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Examining the impact of couple relationship factors on male engagement pregnancy health and communal coping

Pamela Musoke
University of Alabama at Birmingham

EXAMINING THE IMPACT OF COUPLE RELATIONSHIP FACTORS ON MALE ENGAGEMENT IN PREGNANCY HEALTH AND COMMUNAL COPING

by

PAMELA MUSOKE

JANET M. TURAN, CHAIR
JUSTIN BLACKBURN
LYNAE DARBES
NATALIYA V. IVANKOVA
KARI WHITE

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PAMELA MUSOKE

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ABSTRACT

Focusing on male partner engagement in HIV prevention is an important aspect of intervention and policy development and implementation within the sub-Saharan African context. However, finding ways to engaging male partners safely and effectively to improve the impact and sustainability of HIV prevention modalities remains challenging due to continued impact of traditional gender roles that impact the willingness and confident to engage as well as the lack of knowledge of how best to engage in pregnancy health beyond financial support. This dissertation's overall aim to explore aspects of male partner engagement influences in the Kenyan context, using a three-manuscript paper model. The first aim of the dissertation (N= 24) is to explore male partners' perceptions about engaging in pregnancy health; the second aim (N= 96 couples) is to examine the association between couple relationship dynamics and the extent couples collaborate confidently to prevent HIV transmission using the actor-partner interdependence model. The third aim of the dissertation (N= 81 couples) is to use a sequential explanatory mixed method approach to dyadically explore if couple relationship factors mediate the association between intervention exposure and male partner ANC engagement. Findings indicated that male partner were willing to engage in health but felt hindered due to tradition gender norm expectations, logistic and health care level challenges. Further, a couple's confidence and ability to address an HIV threat appeared dependent on mutual influences

of couple relationship quality perceptions. Although we were unable to establish a mediatory relationship between couple relationship quality and male partner ANC attendance, findings suggested that couple relationship quality appeared to influence ANC attendant in both expected and unexpected ways. For example, couples whose male partners appeared to be more trusting than their wives seemed to be less likely to attend ANC. Also, couples randomized to receive the intervention appeared to report higher relationship satisfaction and commitment at follow-up. Overall, these findings may inform how to improve couple relationship-focused interventions, by focusing on leveraging aspects of couple relationships that impact male partner engagement in HIV prevention and can be further tailored for couples who may benefit most.

Keywords: communal coping, couple relationship dynamics, male partner engagement, maternal and child health

DEDICATION

I dedicate this work to my mother, Milka Musoke. She was the light of my life, my constant champion- because of her, I found the strength and perseverance to complete this journey. I have been truly blessed to have shared this life with her! Blessed be! To my family and my friends, I give thanks for their constant words of encouragement and their reminders to always find joy in all that I do!

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I would like to also thank my committee members and advisors, namely Dr. Debra Kashy and Dr. Bulent Turan, for their direction and support- their advice enabled me to better understand and apply newly learned methodological concepts, to tell our participants' stories in a way that brought their truths to life.

To my colleagues, I give thanks to you for being my sounding board and voice of reason! I would also like to acknowledge the sources of funding for this research. I would like to give thanks to the Department of Health Care Organization and Policy for their financial support throughout the program. And to CFAR and the Sparkman Center, I give thanks for their financial support for the added training received to achieve my research goals.

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INTRODUCTION

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EXPLORING EFFECTS OF COUPLE RELATIONSHIP QUALITY ON MALE PARTNER ENGAGEMENT IN PREGNANCY HEALTH AFTER RECEIPT OF A HOME-BASED COUPLES INTERVENTION

INTRODUCTION

The Global Focus on Prevention of Mother-to-Child Transmission of HIV

In 2001, the United Nations General-Secretary, Koffi Annan articulately summarized the agenda set forth by the United Nations General Assembly special session on HIV/AIDS. He highlighted that to reduce the spread of HIV and alleviate its impact, the first priority was to ensure that people everywhere, especially the young, were well educated on HIV prevention (UNGASS, 2001). The second priority was to eliminate mother-to-child transmission (eMTCT) of the virus (UNGASS, 2001). Next, it was imperative that treatment was accessible and provided to all those infected (UNGASS, 2001). Lastly, the research community was to double their efforts in finding a cure and provide care for all whose lives were ravaged by AIDS epidemic (UNGASS, 2001). These goals were widely adopted by the international community.

In most of sub-Saharan Africa (SSA), because HIV disproportionately affected women of reproductive age, the second priority--around eMTCT--became a major focus of research and policy agendas, as well as program interventions (African Union, 2001). Thus, between 2001 and 2003, goals were set for countries in sub-Saharan Africa to reduce the proportion of infants infected with HIV by 20% by 2005, and further reduce infection rates by 50% by 2010 (UNGASS, 2001). In order to achieve this, it was estimated that least 80% of pregnant women accessing antenatal care (ANC) required adequate prevention of mother-to-child transmission (PMTCT) services (UNGASS,

2001). A refocused and ambitious initiative (the Global Plan) was introduced in 2011 to refocus on the 22 countries most heavily burdened by the HIV epidemic (UNAIDS, 2011a). This plan included goals to further reduce the number of new HIV infections among children by 90% and reduce the number of maternal HIV-related deaths by 50% by 2015 (UNAIDS, 2011b).

To achieve these goals and eliminate mother-to-child transmission of HIV, a four-pronged approach introduced by the World Health Organization became the bedrock from which most of sub-Saharan Africa, including Kenya, developed policies that addressed reducing risk factors (Table 1) for mother-to-child transmission of HIV (National AIDS Control Council of Kenya, 2014; World Health Organization, 2012a). The approach included primary prevention of HIV infection among women of child bearing age; prevention of unintended pregnancies among women of reproductive age living with HIV; prevention of HIV transmission from mothers living with HIV to their infants; and lastly, provision of continuous care and treatment for mothers living with HIV, partners and their children (World Health Organization, 2012a).

Table 1: Risk factors for mother-to-child transmission of HIV during pregnancy, labor and delivery, and post-partum (Government of Malawi: Ministry of Health, 2008)

Pregnancy	Labor and Delivery	Post-partum
Unprotected Sex High maternal viral load Low maternal CD4 count Viral or bacterial infections Parasitic infections Sexually transmitted infections (STI) Maternal malnutrition Anemia Chorioamnionitis (from untreated STI or other infections)	High maternal viral load Low maternal CD4 count Rupture of membranes more than 4 hours before delivery Invasive delivery procedures Chorioamnionitis Prematurity First twin Low birth weight Breaks in kin or mucous membranes of the infant	Breastfeeding High maternal viral load Low maternal CD4 count Duration of breastfeeding Mixed feeding prior to 6 months of age Breast abscesses, nipple fissures, mastitis Poor maternal nutritional status Oral disease in the infant (e.g. thrush or sores)

Reaching these goals required many programs to significantly improve HIV testing rates and uptake of HIV care. However, barriers within health systems across sub-Saharan Africa, such as lack of access to HIV testing, inability to afford antiretroviral therapies, lack of CD4+T testing equipment, staff shortages, poor implementation of complicated ART guidelines for PMTCT due to lack of knowledge, poor access to CD4+T testing and timely receipt of laboratory results, limited progress towards these goals (Aizire, Fowler, & Coovadia, 2013; Gourlay, Birdthistle, Mburu, Iorpenda, & Wringe, 2013). In 2012, recognizing the significant barriers faced by many health institutions coupled with a complicated ART initiation strategy for pregnant women, the World Health Organization (WHO) recommended a simpler treatment modality, referred to as Option B+ (World Health Organization, 2012c). This strategy did not require CD4

+T testing and assessment prior to ART initiation among pregnant and breastfeeding women living with HIV. Instead, in countries with generalized HIV epidemics, immediate initiation on lifelong antiretroviral therapy (ART) for pregnant and breastfeeding women living with HIV was recommended, regardless of CD4+T cell counts or clinical staging (World Health Organization, 2012b). This Option B+ initiative aimed to increase coverage of PMTCT services, improve maternal health and reduce transmission among serodiscordant sexual partners (Haas et al., 2016; World Health Organization, 2012b).

As governments across SSA adopted the new guidelines, the PMTCT cascade, illustrating the drop-offs that commonly occur in completion of all the necessary steps that lead to successful PMTCT, was adopted by many programs as a critical evaluation tool (Hamilton et al., 2017). The PMTCT cascade begins with pregnant women's attendance of ANC services and ends with detection of a final HIV status in infants exposed to HIV, and key indicators are defined at each step (Figure 1). Initially, the cascade focused on monitoring the early WHO guidelines: counseling, offering, and acceptance of HIV testing; receiving HIV antibody test results for pregnant women; and infant HIV testing at 18 months (World Health Organization, 1997). Later, the PMTCT cascade was adapted to reflect programmatic and policy changes across SSA with the incorporation of new guidelines including early infant HIV testing at six weeks, and was subsequently used as an evaluation tool to measure the progress of the Global Plan (Hamilton, et al., 2017).

Since the introduction of the Option B+ guidelines, many countries have experienced decreases in HIV incidence among infants and in the number of maternal HIV-related deaths. Globally, an estimated 60% increase in new HIV infections averted

was recorded between 2010 and 2017 (UNAIDS, 2018). According to the final Global Plan report, among countries in sub-Saharan Africa, by the end of 2015, countries participating in the initiative experienced an estimated 60% decrease in new infections among children compared to 24% between the years of 2000 and 2008. Between 2010 and 2017, Eastern and Southern African states realized an estimated 31% increase in averted new HIV infections (UNAIDS, 2018); Western and Central African countries experienced an estimated 14% increase in averted new HIV infections (UNAIDS, 2018). The proportion of pregnant women living with HIV receiving efficacious regimens recommended by Option B+ doubled from a baseline of 36% in 2009 to 80% in 2018 (UNAIDS, 2016, 2018). Access to efficacious ART regimens translated to a 43% decline in HIV-related deaths among women of reproductive age between 2009 and 2015 (UNAIDS, 2016). Secondary analyses conducted by Haas and colleagues (2016) revealed similar trends in Malawi, one of the first countries in SSA that adopted the Option B+ guidelines. In that country PMTCT coverage increased substantially from 49% in 2011 to 85% in 2014.

However, despite these impressive gains, gaps continue to hinder progress towards elimination of mother-to-child transmission of HIV in most SSA countries. Even in Malawi, uptake of PMTCT-services among pregnant women has remained lower than desired; and the country has made only marginal progress in reducing HIV infection among young women (UNAIDS, 2016). Further, low retention in HIV care, especially among pregnant women diagnosed during pregnancy or while breastfeeding, in addition to low rates of early infant diagnosis and infant treatment coverage resulted in a rise in the number of new pediatric infections as of 2013 (Haas, et al., 2016; UNAIDS, 2016).

The Kenyan Situation

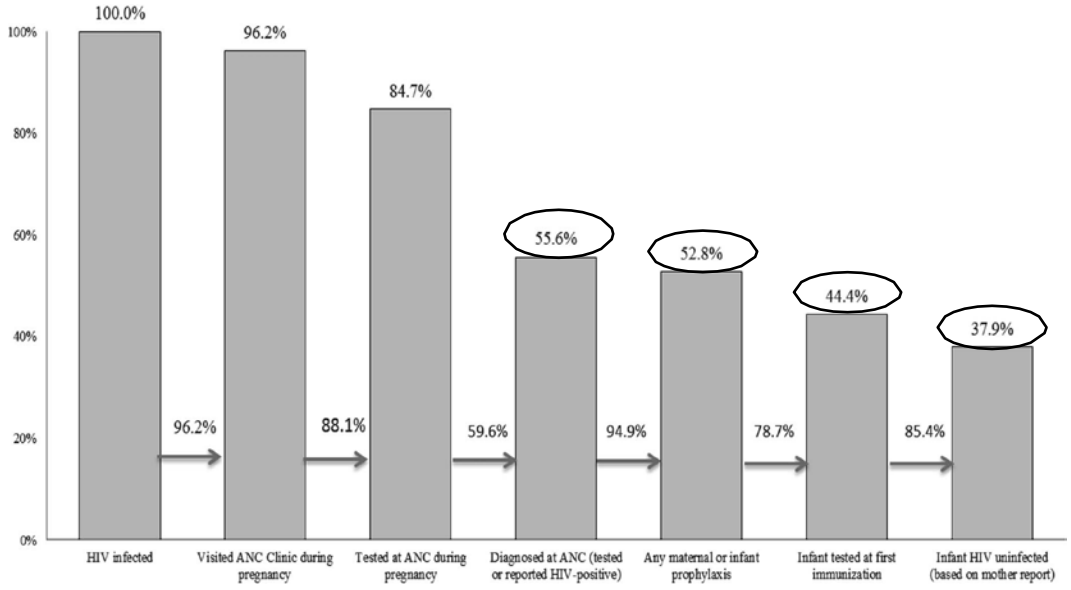
In 2012, Kenya, jointly with Joint United Nations Programme, adopted the Global Plan initiative to eliminate MTCT. The policy involved introducing an opt-out HIV testing strategy, in which HIV testing in pregnancy became routine but women could opt-out, and improving access to antiretroviral therapy (ART) for women testing HIV-positive during pregnancy (National AIDS and STI Control Program, 2015). Additionally, the initiative emphasized continuous treatment, care and support for women and children living with HIV infection and their families (UNAIDS, 2011b). Concurrently, the Option B+ strategy was introduced into national guidelines for PMTCT of HIV (National AIDS and STI Control Programme/Ministry of Health, 2012). Prior to this initiative, the overall national prevalence of HIV infection among pregnant women was 4.8% (UNAIDS, 2018). While some provinces across the country had significantly lower HIV prevalence rates, other provinces had HIV prevalence rates more than double the national rate (National AIDS Control Council of Kenya, 2019). In the former Nyanza province, for instance, the HIV prevalence rate among pregnant women was as high as 17.9% (National AIDS and STI Control Program, 2011).

Since the inception of the Global Plan, the Kenyan national HIV prevalence has remained stable at approximately 4.8% (National AIDS Control Council of Kenya, 2019), but more significantly, new HIV infections among children were reduced by 39% between 2011 and 2017 (National AIDS Control Council of Kenya, 2019). Further, the estimated percentage of child infections from HIV-infected women delivering in the past 12 months reduced from 16% in 2012 to 8.3% in 2015, and PMTCT service coverage increased from 60% in 2013 to 76% by 2017 (National AIDS Control Council of Kenya, 2019). Further, the former Nyanza province realized decreases in MTCT rates, with

current MTCT estimates ranging from 7% to 17.1% in the included counties by 2017 (National AIDS Control Council of Kenya, 2019).

Based on the Kenya AIDS Indicator Survey, Sirengo and colleagues (2014) examined the burden of HIV infection among women of childbearing age including access to and coverage of PMTCT-related services. Although the uptake of HIV testing significantly increased between 2013 and 2015 among pregnant women (National AIDS Control Council of Kenya, 2016) when looking across the PMTCT cascade, loss to follow-up at time of maternal diagnosis, early infant diagnosis and use of any form of maternal or infant antiretroviral prophylaxis remained suboptimal (Figure 1) (Sirengo et al., 2014). Later studies conducted by Nduati and colleagues (2015) and Hamilton and colleagues (2017) had similar findings; retention in care continued to be a challenge for many programs (Hamilton, et al., 2017; Nduati et al., 2015). Consequently, innovative ways in which to bridge these gaps are being sought; many programs are focusing on community-based interventions to address gaps seen along the PMTCT cascade (figure 1). These include home-based couple HIV testing interventions that can increase rates of HIV testing among pregnant couples (Krakowiak et al., 2016; Osoti et al., 2014; Turan et al., 2018); mobile health (mHealth) interventions such as mobile phone text messages that have shown to improve retention in PMTCT services (Finocchario-Kessler et al., 2014; Odeny et al., 2014); peer mentoring such as mentor mothers that have shown to improve adherence to PMTCT-related activities (Conserve, Alemu, Yamanis, Maman, & Kajula, 2018; Futterman et al., 2010; le Roux et al., 2010; le Roux, Rotheram-Borus, Stein, & Tomlinson, 2014; Teasdale and Besser, 2008).

Figure 1: Coverage (% top of bars) of and access (% between bars) to PMTCT interventions at antenatal care clinics among women with laboratory-confirmed HIV infection whose last birth was within the 2 years preceding the survey, Kenya AIDS Indicator Survey 2012 *(Sirengo, et al., 2014)*



Male Partner Engagement as a Strategy to Reduce Drop-offs Along the PMTCT Cascade

One important strategy that has been and continues to be explored to help improve uptake of and retention in PMTCT-related services is male partner engagement in PMTCT-related activities. Since the mid-1990s, the case has been made for enhancing male engagement in reproductive health by increasing their knowledge about reproductive and pregnancy health matters including STD prevention and family planning, understanding their perceptions of their roles in reproductive health, increasing their participation in couple HIV testing and counseling, and linking them to HIV care (Mbizvo and Bassett, 1996). Later studies indicated that male engagement may significantly impact health-seeking behaviors within families. Improving male engagement has been associated with significant reductions in MTCT (Aluisio et al., 2011), uptake of ANC use, as well as improved HIV-free survival among infants born of mothers with engaged partners (Aluisio et al., 2016; Takah, Atem, Aminde, Malisheni, & Murewenhema, 2018b). Additionally, engaging male partners was significantly associated with increased HIV testing among men and couple HIV testing and disclosure, which in turn positively influenced uptake of PMTCT-related services (Audet et al., 2016; Falnes et al., 2011; Krakowiak, et al., 2016; Sileo, Fielding-Miller, Dworkin, & Fleming, 2018; Takah, Kennedy, & Johnman, 2017).

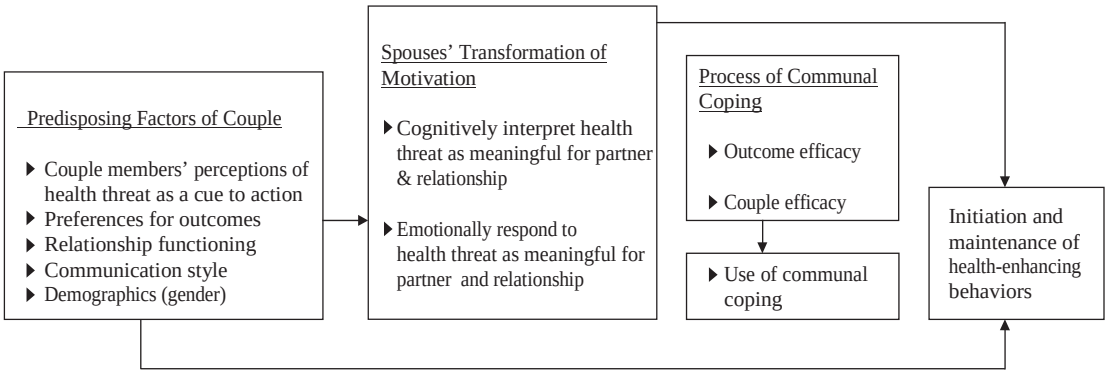
Furthermore, Kiene and colleagues (2017) suggested that positive social partner support was as an equally strong predictor of HIV testing among couple members when compared to the influence of a couple's HIV testing history. This finding speaks to the potential importance of couple relationship dynamics and understanding how such factors influence a couple's willingness to jointly engage in health-enhancing behaviors. Previous studies have shown that positive couple dynamics among heterosexual couples

such as respect, trust and effective communication, especially among married couples (Baker et al., 1999; Conroy et al., 2017; Hartmann, Gilles, Shattuck, Kerner, & Guest, 2012; Kiecolt-Glaser and Newton, 2001), may positively impact health outcomes. Leveraging such relationships to combat MTCT of HIV has become a crucial component of PMTCT-related interventions (Crepaz, Tungol-Ashmon, Vosburgh, Baack, & Mullins, 2015; Desgrées-du-Loû and Orne-Gliemann, 2008; Kiecolt-Glaser and Wilson, 2017; Naik et al., 2018; Takah, Atem, Aminde, Malisheni, & Murewenhema, 2018a).

