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## Peer norms moderate the association between mental health and sexual risk behaviors among young men living in Dar es Salaam, Tanzania

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### Abstract

**Background**—Young men living in Dar es Salaam’s informal settlements face environmental stressors that may expose them to multiple determinants of HIV risk including poor mental health and risky sexual behavior norms. We aimed to understand how these co-occurring risk factors not only independently affect men’s condom use and sexual partner concurrency, but also how they interact to shape these risk behaviors.

**Methods**—Participants in the study were male members of 59 social groups known as “camps” in Dar es Salaam, Tanzania. We assessed moderation by changes in peer norms of the association between changes in symptoms of anxiety and depression and sexual risk behaviors (condom use and sexual partner concurrency) among 1113 sexually active men. Participants nominated their three closest friends in their camp and reported their perceptions of these friends’ behaviors, attitudes, and encouragement of condom use and concurrency. Anxiety and depression were measured using the HSCL-25 and condom use and sexual partner concurrency were assessed through self-report.

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**Results**—Perceptions of decreasing condom use among friends (descriptive norms) and decreasing encouragement of condom use were associated with lower levels of condom use. Perceptions of increasing partner concurrency and acceptability of partner concurrency (injunctive norms) among friends were associated with higher odds of concurrency. Changes in perceived condom use norms (descriptive norms and encouragement) interacted with changes in anxiety symptoms in association with condom use such that the negative relationship was amplified by norms less favorable for condom use, and attenuated by more favorable norms for condom use.

**Conclusions**—These results provide novel evidence of the interacting effects of poor mental health and risky sexual behavior norms among a hard to reach population of marginalized young men in Dar es Salaam. Our findings provide important information for future norms-based and mental health promotion interventions targeting HIV prevention in this key population.

### Keywords

Tanzania; men; mental health; condom use; concurrency; social norms; HIV

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## INTRODUCTION

There are 4 million young people ages 15–24 living with HIV (UNAIDS, 2014), 85% of whom live in sub-Saharan Africa (Idele et al., 2014). AIDS-related deaths among youth rose by 50% between 2005 and 2012 and adolescents and young adults account for a growing proportion of African populations (Idele et al., 2014), making the need to target and engage youth in HIV prevention increasingly important. In Tanzania specifically, 40 percent of new infections occur among 16–24 year olds (ICF International, 2013). Young men are important targets in HIV prevention in this context as gender norms position them to control the terms and conditions of sexual relationships (Barker & Ricardo, 2005), and encourage them to engage in high risk sexual behaviors including inconsistent condom use and sexual partner concurrency (Dunkle et al., 2006; Noar & Morokoff, 2002; Raj et al., 2006). Half of sexually active Tanzanian youth ages 15–24 did not use a condom at last intercourse in 2010, and nearly one-third reported concurrent partners (ICF Macro, 2011).

HIV risk in eastern and southern Africa has been observed to cluster in informal urban settlements (Greif et al., 2010; Magadi, 2013). The majority of urban residents in southern and eastern Africa live in these settlements, informally known as slums (United Nations, 2014). The populations of these settlements are growing due to rapid urbanization. In Dar es Salaam, the city's growing population has led to a high demand for improved infrastructure, which the government has been largely unable to meet, and as a result an estimated 70% of the city's population lives in informal settlements (United Nations, 2014). People living in these settlements lack access to sufficient housing and basic services such as water and sanitation (United Nations Human Settlements Programme, 2009). The prevalence of these living conditions is also explained by the high levels of poverty (Dar es Salaam City Council, 2004) and unemployment (21.5%) in the city (National Bureau of Statistics, 2014). Residence in contexts like these settlements is linked to HIV risk through a number of mechanisms. Both the state of poverty itself and the context of disadvantage in impoverished neighborhoods promote sexual risk behaviors (Akers et al., 2011; Bauermeister et al., 2011; Bowleg et al., 2014). As there are often poor education and employment options in these

settings (MacLeod, 2010; South et al., 2003), youth often lack hope and positive orientation to the future (Smith & Elander, 2006), which is in turn linked to risk behavior (Prince et al., 2016; Robbins & Bryan, 2004). Neighborhood physical disorder also contributes to psychological distress (Curry et al., 2008) by providing a constant reminder of one's status in poverty (Wilson, 2012). The living environment can shape mental health through other stressors, such as violence, poor housing, noise, and crowding (Morello-Frosch et al., 2011; Wallis et al., 2010); poor mental health in turn can shape sexual risk (Bowleg et al., 2014).

An impoverished living context has also been associated with riskier norms related to sexual behavior. The social isolation of impoverished neighborhoods can create a context in which distinct norms emerge and sustain themselves (Baumer & South, 2001; Wilson, 2012). Neighborhood disorder is also associated with the perceived prevalence of sexual risk behaviors (Davey-Rothwell et al., 2015). The potential clustering of risky social norms is of concern for HIV prevention as norms shape individuals' perceptions of acceptable behavior, particularly for youth who are more strongly influenced by the attitudes and behaviors of their peers than older adults (Giordano, 2003). Normative influence may take the form of active peer pressure (Bernburg & Thorlindsson, 2005), leading to perceptions of what behaviors are considered acceptable to peers, known as *injunctive norms* (Cialdini et al., 1990). Influence can also occur through less direct social learning processes (Browning et al., 2004; Harding, 2009) whereby peers both transmit and reinforce norms (Oostveen et al., 1996) shaping individual perceptions of what peers are actually doing, known as *descriptive norms* (Cialdini et al., 1990).

