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Systematic assessment of condom use measurement in evaluation of HIV prevention interventions: need for standardization of measures

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Abstract

When evaluating HIV prevention interventions, condom use is a common outcome measure used to assess changes in HIV-related behaviors; however, no widely accepted standards exist for its measurement. Using systematic review data on HIV prevention interventions conducted in low- and middle-income countries, we examined trends in condom use measurement since 1990. We abstracted data from standardized forms on six dimensions of condom use: partner type, temporal period, measurement scale, consistency, controlling for abstinence, and type of sex. Of 215 studies reviewed, 109 studies (51%) measured condom use as a primary outcome. Outcomes were stratified by partner type in 47 studies (43%). Assessing condom use at last sex was the most common measurement. Consistency of condom use was assessed in 47 studies (43%). Developing and utilizing standards for condom use measurement would increase comparability of findings across studies and benefit HIV prevention research. Recommendations include measuring condom use at last sex, frequency of condom use, and number of protected sex acts in studies evaluating the efficacy of behavioral interventions on sexual risk behavior.

Keywords

HIV; intervention; condom use; measurement

Introduction

The correct and consistent use of condoms during sexual activity can effectively reduce the transmission of HIV,^{1,2} so condom use is regularly measured as a proxy for HIV risk.

Because no gold standard exists for measuring condom use, researchers have developed a myriad of condom-related questions, answered through self-report, to assess this behavior.

However, these measures are widely inconsistent across studies. For example, in the July

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2012 issue of *AIDS and Behavior*, 10 of 26 original research articles measured condom use in multiple ways. One study compared participants reporting “any” condom use to no use,³ another looked at condom use at last sex and “always” or “often” condom use in the past 6 months,⁴ and yet another measured “sometimes,” “always” or “never” use.⁵ The most common measurement involved counting the number of sex partners in a certain period of time, the number of sex acts (vaginal and/or anal), and the percent of sex acts protected.^{6–9}

Although condom use is a concrete behavior study participants should be able to report with relative accuracy, its measurement has proven complex. Sexual behavior, including condom use, is a sensitive subject for many people. Responses can be influenced by social desirability bias, participation bias, and memory error.^{10–12} In cultures with restrictive norms surrounding acceptable sexual practices, response bias can play an even larger role.¹³ Studies have also shown that the manner in which data are collected, such as through self-administered surveys or face-to-face interviews, can influence how condom behaviors are reported.^{10,14,15} Additionally, ambiguity with survey questions relating to condom use can be problematic, especially if terms such as “sex” and “condom use” are not explicitly defined for participants.^{16,17} For example, when asked about condom use during a survey, participants may not know whether “sex” refers to vaginal, oral, and/or anal sex acts or whether “condom use” is contingent upon factors such as the type of condom used (e.g., male or female), length of time condom was used (e.g., a condom can be worn for the entire duration of sex or removed part way through), or which partner actually wore the condom. Finally, condom use, which is a repeated behavior that must be reenacted each time one has sex with each different partner, is complex. People may choose to use condoms with certain partners but not with others. Condoms can be used every time someone has sex or just occasionally. And in some cases, condom use or non-use is not a choice, but a decision made solely by one of the two parties involved. Further, condoms can be used incorrectly, which can increase rates of breakage and slippage, thus negating their protective benefits against HIV.

Challenges to accurately measuring condom use exist on three levels. First, question wording and participant understanding are critical. Having a poorly worded question that is not understood by participants, such as not defining what is meant by “sex,” can lead to errors in measurement. Social desirability is another pitfall, and one that is difficult to avoid as self-report is required to obtain such information, although methods have been developed to reduce bias and minimize over-reporting.¹⁶ Second, there are issues with condom use measures themselves. What information about condom use is important to capture? How can these metrics be integrated into survey questions that lead to analyzable results? Third, the way in which investigators present and interpret data can influence measurement depending on how response categories are collapsed during analysis and which indicators are presented. Although this paper mainly focuses on the actual metrics of condom use, all three levels of measurement are interrelated and cannot be easily separated.

Condom use measures are often criticized for relying on self-report. Researchers have attempted to validate condom use measures through a variety of means, including comparing agreement in condom use rates reported by both members of a couple,¹⁸ comparing reported condom use to rates of sexually transmitted infections^{19–21} or HIV prevalence,²² comparing

different measures and modalities of self-reported condom use,¹⁵ and validating reported condom use through testing for biological evidence of recent unprotected sex.^{23–26} Results from these validation studies are mixed. For example, studies have associated increased condom use with decreased incidence and/or prevalence of sexually transmitted infections (STIs),^{20,27} thus helping validate condom use measures. However, other studies have failed to show a link.^{19,21} Such discrepancies can potentially be explained not only by differing study designs, such as retrospective vs. prospective assessments, but also by studies measuring and defining condom use differently.^{22,28} One study found that STI rates were significantly lower among consistent condom users compared to inconsistent users, but when all condom users were compared with no condom users, there was little protective effect.²⁹ These results highlight the importance of quantifying fine gradations in condom use, particularly as background prevalence and incidence of HIV and other STIs play a role in determining effectiveness. For example, the impact of less than 100% condom use can be profound in areas with extremely high HIV or STI incidence, like KwaZulu Natal, where recent studies have found HIV incidence of nearly 6% overall, approaching 10% in specific sites.³⁰

