.2
			All	7,881	73.0%	-. -	13.2	7.8
Nigeria	1999	Men	Unmarried	1,072	42.9%	-. -	0.8	5.6
			Married	1,608	92.0%	-. -	3.4	7.2
			All	2,680	72.4%	-. -	2.7	6.8
		Women	Unmarried	4,002	34.5%	-. -	2.2	3.5
			Married	5,808	82.0%	-. -	6.2	4.6
			All	9,810	67.8%	-. -	5.6	4.5
Tanzania	1996	Men	Unmarried	985	43.0%	-. -	13.8	8.7
			Married	1,268	92.0%	-. -	51.8	7.9
			All	2,256	70.6%	-. -	41.6	8.1
		Women	Unmarried	2,715	31.2%	-. -	14.2	5.3
			Married	5,404	86.2%	-. -	49.7	5.5
			All	8,120	67.8%	-. -	44.2	5.4
	1999	Men	Unmarried	1,544	57.6%	-. -	7.0	5.0
			Married	1,998	98.1%	-. -	48.9	15.6
			All	3,542	80.5%	-. -	35.9	12.3
		Women	Unmarried	1,421	47.0%	-. -	7.7	3.6
			Married	2,608	96.7%	-. -	48.5	10.2
			All	4,029	79.2%	-. -	39.9	8.9
Zimbabwe	1994	Men	Unmarried	1,126	53.3%	20.9	8.4	4.2
			Married	1,015	99.3%	81.9	60.9	17.0
			All	2,141	75.1%	59.4	41.6	12.3
		Women	Unmarried	2,349	36.5%	9.3	9.3	2.7
			Married	3,777	94.9%	82.2	70.3	9.7
			All	6,128	72.5%	68.1	58.5	8.3
	1999	Men	Unmarried	1,406	48.1%	-. -	7.9	3.6
			Married	1,203	99.4%	-. -	57.9	23.3
			All	2,609	71.8%	-. -	40.4	16.4
		Women	Unmarried	2,354	38.9%	-. -	2.4	2.4
			Married	3,553	99.0%	-. -	43.7	13.8
			All	5,907	75.0%	-. -	35.1	11.4

For all other surveys examined here, we also compared the estimates based on the proportion reporting intercourse the day before the survey (F_2) and those based on the survival

analysis with the assumption of a constant hazard (F_3). The results confirmed that this latter method consistently yielded very low estimates of the number of sex acts. For example, among sexually active married males, the estimate of the annual number of sex acts ranges from 7.2 coital acts per year in the 1999 Nigeria survey to 23.3 in the 1999 Zimbabwe survey. For sexually active married females, the range is from 4.6 to 13.8 in those same surveys. In other words, the results from the survival analysis using the assumption of a constant hazard suggest that in several countries, even married couples have intercourse less than once per month. Method F_2 tended to yield higher estimates of the annual number of sex acts, but for both the 1998 Kenya and 1999 Nigeria surveys these estimates are also unrealistically low. In these latter cases, the low estimates are due to the fact that the number of respondents reporting last having intercourse the day before the survey was considerably lower than the number reporting last having intercourse two days prior.

The results based on the survival analyses appear unrealistic and are inconsistent with the published literature on the frequency of intercourse. For example, a study on coitus in sub-Saharan Africa estimated that the monthly coital frequency among sexually active married women ranged from 3.0 in Ghana to 8.1 for Rwanda (Brown, 2000), which corresponds with an annual frequency of 36 and 97 acts, respectively. Similarly, another study estimates the monthly coital frequency among married women at 6.1 acts for Burundi, 3.0 for Kenya, and 5.7 for Uganda. Only Ghana had a substantially lower frequency of intercourse, at an average of 1.2 per coital acts per month (Blanc & Rutenberg, 1991). The same study estimates that monthly coital frequency in Latin America ranged from 3.2 in Mexico to 8.0 in Brazil. A study on sexual activity among young women in Africa estimated the average number of sex acts in the previous four weeks among women aged 15–24 in Kenya at 1.9 for those never married and at 4.0 for those married. The corresponding data for Ghana were 0.7 and 1.0, respectively (Gage & Meekers, 1994). Hence, there is reason to believe that the results from the survival analysis are unreliable.[6]

[6] It is noteworthy that the results for Nigeria are substantially lower than those for the other countries for both F_2 and F_3, largely because a substantially lower percentage of respondents reported having intercourse the day before the survey. Since the percentage reporting intercourse on other days is more in line with the results from the surveys in other countries, we suspect that this inconsistency is the result of a coding error.