In disadvantaged contexts, youth are exposed to multiple susceptibilities including normative risk behaviors and poor mental health. It is important to understand if these coexisting susceptibilities simply add to one another or compound in shaping young men's predisposition to sexual risk behaviors. Knowledge of such a compounding (or interaction) effect would indicate the need to address these susceptibilities in tandem and not in separate, targeted programs. Because of previous preliminary quantitative evidence from the study population (Hill et al., 2016; Mulawa, Yamanis, Hill et al., 2016), we have chosen to focus on mental health and social norms to assess the extent to which these susceptibilities act together to shape sexual risk. Qualitative evidence from the study population also suggests the importance of sexual behavior norms in this context, indicating that men pressure and encourage each other to engage in sexual risk behaviors (Yamanis et al., 2010).

Behavioral norms and mental health have been shown to interact to shape drinking behaviors among youth in the US (Pedersen et al., 2013), but there are no studies to our knowledge assessing a similar relationship for sexual behaviors. To address this gap, we aim to understand if social norms moderate the relationship between mental health and sexual risk. The experience of anxiety and depression may create an inclination toward sexual risk behaviors through maladaptive coping to deal with stress (Bachanas et al., 2002) and impaired decision making (Bennett & Bauman, 2000). As peers serve as a reference groups which individuals look to in behavioral decision-making (Kemper, 1968), riskier norms among peers may increase the likelihood that an inclination toward risk behavior resulting from poor mental health manifests in actual risk behaviors. We therefore hypothesize that higher levels of risk behaviors among peers and perceptions of riskier norms among peers

will serve to magnify the risk relationship between mental health and sexual risk behaviors. Further, we aim to gain specific understanding of the role of different types of social norms in shaping men's sexual behaviors, and do so by additionally assessing the direct effect of observed peer behaviors and perceived behavioral norms on men's sexual behaviors. The results of this study offer implications for future interventions aiming to reduce HIV risk among young men living in urban informal settlements in East Africa.

## METHOD

### Study context

This study was conducted in the context of an HIV prevention trial, a cluster randomized trial of a microfinance and health leadership intervention to prevent sexually transmitted infections and intimate partner violence (Kajula et al., 2016). Participants in this trial were members of venues known as “camps” in Dar es Salaam where young men 1) socialize and engage in small-scale enterprise; 2) who typically belong to only one camp; 3) pay membership fees to belong to that camp; 4) frequent the venue for its supportive social environment; and 5) most camp members are not formally employed and spend several hours each day at their camp (Yamanis et al., 2010).

### Sampling and data collection

We identified camps for inclusion in the trial in four wards (equivalent to U.S. census tracts) of Dar es Salaam (Manzese, Tandale, Mwananyamala, and Mabibo) using an adaptation of PLACE (Priorities for Local AIDS Control Efforts) methodology (Weir et al., 2003). To be eligible for inclusion in the trial, camps had to have between 20 and 80 members, have been in existence for at least one year prior to the baseline assessment, and report no violent incidents with weapons in the past 6 months. A total of 303 camps were verified, of which 205 were eligible; 60 camps were randomly selected for inclusion in the study. Through member rosters completed by the leaders of these camps, 1,581 male members were identified and assessed for eligibility. To be eligible, men had to: 1) be a registered camp member for at least three months; 2) plan on residing in Dar es Salaam for the next 30 months; 3) be 15 years or older; 4) visit the camp at least once per week; and 5) be willing to provide contact information for themselves and two family members or friends to facilitate future participant contact regarding follow-up assessments for the study.

Eligible participants were asked to provide written consent, and consenting participants completed the baseline assessment in fall 2013 and a follow-up assessment 12 months after the launch of the intervention. Both questionnaires were administered by trained Tanzanian interviewers in Swahili using computer assisted personal interviewing (CAPI). A total of 1,258 men completed the baseline behavioral assessment, after which camp members from one camp ( $n=9$ ) were removed from the study because of new information rendering them ineligible for participation, resulting in a final baseline sample of 1,249 men within 59 camps. 978 men in the 59 camps completed the follow-up assessment for 78% retention.

## Measures

Condom use was measured as an ordered-categorical variable created from men's self-report of condom use with up to their three most recent sexual partners over the past 12 months. For each sexual partner, men reported how many times they engaged in sex with these partners over the most recent month of the relationship, and how many of these times they used a condom. We calculated men's proportion of condom use by dividing the number of times condoms were used by the total number of sex acts. Using these proportions, participants were assigned to one of three categories: "never use" (0% use), "some use" (greater than 0%, less than 100%), or "always use" (100%). This categorical approach is preferred to a continuous variable to minimize the effect of recall bias (Noar et al., 2006). To evaluate sexual concurrency, participants were asked to report if they had sex with anyone else during any of the same three most recent partnerships over the past 12 months. This measure was developed following best practices recommended by USAID (Zelaya et al., 2012).