Theoretical Models

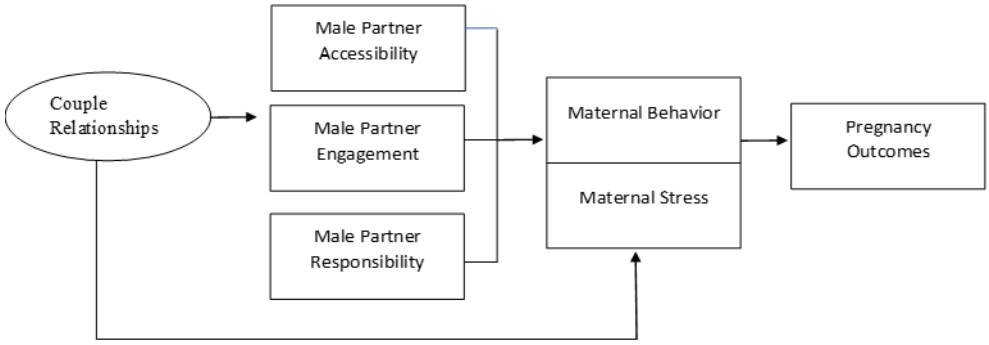
Lewis and colleagues (2005) introduced an integrative model, based on the interdependence theory and communal coping, that considered determinants of couple health behavior (Figure 2). The integrated model provided a framework for examining how couple relationship dynamics influence risk-reduction health behaviors (Lewis et al., 2006). Rogers and colleagues (2016) subsequently conducted a qualitative study with pregnant couples in Kenya using an adaptation of this model to explore the impact of couple relationship factors on HIV-related health-enhancing behaviors. In their findings, jointly engaging in PMTCT-related behaviors such as couple HIV testing, the disclosure of HIV status, retention and adherence to HIV care were linked with strong communication skills involving honesty, active listening, and effective conflict resolution skills, as well as mutual trust (Rogers et al., 2016). Similarly, Conroy and colleagues (2017) found that relationship dynamics such as intimacy and trust served as determinants for social support in South Africa; such positive and supportive relationships were associated with maintaining good ART adherence (Conroy, et al., 2017).

Figure 2: Interdependence model of couple communal coping and behavior change (Lewis, et al., 2006)



When looking specifically at determinants of male engagement in pregnancy health, an adapted conceptual framework developed by Alio and colleagues (2013) is useful (Figure 3). This framework, depicted in Figure 3, proposes that couple relationship factors play a significant role, and identifies variables that may mediate the relationship between the constructs (accessibility, engagement, and responsibility) and pregnancy health outcomes. In that study conducted in the United States, male partners emphasized that their level of involvement was directly related to the quality of their relationships with the spouses. The strength of their emotional or romantic connection determined the level of involvement in pregnancy health, as well as the emotional and mental wellbeing of the mother (Alio, Lewis, Scarborough, Harris, & Fiscella, 2013). In such circumstances, male partners who engaged in pregnancy health were more often described as accessible (e.g. present, available), engaged (e.g. cared about the pregnancy) and responsible (e.g. caregiver, protector) (Alio, et al., 2013). Other studies reported similar findings (Auvinen, Suominen, & Valimaki, 2010; Matovu et al., 2014; Muhindo, Nakalega, & Nankumbi, 2015; Sileo, Wanyenze, Lule, & Kiene, 2017).

Figure 3: Adapted model for fathers' involvement during pregnancy (Alio, et al., 2013)



However, further investigation into the impact of couple relationship dynamics and male engagement in pregnancy health are required in the socio-cultural setting in Kenya, especially as it relates to improving male engagement in PMTCT.

OVERVIEW OF THE DISSERTATION

The purpose of this dissertation is to explore couple relationship influences on male partner as well as couple engagement in PMTCT-related activities in a high HIV prevalence setting in Kenya. The dissertation utilizes data from the Jamii Bora Study, a home-based couple intervention study that aimed to increase couple HIV testing and counseling and reduce drop-offs along the PMTCT cascade in rural southwestern Kenya [PI: Janet M. Turan; Grant number R34MH102103; ClinicalTrials.gov #NCT02403583]. In this study, a total of five ANC clinics within Migori county were included in the study. After informed consent, women were initially randomized to receive the intervention or continue with standard clinic-based services, including the option for women and partner to return to the clinic for male partner HIV testing or couple HIV testing and counseling. Male partners were recruited and consented to participate after consenting the female partner. The intervention involved three home visits; couples received two home visits

during pregnancy before birth, and a final visit approximately one month after delivery of the infant. The home visit consisted of couple HIV testing and counseling, pregnancy and postnatal care education, as well as couple relationship content and exercises. The home visits were conducted by two counselors, one male and one female, who were trained in couple HIV counseling and testing including linkage to care as well as building couple communication skills and educating couples in maternal and child health information. Couples could test for HIV at any of the three home visits.

The format of the dissertation follows the three-paper dissertation model. The first paper focuses on male partners' perspectives associated with male engagement in pregnancy health. In qualitative interviews, male partners explore what male engagement entails in their view, as well as facilitators and barriers male partners face while attempting to be more involved in pregnancy health. Past studies have well-illustrated facilitators and barriers to male engagement. In many of these cases, financial constraints, inflexible working hours and cultural gender norms that espouse masculine ideologies that negatively impact male partners' uptake of PMTCT-related services were reported as barriers (Falnes, et al., 2011; Kabagenyi et al., 2014; Mbonye, Hansen, Wamono, & Magnussen, 2010; E. Montgomery, van der Straten, & Torjesen, 2011; Mullany, Becker, & Hindin, 2007). Considering facilitators, couple relationship dynamics played an integral role in enabling male engagement in PMTCT (Conroy, et al., 2017; Ditekemena et al., 2012; Dunlap et al., 2014; Dworkin, Fleming, & Colvin, 2015; Hartmann, et al., 2012). However, there continues to be a dearth of literature that explores the impact of couple relationship dynamics on male engagement in this contextual setting, especially from an exclusively male perspective. This paper aims to explore, using qualitative methods, male partners' perspectives on male engagement in

pregnancy health, including how couple relationship factors have influenced their readiness to engage.

The second paper examines the relationship between couple relationship dynamics and the extent that couples collaborate to prevent HIV transmission in the baseline data from the Jamii Bora Study. The aim of this paper is to examine how couple relationship dynamics affect indicators of male engagement in perinatal health through analyses of baseline questionnaire data from pregnant women and male partners. Few studies have explored the relationship between couple relationship dynamics and the mutual influence couples may exert on each other when attempting to implement HIV prevention strategies (communal coping) within the African setting (Salazar, Stephenson, Sullivan, & Tarver, 2013). Further, few have undertaken a dyadic analytical approach in examining the influence of couple relationship dynamics on communal coping. The second paper aims to explore how couple members' mutual influences in terms of couple relationship factors influence their communal coping strategies to reduce the HIV threat using the actor-partner interdependence model (Cook and Kenny, 2005; Kenny and Ledermann, 2010; C. M. Montgomery, Watts, & Pool, 2012). This model integrates a conceptual view of interdependence among a dyad.

The third paper built on the first paper and examined how couple relationship factors mediated the association between being randomized to receive the intervention and male partner engagement in PMTCT-related activities using a mixed methods approach. This paper utilizes quantitative data where couple relationship factors (couple relationship satisfaction, relationship commitment, relationship trust and positive interaction) were assessed as mediators between study arm assignment and male partner participation in antenatal care visits, using data follow-up questionnaires that were

completed 3 months after delivery of the infant. Subsequently, qualitative data from semi-structured interviews were collected from couples chosen from the quantitative sample in order to explore enrolled couples' experiences in engaging in pregnancy health; the qualitative data were integrated to complement and explain quantitative findings in order to construct a deeper and holistic understanding of the phenomena (Creswell, 2013).

The dissertation will add to the growing literature on male engagement in pregnancy health. The results of these analyses may provide a deeper understanding of male engagement in pregnancy health that may help inform couple-based interventions that aim to improve a family's use of health care services during and after pregnancy. Male engagement is an important aspect of couple-based interventions, and gaining a greater appreciation of determinants of male involvement in pregnancy health may dictate their success or failure. By including the strengthening of health-promoting behaviors among couples as part of the multi-prong approach to addressing high HIV incidence and prevalence, elimination of new HIV infections among children and reduction of maternal mortality and morbidity may be realized across sub-Saharan Africa.

MEN'S HOPES, FEARS AND CHALLENGES IN ENGAGEMENT IN PERINATAL HEALTH AND THE PREVENTION OF MOTHER-TO-CHILD TRANSMISSION OF HIV IN RURAL KENYA

by

PAMELA MUSOKE, ABIGAIL HATCHER, ANNA JOY ROGERS, LILLIAN ACHIRO, ELIZABETH BUKUSI, LYNAE DARBES, ZACHARY KWENA, PATRICK OYARO, ELLY WEKE & JANET M. TURAN

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ABSTRACT

BACKGROUND: Male involvement in antenatal care has been shown to improve health outcomes for women and infants. However, little is known about how best to encourage male partners to support essential perinatal health activities.

METHOD: We explored men's perceptions of facilitators and barriers to involvement in antenatal care and HIV prevention including fears, hopes and challenges. Forty in-depth interviews were conducted with the male partners of HIV-positive and HIV-negative pregnant women in southwest Kenya.

RESULTS: Most male partners believed engaging in pregnancy health-related activities was beneficial for keeping families healthy. However, thematic analysis revealed several obstacles that hindered participation. Poor couple relationship dynamics seemed to negatively influence male engagement. Some men were apprehensive that clinic staff might force them to HIV test and disclose; if HIV-positive, men feared being labelled as "victimisers" in situations of serodiscordancy and described fears of abandonment by their wives. Some men avoided accompanying their wives, citing local culture as rationale for avoiding the 'effeminate' act of antenatal care attendance. Amidst these obstacles, some men chose to use their partners' HIV status as proxy for their own.

CONCLUSION: Findings suggest that improving male engagement in essential maternal and child health-related activities will require addressing both structural and interpersonal barriers.

Keywords: Kenya, Men's role, Prevention of Mother-to-Child Transmission, Barriers, Facilitators

INTRODUCTION

Despite advances in reducing HIV incidence globally, Eastern and Southern Africa continue to bear the greatest burden of new HIV infections. Approximately 44% of pregnant women in low- and middle-income countries received HIV testing and counselling in 2013, albeit an improvement from 26% in 2009 (UNAIDS, 2014). This gap in pregnant women accessing HIV prevention, treatment and care could hinder further progress in eliminating maternal and paediatric HIV infections (UNAIDS, 2014).

Kenya adopted the Global Plan Towards the Elimination of New HIV Infections among Children and Keeping Their Mothers Alive in 2012, in addition to introducing the WHO guidelines for providing life-long antiretroviral therapy for all HIV-infected pregnant and breastfeeding women (National AIDS and STI Control Program, 2015). The impact of this scale-up of prevention of mother-to-child transmission services within antenatal care settings in Kenya was investigated using a national population-based cross-sectional household survey, and investigators found that while HIV testing among pregnant women significantly improved, only 53% of women received the most effective regimens to reduce vertical transmission of HIV (Sirengo, et al., 2014). Furthermore, among Kenyan women accessing prevention of mother-to-child transmission of HIV services, rates of retention in care have remained lower than desired at 71% (Nduati, et al., 2015).

Lack of male involvement could be one crucial factor driving suboptimal prevention of mother-to-child transmission of HIV uptake and adherence (Haas, et al., 2016; Tenthani et al., 2014), and there is some evidence that improving male involvement

may result in important benefits for women and children's health. Aluisio and colleagues (2011) examined the relationship between male attendance at prevention of mother-to-child transmission and antenatal care services and infant HIV acquisition and mortality; they found that infant HIV acquisition and mortality were lower in the group with male attendance (Aluisio, et al., 2011). Similarly, a meta-analysis of the use of prevention of mother-to-child transmission of HIV services in sub-Saharan Africa indicated that uptake improved if male partners were involved in care (Wettstein et al., 2012). Consequently, male partner engagement has been endorsed as a promising strategy for improving maternal, new-born and child health (UNAIDS, 2011b; World Health Organization, 2015).

However, many prevention of mother-to-child transmission-related interventions have focused on empowering women, at times alienating male partners and inadvertently identifying them as obstacles instead of possible agents of change (Katz et al., 2009; Shand, Thomson de oor, van den erg, Peacock, Pascoe, 2014; van den erg et al., 2015). This has had marked effects on the health of women, infants, and men themselves. For example, pregnant women who lacked support from their male partners were less likely to accept HIV testing (Turan et al., 2011), initiate antiretroviral therapy (Farquhar et al., 2004), deliver in a health facility (Turan et al., 2012), or adhere to recommended care (Jefferys, Nchimbi, Mbezi, Sewangi, & Theuring, 2015). Additionally, facility-based strategies such as using letter invitations to invite men to attend antenatal care and prevention of mother-to-child transmission services, have had modest effects (Brusamento et al., 2012; Jefferys, et al., 2015).

The global health field therefore urgently needs to gain a better understanding of how men view engagement in perinatal health, and to explore the influence of individual, interpersonal, and structural factors on male engagement in different cultural contexts (E.

Montgomery, et al., 2011). In this study, we explored men's views on the time surrounding pregnancy and birth, and male involvement in antenatal care and prevention of mother-to-child transmission services. Additionally, we explored facilitators and barriers to men's involvement in rural Kenya, including their personal hopes, fears, and challenges. Guided by the definitions provided by Maman, Moodley and Groves (2011), we defined male involvement as attending antenatal care/maternal and child health services, providing emotional and instrumental support related to accessing these services, engaging in couple HIV testing and couple communication related to prevention of mother-to-child transmission and antenatal care activities (Maman, Moodley, & Groves, 2011).

METHODS

Setting

Data were collected between August to September 2014 in southwestern Kenya in communities near Lake Victoria where the primary means of livelihood are fishing, agriculture, and mining. As of 2015, HIV prevalence at the study sites was estimated to be up to four times higher than the national average (5.9%), with rates ranging from 14.3% (Migori County) to 26.0% (Homa Bay County) (National AIDS Control Council of Kenya, 2016). Male partner involvement became encouraged in many facilities during the study period, as national antenatal care registers adopted partner HIV testing and counselling as a reportable outcome. Analogous to strategies employed in similar settings in sub-Saharan Africa, interventions to increase male partner attendance with pregnant women included sending invitation letters through their partners (Jefferys, et al., 2015), and offering incentives such as t-shirts (Rogers, et al., 2016), although neither of these specific interventions was ongoing at the time of this study.

Study design

As part of a larger intervention development pilot study, we conducted in-depth interviews with 40 pregnant and postpartum women (half HIV-positive and half HIV-negative) and 40 male partners of such women in rural southwestern Kenya from antenatal care clinics. If a woman attending antenatal care gave her permission for her male partner to be contacted for potential study participation, research staff directly contacted male partners, gave them further information, and invited them to participate in an informed consent process and in-depth interview. Male partners who were 18 years or older and aware of their female partners' HIV status were invited for interview. The inclusion of HIV- negative participants enabled the design of the intervention, which was intended for all pregnant women and their male partners (both HIV-positive and HIV-negative) and aimed to provide feasible and acceptable home-based services for pregnant couples of different HIV status combinations. The current analysis utilises data from the 40 male partner interviews.

Data collection

A purposive sampling technique--that is, inviting male partners currently in the pregnancy period who were willing to provide insights surrounding pregnancy, birth, antenatal care and HIV testing--was used to allow for the in-depth exploration of perspectives on issues that could potentially impact many individuals. Participants were interviewed individually by a gender-matched interviewer in a private room within the health facility or a place of their choosing. Interviews were conducted after obtaining informed consent, lasted for about one hour, and were digitally recorded with permission

from participants. The semi- structured qualitative interview guide for men was developed based on literature to explore several dimensions of male engagement in antenatal care and prevention of mother-to-child transmission of HIV services (Table 1). Following the interview, participants were reimbursed 400 Kenyan shillings (roughly equivalent to US $5) for travel expenses and their time. Professional transcriptionists transcribed the digital interview recordings verbatim from the local language (Kiswahili or Dholuo) and translated them into English. Transcripts were checked for translation accuracy by the study coordinator andqualitative interviewers.

Table 1. In-depth interview discussion topics for male partners

Theme	Sub-theme	Example questions
Health care utilisation	**Antenatal care clinic male attendance**	Have you accompanied her to any antenatal care visits?
	Antenatal HIV testing	
Barriers and facilitators for utilisation of health care services	**Perceptions about use of antenatal care services and facility-based child delivery**	What about the father of the child? Does he need to visit the health facility for services? What type of services?
	Role of the father during visits	
Couple relationships	**Perceptions of quality of relationships**	How long have you been in your relationship with your wife/female partner who is currently pregnant?
	Couple communication	What role does communication play in your relationship?
	Decision-making	Who usually makes decisions your family?
HIV testing	**HIV testing experience**	Can you tell me about your experience(s) with HIV testing?
Disclosure	**Experiences with disclosure**	Can you tell me why you decided/decided not to share your HIV testing and HIV test result with your wife/female partner?
Home visit	**Perceptions of home vs. clinic visits**	What would you think if someone from the health facility came to your home for a visit?
	Perceptions of home-based Couple HIV Testing and Counselling	Can you tell me your thoughts about offering couple counselling and testing for HIV in such home visits?

Data analysis

A team of five researchers (PLM, AJR, LA, EW, AMH) preliminarily coded and analysed the transcripts in Dedoose (SocioCultural Research Consultants, LLC; Los Angeles, California) using a thematic analysis approach, with each transcript being coded by two researchers (Corbin and Strauss, 2014). Initial broad codes were developed using the interview guide (Table 1) and literature; the codes were agreed upon by the whole team and subsequent meetings were conducted to review the coding scheme and reliability of assigning codes. In a subsequent round of coding conducted by two researchers (PLM, AJR) following study team consensus, fine codes were identified using participant language to inductively assign meaning to each sub-theme (Attride-Stirling, 2001). Quotes presented here have been given pseudonyms. Ethical approval for the study was given by the University of Alabama at Birmingham and the Kenya Medical Research Institute Institutional Review Boards, and all participants provided signed informed consent.