Additionally, condom use may be inaccurately reported. In biomarker validation studies, investigators examined rates of discordance between women who reported having only protected sex in the last 48 hours and those who had a positive vaginal swab for the presence of prostate-specific antigen (PSA), the most common protein found in semen. Across four studies, rates of discordance ranged from 7.1% to 36.2%,^{23–26} suggesting many women either failed to report unprotected sex or experienced condom breakage or slippage during sex.

Previous efforts have sought to examine how condom use is measured and which measures yield the most valid and useful results. In 1994, Sheeran and Abraham published a review of condom use measures in 72 correlational studies identifying 94 different measures of condom use.³¹ Similarly, Weinhardt et al. found a wide variety of condom use measures in 30 studies and made recommendations for improving assessment of sexual behavior.³² Crosby et al. examined condom use measures in 10 intervention studies based in both high and low income countries and concluded that meta-analysis was not feasible given the significant heterogeneity across measures.¹¹ Schroder et al. reviewed 116 studies involving condom use and focused on differentiating between frequency measures, which refer to how often a condom is used, and count measures, which refer to how many times a condom is used.³³ Schroder suggests count data are more relevant to intervention studies because this type of measure provides more specific information about risk and exposure, which can be used to determine whether the intervention succeeded in reducing the absolute number of participants' high-risk encounters.³³ Most recently Noar et al. reviewed 56 correlational studies and concluded that although condom use measures have improved in quality over time, more is needed to implement recommendations and standardize measures.¹⁷

Globally, the majority of HIV infections occur in low- and middle-income countries, and one primary reason for measuring condom use is to evaluate the effectiveness of HIV prevention interventions. Previous reviews of condom use measures have not focused on intervention studies in these settings. Our objective was to describe how condom use has

been measured in HIV prevention interventions in low- and middle-income countries from 1990 through 2010 using a database amassed by the Evidence Project. The Evidence Project has been conducting systematic reviews and meta-analyses of HIV prevention interventions for over a decade. This research endeavor commenced in 2001 as a collaboration between representatives of the World Health Organization (WHO) Department of HIV/AIDS and researchers at the Johns Hopkins Bloomberg School of Public Health and the Medical University of South Carolina. Over the past 12 years, the Evidence Project has accrued a database containing systematically abstracted information from 215 intervention studies. Within these studies, condom use is by far the most commonly measured behavioral outcome. By using this database to explore the different methods employed for condom measurement, we sought to describe frequencies reported for each dimension of condom use, limitations with using different measures, and implications for future research.

METHODS

Methods for conducting systematic reviews

Interventions that have been systematically reviewed under the Evidence Project include mass media,³⁴ psychosocial support,³⁵ the impact of HIV treatment on risk behavior,³⁶ voluntary counseling and testing (VCT),^{37,38} peer education,³⁹ positive prevention (also known as prevention with positives or positive health, dignity and prevention),⁴⁰ condom social marketing,⁴¹ provider-initiated testing and counseling (PITC),⁴² family planning counseling for women living with HIV,⁴³ and income generation.⁴⁴ Topics currently under review include free condom distribution, needle/syringe programs, school-based sex education, behavioral counseling, and policy interventions. We began each review by defining the intervention and developing inclusion criteria. We then created a list of search terms and systematically search and screen the literature for articles meeting the inclusion criteria. We searched five electronic databases: PubMed, PsycInfo, EMBASE, CINAHL, and Sociological Abstracts. We also hand searched the table of contents of four key journals: *AIDS*, *AIDS Care*, *AIDS and Behavior*, and *AIDS Education and Prevention*, and iteratively searched reference lists of all included articles until no new articles were identified. For each review, we included only articles published in peer-reviewed journals from 1990 through the search date per inclusion criteria followed by the Evidence Project for all review topics. Data from these articles were abstracted into a standardized form by two independent reviewers; discrepancies were resolved through consensus. All abstracted data were entered into an SPSS v21 (SPSS Inc., Chicago IL) database using Epidata Data Entry software.⁴⁵

In order to consider as much evidence as possible, we included randomized trials along with less rigorous study designs including pre/post comparisons, cross-sectional studies with a control group, serial cross-sectional studies, case-control studies, non-randomized trials (for individuals and groups), prospective and retrospective cohort studies, and time-series study designs. To be included in our reviews, all studies must be specific to HIV, present either pre/post or multi-arm comparisons that measure the effect of the intervention on biological, behavioral, or psychosocial outcomes relating to HIV prevention, and take place in a low- or middle-income country as defined by the World Bank.⁴⁶ For purposes of this review, articles measuring condom use among multiple populations were only analyzed once to

avoid double-counting, since condom use measures were similar across different study groups.