Four types of norms were measured for both condom use and concurrency: friends' reported behaviors, perceived descriptive norms, perceived injunctive norms, and friend encouragement of the behavior. Men were asked to nominate their three closest friends in their camp by selecting names from a camp roster. Each friend nomination was linked to a record of the friend's reported behavior according to their own completed questionnaire using a unique identifier. Taking the reported behavior of all three friends for each individual, we created an average percent condom use and a percent of friends reporting concurrency measure for each participant. To assess perceived descriptive norms, men were asked for each of these three closest friends, "Do you think friend X uses condoms all the time?" For injunctive norms men were asked "Do you think friend X thinks that he should be using condoms all the time?" Finally, to assess friends' encouragement of behaviors men were asked "Has friend X encouraged you to use condoms all the time?" Men were asked analogous questions for partner concurrency and provided yes/no answers. We created a measure of the proportion of friends for which the respondent answered "yes" for each item.

Symptoms of anxiety and depression were measured using a version of the Hopkins Symptom Checklist-25 (Hesbacher et al., 1980), that had previously been translated and validated in Tanzania (Kaaya et al., 2002; Lee et al., 2008). Participants rated a total of 25 symptoms (10 related to anxiety, 15 to depression) rated on a four-point Likert-type scale. Anxiety and depression scores were calculated by taking the mean of the corresponding 10 and 15 items, respectively. At baseline both subscales showed good internal consistency ( $\alpha = 0.94$  for anxiety,  $\alpha = 0.91$  for depression).

Covariates included in all analyses include age, education level, economic status, marital status, and treatment condition. Age was calculated based on reported date of birth, or when not available the reported age in years. Participants reported the highest level of education they had completed and responses were collapsed into three categories: primary school or less (no education, Standard 4 or less, or Standard 5–7); some secondary school (Form 1, Form 2, or Form 3); or secondary school completed or greater (Form 4 or Greater than Form 4). Socioeconomic status (SES) was evaluated through the Filmer Pritchett Wealth Index (Filmer & Pritchett, 2001). Participants indicated which of 10 assets they owned (Vyas &

Kumaranayake, 2006), and a composite score was created by weighting each asset by its factor loading on the first component in a principle components analysis (Filmer & Pritchett, 2001). These scores were categorized into terciles (the lowest 33% as “lowest SES”, the highest 33% as “highest SES,” and the remainder as “middle SES”). Marital status was evaluated by asking men if they had ever been married. Finally, as the intervention being evaluated was designed to affect condom use and sexual partner concurrency, treatment condition was included as a covariate to account for this design effect in all analyses.

## Analysis

All statistical analyses were conducted in SAS v 9.4 and used a 2-sided significance level of 0.05. To address missing data (primarily due to attrition), we applied sequential multiple imputation using the fully conditional specification in *proc MI* (40 imputations, linear regression specification for continuous variables and logistic regression specification for categorical variables). To account for missing network ties in the Quadratic Assignment Procedure discussed below, we conducted imputation by reconstruction as recommended by Huisman (2009), randomly imputing ties proportionately to the observed network density.

In a previous study we found that that anxiety and depression were associated with men’s sexual risk behavior (Hill et al., 2016). In the present study we hypothesized that within-person change in behavioral norms would predict follow-up risk behavior controlling for baseline risk behavior, and that change in norms would moderate the relationship between changes in anxiety and depression, and sexual risk. To account for dependence due to clustering within camps, we fit multilevel models with a generalized link function, using *proc glimmix* with quadrature estimation (using 15 quadrature points), random intercepts, and logit and cumulative logit link functions (for dichotomous concurrency, and three-level condom use, respectively). For all models the dependent variable was sexual risk (condom use or concurrency) measured at the follow-up, controlling for baseline sexual risk and the covariates listed above. The primary predictors were change in each behavioral norm score, change in anxiety or depression (baseline score subtracted from follow-up score), and their interaction. In each model, the effect of only one behavioral norm score was tested at a time. Given the one-year time difference between the baseline and follow-up assessments, we selected change score exposure variables as we expected change in exposures over this time period to be more plausibly predictive than cross-sectional exposures at baseline, and more temporally informative than cross-sectional exposures at the follow-up. For each model, we assessed the interaction between mental health and peer norm change scores. Where these interaction terms were significant, we probed each significant interaction found by modeling the focal effect at the mean, one standard deviation above the mean, and one standard deviation below the mean of the moderator variable scores (Bauer & Curran, 2005).

For models including friend-reported behaviors, to adjust standard errors due to the dependence of observations we included controls for subgroup clustering within each camp. To account for such subgroups, we created a distance matrix for each camp where the cell values were the number of steps between each dyad. With each of these matrices we performed a principal components analysis to detect structurally significant subgroups

within the camp, calculated the factor loading of each individual on each of the principal components, and included these factor loading terms in the models as a control (Hoff, 2011).

In a separate modeling approach to further assess the role of peer influence on condom use and concurrency in men's full camp networks (as opposed to among men's closest friends), we tested friendship correlations for condom use and concurrency within each of the 59 camp networks using a Quadratic Assignment Procedure (QAP), which is a non-parametric procedure for significance testing which is used to infer social influence by relating measures of structural similarity (in this case, the existence of friendship tie) between two network members to a measure of their similarity on variables of interest (Borgatti et al., 2013).

