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An Integrated Model of Condom Use in Sub-Saharan African Youth: A Meta-Analysis

Cleo Protogerou
University of Cape Town and Curtin University

Blair T. Johnson
University of Connecticut

Martin S. Hagger
Curtin University and University of Jyväskylä

Objective: We tested an integrated social–cognitive model derived from multiple theories of the determinants of young peoples' condom use in Sub-Saharan Africa. The model comprised seven social–cognitive antecedents of condom use: Attitudes, norms, control, risk perceptions, barriers, intentions, and previous condom use. ***Method:*** We conducted a systematic search of studies including effects between at least one model construct and intended or actual condom use in young people from sub-Saharan African countries. Fifty-five studies comprising 72 independent data sets were included and subjected to random-effects meta-analysis. Demographic and methodological variables were coded as moderators. Hypotheses of the integrated model were tested using meta-analytic structural equation modeling. ***Results:*** The meta-analysis revealed significant nontrivial sample-weighted correlations among most model constructs. Moderator analyses revealed differences in six correlations for studies that included a formative research component relative to studies that did not. There was little evidence of systematic moderation of relations among model constructs by other candidate moderators. Meta-analytic structural equation models revealed significant direct effects of attitudes, norms, and control on condom use intentions, and of intention, control, and barriers on condom use. Including past condom use increased explained variance in condom use intentions and behavior but did not attenuate model effects. There were also significant indirect effects of attitudes, norms, and control on condom use through intentions. ***Conclusions:*** Findings provide preliminary evidence to support the integrated condom use model in sub-Saharan African youth. The model provides guidance on potential targets for improving the effectiveness of condom promotion interventions.

Keywords: HIV prevention, social–cognitive theories, theoretical integration, meta-analytic structural equation modeling

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Young people living in sub-Saharan Africa have an increased risk of sexual and reproductive health problems, including unwanted pregnancies and sexually transmitted infections (STIs; WHO, 2016). The sub-Saharan African region has the highest rates of new HIV infections and the highest rates of unintended pregnancies in the world (Hubacher, Mavranezouli, & McGinn, 2008; Mayondi et al., 2016; UNAIDS, 2015). Similarly, the sub-Saharan African population is affected by a high prevalence of other sexually transmitted infections such as syphilis, gonorrhea, bacterial vaginosis, trichomoniasis, and herpes simplex virus type II (Chico et al., 2012). Unintended pregnancies and STI incidence are substantially reduced through use of barrier contraceptives, and condom use has been identified as a key behavior in the prevention of both outcomes. However, young people living in sub-Saharan

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Cleo Protogerou, Department of Psychology, University of Cape Town, and Health Psychology and Behavioral Medicine Research Group, School of Psychology and Speech Pathology, Faculty of Health Sciences, Curtin University; Blair T. Johnson, Department of Psychological Sciences, University of Connecticut; Martin S. Hagger, Health Psychology and Behavioral Medicine Research Group, School of Psychology and Speech Pathology, Faculty of Health Sciences, Curtin University, and Faculty of Sport and Health Sciences, University of Jyväskylä.

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Correspondence concerning this article should be addressed to Cleo Protogerou, Department of Psychology, University of Cape Town, Cape Town, South Africa. E-mail: cleo.protogerou@uct.ac.za

Africa engage in inconsistent or low condom use, despite repeated exposure to messages aimed at promoting condom use (Eggers, Aarø, Bos, Mathews, & de Vries, 2014; Kalolo & Kibusi, 2015; Protogerou, Flisher, & Wild, 2014). Consequently, condom promotion is a priority for public health and infection control among youth in sub-Saharan African nations.

To date, a number of behavioral interventions aimed at promoting condom use in young people have been implemented in sub-Saharan Africa. Reviews of the efficacy of these interventions typically show favorable knowledge and attitude change, but limited or no change in condom use uptake and maintenance (Eaton, Flisher, & Aarø 2003; Exavery et al., 2012; Protogerou & Johnson, 2014; Scott-Sheldon, Walstrom, Harrison, Kalichman, & Carey, 2013; Wamoyi et al., 2014). The poor success rate demonstrates the need for public health interventions that are based on a fundamental understanding of the determinants of condom use in this population. Interventionists have, therefore, turned to theories from behavioral science and health psychology as basis for understanding condom use in this population, and for informing the development of effective strategies to promote condom use.

Many theories applied to understanding and predicting condom use are based on the social–cognitive tradition (e.g., Bandura, 1986; Fishbein & Ajzen, 2009). These theories adopt an information processing approach and focus on the individual, belief-based factors that affect decisions to engage in health behavior (Conner & Norman, 2015). Prominent social–cognitive constructs identified as antecedents of health behavior in these theories include perceptions of severity and susceptibility to disease and perceived benefits and barriers (e.g., protection motivation theory; Rogers, 1975; the health belief model; Rosenstock, Strecher, & Becker, 1988); attitudes, social norms, and perceptions of control (e.g., the theory of planned behavior; Ajzen, 1985; the I-change model, de Vries, Mesters, van de Steeg, & Honing, 2005; the reasoned action approach, Fishbein & Ajzen, 2009); knowledge, skills, and estimation of costs and benefits (e.g., information-motivation-behavioral skills model; Fisher & Fisher, 1992; health action process approach; Schwarzer, 2008); and self-efficacy (e.g., social–cognitive theory; Bandura, 1986). Although some theories propose belief-based constructs as direct antecedents of health behavior (e.g., health belief model, social–cognitive theory), many propose motivation or intentions as the most proximal predictor of behavior (Ajzen, 1985; Fishbein & Ajzen, 2009; Rogers, 1975). Specifically, intentions are expected to mediate effects of beliefs on health behavior.

Social–cognitive theories have shown considerable promise in explaining and predicting variance in condom use, and informing the development of safer-sex interventions including condom use. Reviews of research applying these theories to predict condom use, including those focusing on populations in sub-Saharan Africa, have provided cumulative evidence of the psychological antecedents of condom use (e.g., Albarracín, Johnson, Fishbein, & Muellerleile, 2001; Protogerou, Flisher, Aarø, & Mathews, 2012; Sheeran, Abraham, & Orbell, 1999). However, one of the limitations of focusing on specific theories is the potential to neglect particular constructs that may have relevance to the prediction of the target behavior. In addition, there is considerable redundancy in constructs across theories, such as constructs with similar content but labeled differently (Block, 1995; Hagger, 2014). Integration of social–cognitive theories may provide a solution to these problems through the development of models that are inclusive, by incorporating conceptually distinct constructs, yet, parsimonious, by consolidating constructs with like content (Eggers et al., 2014; Hagger, Koch, Chatzisarantis, & Orbell, 2017; Montaño & Kasprzyk, 2008). This goal can be achieved through systematic classification of the social–cognitive factors that feature in theories applied to the prediction of health behavior, including condom use, into logical categories. Such classification necessitates close examination of the content of constructs in social–cognitive theories and their accompanying measures and collapsing them to arrive at a nuanced, set of constructs. McMillan and Conner (2007) advocated a "core health cognitions" approach to integration that classifies social–cognitive variables from theories based on definition and content to arrive at an optimally comprehensive set of constructs derived from these theories.

The Present Study

Although conceptual and narrative reviews have identified the theory-based factors that relate to condom use in sub-Saharan African youth (Eaton et al., 2003; Protogerou et al., 2012; Protogerou & Hagger, 2017), there is, to date, no quantitative synthesis of single or integrated social–cognitive theories focusing on condom use in young people from sub-Saharan Africa. There is also very little research on the effects of extraneous factors, such as demographic, environmental, and study parameters, that may interact with psychological constructs from social–cognitive theories in predicting young people's condom use across sub-Saharan African nations. There is, therefore, a need to synthesize evidence from social–cognitive theories that have been applied to explain condom use in this population.