Methods for conducting analysis on condom use measurements

Studies included in the systematic review database measuring condom use as a primary outcome were included in this analysis. A primary outcome was defined as a comparison between pre- and post-test measures or a comparison made between study groups, i.e., groups receiving the intervention compared to controls. Any relevant outcome containing either a pre-post or multi-arm comparison was included as a primary outcome, regardless of whether it was identified as such by study authors. All primary outcomes related to condom use, regardless of how they were labeled (i.e., protected sex, unprotected sex, and condom use), were included.

Data abstraction forms from each article reporting condom use as a primary outcome were reviewed independently by two trained data abstractors for six *a priori* condom use dimensions described below; discrepancies in data abstraction were resolved through discussion and full-text articles were consulted for clarification when necessary. Inter-coder reliability was calculated using the Kappa statistic for four out of the six dimensions (those requiring one and only one categorical response choice). The Kappa statistic demonstrated substantial agreement between coders,⁴⁷ and the average Kappa across dimensions was 0.78.

Dimensions of condom use:

1. **Type of sexual partner:** Dichotomous measure assessing whether condom use was measured for different partner types, such as primary or non-primary partners.
2. **Temporal period:** Describes the timeframe of questions asked regarding condom use. This measure was coded categorically, with categories including condom use at last sex, condom use during a specific number of sex acts, condom use in the last three months or less, and condom use in the past year or longer (e.g., condom use in past 2 years), and “ever” or “never” use (vague time period). If multiple questions covered different timeframes, all were recorded.
3. **Measurement scale:** Refers to the response choices presented for condom measurement questions. Measurement scales were coded as dichotomous (e.g., yes/no or ever/never condom use), ordinal (e.g., sometimes, always, never condom use), ratio (i.e., percentage of protected sexual acts out of the total number of sexual acts within a specific time period), and continuous (number of times condoms were used in a given time period). If multiple measurement scales were used, all were recorded.
4. **Consistency of condom use:** Refers to any mention of “consistent” or “regular” condom use. Results were coded dichotomously; studies that mentioned consistency or regular use were given credit for reporting on this dimension. Consistency was deemed an important measure of condom use since previous studies have shown that using condoms consistently is associated with lower STI infections whereas inconsistent use is not.²⁹

5. **Controlling for abstinence:** Refers to the population among which condom use was measured and ascertains whether the study included people who were not having sex or limited the analysis to sexually active participants only.
6. **Type of sex:** Refers to whether or not studies reported the type of sex being engaged in by study respondents in relation to condom use. Categories included vaginal sex, anal sex, oral sex, and not reported.

RESULTS

Characteristics of Studies

Of 215 studies included in the Evidence Project database, 109 studies (51%) measured condom use as a primary outcome and were included. The majority of these 109 studies took place in sub-Saharan Africa (n=66, 61%). The remaining studies took place in East Asia (n=22), South Asia (n=6), Europe and Central Asia (n=4), Latin America and the Caribbean (n=11), and the Middle East/North Africa (n=1), with one study taking place across multiple locations in sub-Saharan Africa and the Caribbean. Twenty-two studies (20%) were individual- or group-randomized trials; the remaining studies included non-randomized trials, quasi-experimental and observational studies. Study populations included participants recruited from the general population (n=28); youth or young adults (n=32); high-risk populations (n=33), including female sex workers, male transit workers, miners, injection drug users, and prisoners; employees (n=1); teachers (n=1); couples (n=2); serodiscordant couples (n=3); pregnant women (n=2); tuberculosis patients (n=1), and people living with HIV (n=6).

Included studies were published from 1990–1999 (n=21), 2000–2006 (n=63), and from 2007–2010 (n=25). Intervention topics included VCT (n=11); condom social marketing (n=9); family planning counseling for women living with HIV (n=1); mass media (n=18); school-based sex education (n=21); peer education (n=23); needle/syringe programs (n=5); psychosocial support (n=1); positive prevention (n=7); impact of HIV treatment on risk behavior (n=3); PITC (n=7); and income generation (n=6). Three studies were included in two review topics simultaneously. A supplementary table is available online which describes the characteristics of all included studies.