It is important to note that the results of the survival analyses were greatly affected by the type of decay function selected. Preliminary analysis using a Weibull decay function yielded estimates of the annual number of sex acts that were roughly 1.5 to 2 times as high as estimates based on the exponential decay function proposed by Slaymaker and Zaba (Slaymaker & Zaba, 2003). Unfortunately, determining which decay function to use requires information on the distribution of the length of the interval between two successive coital acts, and such information is not available in the DHS.

Probability of Condom Use

The estimates of the probability of condom use are shown in Table 3. As before, the three estimates of the probability of condom use could be calculated only for the 1994 Zimbabwe survey. Moreover, since the self-reported frequency of condom use was coded as "each time," "sometimes," or "never," we estimated the frequency on the basis of the proportion of each of these categories who reported using a condom in last intercourse. Thus, the estimates for p_1 and p_2 were nearly identical (although some differences existed when differentiating by marital status).

When we compared the different methods to estimate the likelihood of condom use, we noticed that in an overwhelming number of cases the estimates based on the proportion reporting condom use at last intercourse of those who reported sex on the day before the interview (p_3) were lower than those based on the data from the last sex act (p_2). For example, in the 1999 Tanzania survey, the proportion who used a condom in last intercourse was 15.7% for males and 7.3% for females. By contrast, of those who had sex the day before the interview, the proportion that used a condom was only 9.5% and 4.3%, respectively. In part, these low estimates of p_3 appear to stem from the fact that only a small number of survey respondents reported having intercourse the day before the interview. Consequently, there were some age groups where none of the respondents reported using a condom (not shown), which substantially lowers the estimate of the overall probability of condom use.

Table 3. Estimated Probability of Condom Use per Sex Act

					Estimation Method		
Country	**Year**	**Sex**	**Marital Status**	**Number of Cases**	**Self-Reported Frequency of Use (p_1)**	**Proportion Using at Last Intercourse (p_2)**	**Proportion Using Day Before Interview (p_3)**
Kenya	1998	Men	Unmarried	1,644	-. -	40.8%	40.3%
			Married	1,763	-. -	9.1%	4.9%
			All	3,407	-. -	21.1%	18.3%
		Women	Unmarried	3,034	-. -	17.2%	0.0%
			Married	4,847	-. -	5.2%	3.0%
			All	7,881	-. -	7.7%	2.4%
Nigeria	1999	Men	Unmarried	1,072	-. -	39.2%	0.0%
			Married	1,608	-. -	6.1%	9.2%
			All	2,680	-. -	14.6%	6.9%
		Women	Unmarried	4,002	-. -	22.1%	7.9%
			Married	5,808	-. -	2.9%	5.4%
			All	9,810	-. -	5.8%	5.8%
Tanzania	1996	Men	Unmarried	985	-. -	34.5%	15.9%
			Married	1,268	-. -	5.5%	2.3%
			All	2,256	-. -	13.3%	6.0%
		Women	Unmarried	2,715	-. -	16.1%	6.2%
			Married	5,404	-. -	2.0%	1.0%
			All	8,120	-. -	4.2%	1.8%
	1999	Men	Unmarried	1,544	-. -	33.1%	23.4%
			Married	1,998	-. -	7.9%	3.2%
			All	3,542	-. -	15.7%	9.5%
		Women	Unmarried	1,421	-. -	20.6%	7.5%
			Married	2,608	-. -	3.8%	3.4%
			All	4,029	-. -	7.3%	4.3%
Zimbabwe	1994	Men	Unmarried	1,126	46.0%	53.6%	35.7%
			Married	1,015	13.9%	12.1%	6.8%
			All	2,141	25.8%	27.5%	17.5%
		Women	Unmarried	2,349	31.8%	30.7%	19.1%
			Married	3,777	5.6%	5.9%	5.0%
			All	6,128	10.7%	10.7%	7.7%
	1999	Men	Unmarried	1,406	-. -	65.6%	63.6%
			Married	1,203	-. -	8.5%	5.1%
			All	2,609	-. -	28.5%	25.5%
		Women	Unmarried	2,354	-. -	32.6%	19.7%
			Married	3,553	-. -	4.4%	1.9%
			All	5,907	-. -	10.3%	5.6%