The present study addresses this need through a meta-analytic synthesis of research of the social–cognitive predictors of condom use in sub-Saharan African youth. We developed an integrated model that includes a core set of social–cognitive constructs expected to be associated with condom use (see Figure 1). The model was guided by McMillan and Conner's (2007) framework, which provides a basis to classify multiple constructs from social–cognitive models applied to health behavior into a set of core constructs, along with the processes by which the constructs relate to behavior. Specifically, McMillan and Conner put forth attitudes, self-representations, norms, control perceptions, and dispositions to act (intentions) as the five conceptually distinct 'core' social–cognitive correlates of health and risk behavior. The attitudes construct encapsulates risk perceptions and perceived barriers from the health belief model (Rosenstock et al., 1988) and protection motivation theory (Rogers, 1975) and evaluations of the behavior and its outcomes from the theories of reasoned action and planned behavior (Ajzen, 1985; Ajzen & Fishbein, 1980). We chose to retain the distinction between attitudes as beliefs about the behavior, and risk perceptions and perceived barriers in our model considering the potential utility of identifying unique effects for each factor in the development of condom use interventions. The control construct encompasses beliefs relating to self-efficacy from social–cognitive theory (Bandura, 1986), and perceived behavioral control from theories of reasoned action and planned behavior. Norms encompass the injunctive and descriptive norms constructs that feature prominently in social–cognitive theory, the theories of reasoned action and planned behavior, the reasoned

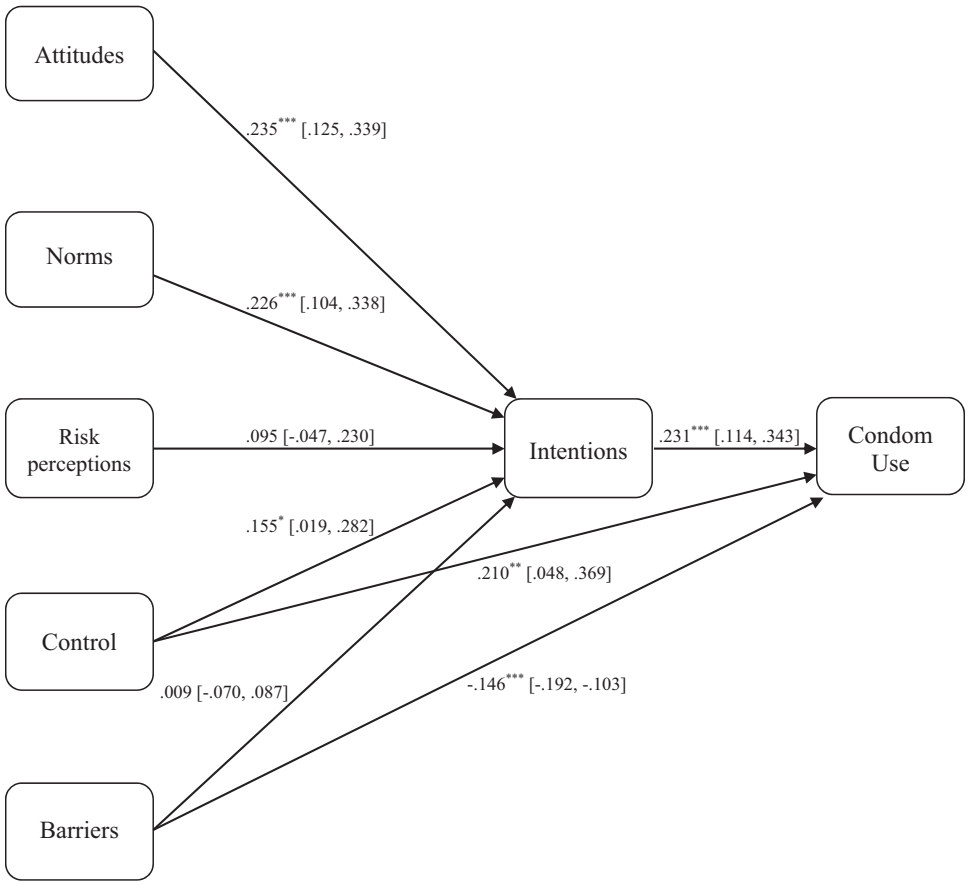

Figure 1. Path diagram of the integrated condom-use model. Coefficients are standardized parameter estimates (β) with likelihood-based 95% confidence intervals in brackets. Effects omitted from model for clarity: total effect, control→condom use, β = .246 [.096, .394]; total effect, barriers→condom use, β = −.144 [–.192, −.099]. * $p < .05$. ** $p < .01$. *** $p < .001$.

action approach, and social identity approaches (e.g., White, Terry, & Hogg, 1994). Following McMillan and Conner, we predicted that effects of these core constructs on condom use would be mediated by dispositions to act, captured by the intentions construct, consistent with previously theories (e.g., Ajzen, 1985; Fishbein & Ajzen, 2009; Rogers, 1975). Alongside this hypothesis, we also proposed direct effects of control perceptions and barriers on condom use, which is consistent with the premise that when control perceptions equate to actual control and real barriers, they serve as proxy measures of actual barriers and likely to predict condom use directly, bypassing intentions (Ajzen, 1985; Fishbein & Ajzen, 2009). Overall, McMillan and Conner's framework enabled us to identify a core set of condom use antecedents and propose testable hypotheses for the relations among them.

We aimed to synthesize research on theories that include constructs from the integrated model and test their effects on condom use in sub-Saharan African youth. In addition to examining the averaged sample-weighted correlations for each relation among model constructs, our analysis also permitted testing predictions of the integrated model in a nomological network (Hagger, Gucciardi, & Chatzisarantis, 2017). Specifically, we tested the unique prediction of the core components on the model on condom use, mediated by intentions, in a meta-analytic structural equation model (Cheung, 2015). We also expected model effects to hold when controlling for past condom use, an important prerequisite in support of the predictive validity of social–cognitive models (Hagger, Chan, Protogerou, & Chatzisarantis, 2016; Ouellette & Wood, 1998), and compared model effects across models that include and exclude past condom use as a control variable (see Figure 2). In addition, we tested the effects of candidate demographic (age, gender, socioeconomic status, religion, geographical location) and methodological (time since publication, time lag between psychological and follow-up behavior measures, sample context, study quality, inclusion of formative research) moderators on relations among the social–cognitive constructs, and condom use intentions and behavior. These moderators have been identified as factors likely to magnify or diminish the relationship between constructs from social–cognitive theories and condom use in young sub-Saharan African populations (Eggers et al., 2016; Protogerou & Hagger, 2017). In the event of substantive moderation, we tested differences in model effects using separate meta-analytic structural equation models in groups of studies representing each level of the moderator.