Characteristics of Condom Use Questions

About half of studies (n=58, 53%) reported more than one measure of condom use. The remaining 51 studies reported only one measure of condom use. In most cases, measures referred only to “condom” use with no distinction made by condom type (e.g., male or female). Only two studies measured female condom use as a primary outcome,^{48,49} while one study examined changes in “condom use” following the introduction of the female condom.⁵⁰ Results pertaining to the six condom use dimensions reported in the included studies are presented in Table I.

Differentiation by Partner Type

Differentiation by partner type occurred in 43% of studies (n=47). There was little consistency in how partners were defined. Some studies differentiated between regular and

casual partners while others differentiated between boyfriends/girlfriends, spouses, and sex workers. The definition of primary or regular partners typically included spouses, or, if not married, cohabitating partners. Casual or non-primary partners were often vaguely defined as non-spousal partners or “other” partners. Many studies provided no definition of partner types. About a quarter of studies involving youth (n=9/32) differentiated between types of sexual partners when referring to condom use. In contrast, 79% of studies involving female sex workers (n=11/14) asked participants about condom use with different partners. Partner types for female sex workers included regular clients, casual clients, and non-paying boyfriends. Studies involving participants from the general population differentiated between partner types in 15 out of 28 studies (54%). One study assigned partner type based on the reported relationship status and living arrangements as reported by participants (options included primary partner, non-primary partner, or enrollment partner).⁵¹ For the remaining studies differentiating between partner types, survey questions referenced a specific partner type directly (e.g., was a condom used at last sex *with a casual partner*) rather than having interviewers assign partner types based on reported partner characteristics.

Temporal Period

The most common recall period was condom use “at last sex” (n=39/109, 36%). Non-specific timeframes, such as condom use “always” or “never,” were also common (n=37/109, 34%). Studies involving sex workers tended to measure condom use within short time periods, such as in the past week or past month, while studies among the general population measured condom use less frequently. Fourteen studies included a measure of condom use in the last year or more (13%) and 20 studies measured condom use in the last 3 months or less (18%). Surprisingly 29 studies (27%) contained a measure of condom use without mentioning the relevant temporal period. In these cases, reported outcomes measured “condom use” but failed to specify the time period during which condoms were or were not being used. Only 4 studies (4%) asked participants if condoms were used during a specific number of sex acts, such as condom use in the last 5 sexual encounters. Over a quarter of studies (n=30/109) included multiple questions with different recall periods. The most common combination was asking about condom use “at last sex” and condom use during a longer time period, such as condom use in the last 3 months or 1 year. Asking about condom use across multiple temporal periods was often used as a way to infer consistency of use. For example, participants would only be considered “consistent condom users” if they reported having used a condom at last sex and “always” use during the past 3 months.

Measurement Scale

Condom use was most commonly measured as a dichotomous outcome (n=79/109, 72%). Dichotomous measures either resulted from individual survey questions (e.g., condom used at last sex, “always” condom use, or any reporting any unprotected sex in a specified time period) or from combining answers from multiple questions to develop a composite measure, such as an index of consistent condom use, or collapsing response categories (e.g., sometimes, always, never) into two (e.g., any report of “some” condom use vs. none). Describing the proportion of respondents who reported using condoms on an ordinal scale (e.g., always, almost always, sometimes, almost never, and never condom use) was also

employed (n=13/109, 12%). Five studies reported condom use on a continuous scale (e.g., how many times a condom was used in a given time period). Five studies reported results in the form of a ratio with the numerator containing the number of protected sex acts reported within a given time period and the denominator containing the number of all sex acts in the same time period. Some studies used this ratio to categorize participants as consistent condom users (if number of protected sex acts equaled the number of sex acts overall).

Consistency of Condom Use

Consistent condom use was measured in 43% of studies (n=47). The definition of “consistent” condom use varied between studies. Studies commonly defined consistent use as reporting condom use at every sexual encounter in a given time period, but some defined consistent use as condom use in 90–100% of sexual encounters, or used terms such as “regular” or “systematic” condom use without providing specific definitions.

Within studies consistency was accounted for in one of three ways: 1) asking participants about “always” condom use, 2) creating a composite measure of consistency based on responses to other condom use questions, or 3) defining consistent condom use based on the ratio of reported protected sexual acts over all sexual acts within a certain time period. One VCT intervention study measured condom use ratios per partner within a couple. “Regular” condom use was defined as when both partners reporting having a condom ratio (number of protected sex acts/all sex acts) above 0.90.⁵² Another study created a composite measure for consistent condom use for male clients of female sex workers through averaging responses to three questions, including: 1) condom use at last sex, 2) used condom for every sex worker in last 12 months, and 3) no occasion in which condom use was not used with a female sex worker in the past 12 months.⁵³ One study calculated Cronbach’s alpha to assess internal consistency among condom use questions used to create the composite consistency measure⁵⁴ and another calculated percent agreement between couples reporting “any unprotected sex” to assess validity.⁵¹