The results shown in Table 3 also indicate that the likelihood of having used condoms was substantially higher among unmarried than among married respondents. This finding is consistent with the literature (Adetunji & Meekers, 2001; Meekers, 2001; Slaymaker & Zaba, 2003; Van Rossem et al., 2001) and thus confirms that our stratification by marital status was necessary because the two groups also substantially differ in frequency of intercourse.

As other authors have also noted, women tended to report a much lower likelihood of condom use than men (Agha et al., 2003; Central Statistical Office [Zimbabwe] & Macro International Inc., 1995; Van Rossem et al., 2001). For example, Table 3 shows that in the 1999 Zimbabwe survey 29% of men but only 10% of women reported using a condom in last intercourse. Similarly, in the 1998 Kenya survey, 21% of men but only 8% of women reported using a condom in last intercourse. These differences persist when differentiating by marital status.

It is noteworthy that some gender discrepancies in the probability of condom use would be expected because African men may have had sexual partners who were substantially younger. If the age difference between partners explained the gender differential in the probability of condom use, then we would expect that the probability of condom use for males aged 30–34 should be closer to that of women aged 25–29 or 20–24. Several data sets show that these probabilities are indeed closer, but the differences remain very large (Agha et al., 2003; Central Statistical Office [Zimbabwe] & Macro International Inc., 1995). As most condoms are used in heterosexual sex acts, this discrepancy constitutes a serious problem when estimating overall condom use because there is no way of verifying which of the two provides the best estimate of the true probability of condom use.

Estimated Annual Number of Condoms Used

Table 4 shows the estimates of the total annual number of condoms used based on different combinations of estimates for the frequency of intercourse and the probability of condom use. To facilitate interpretation, the bottom panel of the table also provides the highest and lowest estimates. For comparison, we also added data on the reported number of condom sales in the survey year and in the year prior to the survey.