### **Ethical Review**

The study was approved by the ethical review committees at the University of North Carolina at Chapel Hill and Muhimbili University of Health and Allied Sciences in Dar es Salaam, Tanzania. Individual written informed consent was obtained from all study participants.

## **RESULTS**

1249 men were interviewed at baseline, of whom 1113 (89%) reported being sexually active. 871 of these 1113 men (78%) participated at the follow-up. Men who did not participate at the follow-up did not significantly differ in their risk behavior from men who did (condom use:  $\chi^2 = 0.31, p = 0.58$ ; concurrency  $OR = 0.94, p = 0.75$ ). The 1113 men who reported being sexually active at baseline were included in the analyses presented below.

### **Participant characteristics**

Sexually active men interviewed at baseline had an average age of 27 years (Table 1; range: 15 to 59). Over half had a primary school education or less (59%), nearly a third had graduated from secondary school (31%), and the remaining 11% had some secondary school but had not graduated. A quarter of the men had ever been married (25%) and 38% had children.

### **Cross-sectional description and change in key variables**

Men had an average score of 1.4 (range 1 to 4 with higher scores indicating more severe symptoms) for both anxiety and depression symptoms at both baseline and at the follow-up assessment (Table 2). The mean change in depression and anxiety scores were both close to zero, but there was substantial variation in change scores ( $-0.03 \pm 0.76$  for depression and  $-0.03 \pm 0.72$  for anxiety). At baseline 21% reported clinically significant symptoms of depression and 19% did for anxiety based on a standard cutoff (score  $> 1.75$ ; Sandanger et al., 1998). At the follow-up 20% and 16% of respondents met the criteria for depression and anxiety, respectively.

At the sample level, there were relatively similar levels of condom use and concurrency across the two time points. About half of men reported never using condoms at both baseline

and the follow-up (53% and 52%, respectively). More men reported always using condoms at baseline than at the follow-up (33% and 26%, respectively). 14% of men reported sometimes using condoms at baseline, and this proportion increased to 22% at the follow-up. Many more men reported concurrency at the follow-up (262, 32%) than at baseline (193, 20%).

On average, men's three closest friends reported using condoms 43% of the time at baseline and 38% of the time at the follow-up. At baseline, on average, 21% of men's friends reported concurrency, and 30% did so at the follow-up. In comparison, at baseline, men perceived on average that 42% of their friends used condoms all the time, and that 24% of their friends had concurrent sexual partners (perceived descriptive norms). They also perceived that 59% of their friends thought that they should use condoms all the time and that only 18% would approve of them having concurrent sexual partners (perceived injunctive norms). Participants reported on average that 49% of friends had encouraged them to use condoms all the time, while 39% had discouraged them from having concurrent sexual partners. 150 (12%) men had no changes in their three closest friends named between baseline and the follow-up. 305 (35%) changed one friend, 312 (36%) changed two friends, and 141 (16%) changed all three friends.

### **Association between friend-reported and perceived norms**

In comparing friends' reported behaviors and men's perceptions of behavioral norms among their friends (Table 3), none of the correlations surpassed an absolute value of 0.04. Friends' own reports of their condom use and concurrency were not associated with men's perceptions of their friends' behaviors, their approval of these behaviors, or reports of their friends' encouragement of these behaviors.

### **Behavioral similarity among camp peers**

The results of the QAP analyses appear in Figure 1 as box plots of the individual results for each of the 59 camps. Overall, there was little evidence for peer similarity in concurrency or condom use at the camp level. On average, friends had 0.92 times the odds of having the same concurrency as non-friends (range: 0.43, 2.38;  $\beta(\log\text{ odds}) = -0.08$ ), but the estimated association was only significant at the .05 level only for 9 (15%) camps. Friends had 0.07 greater similarity in percent condom use than non-friends (range: -0.10, 0.40), but the estimated association was only significant for 7 (12%) of camps.

### **Condom use models**

In assessing moderation by condom use norms of the relationship between mental health and men's own condom use, we found that change in perceived descriptive condom use was significantly associated with men's condom use (Table 4;  $aOR = 1.63$ ; 95%  $CI = 1.20, 2.22$ ) and significantly interacted with changes in anxiety symptoms in association with condom use ( $aOR = 1.95$ ; 95%  $CI = 1.10, 3.47$ ). Changes in friend encouragement of condom use were also significantly associated with men's condom use ( $aOR = 1.54$ ; 95%  $CI = 1.15, 2.05$ ) and significantly interacted with changes in anxiety symptoms in association with condom use ( $aOR = 1.75$ ; 95%  $CI = 1.01, 3.02$ ). Changes in perceived injunctive condom use norms and



friends' self-reported condom use were not significantly associated with men's own condom use and did not significantly interact with anxiety or depression change.

Looking specifically at the interaction between anxiety symptoms and descriptive condom use in association with men's condom use, we present plots of the simple intercepts and slopes of the association between anxiety change and condom use, at the mean, at one standard deviation above, and at one standard deviation below the mean of each condom use norm change scores (Figure 2).