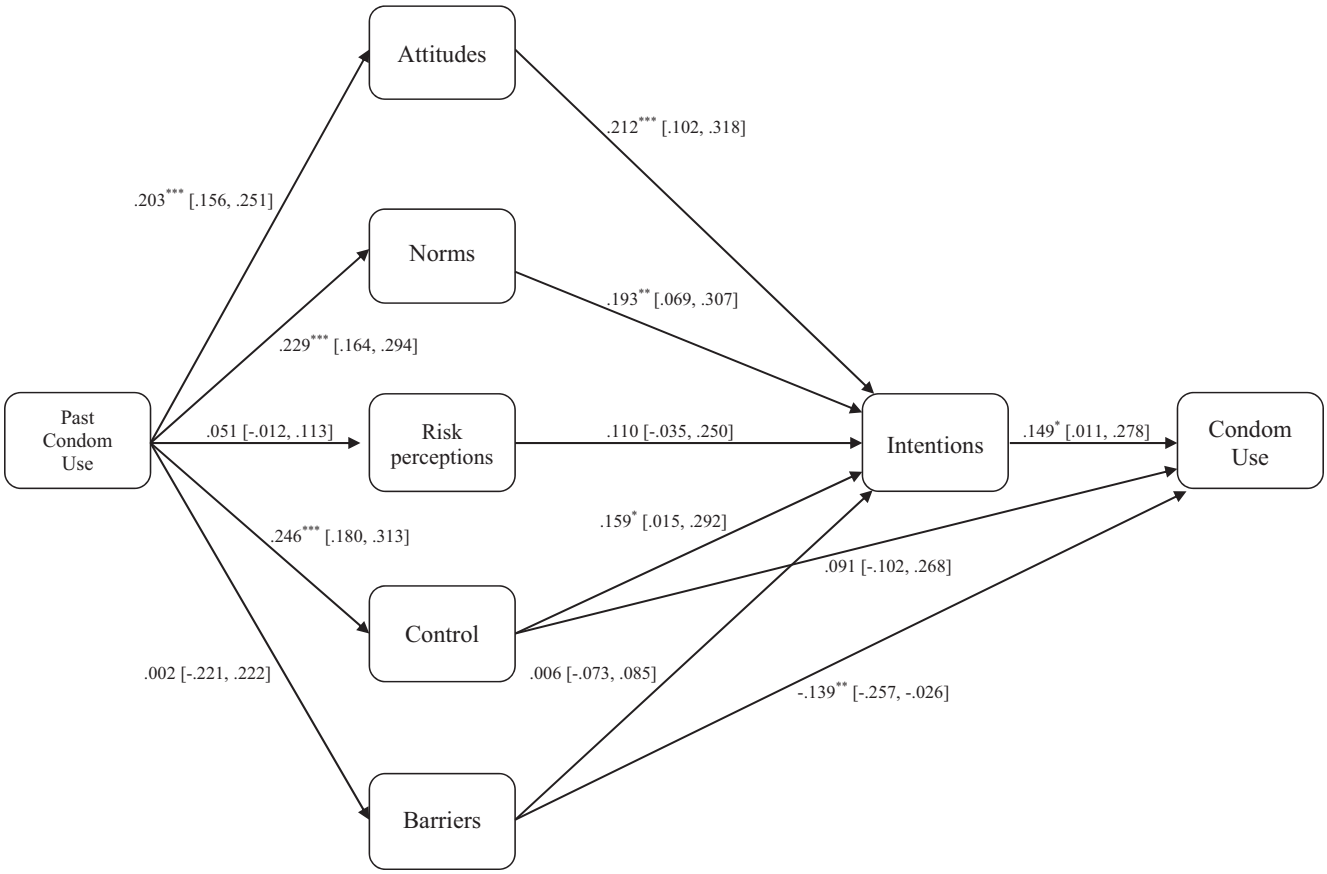

Figure 2. Path diagram of the integrated condom-use model including effects of past condom use. Coefficients are standardized parameter estimates (β) with likelihood-based 95% confidence intervals in brackets. Effects omitted from model for clarity: total effect, control→condom use, β = .115 [–.061, .280]; total effect, barriers→condom use, β = −.138 [–.252, −.022]; direct effect, past condom use→condom use, β = .433 [.225, .639]; total effect, past condom use→condom use, β = .510 [.306, .714]. * $p < .05$. ** $p < .01$. *** $p < .001$.

Method

Search Strategy

We conducted a search of electronic databases including Web of Science, PubMed, PsycINFO, and Google Scholar up to August, 2016. In addition, we hand-searched reference lists of studies included from the database search, as well as relevant systematic reviews and meta-analyses, for additional eligible studies. Each sub-Saharan African country's name was a key word in the literature search, in addition to "Sub-Saharan Africa," "West Africa," "East Africa," "Southern Africa," and "South Africa." We combined these words with key terms describing sexual risk-taking ("sex," "condom," "HIV," "AIDS," "sexually transmitted disease," "STD," "sexually transmitted infection," and "STI"). Moreover, we combined the above terms with the names of separate social–cognitive theories and variations of the core constructs drawn from McMillan and Conner's classification system.

Selection Criteria

Studies were included if they (a) sampled young people from sub-Saharan African nations in educational (i.e., elementary, high-school, and higher education students) or noneducational settings (e.g., households, community settings); (b) were cross-sectional, prospective, or intervention-type designs; (c) used a measure of intended or actual condom use as an outcome variable; (d) provided at least one bivariate correlation between a social–cognitive construct falling into seven identified construct categories and condom use; and (e) were full-text peer-reviewed published articles and unpublished theses, written in English. Studies were excluded if they (a) did not use condom use as an outcome variable but employed other safer-sex or condom-use related behaviors (e.g., hormonal contraception, abstinence, delaying intercourse, condom use at first intercourse, purchasing, carrying, and negotiating condoms); (b) used composite outcome variables that included some parameter of condom use (e.g., averages of condom use and illegal substance use); (c) were duplicate versions of the original study (e.g., abstract-only report, conference presentation); and (d) were qualitative designs, government reports, and editorial/opinion pieces. There were no publication date restrictions. Following UNESCO's (2017) conceptualization of youth as ". . . a period of transition from the dependence of childhood to adulthood's independence and awareness of our interdependence as members of a community," and the African Youth Charter's def-

inition of youth as people between 15 and 35 years (African Union Commission, 2006), we included studies that had sampled people up to age 35. Two coauthors independently screened the abstracts for eligibility; then the full copies of eligible titles were screened using a priori inclusion–exclusion criteria, which resulted to the final list of included studies. Study selection and reasons for exclusion are presented in a flowchart (see Figure 3) based on PRISMA guidelines (Moher, Liberati, Tetzlaff, Altman, & the PRISMA Group, 2009).

Classification of Constructs

Guided by our proposed model based on McMillan and Conner's (2007) core health cognitions framework, we identified constructs from eight social–cognitive theories applied to condom use in the included studies: the theories of reasoned action and planned behavior (Ajzen, 1985; Ajzen & Fishbein, 1980); the health belief model (Rosenstock et al., 1988); social–cognitive theory (Bandura, 1986); information-motivation-behavioral skills model (Fisher & Fisher, 1992); the health action process approach (Schwarzer, 1992); the AIDS risk-reduction model (Catania, Kegeles, & Coates, 1990); protection motivation theory (Rogers, 1975); and the I-change model (de Vries et al., 2005). Constructs from these theories were matched with one of the seven constructs in our model: attitudes, norms, control, risk perceptions, barriers to condom use, intentions, and previous condom use. The process required a content analysis of the measure tapping the study construct and matching it with the appropriate model construct. We allocated content to category, matching independently, and compared our classifications. The classifications were the identical, which was expected, given that most studies used inventories developed by the social–cognitive theorists themselves. Protogerou and Hagger (2017) described the detailed process of construct classification.

Data Extraction

As all studies included in the current analyses were correlational in design, the zero-order Pearson correlation coefficient (r) was selected as the effect size metric. Effect sizes and associated