Accounting for Abstinence and Type of Sex

Studies reported limiting condom use analyses to sexually active participants in 39% of studies (n=43). It is possible that more included studies controlled for abstinence but did not explicitly report this in their findings. Similarly, only one of the 109 included studies (0.9%) specified the type of sexual act in which condoms were used when reporting results from condom use measures.⁵⁵ One study reported asking participants about their frequency of anal and vaginal sex during data collection, but no differentiation was made between the types of sexual activities when presenting results.⁵¹ Another study reported asking participants about the number of vaginal and anal sex acts with each recent partner, but clarified that no respondents reported anal sex.⁵⁶

Discussion

We reviewed six dimensions of condom use outcomes reported across 109 HIV prevention intervention studies in low- and middle-income countries and identified wide inconsistencies in measurement despite decades of recommendations and previous reviews advocating for

standardization. To our knowledge, this is the first review to focus on condom use measurement in low- and middle-income countries. Results show that less than half of studies differentiated between partner types when assessing condom use and that condom use at last sex was the most common measure. Consistency of condom use was measured in about 40% of studies and the type of sex act in which condoms were used was rarely specified. These results are surprising given several previous recommendations and calls for standardization. Differences across measures hinder the ability to compare across studies and synthesize effects in meta-analysis. In the current climate of limited resources for global HIV prevention, the ability to effectively compare intervention efficacy is critical. Standardization of condom use measures would help with this significantly.

Patterns observed in the data

Less than half of included studies differentiated between types of sexual partners despite previous recommendations advocating for separating condom use questions by partner type in HIV prevention research.^{17,31} When studies did differentiate by partner type, they often failed to report explicit definitions for partner types. We recommend that studies differentiate in all condom-related survey questions between at least two sexual partner types, primary/regular partners and non-primary/casual partners. Defining what makes someone a primary or non-primary partner may depend on the population and context under study. For some populations, such as sex workers, further differentiation may be necessary due to the complex sexual relationships involved (e.g., new clients, regular clients, and non-paying partners). In this review, we found few studies involving youth differentiated condom use by partner type. However, previous literature supports the utility of asking youth partner-specific sex questions related to sexual behavior,⁵⁷ so interventions involving youth would benefit by distinguishing between partner types, or at least asking questions specific to a particular partner, when measuring condom use.

Similarly, defining the specific sexual behavior of interest, i.e., oral, anal or vaginal sex, provides useful information about condom use, yet only one included study explicitly defined the type of sex act in which condoms were used.⁵⁵ This number is much lower than seen in a previous review¹⁷ and is perhaps explained in part by our restriction to interventions conducted in low- and middle- income countries where certain sexual behaviors, such as anal sex, may be considered taboo, and certain populations, such as men who have sex with men, are often underrepresented in intervention studies in these settings. Although rates of anal sex remain understudied in many developing countries, a recent study conducted among heterosexual participants in South Africa found that 15% of men and 11% of women reported engaging in anal sex in the previous month.⁵⁸ In studies where the type of sex is not made explicit, certain sexual behaviors may be missed due to question wording. As rates of HIV transmission vary widely between anal and vaginal sex, differentiating between these behaviors would provide valuable information in regards to condom use and risk of infection. If participants report no anal sex, it would be helpful to state this and refer to all subsequent condom use measures as pertaining to vaginal sex only.

Last sex was the most common temporal period used for assessing condom use. Previous studies show mixed results on the utility of this measure. Several studies have demonstrated

a high correlation between condom use at last sex and consistent condom use reported over a longer period of time,^{59,60} but recent biomarker validation studies show that condom use at last sex can be substantially over-reported.^{23–26} Additionally, concerns exist about this measure because it pertains to a single event and may not reflect a person's sexual behavior over a longer period of time.^{33,61} Some included studies used condom use at last sex as part of a composite measure assessing consistent condom use to help build a more robust assessment of consistency. For measuring condom use over longer periods, the literature clearly demonstrates that using shorter recall periods (between 2 and 3 months) produces more reliable estimates of behavior than longer follow-up times.^{17,31}

Dichotomizing condom use was the most common measurement scale used in studies included in this review. One advantage of using dichotomous outcomes is that results can be converted into a readily interpretable metric, such as an odds ratio, thus more easily allowing effect sizes to be synthesized across interventions in meta-analysis.^{37–39,41} However, as noted in previous methodological studies, dichotomizing a complex behavior such as condom use results in losing valuable information regarding frequency of condom use and sexual activity that help characterize risk³³ and is not recommended by previous research.¹⁷ Ideally, intervention studies would retain specific count data, i.e., how many times a person used a condom and how many times he/she had sex over a certain period of time, as well as provide a robust and valid dichotomous measure. The most meaningful dichotomous measure is one that conveys consistency of condom use, measured by partner type and specific sex act, such as through developing a composite measure comprising several questions relating to frequency of condom use. Among included studies less than half reported measuring consistency in condom use. However, as evidence shows that consistent condom users have significantly lower rates of STI infection than those reporting inconsistent use,²⁹ consistency is an important characteristic to emphasize when reporting results.