Men with greater increases in anxiety symptoms reported lower levels of condom use at the mean level of change in perceived descriptive condom use (simple slope =  $-0.20$ ,  $p=0.035$ ) and in condom use encouragement (simple slope =  $-0.21$ ,  $p=0.030$ ). This association was amplified with decreasing/worsening perceived descriptive condom use norms (simple slope at mean -  $1SD = -0.44$ ,  $p=0.004$ ) and with decreasing encouragement of condom use (simple slope at mean -  $1SD = -0.39$ ,  $p=0.009$ ). The association was attenuated by increasing/improving perceived descriptive norms for condom use (simple slope at mean +  $1SD = 0.03$ ,  $p=0.776$ ) and by increasing encouragement of condom use (simple slope at mean +  $1SD = -0.03$ ,  $p=0.761$ ).

### Concurrency models

In testing the hypotheses regarding moderation by concurrency norms in the relationship between mental health and partner concurrency, changes in perceived descriptive concurrency norms (Table 5;  $aOR=1.42$ ; 95%  $CI=1.02, 2.00$ ) and injunctive concurrency norms ( $aOR=1.50$ ; 95%  $CI=1.08, 2.10$ ) were significantly associated with men's concurrency. However, changes in levels of concurrency discouragement and friend-reported concurrency were not significantly associated with concurrency. None of these hypothesized moderators significantly interacted with either change in anxiety or depression in association with concurrency.

## DISCUSSION

The results of this study indicate that changes in perceived norms of behaviors among men's closest friends are associated with men's own condom use and concurrency behaviors. Specifically, perceived descriptive norms were associated with both condom use and concurrency, perceived injunctive norms were associated with concurrency, and direct encouragement was associated with condom use. Changes in perceived condom use norms (descriptive norms and reported encouragement) also interacted with changes in anxiety symptoms to shape condom use. Perceived norms and the self-reported behaviors of men's closest friends were not significantly correlated. Changes in the self-reported behaviors of men's closest friends were also not associated with men's own behaviors. Further, there was no observed similarity in these behaviors in men's larger camp friendship networks.

We found multiple significant associations between men's perceptions of behavioral norms among their closest friends and their own behaviors. Such perceptions can affect behavior as a normative behavior is seen as the "correct" thing to do in a given social context (Cialdini & Trost, 1998). People may also anticipate social acceptance or increase in social status as a

result of assuming a normative behavior (Bandura & McClelland, 1977; Heilbron & Prinstein, 2008). Motivation to adhere to the norm may even increase when peers directly reinforce perceptions of anticipated social rewards e.g. through direct encouragement (Brechwald & Prinstein, 2011). Among men's closest friends, we found that both perceived descriptive norms and friends' encouragement were associated with men's condom use, and descriptive and injunctive norms were associated with concurrency. While it appears that men's perceptions of their friends' adoption of behaviors (descriptive norms) are related to both condom use and concurrency, future studies should attempt to understand why direct encouragement may be related to condom use but not concurrency, and why perceptions of what behaviors friends find acceptable (injunctive norms) may be related to men's concurrency but not condom use.

We also found that descriptive condom use norms and encouragement to use condoms interacted with anxiety to shape condom use. As expected, with worsening condom use norms the risk relationship between anxiety and condom use was amplified, and with improving condom use norms the risk relationship between anxiety and condom use was attenuated. This interaction between mental health and peer norms can be understood through the fact that peer influence not only acts to directly shape behavior but peers may serve as a reference groups which individuals look to in behavioral decision-making (Kemper, 1968). In this way, higher levels of risk behaviors and approval thereof among direct peers will serve to magnify individual-level risks, such as those posed by poor mental health. Our results echo previous findings related to mental health, behavioral norms, and alcohol use (Buckner et al., 2011; Pedersen et al., 2013), and provide novel evidence of the interaction between mental health and sexual behavior norms. As we only found interactions in the relationship between anxiety and condom use, future studies should seek to understand why perceived norms might not interact with depression to shape young men's sexual behaviors, and why norms related to concurrency may not magnify the relationship between mental health and concurrency as they seem to do for condom use.

While we found numerous associations between changes in perceived norms and men's behavior, we found no support for the association between men's behavior and changes in the self-reported behaviors of men's closest friends or in their larger camp friendship networks. These results were surprising given previous studies which have found that individuals' sexual behaviors, including partner concurrency (Catania et al., 1989) and condom use (DiClemente, 1991; Romer et al., 1994; Zapka et al., 1993), reflect their peers' behavior. It is possible that men have other important friendships outside of their camps which may be more relevant to their sexual behavior than camp friendships. However, the fact that men's perceptions of camp friends' behaviors *were* associated with their own behaviors gives precedence rather to the hypothesis that men's perceptions of their friends' behaviors simply did not match their friends' actual behaviors.

To this point, we found no significant correlations between men's perceptions of their friends' behaviors and their friends' own self-reported behaviors, similar to previous findings in this population with regard to perceptions of friends' HIV testing (Mulawa, Yamanis, Balvanz et al., 2016). Such a finding is not entirely surprising, as individuals' perceptions of norms are related to observable peer behaviors, but these perceptions rarely

match what peers are actually doing as perceptions of norms are filtered through each individual's unique position and perspective (Tankard & Paluck, 2016). Previous research has shown that individuals tend to underestimate their peers' protective behaviors and overestimate their risky behaviors (Black et al., 2013). Other studies have observed a false consensus effect, or a tendency to misperceive peer behavior in a direction that is consistent with one's own behavior (Prinstein & Wang, 2005; Ross et al., 1977). Further, as people have limited opportunity to observe their friends' behaviors, they often use availability heuristics to interpret norms from memories of observed behaviors that are most readily available (Fiske & Taylor, 1984). For example, a peer who has a second concurrent partner may draw more interest or attention than peers who have only one partner, making the examples of concurrency more cognitively available.