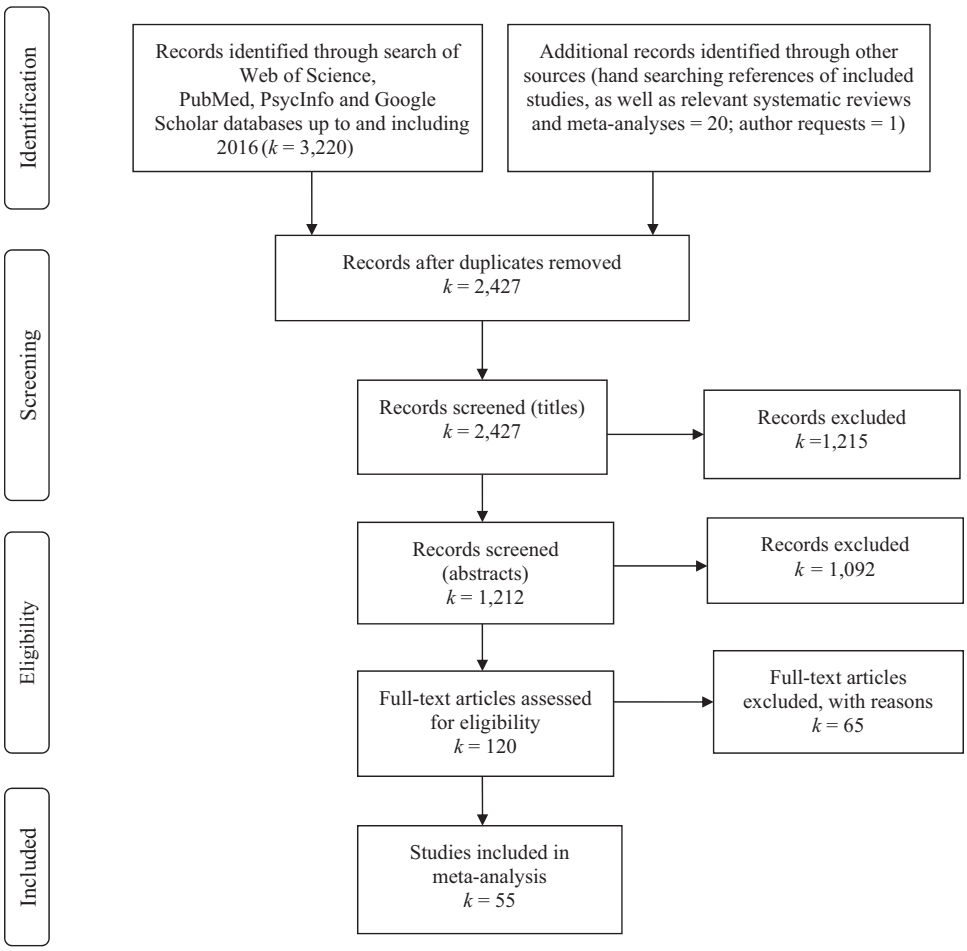

Figure 3. Flow of studies through meta-analysis based on PRISMA guideline. Reasons for excluding studies are as follows: (1) outcome variable was not condom use; (2) composite outcome variable included a parameter of condom use (e.g., averages of condom use and illegal substance use); (3) duplicate version of an original study (e.g., abstract-only report, conference presentation); and (4) a qualitative design, government report, or editorial/opinion piece.

sample sizes for relations among the model constructs were extracted from the source studies. In cases where an effect of interest was tested but insufficient statistics were reported to compute an effect size, we requested the data from the study authors. We also approached authors if information relevant to candidate moderators was missing. In the event that zero-order correlation coefficients among variables were not available but other effect size statistics were (e.g., t tests, χ^2, odds ratios), we used these to produce zero-order correlation coefficients using appropriate transformations. In cases in which studies included multiple measures of the dependent variable, we used the measure that was most closely matched to the target behavior (frequency of condom use). For studies that included relationships between condom use and more than one measure of the seven core social–cognitive constructs identified a priori (e.g., self-efficacy and perceived behavioral control), we produced an aggregated effect size by taking the average of the effects (Marín-Martínez & Sánchez-Meca, 1999). For studies that had adopted a prospective design and included follow-up measures of condom use behavior on multiple occasions, we used the dependent measure taken at the most distal time point to compute the effect size given that long-term follow up behavioral data are relatively rare in this literature. Of the 12 eligible prospective studies included in the analysis, only one had multiple follow-up measures of condom use.

Appraisal of Study Quality

Quality of included studies was appraised using the evidence-based librarianship (EBL) critical appraisal checklist (Glynn, 2006) and was included as a moderator of model effects. Study quality was evaluated on four domains: population (e.g., representativeness, appropriateness of selection criteria, response rate), data collection (e.g., clarity and validation of instruments, inclusion of instruments in report), study design (e.g., appropriateness of methodology, replicability, ethics approval), and results (e.g., clarity and accuracy of results, recommendations for future research, external validity). Each research domain is critically appraised by checking a yes, no, unclear, or not applicable, next to each criterion. "Yes" responses were assigned a score of 1, "no" responses were assigned a score of 2, "unclear" responses were assigned a score of 3, and "not applicable" responses were assigned a score of 4. A total score (per quality domain items or for all items) was computed by dividing the "yes" answers by the total number of items. Finally, in line with the tool's guidelines, we created a dichotomous study quality variable. Studies receiving a total score of less than 75% were considered of questionable quality, whereas studies with a total score of 75% or above were considered of acceptable quality. All included studies were scored by one coauthor, with a second coauthor assessing the quality of 15 randomly selected studies.

Moderator Coding

We coded studies into groups on the following moderator variables: participant age (younger or older), gender (predominately male, predominately female, balanced, male-only, or female-only), socioeconomic status (high, low, or not stated), predominant religion (Christian, other, or not stated), geographical location (peri-urban, rural, or both); sample context (school, higher education, or community), study quality (acceptable or questionable); and the inclusion of a preliminary formative research component (included or not included). In addition, time since publication (defined as number of years since publication to the end of the current search period), time lag between measures of social–cognitive constructs and follow-up measures of behavior (measured in weeks), and study quality were treated as continuous moderators. Testing for age as a moderator presented some challenges, as there was substantive within-study variability in the age of participants. We therefore performed moderator analyses with age as a categorical variable, defined as above or below the sample median of 18.5, and as a continuous variable by using the sample average. This value corresponds with the end of adolescence, when young people are expected to assume many more responsibilities (UNESCO, 2017). However, we recognize the inherent limitations of dichotomizing age, and of using the sample average as a continuous variable, which does not account for within-study variability. We also conducted moderator analyses with study quality as a categorical and continuous variable given that methodological tools have, by convention, been dichotomized into "acceptable" and "questionable" categories according to guideline cutoff scores but can also be treated as a continuous variable (Johnson, Low, & MacDonald, 2015). The extant literature has suggested that all these variables have the potential to influence the relationship between social–cognitive constructs and condom use in sub-Saharan African settings (Eggers et al., 2016; Protogerou & Hagger, 2017; Protogerou & Johnson, 2014). Nonetheless, sub-Saharan African studies have also found that these variables can increase, decrease, or leave the relationship between social–cognitive constructs and condom use unaffected (e.g., Bryan, Kagee, & Broaddus, 2006; Heeren, Jemmott, Mandeya, & Tyler, 2009; Protogerou, Flisher, Wild, & Aarø, 2013). Given these inconsistencies, we made no a priori predictions about the direction of moderator effects and viewed all moderator analyses as exploratory.

Data Analysis

Random-effects meta-analysis was used to compute averaged sample-weighted correlations (r_+) among model constructs using Hedges and Vevea's (1998) methods and SPSS macros developed by Field and Gillett (2010). The averaged sample-weighted correlations were considered nontrivial in value if they equaled or exceeded a small effect size ($<.10$) according to Cohen's (1992) guidelines. We also conducted heterogeneity tests of the averaged correlations using Cochran's (1952) Q and the I^2 statistics (Higgins & Thompson, 2002). Statistically significant Q values and I^2 values exceeding 25% are indicative of substantial heterogeneity in the correlations (Higgins & Thompson, 2002). We evaluated the presence of small-study bias in the averaged sample-weighted correlations by computing statistics based on plots of the correlations from each study against study precision (usually the reciprocal of the study sample size). Asymmetry in the predicted "funnel" shape of the plots is considered evidence of small study bias, that is, the tendency for studies included in the analysis to exhibit large effects relative to their size. This is often taken as a potential indicator of publication bias. We used Begg and Mazumdar's (1994) rank-order correlation to test for the interdependence of variance and effect size, with a significant correlation indicating the presence of publication bias.

Effects of categorical moderator variables on the correlations among model constructs were tested by conducting separate meta-analyses for correlations among constructs in groups of studies defined by each level of the moderator (e.g., younger and older participants). Comparisons were made using 95% confidence intervals about the averaged sample-weighted correlations in each moderator group with a formal test provided by Welch's t test. Categorical moderator analyses were conducted in cases where there were at least two studies at each level of the moderator. We also conducted a series of multivariable meta-regression analyses to examine effects of moderators that were continuous in format (e.g., study quality, average sample age, time lag between measures of psychological constructs and follow-up measure of condom use, time since publication) using Wilson's (2001) Metareg macros for SPSS. As moderator variables may be related, the meta-regressions also allowed us to examine unique effects of selected categorical and continuous moderator variables on the correlations among model variables. As the numbers of studies that included a follow-up measure of condom use numbered very few ($k = 12$), we opted to conduct single-variable meta-regressions for the time lag moderator to maximize statistical power, but we acknowledge the limitation of this analysis as it does not test the unique effect of this moderator when controlling for other moderators. In this analysis, we did not predict that time lag would moderate correlations among concurrently measured variables. However, recognizing that effects in prospective models tend to decline over time (Gollob & Reichardt, 1987), we expected effects between psychological variables and prospectively measured condom use would be smaller with increasing time lag. In instances where a moderator indicated a significant prediction of the effect size, we used the moving constant technique to estimate the conditional effect size (and its statistical significance) at meaningful levels of the moderator, such as the mean and one standard deviation above and below the mean (Johnson & Huedo-Medina, 2011). The analysis involves subtracting the conditional moderator value of interest from each moderator, rerunning the meta-regression, and repeating as necessary. The analysis produces an index of moderation (Q_M) and conditional values of the correlation ($\hat{r}$) at the conditional levels of the moderator.