RESULTS

Socio-demographic characteristics

The characteristics of the 40 male partners are presented in Table 2. Ages ranged from 18- 70 years with a median of 34.5 years. Most of the participants had some primary education and worked in either manual labour (e.g. miner, casual labourer) or agriculture. The proportion of men practicing marital monogamy in our sample (70%) was somewhat lower but similar to the overall rate in the study region, where around 80% of relationships were reported to be single partner marriages in 2014 (Kenya National Bureau of Statistics et al., 2015).

Table 2. Characteristics of male interview participants

Characteristics	**N (%)**
Currently living with spouse	37 (93)
Participant age	
18-24	8 (20)
25-34	12 (30)
35-44	10 (25)
45	10 (25)
Self-reported HIV Status	
HIV-positive	15 (38)
HIV-negative	20 (50)
Unknown	5 (13)
Participant education	
Did not complete primary	12 (30)
Completed primary	13 (33)
Did not complete secondary	5 (12)
Completed secondary	8 (20)
Any college	2 (5)
Marital status	
Monogamous marriage	28 (70)
Polygamous marriage	12 (30)
Unmarried	0 (0)
Number of living children	
0	6 (15)
1	2 (5)
2	8 (20)

3 or more	24 (60)
Occupation	
Agriculture	19 (47)
Small business/sales	3 (8)
Skilled or semi-skilled worker	18 (45)

Qualitative findings

For many men in this sample, perceptions about attending antenatal care and participating in prevention of mother-to-child transmission activities were positive, illustrating a willingness to support pregnancy-related health. Despite their readiness to participate, men described several barriers to their involvement.

Men's desire to be involved in antenatal period

Some men recognised the importance of participating in antenatal care as well as in prevention of mother-to-child transmission of HIV. Many perceived it was important to be involved beyond simply providing financial support – a typical level of engagement in this setting. Engaging in antenatal care activities and learning how to keep their wives and their infants healthy was of interest to many male participants. For example, an older husband explained how couple attendance at the antenatal care clinic was encouraged by health providers and recognised how learning about the pregnancy could help him manage pregnancy-related crises:

> This is because the healthcare providers want the male partners to accompany their female partners to the clinic so that they may both know the status of the foetus to be able to get the necessary assistance in case of any problems concerning the pregnancy. (James, 50 years)

One participant further highlighted that the value of attending antenatal care extended beyond keeping a pregnancy healthy. He emphasised that male partners also had the opportunity to seek care for health concerns other than HIV:

> There are some services he should visit the clinic to receive, for example, he can get some injections, drugs, and others that the doctors may feel necessary to give because there are so many diseases apart from HIV so when he goes to the clinic then he can get the treatment. (Omondi, 21 years)

The idea that the responsibility of maintaining the health of the family was "women's work" was dispelled by some male partners. They viewed the pregnancy as an equal investment and interest and thought that the responsibility of the child should be shared. This man expressed that staying educated enabled him to remain supportive:

> I went with her based on some of the lessons that people normally get there. There are some lessons that are given to couples. Some will touch on men while others will touch on women. As you know, sometimes people do forget. Since people do forget, it is better if you get the information as a couple. This means you will easily encourage one another as you remind those who tend to forget what they were taught. (Moses, 45 years)

Living with HIV presented unique challenges to male partners in ensuring their partners and infants remained healthy. For instance, one young father-to-be explained that by attending antenatal care visits, he would also learn how to ensure his wife remained healthy during the pregnancy while living with HIV, and more importantly how to ensure his child did not become infected:

> One of those things that made me think of accompanying her was because we know that we are living with HIV virus, we feel that if she is not well taken care of then she can pass the disease to the child, that is why I thought that we should go together so that she can be given proper medical treatment so that she gives birth to a child who is not HIV positive…another one is that we were given a medicine to give the baby immediately the baby is born. (John, 39 years).

Influences on male participation in antenatal care

Men also identified a variety of challenges to participating in pregnancy-related health. Perceived barriers to male involvement ranged from poor couple relationship dynamics to fears around HIV testing and disclosure. Men also mentioned clinic characteristics as limiting their participation in antenatal care.

Couple Relationship Dynamics and Male Engagement

Some male partners did not believe they had a significant role to play in prevention of mother-to-child transmission of HIV or maintaining a healthy pregnancy, and this seemed to be in part due to the lack of communication between couples. In some instances, some male partners expressed that their partners rarely shared information about their antenatal care experiences. Further, this male partner believed an invitation was needed from his spouse or doctor in order for him to engage:

> She hasn't invited me yet…I have the time. She is the one who has never asked me to accompany her…My wife has told me nothing about it…I will come if she accepts or the doctor invites me. (Isaiah, 41 years)

Lack of communication between couples was compounded by negative community attitudes toward male participation in antenatal care activities. Some male partners accepted traditional values and gender norms; the paternalistic nature of the local culture reinforced such attitudes. Antenatal care activities were regarded as "women's work", and to be seen participating in such activities would bring ridicule and loss of perceived masculinity among community members. Additionally, pregnant partners who requested their partners to accompany them to antenatal care clinic visits might have appeared dominating, or less feminine. A male partner articulated how traditional gender norms hindered male partners' willingness to participate in antenatal care clinic visits:

> People feel embarrassed when they are seen taking their wives to the clinic. A Luo man will feel that he will be laughed at and told that his wife is controlling him… (Odhiambo, 48 years)

The strength of intimacy between couples also seemed to dictate the willingness of a male partner to engage in antenatal care-related activities. For instance, the intimacy that this male partner shared with his wife made it easy for him to attend antenatal clinic visits:

> What has made it easy is the fact that we love each other, and it can be made easier by her reminding me the visit dates because I always do so many things and am likely to forget, so if she reminds me even two days prior then I can organise myself and go with her. (Omondi, 21 years)

On the other hand, according to this male partner, men without close relationships with their wives did little to support them during pregnancy:

> …Some men tend to ignore pregnant women and send a relative to them in case they have a message to communicate to them. They avoid the women when pregnant. However, there are some men who still love their wives that when they are to leave, the women feel like they are going to be very lonely. [These] are the two groups that we have: One that hates each other during pregnancy and the other that loves each other during pregnancy. (Anthony, 52 years)

Proxy Testing

Some men in the community believed the HIV status of their pregnant partners or wives reflected their own HIV status and saw no reason to test for HIV. This view was further compounded by the assumption that being in a monogamous partnership equated to fidelity and trust among couples. Some men who believed to be in trusting relationships talked about becoming less compliant with safe sex practices, due to their belief that their partners would not engage in extra-marital affairs. In the following example, a male partner saw little use in HIV testing, believing that since both he and his wife were faithful, there was little risk of acquiring HIV. He described how he believed they both shared similar HIV status.

> I don't get involved into extra marital affairs. I trust myself that I am clean.… Let me just say that I trust myself...That is another reason preventing me from going for the test. There is no need of going [for HIV testing] when my wife doesn't have it. (Brian, 35 years)

In other cases, men believed that being found HIV-positive was a sign of weakness. Participating in couples' HIV testing and counselling was, therefore, not an

option; they instead gauged their own HIV status through their spouses'. As this young male participant expressed, some men feared the idea of HIV testing and the consequences of disclosing an HIV-positive result:

> I have to confess that men are always fearful concerning the issue of HIV. They would rather not let their wives know that they are infected because of perceived exposure of weakness. Sometimes they fear of other things. Many men would rather find out their HIV status through their wives. (Ochieng, 24 years)

Fear of Forcible HIV Testing and Disclosure

Several men believed that male partners refuse to accompany their wives to antenatal care clinic visits for fear of being forcibly tested for HIV as a couple. Refusal to participate brought speculation of possible infidelity and consequently, relationship turmoil; to test and be found serodiscordant would confirm their infidelity. One participant reasoned that some men in his community avoided antenatal care clinic visits to hide indiscretions:

> Why do you think that men don't go with their wives? ...They fear that the partner will be there to receive the results with them. This means they know what they have been doing in the dark... (Otieno, 35 years)

A few male partners feared rejection and abandonment by their partners or wives especially if disclosure revealed discordance. They feared being seen as undesirable and losing status as a patriarch. Such fears discouraged them from participating in couple HIV testing and counselling, as shared by this male partner:

> …If we are tested together and I might be found positive and my wife negative this makes me feel that our marriage can come to an end. She can run away from me if I have the virus and she doesn't have… (John, 39 years)

Further, this quote underscores the pervasiveness of HIV-related stigma in the study community. Similar to studies among women, who often report fear of abandonment following a positive HIV test (Falnes, et al., 2011; Maman, et al., 2011; Walcott, Hatcher, Kwena, & Turan, 2013), it is notable that men expressed similar fears.

Clinic Logistical Challenges

Male partners also cited logistical constraints as barriers to engaging in antenatal care clinic visits. For some participants, the inability to afford transport costs hindered them from accompanying their wives to clinic visits. As this older individual lamented:

> Yeah, Lack of money is another reason! It could have also prevented me from coming because for you to get to the clinic, it will cost you 300 [Kenyan Shillings] on a motorcycle. (Stephen, 58 years)

Lack of time to participate in clinic visits was cited as another major constraint. Although many male partners desired to be involved, time spent at the clinic and away from income- generating activities interfered with their responsibilities as providers. As this male partner articulated, it was not for lack of care that he felt for his wife; conflicting work and antenatal care clinic visit schedules made it impossible for him to attend clinic visits with his partner:

> I am very busy. It is not that I am avoiding her because I took my time to bring her all the way to stay with me… (Fred, 38 years)

Another factor deterring men from accompanying their wives or partners to antenatal care clinics was perceived disapproval of male presence by clinic staff.

> … In some cases, the doctor may make you avoid visiting the clinic. Some of them do not welcome us. (Paul, 43 years)

On the other hand, being the only man at his wife's antenatal care clinic did little to discourage this young male partner from participating in clinic visits, with the understanding that the knowledge gained would make him a better husband and father:

> …We came to the clinic and I never saw any guy there. They were all women. I was all alone…We waited for some time and she was called inside. I was also called, and we met the doctor together… We went to the clinic and were taught how to take care of our marriage. We were also taught how to take care of our health. I, therefore, believe it is something important because we were educated. I learnt that a pregnant woman must have someone available to assist her... It was good because everything that we learnt impacted positively in my life. It, therefore, had a positive result in our life as a couple. (Otieno 35 years)

The above quote illustrates the pride and empowerment that some men in our sample felt after being engaged in antenatal care. It also highlights the potential effects on couple relationship dynamics, suggesting that male involvement in antenatal care may positively impact couple relationships in addition to positive health outcomes.

DISCUSSION

Most men in this study recognised the importance of attending antenatal care clinic visits and participating in the prevention of mother-to-child transmission of HIV with their pregnant partners. Many felt that pregnancy was an equally vested interest of both partners and that staying well-informed about the health of the pregnancy was imperative. Additionally, some male partners understood that the opportunities antenatal care services offer, including prevention of mother-to-child transmission of HIV services, would enable them to keep their families healthy. Indeed, male partners' positive sentiments about such maternal and child health services have been revealed in other African settings, such as Uganda and Tanzania (Falnes, et al., 2011; Matovu, et al., 2014; Theuring et al., 2009).

Despite these positive opinions, it is evident that gaps still exist in achieving significant male partner involvement in antenatal care and prevention of mother-to-child transmission of HIV-related activities (Mills, Beyrer, Birungi, & Dybul, 2012; Morfaw et al., 2013). Moreover, even though viewpoints about male engagement did not appear different for HIV-positive versus HIV-negative men in our sample, it was evident that concerns around HIV status continued to influence male engagement in prevention of mother-to-child transmission of HIV. We found men's fears of forced couple HIV testing and couple conflict arising from unwanted HIV status disclosure. Others

expressed fear of mockery and possible abandonment if HIV results were positive and serodiscordant. Similar male fears have been reported in other studies (Byamugisha, Tumwine, Semiyaga, & Tylleskar, 2010; Katz, et al., 2009; Matovu, et al., 2014). Furthermore, the occurrence of "by proxy" testing appears to indicate that men who would benefit from HIV testing for their own health may not be accessing this service. Therefore, assisting couples together through couple HIV-testing and disclosure may help male partners improve their knowledge about the role they play in prevention of mother-to-child transmission of HIV, as well as help those apprehensive of couple HIV-testing and counselling acknowledge and cope with their fears. Working with men who fear couple HIV testing in small male-only groups may also be a good strategy for creating safe spaces for examining fears associated with HIV and partner commitment.

The perceptions and opinions voiced by male partners illustrate that the barriers surrounding male engagement in pregnancy health-related activities are many and are impacted by circumstances beyond the individual (Alio, et al., 2013). To help address facility-level barriers, such as conflicting work schedules with antenatal care clinic hours and the lack of a "male-friendly" environment, antenatal care programs have instituted various strategies, such as providing shorter waiting times for couples presenting at clinic and using letter invitations to invite male partners to the clinic, albeit with modest success (Ditekemena, et al., 2012; Ditekemena et al., 2011; Morfaw, et al., 2013; Sharma, Barnabas, & Celum, 2017). Added strategies such as patient tracing where patients who are non-adherent to clinic visit appointments are physically traced, have been employed to improve male engagement in prevention of mother-to-child transmission of HIV-related activities with better success (Rosenberg et al., 2015; Thomson, Cheti, & Reid, 2011). Furthermore, home-based couple HIV testing

interventions have shown some promise in improving male engagement in prevention of mother-to-child transmission of HIV-related activities and may provide a feasible option to overcoming constraints associated with access and use of maternal and child health-related services (Krakowiak, et al., 2016; Osoti, et al., 2014; Walcott, et al., 2013).

Within our study communities, results also indicated that predominant social norms deterred men from engaging in activities that were perceived as effeminate, and to do so would be perceived as aberrant, as has also been found in other settings (C. M. Montgomery, Hosegood, Busza, & Timaeus, 2006; Morfaw, et al., 2013). In recognizing the negative impact of traditional masculinity on men's health as well as on engagement in antenatal care and prevention of mother-to-child transmission of HIV, community-based education programmes that involve educating male partners about the benefits of male engagement in prevention of mother-to-child transmission of HIV, address issues surrounding stigma, and challenge gender norms have had some success in increasing HIV testing among male partners. In a community mobilisation intervention centred around promoting gender equity and intimate partner violence prevention, participants in communities randomised to receive the intervention had better HIV prevention behaviours and described improved communication about prevention of mother-to-child transmission of HIV, although there were some challenges experienced by men (Kyegombe et al., 2014). Community-level interventions could improve male engagement and couple relationships dynamics which in turn could be used to model redefined masculine expectations and help address negative influences of traditional gender roles in the context of maternal and child health.

However, to effectively address challenges in male involvement, understanding the mechanisms by which male partners engage in antenatal care and HIV prevention during pregnancy is essential. Alio and colleagues (2013) posited that couple relationships influence the degree to which male partners become involved with their wives during pregnancy (Alio, et al., 2013). Indeed, one of the most important contributions of our study was the finding that couple relationship factors played an integral part in male partner involvement in maternal and child health-related activities. A closeness between spouses where effective communication about HIV and maternal and child health matters was encouraged appeared to positively impact male involvement. Couples in our study who described poor or weak couple communication experienced less male partner involvement, especially if female partners also subscribed to traditional gender roles and saw little need for male partner involvement in antenatal care. In such instances, open dialogue between couples relating to pregnancy-related topics including HIV prevention during pregnancy, would be difficult to initiate and maintain. However, we recognise that couple relationship dynamics are one factor among many that influences male engagement in antenatal care and prevention of mother-to-child transmission of HIV in this and similar settings.

Nonetheless, it is important, as it is a factor that is amenable to interventions that can strengthen couple communication and relationship skills (Conroy, et al., 2017; Darbes et al., 2016).

LIMITATIONS

The findings from this study should be viewed in the light of several limitations. The focus of analysis was on male views of male engagement in perinatal health and the influence of couple relationship factors, which gives unique voice to a population less often heard and supported around these issues (i.e., men) (Comrie-Thomson et al., 2015; Mills, et al., 2012). That said, future research could usefully access the views of women and perhaps use dyadic in-depth interview approaches to understand viewpoints from both members of a couple.

Engaging a few male partners in lengthy in-depth interviews that required time and extensive discussion about their perceptions and experiences remained a challenge; this was due to men's engagement in occupations requiring long working hours away from home such as mining and limited time to participate. Due to time constraints, eliciting deep and rich stories from a few these men was challenging; however, most interviews with male partners yielded rich and informative results.

Because the study recruited pregnant women visiting antenatal care clinics and their male partners, these men's perceptions may differ from those of participants not engaged in health services. Additionally, since we only contacted men whose female partners gave consent for recruitment, male partners interviewed for this study may be more supportive on the topics of HIV and prevention of mother-to-child transmission of HIV-related activities in addition to being in more positive couple relationships than men in the general population.

Finally, because recruitment occurred at the health facilities, perceptions shared about male engagement may have been more favourably presented if participants were

reluctant to express negative views to a researcher who seemed linked to the clinic (Nederhof, 1985). To foster a safe environment in which participants were encouraged to share views candidly and without apprehension, professional qualitative interviewers who were not affiliated with the health facilities were employed to conduct the in-depth interviews at a place of the participants' choosing.

CONCLUSION

To actualise the Global Plan initiative, a multipronged approach is needed to successfully engage male partners in maternal and child health services. Beyond addressing improved access and knowledge among male partners, culturally appropriate community-based interventions that attend to redefining gender roles and couple relationship dynamics are essential. In this explorative study, male partners' perceptions of their relationships to their spouses did appear to impact male engagement and understanding key mechanisms within couple relationships that enable male partners' support and engaging in pregnancy health is pertinent to refining interventions for better success.

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USING THE ACTOR-PARTNER INTERDEPENDENCE MODEL TO TEST THE EFFECT OF COUPLE RELATIONSHIP FACTORS ON COUPLE EFFICACY AND COMMUNAL COPING TO REDUCE HIV THREAT IN PREGNANT COUPLES IN SOUTHWESTERN KENYA

by

PAMELA MUSOKE, LYNAE DARBES, JUSTIN BLACKBURN, NATALIYA V. IVANKOVA, KARI WHITE AND JANET M. TURAN

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ABSTRACT

INTRODUCTION: Involving both partners of a couple in prevention of mother-to-child transmission (PMTCT) of HIV improves maternal and child health outcomes. Thus, understanding how best to involve both female and male partners effectively and safely in PMTCT programs is imperative, especially in high HIV prevalence settings in sub-Saharan Africa. Previous research showed that marital cohesion is associated with sustaining healthy behaviors. Deepening our understanding of how couple relationship dynamics influence uptake of and adherence to HIV prevention strategies can aid in designing effective interventions for PMTCT.

METHODS: Using the Actor-Partner Interdependence Model, we dyadically explored the effects of each member of a couple's perceived relationship dynamic (relationship satisfaction, relationship trust, relationship commitment and communication) on their own confidence (couple efficacy) and ability (communal coping), as well as on their partner's, in reducing an HIV threat at baseline (N=96 couples).