Taken together, these perceptual biases could explain the fact that men's perceived norms did not correlate with directly friends' self-reported behaviors, and may explain the observed relationship between perceived norms and men's own behaviors. Though the change predictors included in our models indicate that within-individual changes in perceived norms were associated with men's behaviors, future research is needed to better determine the temporality of these relationships, that is, to determine if changes in perceived norms precede changes in behaviors or vice versa. It is also possible that norms and behaviors are mutually deterministic, that norms shape behaviors and perceived norms may in turn be revised to align more closely with one's own behaviors. A better understanding of these relationships is needed to inform norm change interventions, such as popular opinion leader interventions which aim to leverage the normative influence of key community members often used to target HIV risk behaviors (Jones et al., 2008; Kelly et al., 1997; Sikkema et al., 2000).

### Limitations

There are important limitations to this study. Respondents' willingness to report sexual risk behaviors may have been associated with the social acceptability of such an acknowledgment. Reports of sexual risk behaviors were retrospective, creating the opportunity for recall bias. Recall may have been more difficult in reporting condom use over 30 days of sexual contact than in reporting any concurrent sexual encounter over the course of a relationship, making recall bias a potentially larger issue in measuring condom use than partner concurrency. Given this potential reporting bias, the coding of the sexual behavior variables was designed to minimize this issue as discussed in the Methods. The HSCL-25 scale which was used to measure anxiety and depression was developed in a different cultural context than the study setting, though the scale version used has been previously validated in Tanzania (Kaaya et al., 2002; Lee et al., 2008). We were unable to represent all of the influence of peers in men's lives beyond camp relationships, thus the results of this study can only represent the normative context within camps. Nevertheless, these camps reflect an important peer groups for their members. There was approximately 22% attrition in the analytic sample at the follow-up assessment. While loss to follow-up might be speculated to occur among men with the poorer mental health and more sexual risk, men who did not participate at the follow-up did not significantly differ in their risk behavior from men who did (condom use:  $\chi^2 = 0.31$ ,  $p = 0.58$ ; concurrency  $OR = 0.94$ ,  $p =$

0.75). Furthermore, the application of multiple imputation served to minimize the influence of any potential bias from loss to follow-up. Finally, with the present data we cannot say if changes in norms and mental health preceded changes in men's sexual behaviors.

Experimental research with successful manipulation of perceived norms is needed to better determine the temporal direction of a potential causal relationship between perceived norms and these behaviors.

### **Implications for future research and intervention**

Future studies should seek to understand why different perceived descriptive, injunctive, and encouragement norms are more closely related to condom use or concurrency, and why perceived behavioral norms would interact with anxiety but not depression to shape sexual risk behaviors. A better understanding of these relationships and potential mechanisms explaining them would help to understand how to target different types of norms for different behaviors to optimize HIV prevention interventions. Scientists should also seek to understand what shapes men's perceptions of their friends' behaviors if not their friends' actual behaviors. Such an understanding would help to identify other potential important psychosocial targets for behavioral interventions. Future HIV prevention interventions should consider the importance of targeting perceived social norms and mental health simultaneously, as our results indicate that these factors act together to shape sexual behavior. In norms-focused interventions, it will be important to consider how participants' mental health, specifically anxiety, could affect the success of the intervention. In programs aiming to promote mental health, interventionists should consider the additional importance of condom use and concurrency norms, and aim to target perceptions of risky norms to prevent risk behaviors in high HIV prevalence populations. These measures will be particularly important among marginalized populations similar to the camps in the study, as men in these contexts may be exposed to multiple susceptibilities to risk behavior, including poor mental health and risky social norms.

As we found that men's perceptions of peer behaviors did not match their friends' actual behaviors, social norms interventions aiming to prevent sexual risk should consider promoting less risky perceived norms rather than or in addition to targeting the behavior of influential individuals. One successful approach to promoting realistic perceptions of peer behaviors and attitudes toward risky behaviors is found in myth-busting interventions (Stewart et al., 2002). In one example, a brief intervention in which university students were asked to estimate condom use and concurrency levels among their peers, and then to compare these estimates to actual data from a campus survey, was effective in increasing condom use and reducing partner concurrency (Chernoff & Davison, 2005). Where risk behavior data from a salient peer reference group are available, the efficacy of this type of intervention should be evaluated among marginalized youth.

### **Conclusion**

In this study of sexual risk behaviors among young men living in Dar es Salaam, we found that perceived norms affected young men's behaviors, and that these norms interacted with anxiety to shape sexual risk. We further found that perceived norms may not reflect actual peer behaviors, and found no evidence of peer influence in comparing self-reported

behaviors among men's closest friends and in their larger friendship networks. The results of this study provide novel evidence of the interacting effects of poor mental health and risky perceived norms among a hard-to-reach population of marginalized young men in Dar es Salaam. As such susceptibilities are common in the many informal settlements throughout eastern and southern Africa, our findings provide important information for future norms-based and mental health promotion interventions targeting HIV prevention in this key population.