Although this review focused on analyzing how condom use was reported and not on how condom use questions were asked, it is clear many studies analyzed data differently than how data were originally collected. The most common example of this is collapsing response categories during analysis (e.g., considering “always” or “some” use as any use), although this practice has been discouraged by previous reviews.^{17,31} Additionally, some studies failed to report if condom use measures were restricted to only sexually active participants during analysis. For purposes of meta-analysis, it is important to know the relevant sample size for analyses and, if applicable, reasons why some participants were excluded. In this case, if studies did not restrict condom use analyses to sexually active participants, those reporting no condom use could have been abstinent, thus misclassifying sexually inactive participants as non-condom users.

Recommendations for measuring condom use in HIV prevention interventions

Previous studies have made thoughtful and pertinent recommendations regarding condom use measurement^{10,11,17,31–33} which are summarized in Table II. We seek to build upon these recommendations to propose a set of recommended measures, similar to the concept developed by Pinkerton in 1998.⁶² Pinkerton recommend 5 aspects of data to collect when

evaluating HIV prevention interventions, including measuring the average number of condom-protected sex acts per partner, the average number of unprotected sex acts per partner, the HIV prevalence among partners of intervention participants, per-contact probability of transmission, and condom effectiveness and, proportion of sex acts protected.⁶²

Our recommended set of condom use measures are presented in Table III and include three indicators: 1) condom use at last sex, 2) consistent condom use, and 3) number of protected/unprotected sex acts. Measuring condom use at last sex was found to be the most common condom use measure reported in this review. We have included this measure in our recommendations because it is comparable to one of the United Nations General Assembly Special Session (UNGASS) indicators (condom use at last sex among those reporting more than one sexual partner in the past 12 months), is easy to understand, and minimizes potential for recall bias. Although there are concerns this measure may not accurately reflect HIV-risk since it measures behavior during only one sexual occurrence, we believe it can be a useful measure, particularly when used in conjunction with other measures to establish consistency of condom use.

Measuring frequency of condom use is our second recommended measure with a focus on consistent condom use. This measure categorizes respondents as consistent, inconsistent, or non-condom users. Using this measure to compare consistent (“always”) condom users to anything less than consistent users (i.e., using condoms “most of the time”, “sometimes”, or “never”) is most appropriate given that vague response choices for “some” condom use can be imprecise and unreliable⁶³. Researchers can also overcome this drawback by developing multi-item composite indices for consistent condom use. Our recommended composite measure for consistent condom use includes defining consistent use as reporting 1) condom use at last sex, 2) always condom use during a specified time period, and 3) using a test-retest question similar to the one used by Lipovsek et al. to ensure condoms were used during all sexual encounters (“Was there any time [in a specific period of time] when you did not use a condom with this partner?”)⁵³. Respondents would have to meet all three conditions to be considered consistent condom users. However, psychometric evaluation is needed to understand the reliability and validity of this composite measure.

The third indicator measures the frequency of sex with each partner and the frequency of condom use with each partner. A proportion of protected sex acts can then be calculated by dividing the number of protected acts by the number of total sex acts. Alternatively, an absolute measure of unprotected sex acts can be calculated by subtracting the number of condoms used from the total number of sex acts.

In addition to these recommendations, it is important to consider other aspects of sexual behavior when measuring condom use. For example, questions should first establish whether a respondent is sexually active before assessing condom use. Asking respondents about the number of sexual partners they have had in a given time period can establish sexual activity (i.e., those reporting 0 sexual partners can be categorized as abstinent) and can be used to quantify potential risk of HIV exposure.

It is our hope that studies could incorporate these recommended measures into their survey instruments so effects across interventions could be meaningfully evaluated. However, we recognize that measuring indicators consistently for the purposes of conducting meta-analyses may not always align with the specific aims of research studies. For example, an intervention to reduce HIV-related risk may be interested in how many potentially risky sexual encounters were averted as a result of an intervention. Answering this question would require authors to measure other factors related to condom use, including frequency of sex, number of sexual partners, and potentially inquiring about the HIV status of sexual partners. Additionally, we recognize that our three recommended measures are not the most robust condom measures in existence. For example, establishing a valid measure for consistency of condom use may require more than one survey question, such as by defining consistency as not only reporting “always” condom use with all partners, but also reporting condom use at last sex and reporting no instances where condoms were not used. Constructing this type of scale can increase the validity of the measure, but again, its use depends on the research question being asked. We have recommended three measures that are applicable to most studies but understand that more extensive measures of condom use may be warranted. Additionally, we make these suggestions with several caveats: 1) although we are basing our recommended standards on previous research, more needs to be understood about the reliability and validity of the measures, and 2) these recommendations are mutable and should be refined as more data become available.