RESULTS: Couples reporting significantly high relationship quality (positive communication, high relationship satisfaction, commitment, and trust) were more likely to report high couple efficacy to reduce HIV risk. Negative communication was negatively associated with one's own confidence to reduce HIV risk with one's partner. Actor effects in couple efficacy appeared to be stronger for males than female partners with respect to relationship commitment (beta coefficient=-0.070, SE=0.029, $p<0.05$) and relationship satisfaction (beta coefficient=-0.095, SE= 0.041, $p<0.05$). For partner effects, an actor's perceived high relationship quality (positive communication and high relationship trust) was significantly positively associated with their partner's confidence to reduce HIV risk with their spouse. Partner effects were stronger from males to female

partners for relationship satisfaction (beta coefficient= 0.093, SE=0.045, $p<0.05$) and relationship trust (beta coefficient= 0.062, SE=0.030, $p<0.05$). Similar findings were noted for actor effects in aspects of communal coping- high relationship quality was associated with their own increased communal coping ability. No statistically significant partner or gender effects were noted for communal coping.

CONCLUSION: Using a dyadic approach enabled studying how relationship dynamics on aspects of implementing HIV prevention strategies, holistically, by considering the mutual influences of both members of a couple. Such findings could have implications in designing efficacious and sustainable couple and family-oriented interventions aimed at improving HIV prevention.

Keywords: actor-partner interdependence model, couple relationship factors, couple efficacy, communal coping, pregnancy couples, Kenya

INTRODUCTION

Historically, individual patient-oriented interventions have resulted in only marginal effects on health outcomes, including psychological well-being (Martire, Schulz, Helgeson, Small, & Saghafi, 2010b). A growing awareness of the influences of couple relationship dynamics on health has led to an increase in studies exploring behavioral interventions that include spouses (Kiecolt-Glaser and Newton, 2001).

The success of couple-based interventions hinges on an understanding of how couples mutually influence each other's health behaviors (Kiecolt-Glaser and Wilson, 2017). Researchers have found that health and health behaviors are often similar in couple relationship partners and seem to converge over time (Leong, Rahme, & Dasgupta, 2014). Additionally, studies have found that couples' lifestyles, stressors, and daily life activities are intertwined and that each partner's personal attributes, moods, attitudes, behavior, health stress, and lifestyles affect both spouses (Kiecolt-Glaser and Wilson, 2017). For example, "positive control behaviors" such as modeling a behavior for health promotion were related to greater intentions to change health behaviors (in a health-promoting direction), while "negative control behaviors" such as inducing fear had no effect on intentions (Robles, Slatcher, Trombello, & McGinn, 2014). Further, positive marital support could act as a buffer against the impact of negative outside influences on health behaviors and such support could also increase personal resources (i.e., self-efficacy, self- regulation) needed for initiating and maintaining health behavior change

(DiMatteo, 2004). As such, any attempt to change health behaviors in spouses would be more successful in satisfying relationships, as compared to distressed relationships (Martire and Helgeson, 2017).

One health condition that is clearly influenced by couple relationship dynamics is HIV. HIV has slowly shifted from being an acute to a chronic manageable disease. Within sub- Saharan Africa (SSA), HIV transmission most frequently occurs in heterosexual couples (Deeks, Lewin, & Havlir, 2013; Kharsany and Karim, 2016; Vermund, Narayan, & Glass, 2014).

However, unlike other chronic illnesses, the risk of sexual transmission of HIV makes it especially important to address HIV in the context of couples, and interventions must address both partners' health behaviors. Some HIV-focused couple-based behavioral strategies have thus been designed to promote mutual responsibility for preventing HIV acquisition by working to improve couple relationship quality (Wechsberg et al., 2015). However, the cultural context in which couple relationships exist adds complexity to the issue (van den Berg, et al., 2015).

Early PMTCT interventions in SSA focused primarily on pregnant women, without regard to cultural norms that would have otherwise influenced effectiveness and sustainability of such interventions (Ramjee and Daniels, 2013). In many studies, traditional gender norms and lack of male partner support have been discussed as key factors that adversely influence the impact of PMTCT programs. The lack of male engagement in PMTCT programs and interventions appeared to negatively influence ART adherence and retention in HIV care (Aluisio, et al., 2016; Falnes, et al., 2011; Hagey, Rulisa, & Perez-Escamilla, 2014; Medley, Garcia-Moreno, McGill, & Maman, 2004; Turan, et al., 2011; Wettstein, et al., 2012). Additionally, traditional gender roles

and expectations play a significant role in HIV prevention (Conroy, 2015; Conroy et al., 2016; Gipson et al., 2010; Vamos et al., 2013). In Kenya, male partners are often seen as the primary decision-makers for all family matters, including health. Lack of their support could hinder uptake of health promoting behaviors of their spouses (Farquhar, et al., 2004; Jefferys, et al., 2015; Musoke et al., 2018; Peltzer, Phaswana-Mafuya, & Ladzani, 2010; Turan, et al., 2011).

In this context, couple-oriented interventions, aimed at improving health and longevity among couples affected by HIV and preventing new infections in infants and serodiscordant couples, are exploring how couple dynamics and cultural influences affect health behaviors. Couple-oriented HIV prevention interventions have shown promise in addressing gaps in access and retention in PMTCT-related services among pregnant couples (Conroy, 2015; Krakowiak, et al., 2016; Osoti, et al., 2014). However, to ensure the success of couple-oriented interventions, there is need to gain a better understanding of how couple relationship factors actually influence couple strategies to engage in health-promoting behaviors in African contexts (Ambia and Mandala, 2016; Lewis, et al., 2006). To this end, we examined how couple relationship dynamics affected indicators of couple engagement in HIV prevention during pregnancy (the process of communal coping), including the effect of gender roles, through dyadic analyses (using the actor-partner interdependence model) of baseline questionnaire data from pregnant women and their male partners enrolled in a study in rural southwestern Kenya (Turan, et al., 2018). We aimed to test the following hypotheses:

- Hypothesis 1 (H1): There will be a significant positive actor effect between high relationship quality and his or her increased confidence (couple efficacy) and ability (communal coping) to work together with their spouse to reduce HIV risk;

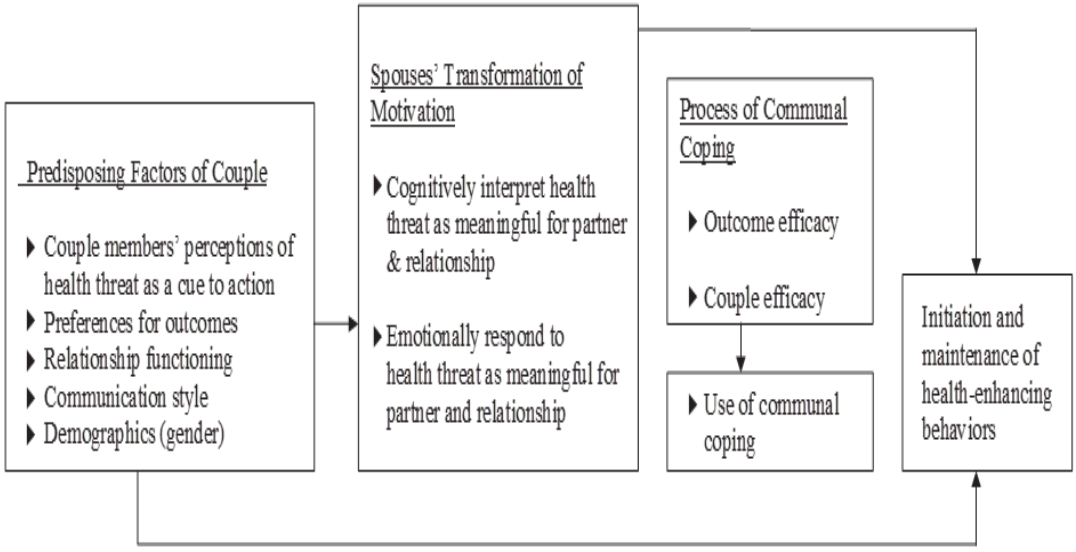
- Hypothesis 2 (H2): There will be a significant positive actor effect between poor relationship quality and lowered confidence (couple efficacy) and ability (communal coping) to work together with their spouse to reduce HIV risk;
- Hypothesis 3 (H3): There will be a significant positive partner effect such that a partner's better relationship quality is associated with increased actor's confidence (couple efficacy) and ability (communal coping) to work together with their spouse to reduce HIV risk;
- Hypothesis 4 (H4): There will be a significant positive partner effect such that a partner's poor relationship quality is associated with an actor's lower confidence (couple efficacy) and ability (communal coping) to work together with their spouse to reduce HIV risk*;*
- Hypothesis 5 (H5): There will be an interaction between gender and actor effects such that actor effects will be stronger for men when compared to women;
- Hypothesis 6 (H6): There will be an interaction between gender and partner effects such that actor effects will be stronger for men when compared to women.

Conceptual Model: Interdependence Model of Couple Influence

Lewis and colleagues (2006) developed a conceptual model of the dyadic interaction and its influence on health behavior change (Figure 1). The model was built on the premise that couples who collaboratively adopt health-promoting behaviors are motivated by the considerations couple members give to their relationship and their

partner. The model examines how interpersonal factors (as well as intrapersonal factors) might influence a couple member's motivation, and consequently bring about positive health behaviors. As such, the model provides a framework by which interventions could leverage the positive influences of couple relationships to bring about long-lasting health behaviors. The model also provides an analytical framework that emphasizes motivations and behaviors of both members of the couple and allows for a better understanding of couple functioning and its impact on health behavior change.

Figure 1: Interdependence mode of couple communal coping behavior change



Based on the interdependence model, the current study focused on examining predisposing factors of couples (relationship functioning and communication style) on the process and use of communal coping.

ETHICAL CONSIDERATIONS

Approval for the overall study was obtained from the Scientific and Ethics Review Unit of the Kenya Medical Research Institute, and the University of Alabama at Birmingham Institutional Review Board. All participants provided their written informed consent and were reimbursed for travel related to study participation.

METHODS

Study setting, population, design and sampling procedure

The Jamii Bora Study was a randomized controlled pilot trial of an intervention for pregnant women and their male partners for promotion of PMTCT and family health (Turan, et al., 2018). It was conducted in Migori County, Kenya, an area that continues to be severely burdened by high rates of HIV. As of 2013, HIV prevalence in this region was estimated to be at least two times higher than the national average (13.9% vs. 6%), with rates ranging from 14.7% (Migori County) to 19.3% (Kisumu County) and 25.7% (Homabay County) (NASCOP, 2014). By 2018, the nation experienced a decline in HIV prevalence to 4.9%. HIV prevalence in this region also declined with rates ranging from 13.3% (Migori County) to 16.3% (Kisumu County) and 20.7% (Homabay County), albeit remaining significantly higher than the national average.

The methods of the Jamii Bora Pilot Study are presented in detail elsewhere (Turan et al., 2018). In summary, pregnant women presenting at one of five rural health facilities offering antenatal care services were invited to participate in the study during the period of June 2015 through May 2016. The recruitment catchment area for this study was mainly rural; however, one of the participating ANC clinics was based in a larger

sub-district hospital in a small town. Women were eligible to participate in the study if they met the following criteria: gestational age less than or equal to 36 weeks; had been offered HIV testing at an ANC visit; aged 18 years or older; in a stable relationship with their primary male partner for at least 6 months; currently living with their male partner; no previous history of couple HIV Testing and Counselling (CHTC) during the current pregnancy; and no disclosure of their current HIV status (positive or negative) to their current male partner. Further, women who already knew their current male partner was HIV-positive were ineligible for the study, as they had no need for CHTC during the current pregnancy. Male partners were eligible if they were at least 18 years of age and identified as the primary partner by pregnant women recruited. Approximately half of the women recruited into the study were HIV-positive at baseline and half were HIV-negative, by study design. The pilot study consisted of two arms: an intervention arm that involved couple home visits during pregnancy and postpartum and a standard care arm. Following a baseline questionnaire, pregnant women who did not report recent severe intimate partner violence at baseline were randomized to intervention or standard care. After randomization, researchers gained permission from the women to contact their male partner for informed consent and a baseline questionnaire. This exploratory analysis utilizes baseline data from 96 couples who met eligibility criteria and in which both partners of the couple enrolled in the study and completed a baseline questionnaire.

Data Collection Methods

The baseline questionnaires were administered by trained interviewers in the participant's preferred language (English, Dholuo (local language) or Kiswahili (national language)).

Following the questionnaire, all participants were reimbursed 400 Kenyan shillings (roughly equivalent to US $5) for travel expenses and their time. Tablet computers using the Open Datakit (ODK) platform were used to administer the questionnaires. The baseline questionnaires consisted of socio-demographic questions, a series of couple relationship measures, depression measures, HIV-related stigma measures, and health care utilization questions (Turan, et al., 2018). The baseline questionnaires were conducted either at the clinic where recruitment occurred for pregnant women or in the community in a private location. Two hundred and fifty women were screened for eligibility. One hundred and thirty-seven pregnant women were eligible and participated in baseline questionnaires. Of the 137 pregnant women who participated, ten women were excluded from the randomized part of the study due to reports of recent severe intimate partner violence (IPV) in the baseline questionnaire. Women who reported severe IPV were counselled by our study coordinator who is a certified counselor and were referred to counseling services for further support.

Measures

Dependent Variables

Communal coping scales developed by Salazar and colleagues (Salazar, et al., 2013) based on the model developed by Lewis and colleagues (2006) were adapted for use in this study. *Process of Communal Coping: Couple Efficacy to Reduce HIV Threat Scale*

Couple efficacy scales, based on the self-efficacy theory developed by Albert Bandura (1997), aim to measure the couple's confidence in their ability to engage in HIV-related behaviors (Salazar, et al., 2013). For the current study, behaviors were

adapted for the PMTCT context. Each subscale was examined separately and was characterized by the following stems exploring a couple's perceptions about joint effort, communication and joint-decision-making and planning to reduce HIV threat for the behaviors of 1) reducing our risk of HIV; 2) using condoms; 3) getting tested regularly for HIV, and 4) preventing HIV transmission to our children. The couple efficacy construct is made up of three subscales that examine the following for each of these behaviors (X): a) joint effort: "How confident are you that you and your partner can act together (rather than separately) for X?" b) couple communication: "How confident are you that you and your partner can communicate about X?" and c) joint decision-making: "How confident are you that you and your partner can make decisions together (rather than separately) about X?"

The scales use a five-point Likert scale (1= not at all confident to 5=very confident) for the series of statements. Each subscale score has a potential to range from 4 to 20. Higher scores indicated higher levels of couple efficacy to reduce HIV threat. We conducted reliability tests for each of the subscales in our sample. Cronbach's alphas were adequate at 0.60 for women and 0.74 for men for joint effort, 0.63 for women and 0.71 for men for couple communication, and 0.67 for women and 0.76 for men for joint decision-making.

Use of communal coping communal coping to Reduce HIV Threat Scale

The communal coping scale assesses couples' abilities to actually utilize communal strategies that help reduce HIV threat in their families (Salazar, et al., 2013). The same PMTCT behaviors described above were addressed in these items. The stems for this scale include: "To what extent do you and your partner work together for X?"; "To what extent do you and your partner communicate about X?"; and for the last subscale, "To what extent do you and your partner make decisions together (rather than separately) about X?". Each subscale score had a potential to range from 4 to 20 and higher scores indicated greater frequency in engaging in these strategies. Cronbach's alphas for these subscales in our sample were somewhat lower: couple communication (Cronbach alpha: women=0.56; men=0.54), joint decision -making (Cronbach alpha: women=0.59; men=0.55) and "working together" (Cronbach alpha: women=0.61; men=0.53).

Independent Variables

Couple Relationship Measures

We used the following validated relationship scales as predictor variables to explore the association between couple relationship factors and communal coping to reduce HIV threat: relationship satisfaction, commitment, dyadic trust, and communication/conflict resolution.

Overall Relationship Satisfaction. Relationship satisfaction was measured using a 5-item scale with each item using a 9-point Likert scale ranging from 1 indicating no agreement to 9 indicating complete agreement (Rusbult, Martz, & Agnew, 1998). The scale score ranged from 5 to 45, with a higher score indicating higher levels of relationship satisfaction. We achieved high reliability in our sample, with Cronbach alpha scores being 0.94 for women and 0.93 for men.

Dyadic Trust. We used a dyadic trust scale composed of eight items and scored on a 7-point Likert scale (1= strongly disagree to 7=strongly agree) (Larzelere and Huston, 1980). Three items that were negatively worded were reverse coded to ensure that a high value indicated the same type of response on every item. The scale score ranged from 8 to 56; a higher score indicated high levels of trust between members of a dyad. The Cronbach alphas in our sample were 0.88 for women and 0.79 for men.

Communication and Conflict Resolution. In this study, we used a condensed version of the commitment and conflict resolution scale developed by Christensen and Heavey (1990). It consists of eleven items and explores a couple's communication patterns at times when issues or problems arise. The scale also examines positive interactions, as well as a partner's tendency to criticize or defend and demand or withdraw during an interaction . These interactions are divided into subscales with the following being used for this study: the overall use of demand and withdrawal by the couples when trying to initiate a discussion or during a discussion (total demand/withdrawal) (Cronbach alpha 0.82 and 0.89 for women and men, respectively); the use of criticism by the female partner, male partner or both during a discussion and a couple's defense response to the

criticisms (criticize/demand) (Cronbach alpha 0.85 and 0.90 for women and men, respectively). The last subscale used was positive interaction among couples during discussions (Cronbach alpha was 0.77 for women and 0.56 men, respectively). Higher scores on each subscale indicated a greater likelihood of using that communication pattern during communication and conflict interactions.

Commitment. The commitment scale used in this study was developed by Rusbult and colleagues (1998) as part of the investment model that builds upon Interdependence Theory (Figure 1). Items were culturally adapted to our study population; reliability testing yielded a Cronbach alpha of 0.97 and 0.96 for women and men, respectively. The scale is composed of eight items and scored on a 9-point Likert scale (1=not at all true to 9=extremely true). The scale score had the potential of ranging from 8 to 72; a higher score indicated high levels of commitment between members of a dyad.

Control Variables

Across all built models (for all relationship factors in both couple efficacy and communal coping), these couple level variables included as control variables in the analyses (due to their significant association with couple relationship dynamics or theoretical importance): couple HIV status (represented as a binary variable categorized as concordant HIV positive or negative (=1) or serodiscordant (=-1)) (Ezeanolue et al., 2017), and being first-time parents, categorized as a binary variable consisting of yes (=1) or no (=-1). Inclusion of a few control variables was due to a small sample size.

Data Analysis

Prior to conducting analyses, descriptive statistics were examined. For analysis, all predictors were grand mean centered and gender effect coded, that is, female partners took a value of 1 and male partners took a value of -1, to allow for easier interpretation. IBM SPSS Statistics, version 23 was used for all analyses.