Hypothesized relations among constructs in the integrated model were tested through meta-analytic structural equation modeling using the MASEM package (Cheung, 2015; Cheung & Hong, 2017) on R (R Development Core Team, 2017). Traditional approaches to analyzing multiple relations among social–cognitive variables have typically adopted a univariate approach, which involves subjecting matrices of averaged sample-weighted correlations among variables in the model, derived from meta-analysis, to path analysis (Hagger, Chan, et al., 2016; Hagger & Chatzisarantis, 2016). Such approaches have inherent limitations such as using the same sample size to estimate the models and treating the averaged correlation matrix as a covariance matrix, which may lead to inaccuracies in the estimated standard errors, confidence intervals, and χ^2 values of the resulting models (Cheung, 2015). The meta-analytic structural equation modeling approach is a two-stage alternative that overcomes the limitations of the univariate approach. In the first stage, transformations are applied to correlation matrices from individual studies to account for study-specific random effects so that they can be analyzed as covariance matrices a structural equation model. Specifically, the analysis yields a pooled correlation matrix, which represents the estimated average correlation matrices of the population, and the associated asymptotic sampling covariance matrix, representing the precision of the estimated average correlation matrix. In the second stage, the a priori model is fitted to the covariance matrix from the first stage. Missing data are handled by use of full information maximum likelihood estimation.[1]

We estimated two models in our meta-analytic structural equation modeling analysis: A model testing the hypothesized effects among study constructs as stipulated in the proposed integrated model (see Figure 1), and a modified model that included past condom use as a predictor of all other constructs in the model (see Figure 2). Fit of the proposed model with data from the meta-analysis was evaluated using multiple goodness-of-fit indices: the model goodness-of-fit chi-square, the comparative fit index (CFI), the Tucker–Lewis index (TLI), the standardized root mean square of the residuals, and the root mean error of approximation (RMSEA). A nonsignificant chi-square, and CFI and TLI values that approach or exceed .95, a standardized root mean square residual (SRMSR) value of less than .008 and a RMSEA value of .005 or less indicate good fit of the model with the data (Hu & Bentler, 1999). Variability about parameter estimates including direct and indirect effects was estimated using likelihood-based confidence intervals. Likelihood-based confidence intervals have an advantage of Wald confidence intervals based on the standard errors as they capture asymmetry in the parameter distributions (Cheung, 2007, 2009). On the basis of guidelines proposed by Seaton, Marsh, and Craven (2010), we adjudged a .10 value for parameter estimates to be the minimum considered for the effect to be nontrivial and have "meaningful value", with smaller values ($<.075$) regarded as unsubstantial, even if they achieve statistical significance. We evaluated whether inclusion of past condom use as a predictor in the model would result in an attenuation of effects of study constructs (attitudes, norms, control, risk perceptions, and barriers) on intentions, and of intentions on behavior, by comparing the confidence intervals of the parameter estimates from the model excluding past behavior, with those from the model including past behavior. In cases where our moderator analyses indicated systematic effects of a moderator on relations among model constructs, we estimated the meta-analytic structural equation model in sets of studies at each level of the moderator. Heterogeneity statistics from the first stage of the model were used to evaluate whether the moderator had resolved the heterogeneity in correlations among variables. We used Schenker and Gentleman's (2001) standard method to test for differences in parameter estimates at each level of the moderator. Specifically, we computed 95% confidence intervals about the difference in the parameter estimates of interest. Confirmation of a statistically significant difference in a parameter estimate was supported if the confidence interval did not contain zero.

[1] See other sources for a full account of meta-analytic structural equation modeling approach (Cheung, 2015; Cheung & Hong, 2017), and online materials with worked examples are available at https://courses.nus.edu.sg/course/psycwlm/internet/metaSEM/masem.html

Results

Study Characteristics

Fifty-five studies, comprising 72 independent data sets (N = 55,069), were included in the meta-analysis. A list of included studies is provided in Appendix A (in the online supplemental material) and study characteristics are summarized in Appendix B (in the online supplemental material). Studies appeared between 1992 and 2016 as published journal articles (k = 50, 91%) or postgraduate dissertations (k = 5, 9%). Most studies used a cross-sectional design (k = 43, 75%) and reported a preliminary formative research phase (k = 34, 64%). Average sample age ranged between 12.1 and 26.5 (M = 19, SD = 3.43). Male participants were overrepresented, with 23 studies (42%) including predominately male samples (male composition >50%) and 13 studies (24%) including male-only samples. Thirteen sub-Saharan African nations were represented (Botswana, Cameroon, Ethiopia, Ghana, Guinea, Kenya, Namibia, Nigeria, Rwanda, South Africa, Tanzania, Uganda, and Zimbabwe), with a large number of studies being conducted in South Africa (k = 16, 29%). About half of the studies were conducted in (peri)urban (k = 30, 54%) and school settings (k = 27, 49%).

Appraisal of Study Quality

The majority of studies (k = 45, 88%) received a total score of <75% on the EBL checklist indicating questionable overall quality.[2] In terms of the separate domains of the checklist, studies exhibited highest quality scores in the *results* validity domain (M = 65.45, SD = 25.37), with most studies reporting results clearly (k = 47, 85%), accurately (k = 42, 76%), and completely (k = 48, 87%). Studies received the lowest quality scores in the sample validity domain (M = 42.75, SD = 22.59), revealing potential selection/sampling (k = 38, 69%) and representativeness (k = 25, 45.5%) biases. Inspection of individual checklist items revealed that the strongest study domain was the reporting of results, with 48 studies reporting full disclosure of findings (87.3%). The weakest study domain was replicability with only 10 studies (18%) providing sufficient methodological detail to allow replication. Interrater reliability analysis indicated substantial agreement in study quality ratings across all items (mean Cohen's κ = .73, 95% CI [.67, .80]) and total study quality scores (intraclass correlation = .949, p < .001) for the randomly selected subsample of studies.

Sample-Weighted Correlations

Averaged sample-weighted correlations among model constructs in the meta-analysis appear in Table 1, along with confidence intervals, heterogeneity tests, and publication bias statistics.[3] The averaged correlations among all but seven of the constructs were statistically significant and of sufficient size to be considered nontrivial.[4] However, correlations between barriers and all other constructs, between attitudes and risk perceptions, and between control and condom use, were not statistically significant, with confidence intervals that included zero. Levels of heterogeneity ranged from small to moderate in the current sample according to Q and I^2 statistics.

Moderator Analyses

Results of categorical moderator analyses are presented in Appendix C (in the online supplemental material), and results of meta-regression analyses are presented in Appendixes D and E (in the online supplemental material). We found relatively few effects of the moderators on model relations for moderator analysis with categorical moderator variables (see Appendix C in the online supplemental material). The formative research moderator had the most pervasive effect with six of the 25 relations among the integrated model variables demonstrating significant differences.[5] Specifically, the effects of attitudes on risk perceptions, intentions, and past condom use; the effects of norms and control on risk perceptions; and the effects of intentions on condom use were larger for studies that included a formative research component, compared with studies that did not. In contrast, we found few moderator effects for the participant age, gender, socioeconomic status, predominant religion, geographical location, sample context, and study quality moderators.