Reliability and validity

Although no gold standard exists for condom use, fundamental principles of reliability and validity can still be utilized to strengthen condom use measures. While this review did not abstract data relevant to validity and reliability, other studies examining condom use have recommended including questions that account for social desirability¹⁷ or self-reported honesty.⁶⁴ Evidence also suggests that adding a “test-retest” question, which includes asking two differently-worded questions about the same issue, can help correct for over-reporting.¹⁶ For example, defining consistent condom use as 1) reporting “always” condom use and 2) reporting no occasion when condoms were not used provides a more realistic estimate of true consistent condoms users as opposed to defining consistent use through only one measure.¹⁶ Utilizing these relatively simple methods can help increase the validity and reliability of condom use measures.

Limitations

This study has several limitations. First, data were abstracted from standardized forms containing information on studies originally completed for systematic review and meta-analytic purposes; we thus may have failed to capture some aspects of condom use measurement. We attempted to minimize this limitation by going back to the original article for clarifications when necessary. Second, interventions included in this review were limited to topics systematically reviewed by the Evidence Project; therefore, this review does not constitute a systematic assessment for every type of HIV prevention intervention. This review included only studies implemented in low- and middle-income countries, limiting the generalizability of our conclusions. Further, studies under review usually examined many outcomes in addition to condom use. For condom use outcomes, useful information includes

reporting 1) the reference time period, 2) any relevant definitions (e.g. defining partner type, consistency, and type of sexual act in which condoms were used), 3) the measurement scale used in data collection and the scale used in analysis, and 4) whether abstinence was controlled for in the analysis. Since journal space is limited, it is understandable that authors fail to report specific information about each outcome of interest in-depth. However, many journals now allow supplementary material to be posted online, which allows studies to include more information. Finally, all measures contained in this review are based on self-report, which is a limitation inherent in measuring a behavior that cannot be directly observed.

Based on our review of the literature, we strongly recommend adopting the following minimum measurement characteristics when measuring and reporting on condom use: (1) differentiate between regular and non-primary partner types; (2) differentiate between oral, vaginal, and anal sex when condoms are used; (3) always report whether condoms were used at last sex; (4) always report consistency of condom use over a clearly defined timeframe; and (5) report clearly the actual number of protected sex acts. Table III provides more specific guidance on these recommendations. Measurement standardization is typical in many other fields, such as psychology (for outcomes such as depression and anxiety) and medicine (clinical outcomes), and other areas of HIV research have been able to reach consensus on standardized definitions, specifically regarding partner concurrency.⁶⁵ We believe it is time to develop standards for condom use measurement in HIV prevention research, and that journal editors, reviewers, and funders of research studies must insist upon a consistent measurement of condom use prior to accepting scientific reports for publication.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table I

Dimensions of condom use in included studies (n=109)

Condom Use Dimension	Number of Studies (%)
Differentiation by Partner Type	
Yes	47 (43%)
No	62 (57%)
Temporal Period (multiple measures possible)	
last sex	39 (36%)
Specific number of sex acts	4 (4%)
3 months	20 (18%)
> 3 months and 1 year	13 (12%)
> 1 year	1 (0.9%)
Ever/never/sometimes condom use	37 (34%)
Not reported/unclear	29 (27%)
Measurement Scale (multiple measures possible)	
Dichotomous (yes/no, always/never)	79 (72%)
Ordinal (sometimes, always, never)	13 (12%)
Ratio (% of protected sex acts/all acts)	5 (5%)
Continuous (number of times condom used)	5 (5%)
Not reported	21 (19%)
Type of Sexual Activity	
Vaginal	1 (0.9%)
Anal	0
Oral	0
Not reported	108 (99%)
Consistency	
Yes	47 (43%)
No	62 (57%)
Controlling for Abstinence	
Yes	43 (39%)
No	66 (61%)