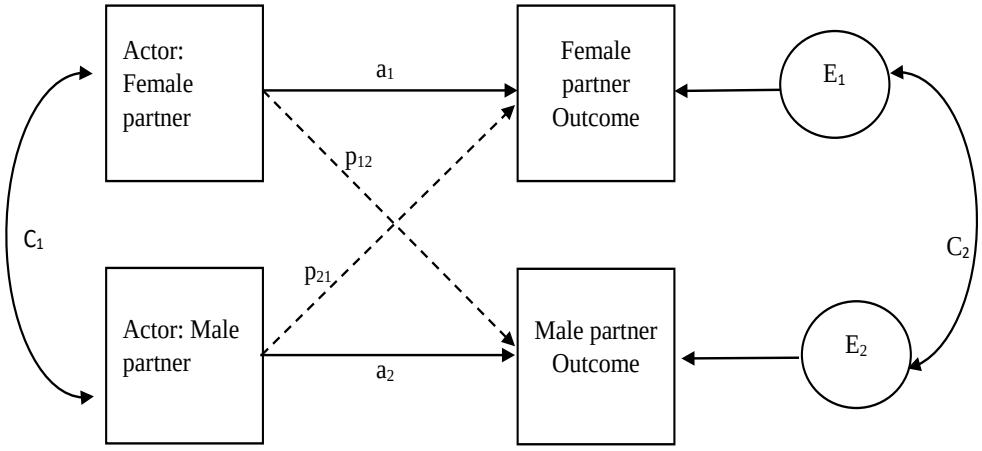
Testing Non-Independence of Data

The manner in which the data were examined took into account the non-independent nature of the variables. Hierarchical data occurs when variables can be classified into groups. In this case, our data can be grouped into dyads (male partners and female partners), the units of analysis; the observations of each member of the dyad are more similar to (or different from) one another when compared to measurements collected from two disparate individuals who are not members of the same dyad (Kenny, Kashy, & Cook, 2006). Ignoring the correlated nature of the data and using analytic procedures that assume independence would lead to biased estimates and tests for non-significance (Cook and Kenny, 2005; Kenny, et al., 2006). Further, by analyzing each member of dyad separately, by gender, for example, we fail to explore and understand the underlying relationship dynamics between members of the dyad that has led to the outcome of interest (Kenny, et al., 2006). Prior to analyzing the dyadic data, the assumption of nonindependence was determined by measuring the association between scores of the dyad members using Pearson's r if dyads are distinguishable (e.g. male partners and female partners dyads).

Actor-Partner Interdependence Model

To account for the nested nature of the data and to simultaneously explore the effect of each member of a dyad on his or her own behavior as well as on the partner's behavior, the actor- partner interdependence model (APIM) was used to estimate both the individual and dyadic factors (Cook and Kenny, 2005). Specifically, the APIM allowed us to explore the extent to which the independent variable of a person influences his or her score on the dependent variable (actor effect denoted as "a") as well as estimate the extent to which the independent variable of an actor influences the dependent variable of his or her partner (partner effect denoted as "p") (see Figure 1 below) (Fitzpatrick, Gareau, Lafontaine, & Gaudreau, 2016). To determine the APIM effects associated with the outcome, the dataset was structured into a pairwise format (Kenny, et al., 2006). The estimation of the APIM was calculated using multilevel modeling with compound symmetry for distinguishable dyads (Cook and Kenny, 2005). The two-intercept model where dummy coded variables for husbands and wives were interacted with predictor variables was employed to estimate separate actor and partner estimates for women and men. Since gender was used at the distinguishable variable, gender effects in actor and partner effects were estimated by examining statistical interactions. Pathways were considered statistically significant if an level of 0.05 was observed.

Figure 2: Actor-Partner Effects



RESULTS

Participant Characteristics

Table 1 shows characteristics of the 192 participants (96 wives and 96 husbands) who were included in this analysis. Wives had a median age of 23.5 years while husbands had a mean age of 32 years with median difference being significant. Approximately two thirds of wives and half of husbands had a primary school education or less with significant differences in gender, X^2 (1)=4.92, p=0.027, while a minority of participants had completed secondary school with no observed gender differences. Most participants reported being married and described their relationship as monogamous. Approximately 14% of women and 12% of husbands reported being first-time parents with no observed gender differences. In terms of HIV status, about half of the wives reported being HIV positive (by study design), while majority of husbands (77%) reported being HIV-negative.

Both wives and husbands generally reported high relationship satisfaction with median scores of 40 and 41, respectively. Additionally, high relationship trust was reported by both women (median=47) and men (median= 50). However, in both cases, husbands reported significantly higher relationship satisfaction (p = 0.009) and relationship trust (p <0.001) (Table 1). Median relationship commitment scores for wives and husbands were 64.5 and 66.5, respectively; median differences by gender were also statistically significant (p=0.031). In terms of communication styles, both wives and husbands in general reported low use of negative communication total demand/withdrawal; criticize/defend) and high use of positive interaction with no observed gender differences. Gender differences were observed in both couple efficacy scores and communal coping with slightly higher couple efficacy scores reported by husbands compared to wives (Table 1).

Table 1: Participant characteristics by sex

Variables [a]	**Women (N=96)**	**Men (N=96)**	**Differences by gender**	
			Z-Value	**p value**
Median Age (in years)	23.5 (20-28.8)	32.0 (26.3-39.8)	-8.34	0.000***
Primary School Education or less	66 (68.8)	51 (53.1)	0.027*	
Secondary School Education	21 (21.9)	31 (31.3)	0.141	
First Time Parent: Yes	14 (14.6)	12 (12.5)	0.673	
HIV Status [b]				
HIV-positive	48 (50.0)	8 (8.3)	0.000***	
HIV-negative	48 (50.0)	77 (80.2)	0.000***	
Relationship Factors				
Communication and Conflict Resolution Style (Scores)				
Median Total Demand/Withdraw	10.0 (6-16)	10.00 (6-14)	-1.53	0.126
Median Criticize/Demand	6.0 (3-9)	5.0 (3-9)	-1.30	0.198
Median Positive Interaction	26.0 (22-27)	26.5 (23-27)	-1.13	0.260

Median Relationship Trust	47.0 (42-51)	50.0 (46-56)	-4.74	0.000***
Median Relationship Satisfaction	40.0 (36-45)	41.0 (38-45)	-2.61	0.009**
Median Relationship Commitment	64.5 (59-72)	66.5 (62-75)	-2.15	0.031
Process of Communal Coping (Scores)				
Median Couple Efficacy- Acting	16.0 (15-18)	18.0 (16-19)	-4.11	0.000***
Median Couple Efficacy- Communication	16.0 (14-18)	17.0 (16-19)	-3.31	0.001**
Median Couple Efficacy- Decision-Making	16.0 (14-18)	17.0 (16-19)	-3.48	0.000***
Use of Communal Coping (Scores)				
Median Communal Coping- Working Together	16.0 (14-18)	16.0 (16-18)	-1.97	0.048*
Median Communal Coping- Communication	16.0 (15-18)	16.0 (16-18)	-1.87	0.062
Median Communal Coping- Decision Making	16.0 (14-18)	16.0 (16-18)	-2.38	0.017*

[a] Continuous variable are reported as medians and interquartile ranges in parentheses (skewness>3; kurtosis>8); differences by gender were tested using the Wilcoxon Signed Ranks. Categorical variables are reported as Ns, with percentages in parentheses, and differences by gender tested using Pearson chi-square tests.
[b] HIV status for women were confirmed using medical records
*p<0.05, **p<0.01, ***p<0.001

Pearson's correlations were calculated to also assess nonindependence of partners' scores for all relationship factors and communal coping processes (Table 2). Relationship satisfaction, relationship trust and positive interaction appeared to be significantly modestly correlated with small to moderate positive coefficients ranging between 0.21 and 0.63. Use of negative styles of communication and conflict resolution (total demand/withdraw and criticize/defend) were significantly but modestly correlated with coefficient values ranging between -0.11 and -0.41.

Table 2 Pairwise bivariate correlations between relationship quality and couple efficacy and communal coping in reducing HIV threat

		Female variables												Male variables											
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Women																									
1	Couple Efficacy- Acting	1																							
2	Couple Efficacy- Communication	0.90**	1																						
3	Couple Efficacy- Deciding together	0.93**	0.96**	1																					
4	Communal Coping- Working together	0.85**	0.76**	0.81**	1																				
5	Communal Coping- Communication	0.86**	0.83**	0.85**	0.91**	1																			
6	Communal Copng- Deciding together	0.83**	0.77**	0.81**	0.93**	0.94**	1																		
7	Total Demand/Withdraw	-0.39**	-0.41**	-0.44**	-0.33**	-0.31**	-.29**	1																	
8	Criticize/Defend	-0.27**	-.291**	-.302**	-.208*	-0.19	-0.17	0.86**	1																
9	Positive Interaction	0.26*	0.30**	0.32**	0.30**	0.28**	0.28**	-0.48**	-0.31**	1															
10	Relationship Trust	0.19	0.25*	0.27**	0.28**	0.23*	0.24*	-0.59**	-0.55**	0.52**	1														
11	Relationship Satisfaction	0.30**	0.31**	0.34**	0.31**	0.24*	0.26*	-0.55**	-0.48**	0.57**	0.81**	1													
12	Total Committment	0.32**	0.41**	0.38**	0.15	0.22*	0.15	-0.62**	-0.48**	0.56**	0.67**	0.68**	1												
Men																									
13	Couple Efficacy- Acting	**0.33****	0.33**	0.38**	0.27**	0.35**	0.34**	-0.18	-0.11	0.23*	0.16	0.16	0.24*	1											
14	Couple Efficacy- Communication	0.30**	**0.32****	0.35**	0.20	0.30**	0.29**	-0.21*	-0.17	0.24*	0.14	0.17	0.27**	0.90**	1										
15	Couple Efficacy- Deciding together	0.38**	0.38**	**0.44****	0.28**	0.37**	0.35**	-0.25*	-0.16	0.30**	0.18	0.24*	0.34**	0.93**	0.93**	1									
16	Communal Coping- Working together	0.45**	0.41**	0.44**	**0.38****	0.45**	0.43**	-0.13	-0.08	0.17	-0.07	-0.02	0.06	0.48**	0.44**	0.51**	1								
17	Communal Coping- Communication	0.45**	0.41**	0.43**	0.36**	**0.43****	0.42**	-0.14	-0.16	0.11	-0.03	0.03	0.09	0.52**	0.44**	0.53**	0.89**	1							
18	Communal Copng- Deciding together	0.47**	0.41**	0.43**	0.38**	0.45**	**0.44****	-0.08	-0.11	0.05	-0.10	-0.01	0.05	0.55**	0.47**	0.56**	0.86**	0.94**	1						
19	Total Demand/Withdraw	-0.24*	-0.26*	-0.29**	-0.17	-0.26*	-0.21*	**0.28****	0.24*	-0.32**	-0.33**	-0.39**	-0.44**	-0.39**	-0.39**	-0.39**	-0.16	-0.17	-0.17	1					
20	Criticize/Defend	-0.11	-0.19	-0.20**	-0.02	-0.11	-0.05	0.25*	**0.24***	-0.16	-0.29**	-0.36**	-0.33**	-0.26*	-0.28**	-0.25*	-0.01	-0.05	-0.02	0.86**	1				
21	Positive Interaction	0.31**	0.35**	0.34**	0.25*	0.29**	0.26*	-0.19	-0.11	**0.38****	0.21*	0.27**	0.38**	0.41**	0.40**	0.47**	0.31**	0.25*	0.30**	-0.39**	-0.25*	1			
22	Relationship Trust	0.26*	0.32**	0.33**	0.23*	0.25*	0.25*	-0.41**	-0.31**	0.41**	**0.48****	0.47**	0.59**	0.34**	0.38**	0.37**	0.11	0.13	0.11	-0.68**	-0.56**	0.62**	1		
23	Relationship Satisfaction	0.31**	0.35**	0.38**	0.27**	0.28**	0.29**	-0.30**	-0.23*	0.47**	0.41**	**0.48****	0.51**	0.45**	0.43**	0.45**	0.18	0.18	0.17	-0.63**	-0.49**	0.56**	0.74**	1	
24	Total Committment	0.25*	0.26*	0.30**	0.19	0.20	0.20*	-0.36**	-0.26*	0.48**	0.45**	0.47**	**0.63****	0.56**	0.52**	0.57**	0.18	0.21*	0.22*	-0.53**	-0.41**	0.59**	0.68**	0.81**	1

Pearson's Correlation (*r*), a test for non-independence across all relationship factors and processes of communal coping; a correlations in bold show associations between women and men on the same variable

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Actor and Partner Effects of Measures of Relationship Quality on Couple Efficacy and Communal Coping to Reduce HIV Threat

Couple Efficacy: Actor Effects

We tested whether an actor's positive perception of relationship quality was associated with his or her confidence to work together with their spouse to reduce an HIV threat (H1), as well as if an actor's negative perception of relationship quality was negatively associated with their confidence to work together with their spouse to reduce an HIV threat (H2). The results of the actor effects are summarized in Table 3. Figures of actor-partner interdependence models demonstrating the associations between the subscales of couple efficacy and the relationship qualities have also been included in Appendix 1.

Overall, in actor effects, most individuals within a couple who reported high relationship quality (positive interaction, high relationship quality and high relationship trust) were likely to report high couple efficacy to reduce HIV threat across all sub-scales. Accordingly, those reporting poor communication and conflict resolution were more likely to report low couple efficacy in reducing HIV threat also across all sub-scales.

Among wives, in all instances, hypotheses 1 and 2 appeared to be supported. For wives, perceived poor communication and conflict resolution (total demand/withdraw communication styles as well as criticize/defend) were significantly and negatively associated with their own reporting of low confidence in acting together rather than separately in reducing HIV threat ($p<0.05$), and lower confidence in deciding together with their partners rather than separately on how to reduce an HIV threat ($p<0.05$). Among wives who reported using criticism to resolve marital conflict, a strong negative

and significant association with their own confidence in deciding together with their male partner how to reduce HIV threat was found ($p<0.05$). Positive interactions were positively associated with high couple efficacy to reduce HIV threat for women. Specifically, positive interactions were strongly and significantly associated with their own confidence in communicating with the male partner about reducing HIV threat ($p<0.01$).

Examination of a couple's perceived level of commitment also appeared to have similar influence on actor effects. Additionally, we noted a statistical trend in the association between wives' perceived commitment and their perceived efficacy in communicating to reduce HIV threat; wives' high perceived levels of commitment appeared to positively affect their confidence in being able to act together with their partners in reducing HIV threat ($p=0.053$). High perceived commitment was significantly and positively associated with perceived confidence in joint decision-making as well as communicating with their spouse to reduce HIV threat. Finally, although wives' relationship satisfaction and relationship trust positively affected all domains of couple efficacy to reduce HIV threat, none of the associations were statistically significant (Table 3).

Among husbands, hypothesis 1 and hypothesis 2 appeared to be supported by findings also. Reported use by husbands of the total demand/withdraw communication style to address conflict appeared to significantly and negatively affect their own confidence to act together, communicate and decide together with their wives ($p<0.05$). Similar to wives, a stronger negative and significant association between husbands who criticized and their confidence to jointly make decisions together rather than separately with their spouse on reducing HIV threat was reported ($p<0.05$). Husbands who reported

positive interactions were significantly more likely to report their own higher confidence in efficacy to reduce HIV threat across all domains (at $p<0.05$). Stronger positive and significant associations between reported relationship satisfaction and couple efficacy to reduce HIV threat in all domains by husbands were observed ($p<0.01$). Additionally, husbands reporting higher levels of commitment were significantly more likely to report greater confidence in being able to jointly make decisions ($p<0.01$), communicate with ($p<0.01$), and act together ($p<0.01$) with their wives to reduce HIV threat. Similar findings were observed with relationship trust, although stronger associations were seen with confidence to communicate about reducing HIV threat and confidence to decide together about actions to reduce HIV threat ($p<0.01$).

Couple Efficacy: Partner Effects

In these analyses, we tested if a partner's positive perception of relationship quality was positively associated with the actor's confidence to work together with their spouse to reduce an HIV threat (H3), as well as whether a partner's negative perception of relationship quality was negatively associated with actor's confidence to work together with their spouse to reduce an HIV threat (H4). The results of the partner effects are summarized in Table 3 and depicted as figures in Appendix 1.

For wives to husbands, across all poor communication styles to address conflict (total demand/withdraw and criticize/ defend), fewer significant partner effects were observed compared to actor effects. In all cases, the woman reporting of use of poor communication and conflict resolution tended to negatively affect the husband’s couple efficacy to reduce HIV threat across all domains.

For husbands to wives, similar to wives who reported higher couple efficacy in reducing HIV threat with positive interaction (actor effects), husbands whose spouses reported increased couple efficacy also reported positive interactions, albeit with stronger associations ($p<0.05$). On a similar note, husbands whose partners reported higher couple efficacy in reducing HIV threat reported statistically significantly higher relationship trust ($p<0.01$). In both instances, the hypothesis that a partner's positive perception of relationship quality is positively associated with the actor's confidence (couple efficacy) to work together with their spouse to reduce an HIV threat was supported.