Focusing on the meta-regression analyses, the single-variable meta-regression analyses revealed significant effects of time lag on study effect size for relations between attitudes and norms, (β = .758, p < .001), attitudes and intentions (β = .541, p = .020), and norms and intentions (β = .626, p = .006; see Appendix D in the online supplemental material). Examining the correlations at conditional values of time lag (see Appendix E in the online supplemental material) indicated larger correlations when the time lag was longer for these three relations. Multivariable meta-regression analyses, in which study effect sizes were regressed on continuous (age, study quality score, time since publication) and dichotomous categorical (formative research) moderators, revealed formative research as a consistent predictor of correlations among study variables (see Appendix D in the online supplemental material). Specifically, the effects of attitudes on norms (β = −.472, p = .014), risk perceptions (β = −.661, p = .004), intentions (β = −.399, p = .016), and past condom use (β = −.411, p = .035) were all larger in studies that included formative research, corroborating the categorical moderator analyses for this variable (see Appendix C in the online supplemental material). In addition, we

[2] Scores on the study quality checklist for each study are available on the Open Science Framework (https://osf.io/usrw8/).

[3] Raw data and analysis files are available on the Open Science Framework (https://osf.io/usrw8/).

[4] There were no studies available to compute effect sizes for two effects: barriers-condom use and barriers-risk perceptions leaving two empty cells in our correlation matrix. In order to complete the correlation matrices for subsequent model test, we filled the empty cells with effect sizes from studies that closely represented the constructs and population of interest. For the barriers-future condom use effect, the effect size was sourced data from Sheeran et al.'s (1999) meta-analysis of the psychosocial correlates of heterosexual condom use. For the barriers-risk perceptions effect, data were taken from Winfield and Whaley's (2002) test of the health belief model in African American students. Although neither study was on sub-Saharan African youth, these effect sizes are the closest estimates for these effects available in the extant literature. In addition, only one study included in the current analysis tested the risk perceptions-condom use effect, so this effect in the matrix is the raw effect size that has not been weighted by sample size.

[5] Our model comprised 28 relationships among constructs. However, two relationships were excluded from the moderator analysis because they were not tested by any study in our sample (we filled these empty cells with data from the Sheeran et al., 1999 and Winfield and Whaley, 2002 studies), and a further relationship (risk perceptions-condom use) was excluded because only one study tested it.

Table 1
Averaged Sample-Weighted Correlation Coefficients (R_+) and Heterogeneity Statistics for Effects Among Constructs From the Integrated Condom Use Model

Relationship[a]	k	N	r_+	CI_{95} LL	CI_{95} UL	τ	Q	df	I^2	τ_k
Attitudes										
Norms	29	26,935	.35	.28	.42	.04	53.82**	28	47.97	–.19
Control	27	28,135	.31	.20	.42	.10	33.00	26	21.19	.06
Risk perceptions	16	10,862	.07	–.06	.20	.07	16.35	15	8.26	–.19
Barriers	7	3,015	.04	–.11	.19	.04	12.54	6	52.16	.15
Intentions	39	30,408	.38	.31	.45	.06	63.98**	38	40.60	.03
Condom use	8	3,668	.20	.13	.26	.01	7.78	7	10.04	.05
Past condom use	30	32,101	.20	.15	.25	.17	36.74	29	21.08	.13
Norms										
Control	28	27,035	.36	.26	.45	.08	38.60	27	30.05	–.19
Risk perceptions	7	4,040	.28	.18	.38	.01	7.59	6	20.95	–.71*
Barriers	2	302	.17	–.06	.38	.02	1.00	1	.00	–1.00**
Intentions	39	30,730	.40	.32	.47	.07	57.84*	38	34.29	–.05
Condom use	8	3,668	.21	.14	.28	.01	30.84***	7	8.19	.28
Past condom use	27	29,283	.22	.13	.31	.06	20.18	26	.00	.10
Control										
Risk perceptions	9	6,401	.30	.13	.45	.07	9.95	8	19.58	–.05
Barriers	2	302	.07	–.04	.18	.00	.72	1	.00	–1.00
Intentions	37	30,539	.39	.31	.47	.09	59.71**	36	39.71	–.25*
Condom use	8	3,668	.17	–.04	.37	.09	6.09	7	.00	.57*
Past condom use	34	40,046	.27	.19	.34	.05	32.49	34	.00	.09
Risk perceptions										
Intentions	17	7,517	.24	.12	.36	.07	17.77	16	9.99	–.19
Condom use[b]	1	1,006	.08							
Past condom use	15	12,472	.05	.00	.10	.01	27.88*	14	49.79	.07
Barriers										
Intentions	5	1,305	.05	–.23	.32	.01	3.27	4	.00	.00
Past condom use	6	3,041	.03	–.18	.24	.07	8.18	5	38.89	–.07
Intentions										
Condom use	9	3,988	.28	.20	.35	.01	16.83*	8	.00	.28
Past condom use	15	23,363	.31	.18	.43	.07	20.03	14	30.11	.10
Condom use										
Past condom use	5	2,050	.49	.21	.70	.13	3.84	4	.00	–.20

Note. r_+ = sample-weighted average correlations; k = number of studies; N = total sample size; CI_{95} = 95% confidence intervals for sample-weighted averaged correlation; LL = lower limit of 95% confidence interval; UL = upper limit of 95% confidence interval; τ = estimated variance in population (Fisher-Transformed correlation); Q = Cochran's (1952) Q homogeneity statistic; df = degrees of freedom for the Q statistic; I^2 = Higgins and Thompson's (2002) I^2 statistic; τ_k = Begg and Mazumdar's (1994) ranked correlation statistic based on Kendall's τ.
[a] Effect sizes for the relationships between risk perceptions and barriers and between barriers and condom use are omitted as no studies in the current sample tested these effects. [b] Only one study in the current sample provided a test of the relationship between risk perceptions and condom use, which precluded a meta-analytic synthesis; the reported effect size is raw effect size reported in the study.
* $p < .05$. ** $p < .01$. *** $p < .001$.

found significant effects of age for the attitude-norms ($\beta = -.573$, $p = .001$), attitudes-risk perceptions ($\beta = -.642$, $p < .001$), norms-control ($\beta = -.483$, $p = .012$), and intentions-past condom use ($\beta = .911$, $p < .001$) relationships. An examination of the conditional values for this moderator (see Appendix E in the online supplemental material) indicated that correlations were generally larger in younger samples, with the exception of the intentions-past condom use relationship for which no significant differences in the effect size were found at each level of the moderator (see Appendix E in the online supplemental material). The multi-variable meta-regressions also revealed a statistically significant effect of study quality on the attitude-risk perceptions relationship ($\beta = -.937$, $p = .025$; see Appendix D in the online supplemental material). However, examination of the correlation at conditional values of study quality did not reveal statistically significant differences in the effect across levels of study quality (see Appendix E in the online supplemental material).

Meta-Analytic Structural Equation Models

Standardized parameter estimates and likelihood-based confidence intervals for the meta-analytic structural equation model of the integrated condom use model excluding past behavior, and the model including past condom use are presented in Figures 1 and 2, respectively.[6] In addition, indirect effects, confidence intervals of parameter estimates, and tests of difference in path coefficients across the models including and excluding past condom are provided in Appendix F (see the online supplemental material). The

[6] Raw correlation matrices, analysis scripts for R, and output from the R workspace can be found at https://osf.io/usrw8/

model excluding past condom use exhibited good fit with the data, $\chi^2(3) = 8.212$, $p = .042$; CFI = .991; TLI = .934; SRMSR = .036; RMSEA = .005. Model parameter estimates revealed statistically significant, nontrivial direct and positive effects of attitudes, norms, and control on condom use intentions, while effects for risk perceptions and barriers were not significant and trivial in size. We also found statistically significant, nontrivial direct and positive effects of intention and control on condom use, and negative effects of barriers on condom use.[7] In addition, the analysis yielded statistically significant indirect effects of attitudes, norms, and control on condom use mediated by intentions.[8] Indirect effects of risk perceptions and barriers on condom use were not statistically significant. The model accounted for statistically significant nonzero proportions of the variance in intentions (24.88%) and condom use (14.73%). Overall, results supported the hypothesized pattern of effects in the proposed model. The model including past condom use as a predictor also exhibited good fit with the data, $\chi^2(3) = 3.728$, $p = .292$; CFI = .999; TLI = .991; SRMSR = .022; RMSEA = .002. The inclusion of past condom use resulted in some observed reductions in the magnitude of the effects of intention and control on condom use. However, these reductions were not statistically significant according to the standard method (Schenker & Gentleman, 2001; see Appendix F in the online supplemental material). The inclusion of past behavior also resulted in no significant differences in the magnitude of the indirect effects of attitudes, norms, and control on behavior mediated by intention. There were nontrivial, statistically significant effects of past condom use on all model variables and statistically significant total indirect effect of past condom use on condom use mediated by the social–cognitive variables. Inclusion of past condom use as a predictor in the model resulted in a minor increase in the proportion of variance explained in condom use intentions (26.39%), and a much larger increase in variance explained in behavior (29.71%), reflecting the substantive direct effect of past condom use on future condom use.