Table 4. Estimated Annual Number of Condoms Used

Estimation Method							
Frequency of Intercourse	**Probability of Condom Use**	**Kenya 1998**	**Nigeria 1999**	**Tanzania 1996**	**Tanzania 1999**	**Zimbabwe 1994**	**Zimbabwe 1999**
Males							
F_1 Self-Reported	p_1 Self-Reported	-. -	-. -	-. -	-. -	18,047,620	-. -
	p_2 Last Intercourse	-. -	-. -	-. -	-. -	19,451,694	-. -
	p_3 Previous Day	-. -	-. -	-. -	-. -	11,408,033	-. -
F_2 Previous Day	p_1 Self-Reported	-. -	-. -	-. -	-. -	12,209,655	-. -
	p_2 Last Intercourse	10,650,977	5,522,394	14,919,839	19,053,896	11,515,528	10,850,758
	p_3 Previous Day	7,734,312	6,779,088	6,231,789	9,805,457	6,275,443	7,660,061
F_3 Survival Analysis	p_1 Self-Reported	-. -	-. -	-. -	-. -	4,136,103	-. -
	p_2 Last Intercourse	10,121,645	18,858,423	4,891,365	7,493,313	3,999,271	4,468,660
	p_3 Previous Day	7,221,404	10,010,100	2,439,635	3,754,680	2,324,967	3,262,927
Females							
F_1 Self-Reported	p_1 Self-Reported	-. -	-. -	-. -	-. -	7,980,256	-. -
	p_2 Last Intercourse	-. -	-. -	-. -	-. -	8,406,142	-. -
	p_3 Previous Day	-. -	-. -	-. -	-. -	7,088,876	-. -
F_2 Previous Day	p_1 Self-Reported	-. -	-. -	-. -	-. -	6,913,439	-. -
	p_2 Last Intercourse	3,375,708	4,632,093	5,529,321	10,744,128	7,253,275	3,700,789
	p_3 Previous Day	2,091,845	7,622,258	2,759,809	8,422,675	6,115,040	1,591,401
F_3 Survival Analysis	p_1 Self-Reported	-. -	-. -	-. -	-. -	1,111,439	-. -
	p_2 Last Intercourse	2,200,502	4,503,194	993,705	2,756,648	1,137,474	1,395,517
	p_3 Previous Day	986,769	5,253,132	444,480	1,994,578	914,083	647,804
Highest Estimate		10,650,977	18,858,423	14,919,839	19,053,896	19,451,694	10,850,758
Lowest Estimate		986,769	4,503,194	444,480	1,994,578	914,083	647,804
Sales, Survey Year		11,797,536	108,444,464	41,629,132	45,024,836	38,316,656	71,432,882
Sales, Previous Year		13,516,931	67,629,732	51,030,840	53,409,352	63,778,992	35,751,329

The results presented in Table 4 indicate that the methodologies yielded radically different estimates of the total number of condoms used. This was anticipated considering that our estimates of the frequency of intercourse and the probability of condom use also varied by estimation method. There are also very large differences between the estimates based on data from the female surveys and those from the male surveys. The bottom panel of Table 4 shows that the range of the estimates is very wide for all surveys. For example, in Kenya the high estimate of the total annual number of condoms used in 1998 is 10.7 million, while the lowest estimate is only 1.0 million. Similarly, for the 1999 Tanzania survey the highest estimate is 19.1 million while the lowest estimate is only 2.0 million.

It is unknown which of the estimates is most accurate. However, as we previously noted, the p_3 estimate (which was based on condom use among those who reported having intercourse the day before the survey) appears unreliable because of the small number of cases. In addition, the survival analyses yielded unrealistically low estimates of the frequency of intercourse (F_3) that appeared inconsistent with the literature. Therefore, estimates that are based on these two factors are unlikely to be reliable. Table 4 confirms that estimates based on F_3 and p_3 usually yield the lowest estimates of the total number of condoms used.

When self-reported data are not available, estimates based on F_2 and p_2 are likely to be the most reliable. Data from the 1994 Zimbabwe survey confirm that the estimates based on the self-reported frequency of intercourse (p_1) and the percentage who used a condom in last intercourse (p_2) yield fairly similar results. This was anticipated given that self-reported frequency of intercourse was coded as a categorical variable and subsequently quantified on the basis of the percentage who reported using a condom in last intercourse. Table 4 shows that estimates based on F_1 and F_2 are also fairly close.

Nevertheless, all survey-based estimates of the annual number of condoms used were substantially lower than the reported number of condoms sold for almost every country. The only exception was Kenya, where the high estimate of the total number of condoms used based on the 1998 Kenya DHS is fairly close to the number distributed (10.7 million vs. 11.8 million). For the other surveys, the reported number of condoms sold or distributed tended to be 2.5 to 3.0 times higher than even the highest survey-based estimate of the number of condoms used. Comparison with sales data from the previous year did not resolve these differences.

Conclusions

The purpose of this analysis was to estimate the annual number of sex acts and condoms used based on survey data and to compare the latter with data on the annual number of condoms sold and distributed. The ability to estimate the number of sex acts from survey data would be a valuable tool for program managers, as it would enable them to estimate the number of condoms needed. Since the available data on condom sales and distribution measure the number of condoms supplied to the trade rather than to the consumer, survey estimates of the total number

of condoms used could also help clarify to what extent data on the number of condoms supplied to the trade reflect actual consumer sales.