Table 3: Unstandardized estimates for actor and partner effects of seven relationship quality constructs on couple efficacy to reduce HIV risk

	Couple efficacy to reduce HIV threat		
	How confident are you that you and your partner can act together… (rather than separately)?	How confident are you that you and your partner can communicate about…?	How confident are you that you and your partner can make decisions together… (rather than separately)?
Communication and Conflict Resolution Style	Estimates (SE)	Estimates (SE)	Estimates (SE)
Total Demand/Withdraw			
Actor effect: Female CCR→female couple efficacy reduce HIV threat	**-0.118 (0.033) ****	**-0.127 (0.034)****	**-0.137 (0.034) ****
Partner effect: Female CCR →male couple efficacy reduce HIV threat	-0.020 (0.029)	-0.029 (0.029)	-0.046 (0.030)
Actor effect: Male CCR→male reduce HIV threat	**-0.100 (0.030)***	**-0.097 (0.031)***	**-0.098 (0.031)***
Partner effect: Male CCR→female couple efficacy reduce HIV threat	-0.038 (0.034)	-0.049 (0.035)	-0.060 (0.035)
Criticize/Defend			
Actor effect: Female CCR→female couple efficacy reduce HIV threat	**-0.110 (0.049) ***	**-0.127 (0.050) ***	**-0.134 (0.051) ***

Partner effect: Female CCR →male couple efficacy reduce HIV threat	-0.019 (0.043)	-0.042 (0.042)	-0.042 (0.044)
Actor effect: Male CCR→male couple efficacy reduce HIV threat	**-0.097 (0.047)***	**-0.101 (0.045)***	**-0.088 (0.048)***
Partner effect: Male CCR→ female couple efficacy reduce HIV threat	-0.009 (0.053)	-0.057 (0.055)	-0.062 (0.055)
Positive Interaction			
Actor effect: Female CCR→female couple efficacy reduce HIV threat	0.09 (0.066)	0.121 (0.067)	**0.144 (0.068)***
Partner effect: Female CCR →male couple efficacy reduce HIV threat	0.0375 (0.055)	0.050 (0.054)	0.074 (0.054)
Actor effect: Male CCR→male reduce HIV threat	**0.216 (0.062)***	**0.204 (0.061)****	**0.248 (0.061)****
Partner effect: Male CCR→female couple efficacy reduce HIV threat	**0.151 (0.075)***	**0.183 (0.076)****	**0.172 (0.076)***
Relationship Satisfaction (RS)			
Actor effect: Female RS →female couple efficacy	0.077 (0.050)	0.084 (0.051)	0.089 (0.051)

reduce HIV threat			
Partner effect: Female RS →male couple efficacy reduce HIV threat	-0.038 (0.041)	0.023 (0.041)	-0.008 (0.042)
Actor effect: Male RS→male reduce HIV threat	**0.267 (0.060)****	**0.235 (0.065)****	**0.243 (0.062)****
Partner effect: Male RS→female couple efficacy reduce HIV threat	0.127 (0.075)	**0.165 (0.074)***	**0.188 (0.074)***
Relationship Commitment (RC)			
Actor effect: Female RC→female couple efficacy reduce HIV threat	0.078 (0.040)	**0.129 (0.040)***	0.106 (0.041)
Partner effect: Female RC →male couple efficacy reduce HIV threat	-0.056 (0.030)	-0.029 (0.030)	-0.013 (0.031)
Actor effect: Male RC→male reduce HIV threat	**0.219 (0.036)***	**0.181 (0.036)***	**0.196 (0.037)***
Partner effect: Male RC→female couple efficacy reduce HIV threat	0.027 (0.047)	-0.002 (0.047)	0.031 (0.049)
Relationship Trust (RT)			
Actor effect: female RT→female couple efficacy reduce HIV threat	0.021 (0.036)	0.036 (0.036)	0.042 (0.036)
Partner effect: female RT	-0.007 (0.029)	-0.018 (0.029)	-0.003 (0.030)

→male couple efficacy reduce HIV threat			
Actor effect: male RT→male reduce HIV threat	**0.113 (0.041)****	**0.134 (0.039)****	**0.128 (0.041)****
Partner effect: Male RT→ female couple efficacy reduce HIV threat	0.078 (0.047)	**0.106 (0.048)***	**0.107 (0.049)***

Models includes the following covariates: couple HIV status and first-time parents
*p<0.05, p<0.01**
CCR (Communication and conflict resolution) RS (Relationship Satisfaction
RT (Relationship Trust)
RC (Relationship Commitment)

Couple Efficacy: Gender Effects

Modest differences by gender were observed with relationship satisfaction and relationship commitment and sub-scales of couple efficacy. Within the couple efficacy subscale joint effort (acting together), actor effects appeared to be significantly stronger for husbands than wives, supporting hypothesis 5. For husbands, higher relationship commitment (beta coefficient=-0.070, SE=0.029, $p<0.05$) and satisfaction (beta coefficient=-0.095, SE= 0.041, $p<0.05$) were positively related to being confident in acting together with his female partner to reduce HIV threat, more so than for women. For the couple efficacy communication subscale, partner effects were stronger for husbands to wives for both relationship satisfaction (beta coefficient= 0.093, SE=0.045, $p<0.05$) and relationship trust (beta coefficient= 0.062, SE=0.030, $p<0.05$). This appeared to be in congruence with our hypothesis that partner effects would be stronger for husbands to wives than wives to husbands (Hypothesis 6). In this case, perceived higher relationship satisfaction and relationship trust among husbands appeared to be more positively related to wives' perceived level of confidence to communicate about reducing HIV threat.

Communal Coping: Actor Effects

We tested whether an actor's positive perception of relationship quality was associated with his or her ability to work together with their spouse to reduce an HIV threat (H1) as well as if an actor's negative perception of relationship quality is negatively associated with their ability to work together with their spouse to reduce an HIV threat (H2). The results of the actor effects are summarized in Table 4. Figures of actor-partner interdependence models demonstrating the associations between the subscales of communal coping and the relationship qualities have been included in Appendix 2.

In actor effects, similar associations between relationship quality and communal coping to reduce HIV threat were observed across all domains (Table 4). However, fewer statistically significant pathways were seen.

For wives, in all instances, hypotheses 1 and 2 appeared to be supported. For wives, poor communication style to address couple conflict (total demand/withdraw and criticize/defend) were significantly and negatively associated with being able to work together, as well as communicate with their spouses to reduce HIV threat (at $p<0.05$). Wives who reported positive interactions were more likely to report higher communal coping to reduce HIV threat.

Specifically, wives were more likely to report higher ability in being able to work together rather than separately to reduce HIV threat ($p<0.05$).

Similar to their spouses, husbands who reported high relationship quality were more likely to report high communal coping to reduce HIV threat across all domains, supporting the hypothesis that an actor's positive perception of relationship quality was associated with his ability to work together with his spouse to reduce an HIV threat. Positive interactions appeared to have the significantly stronger positive associations with

the extent husbands reported being able to work, communicate and make decisions with their spouses about reducing HIV threat ($p<0.05$). Lastly, we observed a modest positive association between relationship commitment and a husband's ability to make joint decisions about reducing HIV threat with their wives ($p<0.05$).

Communal Coping: Partner Effects

We aimed to test if a partner's positive perception of relationship quality was positively associated with the actor's ability to work together with their spouse to reduce an HIV threat (H3) as well as if a partner's negative perception of relationship quality was negatively associated with actor's ability to work together with their spouse to reduce an HIV threat (H4). However, for both wives and husbands, couples' relationship quality was not significantly associated with their partners' perceived extent that they were able to work, communicate, and make decisions with the spouses to reduce HIV threat (Table 4) and depicted as figures in Appendix 2.

Table 4: Unstandardized estimates for actor and partner effects of seven relationship quality constructs on communal coping to reduce HIV risk

	Communal Coping to reduce HIV threat		
	To what extent do you and your partner work together (rather than separately) for?	To what extent do you and your partner communicate about…?	To what extent do you and your partner make decisions together (rather than separately) about?
Communication and Conflict Resolution Style	Estimates (SE)	Estimates (SE)	Estimates (SE)
Total Demand/Withdraw			
Actor effect: Female CCR→female communal coping to reduce HIV threat	**-0.101 (0.034)****	**-0.085 (0.032) ***	**-0.087 (0.034)***
Partner effect: Female CCR →male communal coping to reduce HIV threat	-0.029 (0.029)	-0.025 (0.028)	-0.008 (0.030)
Actor effect: Male CCR→male reduce HIV threat	-0.026 (0.030)	-0.033 (0.029)	-0.038 (0.030)
Partner effect: Male CCR→ female communal coping to reduce HIV threat	-0.022 (0.033)	-0.048 (0.033)	-0.028 (0.034)
Criticize/Defend			
Actor effect: Female CCR→female communal	**-0.097 (0.047) ***	-0.078 (0.046)	-0.0781 (0.048)
coping to reduce HIV threat			

Partner effect: Female CCR →male communal coping to reduce HIV threat	-0.028 (0.041)	-0.059 (0.040)	-0.042 (0.042)
Actor effect: Male CCR→male communal coping to reduce HIV threat	0.015 (0.044)	-0.003 (0.047)	0.012 (0.045)
Partner effect: Male CCR→ female communal coping to reduce HIV threat	0.022 (0.052)	-0.016 (0.050)	0.019 (0.052)
Positive Interaction			
Actor effect: Female CCR→female communal coping to reduce HIV threat	**0.127 (0.063) ***	0.110 (0.062)	0.125 (0.063)
Partner effect: Female CCR →male communal coping to reduce HIV threat	0.013 (0.053)	-0.003 (0.054)	-0.051 (0.054)
Actor effect: CCR Male CCR→male communal coping to reduce HIV threat	**0.155 (0.060) ***	**0.128 (0.060) ***	**0.183 (0.061) ****
Partner effect: Male CCR→ female communal coping to reduce HIV threat	0.104 (0.073)	0.124 (0.069)	0.101 (0.071)
Relationship Commitment (RC)			

Actor effect: Female RC→female communal coping to reduce HIV threat	0.013 (0.039)	0.050 (0.038)	0.019 (0.039)
Partner effect: Female RC →male communal coping to reduce HIV threat	0.026 (0.033)	-0.016 (0.033)	-0.040 (0.033)
Actor effect: Fale RC→male communal coping to reduce HIV threat	0.061 (0.039)	0.066 (0.039)	0.089 (0.040)
Partner effect: Male RC→female communal coping to reduce HIV threat	0.049 (0.047)	0.019 (0.045)	0.044 (0.047)
Relationship Satisfaction (RS)			
Actor effect: Female RS→female communal coping to reduce HIV threat	0.087 (0.048)	0.050 (0.047)	0.063 (0.048)
Partner effect: Female RS →male communal coping to reduce HIV threat	-0.061 (0.043)	-0.033 (0.041)	-0.053 (0.042)
Actor effect: Male RS→male communal coping to reduce HIV threat	0.114 (0.060)	0.098 (0.060)	0.108 (0.061)

Partner effect: Male RS→ female communal coping to reduce HIV threat	0.097 (0.070)	0.112 (0.068)	0.110 (0.070)
Relationship Trust			
Actor effect: Female RT→female communal coping to reduce HIV threat	0.063 (0.033)	0.039 (0.033)	0.044 (0.033)
Partner effect: Female RT →male communal coping to reduce HIV threat	-0.043 (0.028)	-0.032 (0.028)	-0.054 (0.029)
Actor effect: Male RT→male communal coping to reduce HIV threat	0.048 (0.039)	0.052 (0.039)	0.059 (0.040)
Partner effect: Male RT→ female communal coping to reduce HIV threat	0.040 (0.045)	0.059 (0.045)	0.057 (0.045)

Models includes the following covariates: couple HIV status and first-time parents
*p<0.05, p<0.01**
CCR (Communication and conflict resolution) RS (Relationship Satisfaction
RT (Relationship Trust)

Communal Coping: Gender Effects

No significant gender effects were noted between relationship quality (communication and conflict resolution, relationship satisfaction, trust and commitment) and communal coping subscales.

DISCUSSION

In this study, we found that how well a sample of rural Kenyan couples communicate and perceive relationship trust, satisfaction and relationship commitment affected their use of and adherence to HIV prevention strategies. Moreover, partner influences and in some cases gender differences, appeared to add to the complexity of how couples worked together, confidently, towards realizing similar HIV prevention goals (Conroy, 2015; Vamos, et al., 2013). A couple's confidence and ability to reduce HIV threat appeared to be dependent on the communication and conflict style used by the couple, relationship satisfaction and trust. For instance, using communication and conflict resolution styles that were perceived as criticizing, or demanding appeared to lessen a couple's perceived confidence in addressing HIV risk as a couple. These findings from sub-Saharan Africa appear to cross the cultural divides; studies conducted in western couples that examined the impact of communication on health outcomes found that couple conflict could lead to detrimental health effects in couples managing chronic diseases; this is especially true when communication was characterized by criticisms and hostility. Open and positive communication seemed to positively impact couple functionality and cohesion thereby improving coping skills and efficacy in implementing and sustaining health behaviors (Kiecolt-Glaser and Wilson, 2017; Pieczynski, Thilges, Bardsley, & Sher, 2016; Worrell, 2017).

Such findings have implications for HIV intervention development, especially in African settings where patriarchal societal structures are pervasive and husbands, perceived as heads of households, make major familial decisions including matters surrounding health (Hilpert et al., 2016). By understanding how couples interact and communicate, interventions can work towards improving couple communication, and consequently, their confidence and ability to work together to address a crisis, especially among couples living in HIV discordant relationships. However, it is important to note that mutual influences within couples may have unintended consequences. In a study conducted by Conroy and colleagues (2016), South African couples who perceived high relationship satisfaction and trust were less likely to engage in HIV prevention strategies such as HIV testing. Such findings underscore the importance, when designing HIV-related couple interventions, of including male partners, and of striking a balance between providing education and practical skills for HIV prevention as well as building and maintaining healthy relationships that enable couples to feel confident and able to work together in implementing strategies.

A few recent studies have undertaken forms of dyadic analyses to explore partner-influences and gender differences in relationship dynamics, and how such relationships impact the effectiveness of HIV prevention strategies (Carroll et al., 2016; Conroy, et al., 2016; Johnson et al., 2012; Vamos, et al., 2013). Among most of our study couples, the APIM analyses suggested that an individual's perceived relationship quality in terms of communication and conflict resolution styles, relationships satisfaction, trust and commitment were significantly related to his or her own perceived confidence of being able to confidently reduce risk of HIV as a couple.

In other words, a couple's perceived confidence and communal coping abilities was driven by an individual's perceived sense of relationship quality (actor-driven).

These baseline findings are similar to other studies that examined actor-partner influences on health outcomes. In a study that examined HIV adherence in HIV discordant same-sex male couples in the United States, treatment adherence self-efficacy was driven by the patient's (actor's) beliefs about the benefits of adhering to HIV treatment (Johnson, et al., 2012). Similarly, Vamos and colleagues (2013) found condom use among heterosexual HIV seropositive and discordant couples in Lusaka was related to each members' unique perception of relationship quality and influence on their own safer sex behavior. Johnson and colleagues (2012) explained that this association supported an underlying theory on individual determinants of ART adherence, suggesting that a healthy balance between relationship autonomy and intimacy sparked a patient's confidence in his ability to adhere to treatment (Johnson, et al., 2012). Indicated by observed high relationship satisfaction and relationship trust, it is plausible that couples within our cohort who felt safe and able to maintain sovereignty within their relationships built confidence within an individual to implement HIV risk reduction strategies as a couple (Martire and Helgeson, 2017). However, this would require further study to build evidence around relevancy in intervention development and effectiveness in attaining improved health outcomes in this study setting. But despite the lack of empiric evidence within this setting, literature supports the need to establish balance between autonomy and intimacy with an emphasis in communal support in intervention development and delivery, to achieve effectiveness and sustainability of HIV prevention strategies.

A few partner-driven pathways, between relationship quality and couple efficacy, were significantly associated in our analyses, verifying the gender effects where partner effects appeared stronger for husbands to wives than wives to husbands. The husband's use of positive interaction appeared to drive his wife's positive perceptions of feeling confident in being able to reduce HIV risk as a couple. Similarly, a husband's perception of relationship trust appeared to also positively drive a wife's perception of confidence in reducing HIV risk as a couple. It is plausible that women who perceived their male partners to be trusting were able to openly and safely engage in healthy and respectful communication and develop a closeness that was based on perceived or experienced mutual respect. Consequently, such interactions may have created an environment where a wife felt confident and able to address HIV risk with her partner (Conroy, et al., 2016). Although we observed few partner effects, these significant findings highlighted the importance of examining mutual influences of partners on each other to fully understand the interdependent nature of the relationship for better couple-based intervention development in HIV prevention as well as uptake and use of health services (Conroy, et al., 2016). Further highlighted is the importance of engaging male partners in HIV prevention strategies to improve efficacy and sustainability of interventions. Incorporating gender transformative concepts when designing interventions could also help empower couples' confidence and ability to engage and sustain healthy behaviors (C. M. Montgomery, et al., 2006; E. Montgomery, et al., 2011)

We also found that the influence of relationship satisfaction on couple efficacy (acting together to reduce HIV threat; making joint-decisions to address HIV threat; communicating to reduce HIV threat) was stronger for male partners than female partners in terms of actor effects. It is possible that this association captured underlying gender

differences in perceived relationship quality that may have been influenced by patriarchal cultural norms. Consequently, when designing couple-based interventions, it is crucial to understand cultural influences on relationship dynamics that maybe harmful or beneficial. Couple relationship building should include challenging harmful practices and leveraging positive relationship experiences that promote gender equity in order to ensure HIV prevention strategies for couples and families are efficacious and sustainable (Hilpert, et al., 2016). On the other hand, because the effect seemed weak in our analyses, gender differences may be unsubstantial. In a study conducted by Jackson and colleagues (2014), the significance in gender differences in relationship satisfaction was nullified when findings from clinic-base couples and community-based couples were compared (Jackson, Miller, Oka, & Henry, 2014). The authors attributed these findings to selection bias, where they suggested dissatisfied female partners were more likely to report lower levels of relationship satisfaction. Further, other studies have suggested that social desirability may have been the driving factor for husbands reporting higher satisfaction in order to portray themselves as "good husbands" who were able to provide well for their families (Conroy, 2014; Conroy, et al., 2016). Consequently, dissatisfied male partners were more likely to underreport marital dissatisfaction (Jackson, et al., 2014).

LIMITATIONS AND STRENGTHS

The study highlighted important aspects of couple relationship dynamics that impact on couple efficacy and communal coping to reduce HIV threat using a dyadic analyses approach. Relatively few studies have explored such dynamics within the African setting. However, our findings must be evaluated in light of study limitations. Being a cross-sectional study examined at baseline only, establishing causality between relationship quality and couple efficacy as well as communal coping to reduce HIV threat may not be possible. Additionally, as analyses and interpretations were based on self-reports, social desirability may have influenced responses.

Conducting dyadic analyses and exploring couple-level relationship factors enabled in- depth exploration of actor-partner influences and influences of gender differences that appeared to affect couple efficacy and communal coping to reduce HIV threat within couples. However, these efficacy and coping scales had not been used previously in this rural Kenyan population and would need to be evaluated further in order to examine underlying mechanisms related to couple efficacy and communal coping in sub-Saharan African settings, as well as evaluate relevancy, and translation into improved health outcomes over time.

A third limitation relates to the generalizability of our findings to couples living in the region. Pregnant women were recruited from ANC clinics, and as such those who chose to participate in the study may have been in more stable relationships compared to the general population, and consequently, could have reported more favorably in terms of relationship dynamics, couple efficacy and communal coping compared to families who do not utilize clinic- based ANC services.

However, the vast majority of pregnant women in this region utilize ANC services at clinics (Kenya National Bureau of Statistics, et al., 2015; Nyongesa et al., 2018).

A fourth limitation was the inability for us to stratify and explore associations among HIV discordant couples whose perceptions and experiences may have been comparably different compared to concordant couples, due to our small sample size. Further study would be required to understand underlying mechanisms within this population in order to better inform couple- based intervention development (Johnson, et al., 2012; Meyler, Stimpson, & Peek, 2007).

CONCLUSIONS

Conducting couple level analyses and examining partner-driven relationship dynamics provides key information about influences on couple efficacy and communal coping to reduce HIV threat. Consequently, we can identify potential underlying mechanisms that may allow us to tailor couple-based intervention content and delivery, thereby helping couples build and/or maintain healthy equitable relationships based on mutual respect. Empowering couples to confidently implement and maintain improved HIV-related health behaviors together could improve the sustainability of HIV prevention strategies.

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Hamamcıoğlu Akkaya, Karolina Hansen, Wallisen T. Hattori, Ivana Hromatko, Raffaella Iafrate, Bawo O. James, Feng Jiang, Charles O. Kimamo, David B. King, Fırat Koç, Amos Laar, Fívia De Araújo Lopes, Rocio Martinez, Norbert Mesko, Natalya Molodovskaya, Khadijeh Moradi, Zahrasadat Motahari, Jean C. Natividade, Joseph Ntayi, Oluyinka Ojedokun, Mohd S. B. Omar-Fauzee, Ike E. Onyishi, Barış Özener, Anna Paluszak, Alda Portugal, Ana P. Relvas, Muhammad Rizwan, Svjetlana Salkičević, Ivan Sarmány-Schuller, Eftychia Stamkou, Stanislava Stoyanova, Denisa Šukolová, Nina Sutresna, Meri Tadinac, Andero Teras, Edna L. Tinoco Ponciano, Ritu Tripathi, Nachiketa Tripathi, Mamta Tripathi, Noa Vilchinsky, Feng Xu, Maria E. Yamamoto, and Gyesook Yoo. 2016. "Corrigendum: The Associations of Dyadic Coping and Relationship Satisfaction Vary between and within Nations: A 35-Nation Study." *Frontiers in Psychology* 7:1404. doi: 10.3389/fpsyg.2016.01404.