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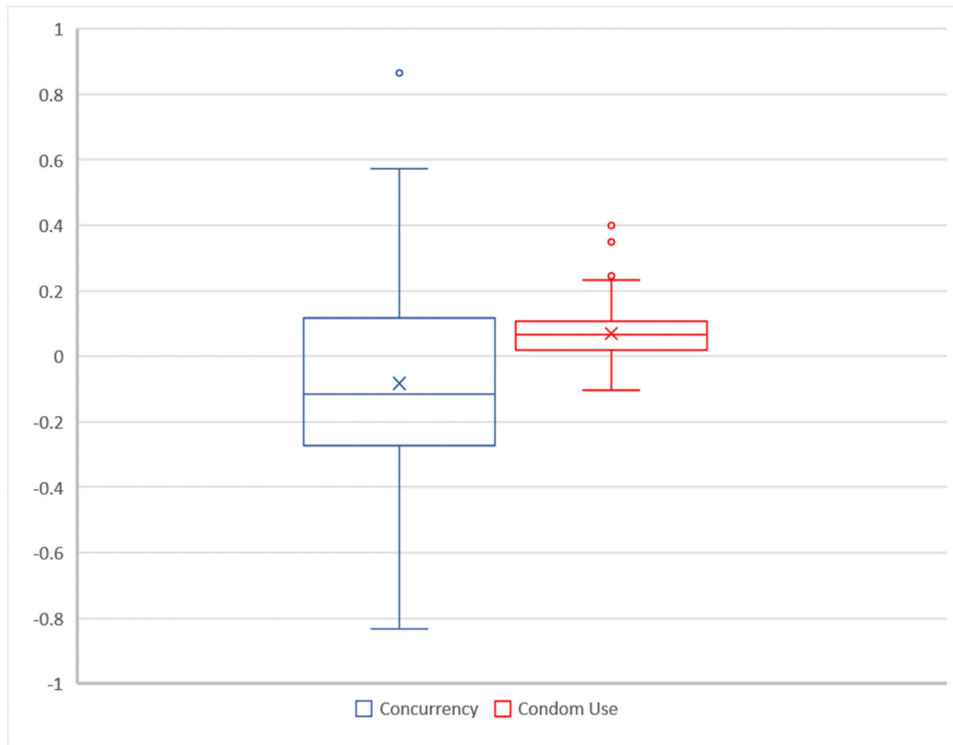
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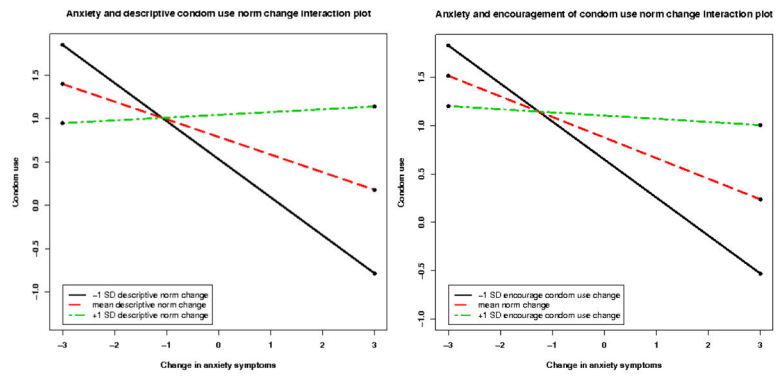


**RESEARCH HIGHLIGHTS**

- Assessed interaction of co-occurring risk factors: mental health and peer norms
- Men's perceptions of peer norms do not match peers' reported behaviors
- Changes in perceived descriptive norms and peer encouragement linked to condom use
- Increased anxiety coupled with riskier peer norms meant less condom use
- Changes in perceived norms was associated with partner concurrency



**Figure 1.** Box plot distributions of quadratic assignment procedure (QAP) correlations by camp



**Figure 2.**  
Condom use as a function of anxiety and peer norms.

**Table 1**Baseline Participant Characteristics ( $n=1113$ ).

	<i>N (%) or Mean <math>\pm</math> SD</i>
Age (years)	26.8 $\pm$ 7.1
Currently in school	97 (8.7%)
Education level (reference = primary school or less completed)	
Primary school or less	652 (58.7%)
Some secondary school	116 (10.5%)
Secondary school completed or greater	342 (30.8%)
Socioeconomic status	
Lowest	291 (26.2%)
Middle	435 (39.1%)
Highest	386 (34.7%)
Ever married	277 (25.0%)
Has children	423 (38.0%)

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**Table 2**

Cross-sectional description of key variables.