Given the pervasive effect of the formative research moderator, we aimed to examine whether the pattern of relations in the integrated condom use model varied in groups of studies that included formative research and those that did not. We therefore set out to conduct separate meta-analytic structural equation models in groups of studies determined by the formative research moderator and compare the magnitude of the effects.[9] However, several of the model relations were not tested in the group of studies without a formative research component, which meant that several of the cells in the pooled correlation matrix were empty, precluding estimation of the model in this group. So we conducted a sensitivity analysis to evaluate whether our conclusions regarding the pattern of effects in our model were affected by excluding studies that did not include a formative research component ($k = 31$). The model for the sample of studies excluding studies without a formative research component exhibited satisfactory fit with the data ($\chi^2 = 3.940$, $df = 3$, $p = .268$; CFI = .999; TLI = .989; SRMSR = .031; RMSEA = .003).[10] Full model results appear in Appendix G (in the online supplemental material).[11] There were no significant differences in the pattern of effects in the model estimated in the full sample of studies and the model estimated in the sample of studies excluding studies without a formative research component according to the standard method (Schenker & Gentleman, 2001; see Appendix G in the online supplemental material). As we found little evidence of systematic moderation of relations among study variables for any of the other moderator variables, we did not conduct additional moderator or sensitivity analyses of model effects for any of the other moderators.

Publication Bias

Begg and Mazumdar's (1994) rank correlation test suggested little evidence of systematic publication bias across effects among model constructs. As Table 1 shows, t test revealed potential bias in four of the 25 averaged sample-weighted correlations: norms—risk perceptions, control—intentions, and control—condom use; one, control–condom use, actually showed a reversal, suggesting stronger linkages in larger studies.

Discussion

The purpose of the current research was to develop an integrated model of the determinants of young peoples' condom use in sub-Saharan Africa, meta-analyze studies adopting model constructs to predict condom use in this population, and test the model using meta-analytic structural equation modeling. We also aimed to assess the impact of candidate moderators on the obtained relationships among theoretical constructs and between theoretical constructs and condom use. The model was developed from research applying social–cognitive theories to condom use with model constructs classified along the lines of McMillan and Conner's (2007) core health cognitions approach. Attitudes, norms, control, risk perceptions, barriers to condom use, intentions, and previous condom use, were included in the proposed model, with intentions serving to mediate the effects of the core constructs on condom use. We identified studies including correlations among these constructs in a comprehensive database search and subjected them to random-effects meta-analysis. Studies were also coded into groups on the following moderator variables: age, gender, socioeconomic status, religion, geographical location, time from publication, sample context, study quality, follow-up time lag, and inclusion of formative research. We found statistically significant

[7] The direct effect of perceived behavioral control on behavior has been identified as a conditional effect in the theory of planned behavior (Ajzen, 1991). Ajzen proposed that when perceived behavioral control approximated actual control, that is, served as a proxy measure of control, it should directly predict behavior, but otherwise its influence should be directed through intention.

[8] Although the sizes of the indirect effects were much smaller compared with the direct effects, they should not be interpreted using the same effect size criteria as they are produced by computing the product of the direct effects.

[9] Given the importance of including past behavior in the model, we only estimated the version of the integrated model that included past behavior at each level of the moderator.

[10] Goodness-of-fit statistics for the model in the full sample were identical to those for the previously-estimated full-sample model including past behavior.

[11] Likelihood-based 95% confidence intervals could not be computed for some of the direct effects in the model excluding studies without a formative research component, most likely due to small sample sizes. In this case, Wald CIs are provided for the direct effects in this model. However, likelihood-based confidence intervals were computed for the indirect effects.

averaged sample-weighted correlations among the majority of the model constructs (i.e., all but seven). Testing the proposed model using meta-analytic structural equation modeling revealed significant, direct, nontrivial, positive effects of attitudes, norms, and control on condom use intentions. We also found significant, positive, nontrivial effects of intention and control on condom use, and a significant negative effect of barriers on condom use. In addition, we found significant indirect effects of attitudes, norms, and control on condom use, mediated by intentions. Inclusion of past behavior in the model resulted in some observed attenuation of effects in the model, particularly the effect of control on condom use, but there were no significant differences. Past behavior also accounted for a substantive proportion of the variance in condom use. Moderator analyses revealed few differences on study variables across moderator groups. Of the moderators, the inclusion of formative research had the most pervasive effect on model relations. A sensitivity analysis using meta-analytic structural equation model was conducted to test whether exclusion of studies that did not include a formative research component altered our conclusions with respect to model effects. The analysis revealed that proposed model effects hold with no substantive variation in effect sizes as a result of excluding studies without formative research.

Implications for the Integrated Model

The integrated condom-use model accounted for substantial variance in condom use intentions and actual behavior in sub-Saharan African youth. Attitudes, norms, control, and barriers to condom use were prominent predictors, while risk perceptions had weak effects. Results are broadly consistent with research that has applied social–cognitive theories such as protection motivation theory and the theory of planned behavior to condom use in other populations (e.g., Albarracín et al., 2001; Bengel, Belz-merk, & Farin, 1996; Sheeran & Orbell, 1998), although the sizes of the effects, particularly the intentions-condom use relationship were smaller in the current study. It is important to note that effect sizes of attitudes, norms, and control factors on behavior through intentions were similar in magnitude. Norms may have an important role in this context, and similar findings have been reported in research applying social–cognitive theories such as the theory of planned behavior and the reasoned action approach to condom use and other risk behaviors (McEachan, Conner, Taylor, & Lawton, 2012; McEachan et al., 2016; Rich, Brandes, Mullan, & Hagger, 2015; Sheeran et al., 1999). Given the equal, additive effects of the three components, interventions that target all three sets of beliefs may be effective in promoting condom use. Therefore, messages that promote the advantages of condom use and downplay drawbacks, promote obligation to sexual partners and significant others, and enhance confidence in using condoms may be optimally effective strategies to enhance condom use. In the present analysis, the direct negative effect of barriers on condom use and the lack of an indirect effect through intentions, suggests that perceived barriers to condom use (e.g., perceived stigma, beliefs in reduced pleasure or effectiveness, religious beliefs) may be less influential than actual barriers (e.g., access to condoms and refusal of partners to use condoms). These findings are consistent with the premise of the theory of planned behavior (Ajzen, 1985) that control-related perceptions and barriers will directly predict behavior to the extent that they align with actual constraints on behavior. These findings also support a basic premise of the health belief model (Rosenstock et al., 1988), which specifies direct effects of beliefs about barriers on health behavior. Reducing these barriers may also be an appropriate avenue for intervention. The nonsignificant, trivial effect of risk perceptions is consistent with previous studies that have tested the unique effects of risk perceptions on health behavior in integrated models (e.g., Barg et al., 2012; Hattar, Pal, & Hagger, 2016; Maher & Conroy, 2016). It seems that beliefs about benefits and costs, significant others' influence, and personal capacity are more salient than beliefs relating to risk. In the context of condom use, this is extremely pertinent as many campaigns and educational programs aimed at condom use have focused on raising individuals' awareness about risk including highlighting perceptions of vulnerability to STIs and the severity of these conditions (e.g., Harvey, Stuart, & Swan, 2000). Such approaches may be less effective compared with targeting personal beliefs on condom use.