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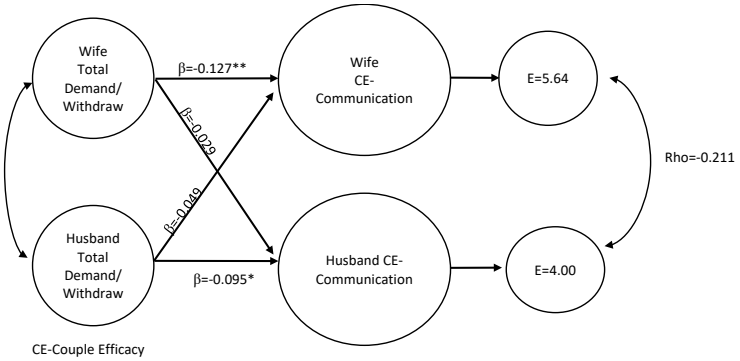
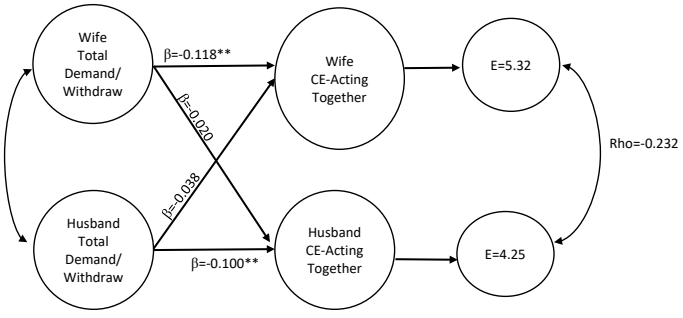
APPENDIX 1
THE ACTOR-PARTNER INTERDEPENDENCE MODEL (APIM) DEMONSTRATING THE ASSOCIATION BETWEEN COUPLES' COUPLE EFFICACY TO REDUCE HIV THREAT AND RELATIONSHIP FACTORS (ONLY STATISTICALLY SIGNIFICANT APIMS SHOWN)

a. APIM depicting the couple efficacy subscale joint communication and the relationship quality of communication and conflict resolution style total demand/withdraw



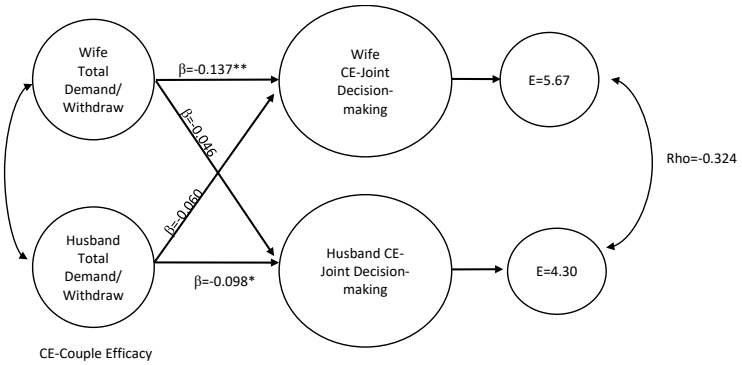
CE-Couple Efficacy
E:Residual Variance
Rho: Covariance of the residual variance
*p<0.05; **p<0.01

b. APIM depicting the couple efficacy subscale acting together and the relationship quality of communication and conflict resolution style total demand/withdraw



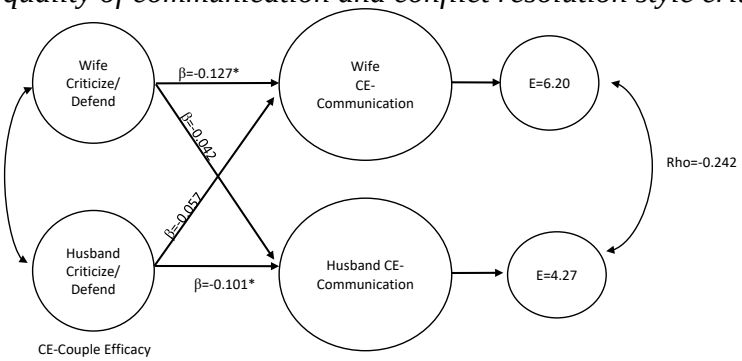
CE-Couple Efficacy
E:Residual Variance
Rho: Covariance of the residual variance
*p<0.05; **p<0.01

c. APIM depicting the couple efficacy subscale joint decision-making and the relationship quality of communication and conflict resolution style total demand/withdraw



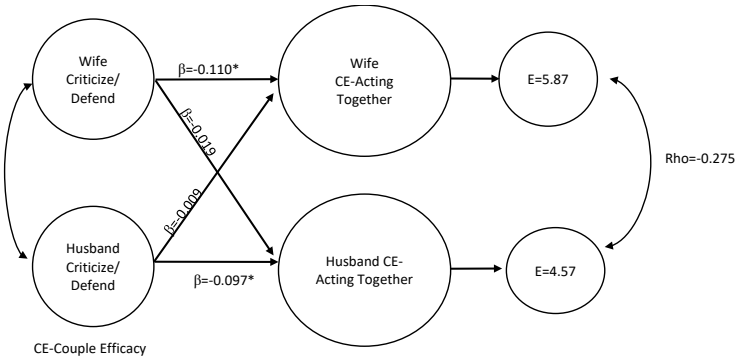
CE-Couple Efficacy
E:Residual Variance
Rho: Covariance of the residual variance
*p<0.05; **p<0.01

d. APIM depicting the couple efficacy subscale joint communication and the relationship quality of communication and conflict resolution style criticize/defend



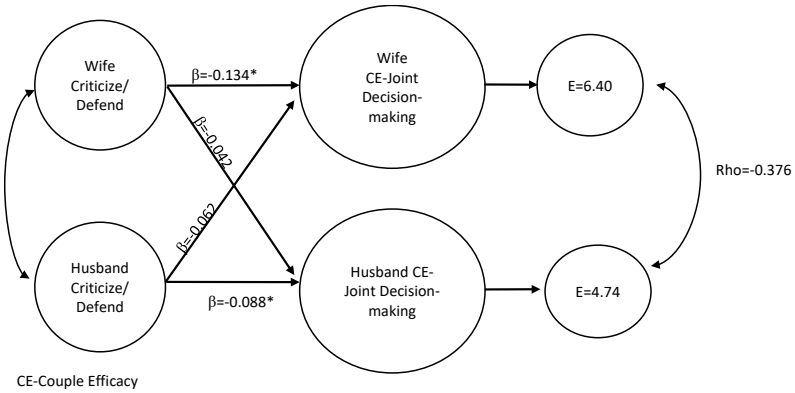
CE-Couple Efficacy
E:Residual Variance
Rho: Covariance of the residual variance
*p<0.05; **p<0.01

e. APIM depicting the couple efficacy subscale acting together and the relationship quality of communication and conflict resolution style criticize/defend



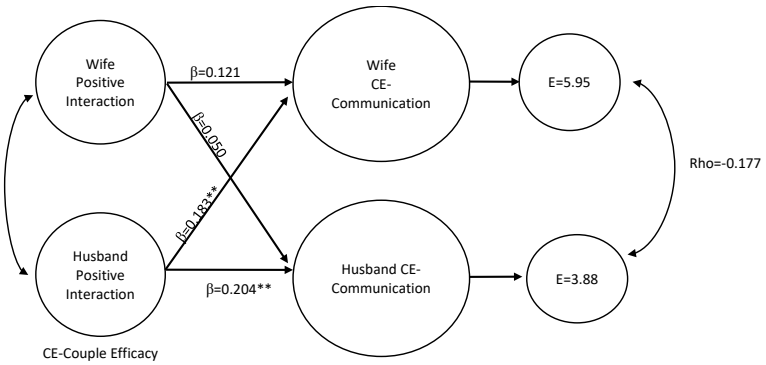
CE-Couple Efficacy
E:Residual Variance
Rho: Covariance of the residual variance
*p<0.05; **p<0.01

f. APIM depicting the couple efficacy subscale joint decision-making and the relationship quality, communication and conflict resolution style criticize/defend



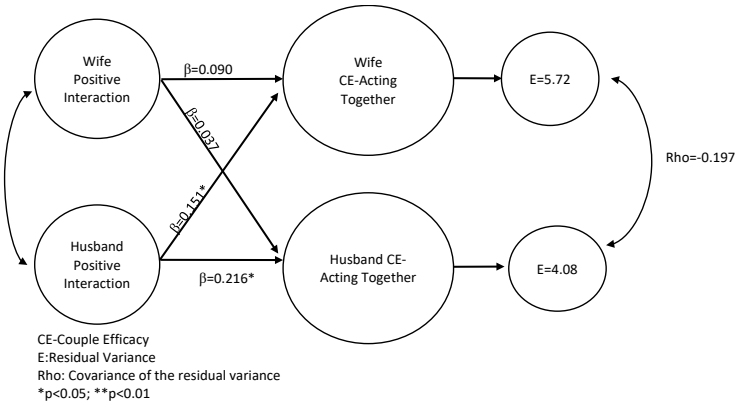
CE-Couple Efficacy
E:Residual Variance
Rho: Covariance of the residual variance
*p<0.05; **p<0.01

g. APIM depicting the couple efficacy subscale joint communication and the relationship quality of communication and conflict resolution style positive interaction

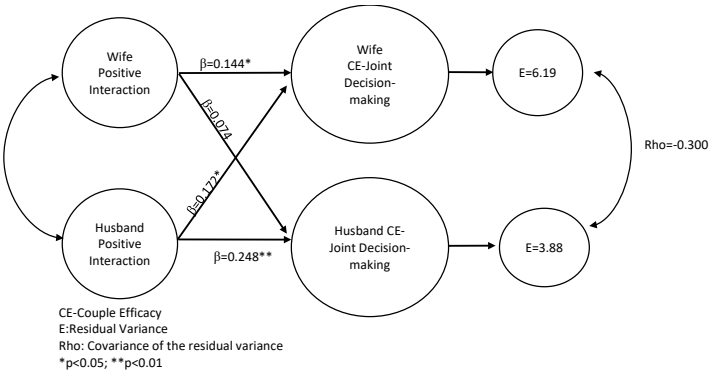


CE-Couple Efficacy
E:Residual Variance
Rho: Covariance of the residual variance
*p<0.05; **p<0.01

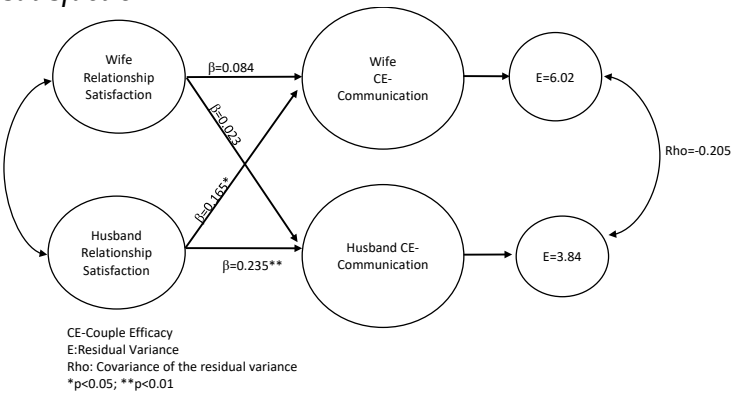
h. APIM depicting the couple efficacy subscale acting together and the relationship quality of communication and conflict resolution style positive interaction



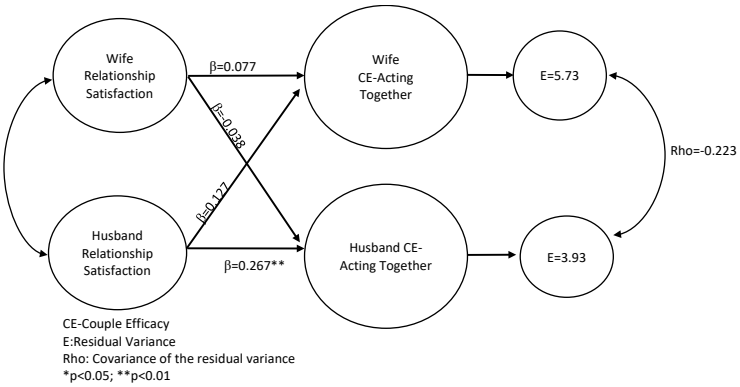
i. APIM depicting the couple efficacy subscale joint decision-making and the relationship quality of communication and conflict resolution style positive interaction



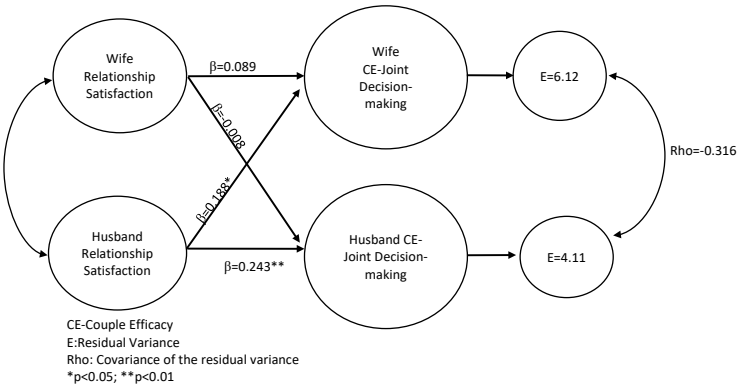
j. APIM depicting the couple efficacy subscale joint communication and the relationship satisfaction



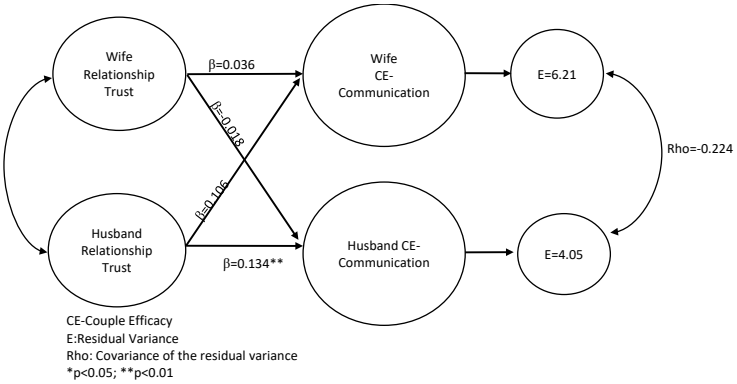
k. APIM depicting the couple efficacy subscale acting together and the relationship satisfaction



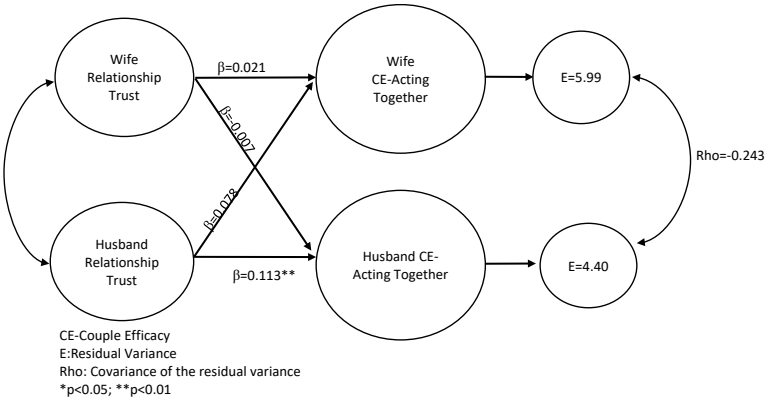
l. APIM depicting the couple efficacy subscale joint decision-making and the relationship satisfaction



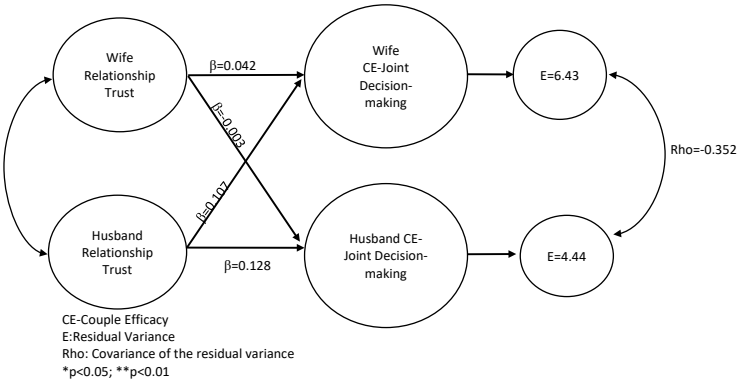
m. APIM depicting the couple efficacy subscale joint communication and the relationship trust



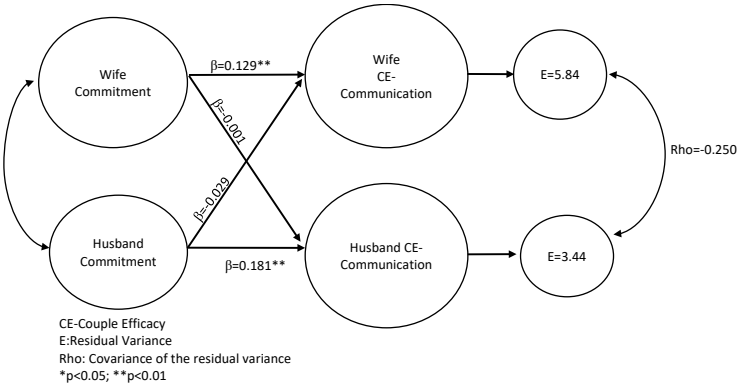
o. APIM depicting the couple efficacy subscale acting together and the relationship trust



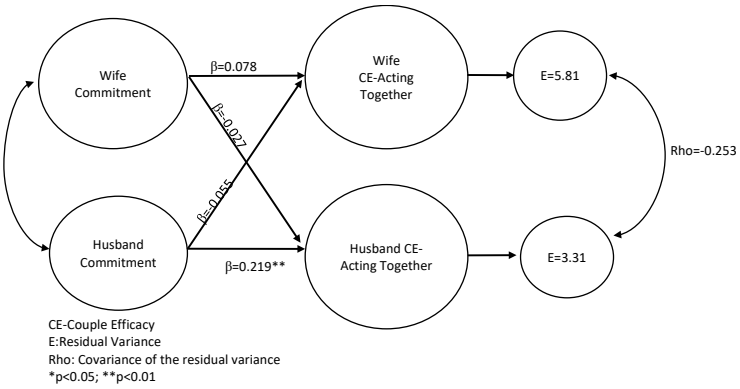
p. APIM depicting the couple efficacy subscale joint decision-making and the relationship trust