Analysis of the annual reported number of condoms sold and distributed revealed very erratic patterns. The large year-to-year differences in the total number of condoms distributed clearly do not reflect differences in the number of condoms sold to consumers, nor in the level of condom use, as these would imply major changes in behavior. The latter is unlikely to have occurred, since behavior is known to change very slowly. In other words, the large fluctuations in the number of condoms provided to the trade are likely to reflect stocking up at various levels in the distribution chain. Because of this, the current data on the number of condoms sold and distributed say very little, if anything, about the number of condoms sold to consumers or about actual levels of condom use.

To estimate the annual number of condoms used from survey data, survey questionnaires would ideally ask respondents how often they had sex during a given reference period and how often they used a condom during that period. Considering that using very long reference periods (i.e., a year) is likely to cause recall errors, a shorter reference period is preferable. Of the DHS used in this analysis, only one (Zimbabwe DHS-III, 1994) asked respondents about the frequency of intercourse during the four weeks preceding the survey. For the other surveys, the frequency of intercourse had to be estimated indirectly on the basis of the duration since last intercourse.

If future surveys are to estimate the annual number of condoms used, then questions enquiring about the total number of sex acts and the total number of condoms used in a fixed time period should be added. For example, recent surveys in Zambia asked about the number of sex acts and the number of condoms used in the past week, which can easily be extrapolated to a one-year period (Muhwava et al., s.d.). Asking about the timing of the previous two sex acts rather than only the last previous sex act would also be recommended. This would provide data on the duration between two successive sex acts, which will improve estimation of the total number of sex acts using survival methodologies. Knowing the distribution of the time interval between successive sex acts would also enable researchers to identify a decay function that best fits the data, which will substantially increase the accuracy of the estimates.

The results of our survey analyses, which were based on DHS data currently available, show that the estimates of both the number of sexual acts and the number of condoms used varied enormously based on the estimation method used. For several surveys, the highest estimate of the annual number of condoms used was tenfold that of the lowest estimate. While some estimation methods could be disregarded because they yielded results that are clearly not plausible, it was impossible to determine which of the remaining methods yielded the most accurate results. Until the reliability of these various estimation methods can be established, estimating the annual number of condoms used from survey data will not be feasible.

To be able to verify the reliability of the estimates of the number of condoms used, it is necessary to have accurate data on the number of condoms sold and distributed to consumers. This is not feasible in developing countries, partially because of the lack of standardized record keeping and because many condoms are distributed through informal retailers such as street venders and hawkers who are unlikely to keep records. For the purpose of testing the feasibility of the estimation methods, it may therefore be more productive to use data from developed countries, where retail-level condom sales data are available (assuming such data are not proprietary). Alternatively, it may be possible to test the reliability of the estimates in developing countries, by obtaining the relevant sales data on a smaller scale (i.e., for one district only). However, sales data have the drawback that they do not provide information about the characteristics of the consumers. Consequently, sales data are unable to provide detailed information about program impact.

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Appendix

Table A1. Background Data for Calculations

Country	Year	Sex	Total Population Size	% Covered by Survey	% Sexually Active
Kenya	1998	Men	28,726,000	22.0%	82.7%
		Women	28,726,000	22.4%	73.0%
Nigeria	1999	Men	123,896,520	24.5%	72.4%
		Women	123,896,520	23.1%	67.8%
Tanzania	1996	Men	30,487,820	21.0%	70.6%
		Women	30,487,820	22.3%	67.8%
	1999	Men	32,922,680	20.8%	80.5%
		Women	32,922,680	23.3%	79.2%
Zimbabwe	1994	Men	11,256,680	21.8%	75.1%
		Women	11,256,680	22.8%	72.5%
	1999	Men	12,388,320	23.6%	71.8%
		Women	12,388,320	23.2%	75.0%