The inclusion of past condom use in the model led to observed attenuation of some of the effects in the model and a strong direct effect of past condom use on subsequent condom use. Reduction of the effect of intention on behavior by past behavior is consistent with other tests of social–cognitive models in health behaviors in primary studies and meta-analyses (Hagger & Chatzisarantis, 2016), including research examining condom use (Albarracín et al., 2001). However, the reduction in the size of the effects in the current analysis with the inclusion of past condom use was relatively trivial and not statistically significant. Inclusion of past condom use in the model, however, accounted for a substantive proportion of additional variance in condom use. Importantly, there were statistically significant direct and indirect effects of past condom use on future condom use through the model constructs. According to Ouellette and Wood (1998), direct effects of past behavior on subsequent behavior may model habitual effects, behavioral stability, and represent the nonconscious, automatic processes by which behavior is enacted. Indirect effects through intentions and other social–cognitive variables may reflect deliberative, rational decision-making processes. Given that the direct effect was much larger than the indirect effect of past condom use on condom use, current findings suggest that condom use in sub-Saharan African youth has a strong habitual component. One interpretation of this pattern of effects is that the decision to use condoms, or not, is predominantly determined by previous experience and past habits. It also implies that intentional processes might play a less important role. Of course, the significant, nontrivial effects of intentions on condom use mean that effects of intentions are not negligible, and that intervening to change intentions remains a viable prospect. However, the impact of intentions may be weakened in the face of strong habits. In such cases, it may be necessary to use intervention strategies aimed at promoting habitual use of condoms, or means to break habitual nonuse. Such strategies may include cue-identification and management and self-monitoring (Hagger, Luszczynska, et al., 2016). Getting individuals to recognize the potential cues or prompts to unwanted behaviors and manage them is one strategy to circumvent habitual action. Similarly, flagging cues to carry or ensure availability of condoms (e.g., going to a social gathering, visiting a potential partner) and also situations in which one is likely to negotiate their use with a prospective partner, and dealing with potential negative responses, may assist in preventing habitual nonuse. It is also

possible that the direct effect of past behavior on condom use is due to shared method variance between the two behavioral assessments. This may have been a possibility given that condom use was measured exclusively by self-report. However, the time lag between assessments may have mitigated such effects.

Effects of Moderators

Overall, few of the averaged sample-weighted correlations among model constructs were related to the moderators we coded. Results provide little evidence to indicate a systematic pattern of moderation. Heterogeneity in effect sizes was low to moderate in most cases, which may explain why candidate moderators did not substantially impact construct relationships. The only exception to this pattern was the formative research moderator. Six of the 25 effects were stronger in studies that included a formative research component, in relation to studies that did not include formative research. The inclusion of a formative research component may have benefited studies in several respects. For example, formative research in these studies focused on the development and piloting of study measures, particularly ensuring that the content of items is relevant to the sample (e.g., by identifying salient beliefs), and improving the correspondence between the measures and the target behavior. This process is likely to have improved the precision of the study measures and reduced method variance. Consequently, the inclusion of formative research is an important methodological step in developing measures when testing social–cognitive models in condom use research in sub-Saharan Africa youth. However, these differences did not translate to variations in effect sizes when testing the full model. Our sensitivity analyses did not indicate any variation in model effects when studies without a formative research component were excluded. Given that the moderator analysis affected relatively few relations the integrated model, it is likely that the moderator effects were insufficiently pervasive to have a substantive effect on the full network of constructs in the proposed model. Overall, these results provide preliminary evidence that excluding studies without a formative research component did not have meaningful effects on model tests and did not affect conclusions drawn. Still, it is important to acknowledge that we were unable to test the model in a set of studies without a formative component due to insufficient studies testing some of the model relations, which precluded a comparison of models for mutually exclusive sets of studies that included and did not include a formative research component.

Strengths, Limitations, and Avenues for Future Research

The current study is the first to develop and test an integrated condom use model in sub-Saharan African youth based on a meta-analytic synthesis of studies testing social–cognitive models in this context. Our model and research synthesis make a number of important contributions. Consistent with the advocacy of integrated theoretical approaches to provide efficient and comprehensive means to explain behavior (Hagger, Koch, et al., 2017; Hamilton, Kirkpatrick, Rebar, & Hagger, 2017; Montaño & Kasprzyk, 2008), we developed our model by integrated constructs from multiple social–cognitive models applied to condom use following McMillan and Conner's (2007) core cognitions framework. This endeavor reduced redundancy across multiple constructs, increased parsimony in predictors, and identified the social–cognitive predictors that may be optimally effective in predicting condom use and associated processes. Our analysis also demonstrated the unique effects of the integrated model constructs on condom use intentions and behavior across studies included in the analysis using meta-analytic structural equation modeling. Finally, we tested the effects of a number of candidate moderators of effects among the integrated model constructs.

Many of the limitations of the current analysis relate to shortcomings in the included studies. For example, the majority of studies were classified as of 'questionable' methodological quality, based on our chosen quality appraisal tool. Still, our moderator analyses indicated that study quality did not systematically influence any of the averaged sample-weighted correlations among model variables. Nevertheless, a separate methodological artifact, the inclusion of formative research, did have an effect on some of the study relations, indicating the importance of developing appropriate measures that are likely to capture constructs of interest with greater precision. A related issue is the relatively small number of studies in some levels of the moderator variables (see Table 1). In some cases, moderator groups' sample sizes included fewer than five studies, which likely reduces the precision of the estimate and increases the sensitivity of the effect size to outlier effects. In addition, to estimate the structural equation models, we had to complete two empty cells in the set of correlation matrices with data from primary research on condom use in other contexts. While we took care in filling these cells with data from condom use studies that had sampled closely related populations, current findings should be interpreted with this caveat in mind. As the number of studies in the field increases, future studies may be able to test the model on complete sets of correlation matrices and test effects of moderators with greater accuracy.

Although a number of the current studies were prospective in design and reported including a follow-up measure of condom use, a further limitation of the current studies was the preponderance of cross-sectional correlational data. Such data provide no basis on which to infer causal relations among model constructs, and the direction of effects is inferred from theory alone. Thus, other statistically plausible models that fit the current data could be found, even if the pattern of effects may be theoretically contraindicated (Hagger & Chatzisarantis, 2016; Hagger, Gucciardi, et al., 2017). We therefore advocate future research that aims to manipulate some of the key predictors of condom use intentions and behavior in sub-Saharan African youth and examine the effects on behavioral outcomes. A further issue is that variation in time lag between measures of the psychological variables and prospectively measured condom use across studies may also have added additional method variance to the sets of relations. Although we found larger effects with longer time lag for the attitudes-norms, attitudes-intentions, and norms-intentions relations, time lag did not moderate the correlations among the majority of the model constructs. Nevertheless, time lag remains a potential source of variance. As the literature expands, the probability of more studies with a greater variation in lag times increases, so examining time lag as a moderator should be a priority in future analyses. Finally, our model is limited in that it focuses exclusively on social–cognitive predictors and an individualist approach. The model is, therefore, silent on other influences such as implicit,

relational, societal, and structural factors (Johnson et al., 2010), which have been shown to impact condom use (Protogerou & Hagger, 2017). Related, although we found nontrivial, statistically significant effects among key model constructs, the effects were relatively small. Finally, a substantive proportion of the variance in condom use intentions and behavior remained unexplained. Future theoretical and empirical work should seek to incorporate additional variables into the model and evaluate the extent to which they add to the prediction of condom use in this population.

Conclusion

Our integrated model provides cumulative evidence of a core set of social–cognitive determinants of condom use intentions and behavior among sub-Saharan African youth derived from multiple models and theories. The model is the first to demonstrate the key predictors of condom use based on a synthesis of research in this population and context, and to identify salient predictors through a systematic synthesis of constructs and measures across social–cognitive models applied in this context. We anticipate that our model may provide a basis for future research examining the predictors, and hope to see further corroboration of the model predictions through primary research. The model may also assist in the development of interventions, particularly those that may assist in breaking habits and facilitating healthy self-regulation. We also expect our findings to inform future research, particularly in relation to the need to conduct formative research in developing measures, and the need for more experimental and intervention research aimed at manipulating key constructs in the model. Finally, we view the model as flexible and modifiable, and we look to future high quality tests of its premises to provide further data on how the model may be modified to improve its predictive validity.

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