	Baseline	Follow-up	Within-person change
<b>Internalizing symptoms</b>			
Depression score (range 1–4)	1.43 ± 0.57	1.42 ± 0.56	−0.03 ± 0.76
Anxiety score (range 1–4)	1.38 ± 0.51	1.36 ± 0.53	−0.03 ± 0.72
Depression (score 1.75)	237 (21.3%)	174 (20.0%)	--
Anxiety (score 1.75)	206 (18.5%)	141 (16.2%)	--
<b>Sexual risk</b>			
Condom use			
Never	491 (52.7%)	408 (51.6%)	--
Sometimes	133 (14.3%)	176 (22.3%)	--
Always	308 (33.1%)	207 (26.2%)	--
Concurrency	193 (20.2%)	262 (32.1%)	--
<b>Friend-reported peer norms (range 0–1)</b>			
Condom use	0.43 ± 0.37	0.38 ± 0.33	−0.06 ± 0.50
Concurrency	0.21 ± 0.30	0.30 ± 0.34	0.10 ± 0.44
<b>Perceived peer norms (range 0–1)</b>			
Descriptive condom use	0.42 ± 0.46	0.54 ± 0.42	0.13 ± 0.57
Injunctive condom use	0.59 ± 0.46	0.81 ± 0.32	0.22 ± 0.52
Condom use encouraged	0.49 ± 0.44	0.66 ± 0.39	0.17 ± 0.55
Descriptive concurrency	0.24 ± 0.38	0.36 ± 0.39	0.11 ± 0.51
Injunctive concurrency	0.18 ± 0.33	0.26 ± 0.38	0.08 ± 0.50
Concurrency discouraged	0.39 ± 0.43	0.48 ± 0.41	0.09 ± 0.57

**Note.** Statistics are number (%) or Mean ± *SD*.

**Table 3**

Baseline correlations between friend-reported and perceived norms.

Friend-reported measure	Perceived measure		
	<i>Perceived descriptive norm</i>	<i>Perceived injunctive norm</i>	<i>Behavior encouraged</i>
Condom use	-0.002	0.037	0.038
Concurrency	0.000	-0.013	-0.034

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**Table 4**

Condom use peer norm interaction model results.

	Norm moderator			
	Descriptive condom use	Injunctive condom use	Encourage condom use	Friend-reported condom use
	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)
<i>Main effect model</i>				
Anxiety	1.14 (0.86, 1.51)	1.04 (0.76, 1.47)	1.14 (0.86, 1.51)	1.09 (0.79, 1.51)
Depression	0.71 (0.54, 0.93) <sup>*</sup>	0.69 (0.53, 0.91) <sup>**</sup>	0.70 (0.53, 0.91) <sup>*</sup>	0.69 (0.50, 0.96) <sup>*</sup>
Norm	1.63 (1.20, 2.22) <sup>**</sup>	1.14 (0.84, 1.55)	1.54 (1.15, 2.05) <sup>**</sup>	0.81 (0.55, 1.19)
<i>Interaction model</i>				
Anxiety	1.07 (0.79, 1.44)	1.11 (0.83, 1.43)	1.04 (0.77, 1.40)	1.09 (0.78, 1.54)
Depression	0.71 (0.53, 0.94) <sup>*</sup>	0.67 (0.49, 0.91) <sup>**</sup>	0.72 (0.54, 0.95) <sup>*</sup>	0.69 (0.50, 0.97) <sup>*</sup>
Norm	1.58 (1.16, 2.15) <sup>**</sup>	1.11 (0.82, 1.52)	1.52 (1.14, 2.04) <sup>**</sup>	0.81 (0.55, 1.18)
Anxiety × Norm	1.95 (1.10, 3.47) <sup>*</sup>	1.25 (0.71, 2.20)	1.75 (1.01, 3.02) <sup>*</sup>	1.03 (0.45, 2.37)
Depression × Norm	0.79 (0.46, 1.33)	1.10 (0.64, 1.89)	0.78 (0.48, 1.26)	1.05 (0.48, 2.26)

\*  
p<0.05;\*\*  
p<0.01;\*\*\*  
p<0.001;

indicates change the listed variable

*Note: All models include controls for condition, age, education level, SES, and ever having been married.*

**Table 5**

Concurrency peer norm interaction model results.

	Norm moderator			
	Descriptive concurrency	Injunctive concurrency	Discourage concurrency	Friend-reported concurrency
	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)
<i>Main effect model</i>				
Anxiety	1.31 (0.94, 1.81)	1.33 (0.96, 1.85)	1.29 (0.93, 1.79)	1.31 (0.90, 1.91)
Depression	1.29 (0.95, 1.74)	1.27 (0.94, 1.72)	1.29 (0.95, 1.75)	1.31 (0.93, 1.84)
Norm	1.42 (1.02, 2.00) *	1.50 (1.08, 2.10) *	0.82 (0.61, 1.09)	0.73 (0.45, 1.18)
<i>Interaction model</i>				
Anxiety	1.36 (0.95, 1.95)	1.34 (0.95, 1.88)	1.28 (0.92, 1.78)	1.33 (0.90, 1.96)
Depression	1.31 (0.95, 1.81)	1.30 (0.94, 1.78)	1.30 (0.96, 1.76)	1.28 (0.90, 1.81)
Norm	1.50 (1.06, 2.11) *	1.57 (1.12, 2.20) **	0.79 (0.60, 1.06)	0.71 (0.44, 1.17)
Anxiety × Norm	0.73 (0.37, 1.47)	0.90 (0.46, 1.77)	1.05 (0.55, 2.03)	0.76 (0.29, 2.01)
Depression × Norm	0.90 (0.46, 1.75)	0.79 (0.42, 1.51)	1.17 (0.66, 2.07)	1.54 (0.60, 3.95)

\*  
p<0.05;\*\*  
p<0.01;\*\*\*  
p<0.001;

indicates change the listed variable

*Note: All models include controls for condition, age, education level, SES, and ever having been married.*