Table II

Previous recommendations for measuring condom use in HIV-prevention research

Previous Recommendations	Source(s)
<ul style="list-style-type: none"> • Use frequency, count, and proportion data in addition to measuring condom use at last sex • Use a recall period of less than 3 months (this may not be applicable for every population) • Differentiate by partner type • Ask questions specific to types of sex acts of interest (e.g. vaginal, anal, oral sex) • If using frequency or proportion data, weight measure by the frequency of sexual intercourse 	Noar et al., 2006 ¹⁷
<ul style="list-style-type: none"> • When possible refrain from collapsing categorical response categories for analysis • Address reliability and validity by reporting test-retest reliability or alpha coefficient • Include measure of social desirability • Assess other types of birth control being employed • Measure correct condom use by including questions relating to condom use skills • Use multiple items to ascertain condom use and calculate internal consistency measures • Establish reasons for non-condom use (e.g. desire to become pregnant) • Employ longitudinal designs to measure changes in self-reported condom use over time 	Sheeran & Abraham, 1994 ³¹
<ul style="list-style-type: none"> • Use measures that have been psychometrically evaluated • Use measures in line with purpose of assessment (i.e. risk screening vs. risk assessment) • Use clear, easy to understand language and establish rapport with respondents • Conduct formative research to learn about relevant cultural sensitivities • Include techniques that improve recall, such as providing anchor dates • Adopt default assumptions (i.e. assume minimal understanding and be explicit) • Arrange questions from least to most threatening • Place “burden of denial” on participants (i.e. ask “how many times” instead of “if”) • Be aware of contextual factors that could potentially influence interview 	Weinhardt et al., 1998 ³²
<ul style="list-style-type: none"> • Separate measures for insertive and receptive condom use • Account for possibilities needed for adopting condom use (e.g. condom use negotiation skills) • Quantify motives for using condom • Determine participation of sex partner in decision to use condoms for HIV prevention • Account for temporal factors affecting condom use such as depressed mood, alcohol intoxication, etc. • Consider quantifying unprotected sex acts as opposed to condom use 	Crosby et al., 1998 ¹¹
<p>Collect the “minimum required data set” to calculate number of infections averted, including:</p> <ul style="list-style-type: none"> • Average number of unprotected sex acts per partner • Average number of condom-protected sex acts per partner • HIV prevalence among partners of intervention participants and their partners • Probability of transmission per sex act • Effectiveness of condom usage 	Pinkerton, 1998 ⁶²
<ul style="list-style-type: none"> • Identify sexual terminology used by different groups in order to find terms that people will understand and feel comfortable using 	Catania et al., 1990 ¹⁰

Previous Recommendations	Source(s)
<ul style="list-style-type: none"> • Conduct research to understand the best ways to present HIV-related sex research to participants to reduce participation bias • Understand the effects of different modes of survey delivery, including the potential effects of interviewers on measurement error 	
<ul style="list-style-type: none"> • Condom use measures are assessed through absolute count and relative frequency measures • Count data provides more specific information on HIV risk reduction and risk of transmission • Count data is better suited for future model-testing • Methods used for analyzing sexual risk behavior data need to be made explicit • Analysis methods involving a loss of information, such as reducing count measures to ordinal or categorical data, should be avoided when possible 	Schroder et al., 2003 ³³

Table III

Recommended condom use measures

Recommendations for Condom Use Measurement				
Question	Notes	Strengths	Limitations	
1 Condom Use at Last Sex Did you or your partner use a condom the last time you had [type of sex] with: <ul style="list-style-type: none"> a. A non-primary partner? b. A primary partner? 	<ul style="list-style-type: none"> Specify type of sex (e.g., oral, anal, vaginal) If applicable, ask about additional partner types (e.g., sex worker, non-paying partner, etc.) Establish definition of “condom use” Explicitly define “primary” and “non-primary” partner 	<ul style="list-style-type: none"> Minimizes recall bias Easy to understand Similar to UNGASS indicator to facilitate comparisons 	<ul style="list-style-type: none"> May not characterize a person’s long-term pattern of condom use⁶⁰ Subject to social desirability bias 	
2 Consistent Condom Use “In the past __ month(s), how often did you use a condom with: <ul style="list-style-type: none"> a. Non-primary partner(s) b. Primary partner(s) 	<ul style="list-style-type: none"> Specify type of sex If applicable, ask about additional partner types Responses choices can vary but must include at least “always” and “never” Establish definition of “condom use” 	<ul style="list-style-type: none"> Separates consistent condom users from inconsistent and non-users Can be used in conjunction with other indicators to create a composite measure of consistent condom use 	<ul style="list-style-type: none"> Response choices can be vague (e.g., “sometimes” condom use) and lack precision Subject to social desirability bias 	
3 Number of Protected Sex Acts Part A: How many times have you had [type of sex] with [type of partner] in the past __ month(s)? Part B: How many times have you used a condom during [type of sex] with [type of partner] in the last __month(s)?	<ul style="list-style-type: none"> Specify type of sex and type of partner Establish definition of “condom use” To create proportion of protected sex acts, use response to Part A as the numerator and Part B as the denominator (relative measure) To generate number of unprotected sex acts, subtract number of condoms used from total number of sex acts (absolute measure) 	<ul style="list-style-type: none"> Incorporates frequency of sex, and therefore frequency of potential exposure to HIV If measured longitudinally, incremental changes in condom use can be observed Preserves count data 	<ul style="list-style-type: none"> Count data usually do not follow a normal distribution, which presents a challenge for data analysis³³ Using proportional data ignores absolute frequency of sex³³ 	