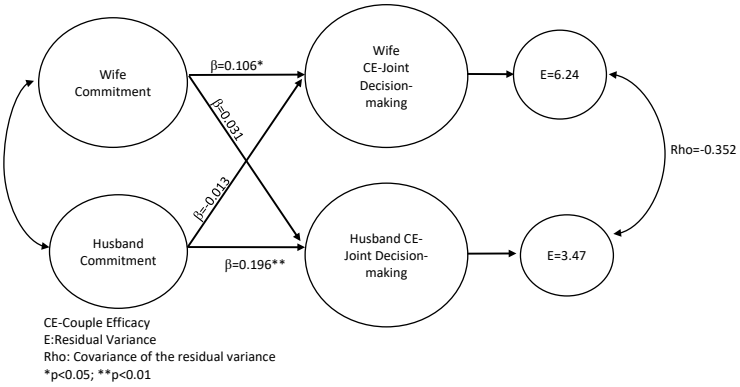
q. APIM depicting the couple efficacy subscale joint communication and the relationship commitment



r. APIM depicting the couple efficacy subscale acting together and the relationship commitment



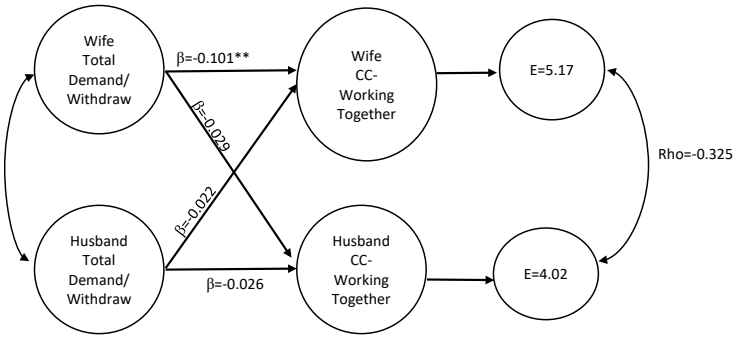
s. APIM depicting the couple efficacy subscale joint decision making and the relationship commitment



APPENDIX 2

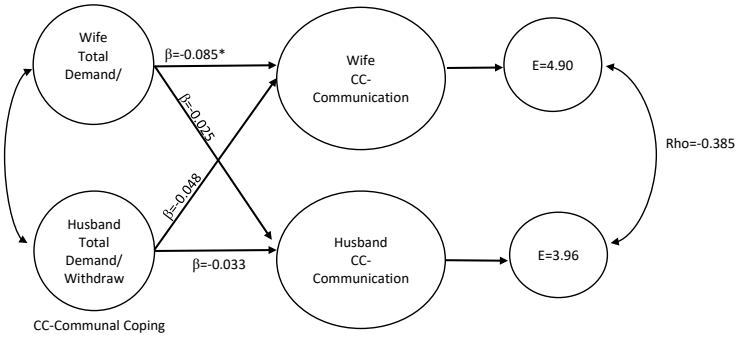
THE ACTOR-PARTNER INTERDEPENDENCE MODEL (APIM) DEMONSTRATING THE ASSOCIATION BETWEEN COUPLES' COMMUNAL COPING (CC) TO REDUCE HIV THREAT AND RELATIONSHIP FACTORS (ONLY STATISTICALLY SIGNIFICANT APIMS SHOWN**)**

a. APIM depicting the communal coping subscale working together and the relationship quality of communication and conflict resolution style total demand/withdraw



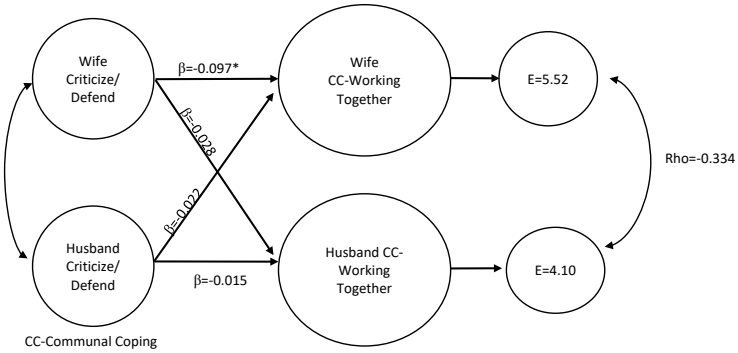
CC-Communal Coping
E:Residual Variance
Rho: Covariance of the residual variance
*p<0.05; **p<0.01

b. APIM depicting the communal coping subscale communication and the relationship quality of communication and conflict resolution style total demand/withdraw

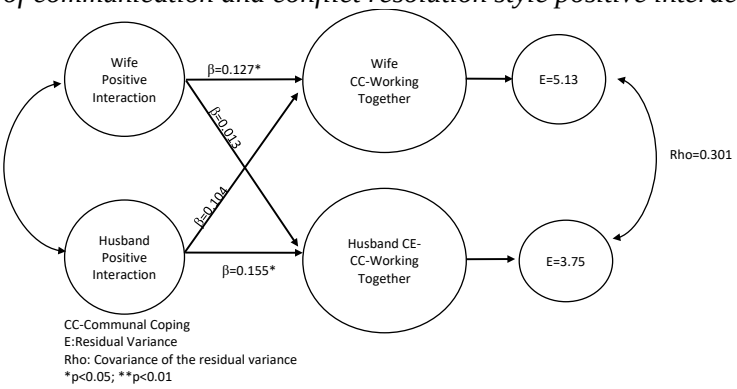


CC-Communal Coping
E:Residual Variance
Rho: Covariance of the residual variance
*p<0.05; **p<0.01

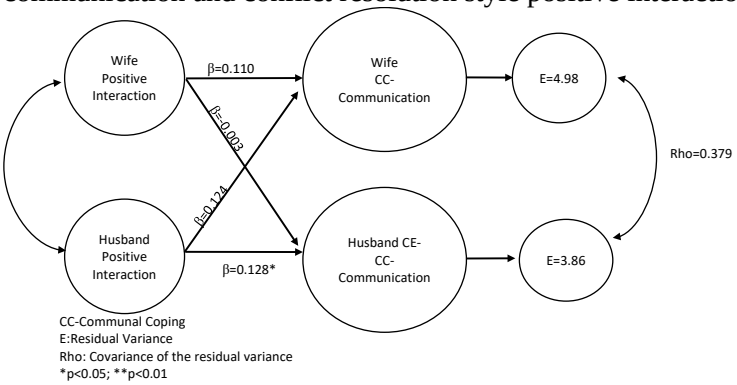
c. APIM depicting the communal coping subscale working together and the relationship quality of communication and conflict resolution style criticize/defend



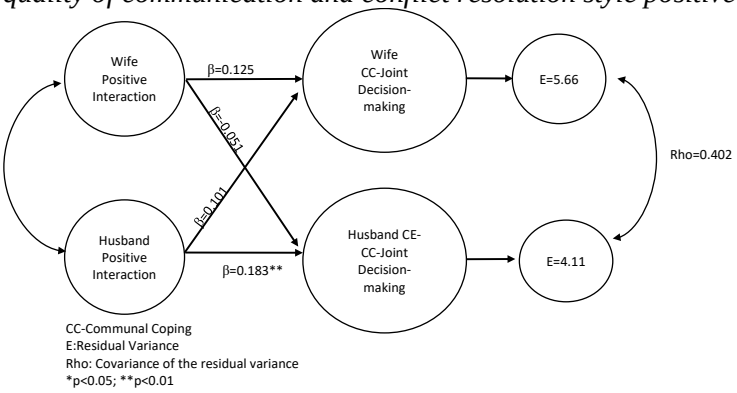
d. APIM depicting the communal coping subscale working together and the relationship quality of communication and conflict resolution style positive interaction



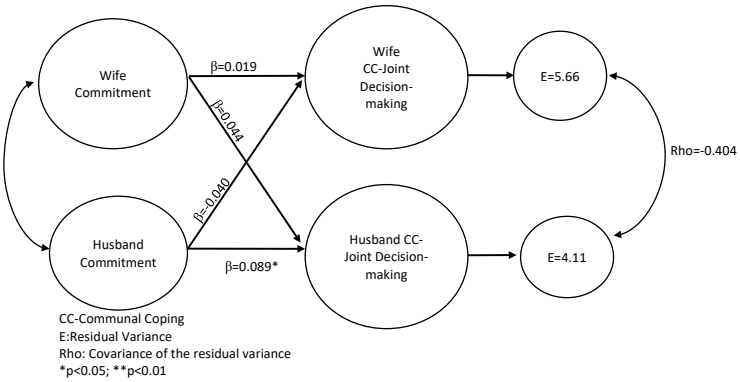
e. APIM depicting the communal coping subscale communication and the relationship quality of communication and conflict resolution style positive interaction



f. APIM depicting the communal coping subscale joint decision-making and the relationship quality of communication and conflict resolution style positive interaction



g. APIM depicting the communal coping subscale joint decision-making and the relationship commitment



EXPLORING EFFECTS OF COUPLE RELATIONSHIP QUALITY ON MALE PARTNER ENGAGEMENT IN PREGNANCY HEALTH AFTER RECEIPT OF A HOME-BASED COUPLES INTERVENTION

by

PAMELA MUSOKE, JUSTIN BLACKBURN, LYNAE DARBES, NATALIYA V. IVANKOVA, KARI WHITE AND JANET M. TURAN

In preparation for journal submission

Format adapted for dissertation

ABSTRACT

INTRODUCTION: Research has shown significant benefits in maternal and child health when male partners are engaged. However, improving male partner engagement in pregnancy health remains a challenge across sub-Saharan Africa, as traditional gender role expectations continue to impact males' willingness to engage. Constructively engaging male partners in safe and effective ways is key to realizing improved family health.

METHODS: Using a sequential explanatory mixed methods design, we initially quantitatively examined differences in couple relationship perspectives among couples in rural Southwestern Kenya (N=81 couples), between the home-based intervention and standard care arms of a pilot intervention study as well as in differences male partner antenatal care (ANC) attendance (outcome). Indirect effects of the intervention on male partner ANC attendance through couple relationship factor pathways were explored using mediation analysis. Qualitatively, we explored perceived influences on male partner engagement using in-depth interviews with purposively selected study participants from the quantitative phase (N=24). Qualitative findings were integrated with quantitative results to garner a holistic understanding of the interplay between couple relationships dynamics and male partner engagement.

RESULTS: Bivariate analyses indicated that couples in the intervention arm reported higher satisfaction and relationship commitment at follow-up. Although, we were unable to find significant indirect effects, multivariate findings suggested that couples in which male partners reported higher relationship trust than their female partners were less likely to have male partner engagement in ANC. Male partners who reported higher positive interactions (communication) than their female partners appeared to be more likely to

engage in ANC. Qualitative findings appeared to support quantitative results in that couples described improved relationship quality after receiving the intervention. Qualitative findings also indicated that perceived relationship quality influenced men's willingness to engage in pregnancy health.

CONCLUSION: Findings highlighted the importance of understanding perceived relationship quality influence on male engagement in antenatal care. Understanding which aspects of couple relationship dynamics influence male partner engagement could improve how couple-focused interventions in HIV prevention, pregnancy and family health are designed and tailored for greater efficacious and sustainable impact.

Keywords: sequential explanatory mixed methods, couple relationship quality, male partner engagement, pregnancy health, home-based couple HIV testing and counseling

INTRODUCTION

Since the Declaration of Commitment of HIV/AIDS released by the United Nations (UN) in 2001, significant efforts have been made across SSA to improve maternal and infant HIV-related sequelae and indeed, many African countries have realized increases in HIV testing as well as decreases in the number of new HIV infections among children (UNAIDS, 2015). However, the current state of HIV infection in the maternal, infant and child health population in SSA indicates that gaps along the PMTCT cascade remain, particularly gaps in retention in care among women initiated on ART during pregnancy or postpartum and early infant diagnosis (Haas, et al., 2016; Hamilton, et al., 2017; Sibanda, Weller, Hakim, & Cowan, 2013; Tenthani, et al., 2014). Innovative ideas are clearly needed to attain the goals set forth by the Declaration (UNAIDS, 2015).

In Kenya, the World Health Organization's (WHO) recommendations to provide lifelong antiretroviral therapy to pregnant and breastfeeding mothers living with HIV were adopted in 2013 (du Plessis et al., 2014). Since its inception, a national population based cross-sectional household survey indicated that HIV testing significantly improved among pregnant women (Sirengo, et al., 2014). However, women accessing PMTCT-related services remained suboptimal. A study conducted by Nduati and colleagues (2015) indicated that rates of retention in HIV care among postpartum mother-infant pairs remained lower than desired at 71%. Furthermore, early infant diagnosis remained

challenging; retention in care postnatally also remained lower than desired (32%-74.7%) and less than one-third of infants infected with HIV were initiated on ART (Finocchario-Kessler et al., 2015; National AIDS and STI Control Programme/Ministry of Health, 2012).

Male engagement in reproductive health has long been viewed important for addressing high rates of mother-to-child transmission of HIV in sub-Saharan Africa (Mbizvo and Bassett, 1996). However, previous research has often neglected to account for men's influence on reproductive health matters, even though they are family patriarchs and primary decision-makers in most matters including reproductive health in most societies (Green, Selim, Gamal, & Mandil, 2005; Katz, et al., 2009). Because such patriarchal structures were seen to benefit men more than women, interventions targeting maternal, infant and child health often had agendas aligned with women's empowerment (Peacock, Stemple, Sawires, & Coates, 2009; Sternberg and Hubley, 2004). The focus on women's empowerment was further intensified as a result of the HIV epidemic, as women of reproductive age were disproportionately burdened by the epidemic in sub-Saharan Africa (Inungu and Karl, 2006; UNAIDS/WHO, 2003). A change in this paradigm became evident at the International Conference on Population and Development in Cairo in 1994, when policy makers, researchers and programs realized men played a crucial role in sexual health and reproductive health (Sternberg and Hubley, 2004). Male engagement in PMTCT significantly impacts pregnant women's use of antenatal care services including retention in care (Brusamento, et al., 2012; Kebaabetswe, 2007; Maman, et al., 2011; Turan, et al., 2011). In particular, quantitative studies showed that male engagement is positively correlated with uptake of antenatal

care (ANC) as well as PMTCT-related services, and may indeed reduce mother-to-child transmission rates of HIV (Aluisio, et al., 2016; Aluisio, et al., 2011; Dahl, Mellhammar, Bajunirwe, & Bjorkman, 2008; Krakowiak, et al., 2016; Theuring, Jefferys, Nchimbi, Mbezi, & Sewangi, 2016). Qualitative findings further suggested that male engagement enhances use of PMTCT-related activities of both partners (Conroy, et al., 2017; Matovu, et al., 2014). But previous attempts to increase male engagement in PMTCT have experienced only modest success (Jefferys, et al., 2015; Katz, et al., 2009; Mohlala, Boily, & Gregson, 2011). Recognizing the importance of gender roles in health-related decision-making processes, including use of PMTCT services, a focus on improving male engagement has taken root in maternal and child health (MCH) programmatic, research and policy agendas across Africa including Kenya.

A large body of research suggests that couple relationships have a large influence on health and may be one avenue by which male partner engagement maybe explored. Couple motivation to overcome a health threat is associated with the quality of the relationship, that is, a relationship that is committed and characterized as having affection and mutual obligation as well as communication styles that are positive and bi-directional (Lewis, et al., 2006). Further, primary relationship partners appear to have a central role in providing HIV-related support when compared to other types of relationships in almost any setting (Conroy, et al., 2017). Therefore, constructively engaging men by improving their knowledge about their roles in PMTCT as well as empowering them by strengthening spousal relationships could play a role in improving PMTCT rates and reducing HIV incidence (Brusamento, et al., 2012; Conroy, et al., 2017; E. Montgomery, et al., 2011). In fact, early studies illustrated that couple relationship dynamics played an integral role in improving health outcomes in chronic illnesses (Martire, Schulz,

Helgeson, Small, & Saghafi, 2010a; Robles, et al., 2014). In HIV, couple relationship dynamics have been shown to impact adherence to HIV treatment and viral load reduction (Johnson, et al., 2012) and increased uptake of HIV-risk reduction activities (Vamos, et al., 2013). More recently, research indicated that power dynamics within couples influenced aspects of couple relationship dynamics including trust and positive communication, and consequently affected how couples implement HIV prevention-related behaviors (Carroll, et al., 2016; Conroy, et al., 2016; Leddy, Chakravarty, Dladla, de Bruyn, & Darbes, 2016; Rogers, et al., 2016).

Realizing the importance of relationship dynamics, couple relationship-focused frameworks are now being used to develop HIV prevention strategies for couples to improve HIV-related health outcomes. As such, the aim of the Jamii Bora pilot study (Turan, et al., 2018) was to develop and pilot a home-based intervention, using the interdependence model of couple communal coping behavior change (Lewis, et al., 2006), that focused on couple relationship dynamics to improve HIV testing and disclosure among pregnant women, and improve use of and adhere to PMTCT and family health services (Turan, et al., 2018). Using data from this study, we examined associations between couple relationship dynamics and male engagement in pregnancy health using a sequential explanatory mixed methods study design.

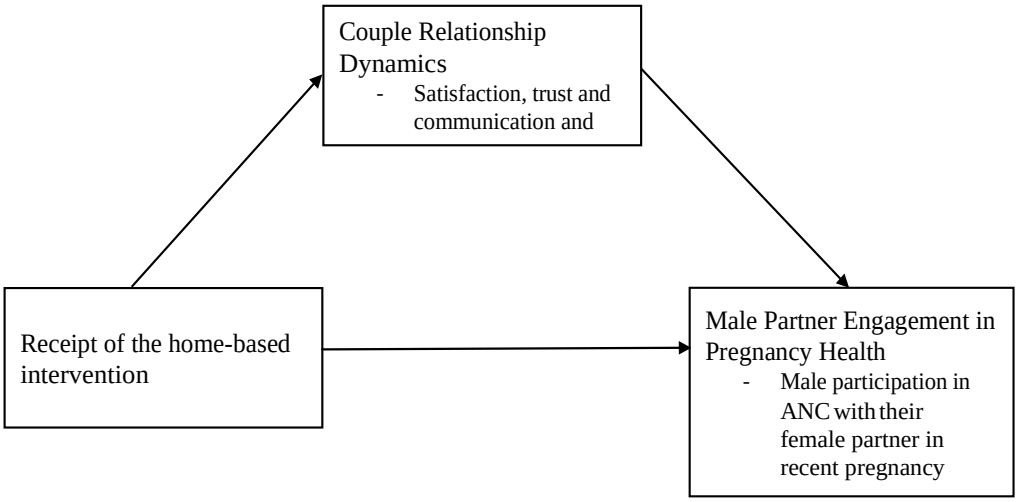
The study builds on existing literature by examining the role of couple relationship dynamics and a home-based couples' intervention on male engagement in antenatal care. Specifically, the associations that were examined included the mediating effect of couple relationship dynamics (relationship satisfaction, trust, commitment, communication, and conflict resolution) on male engagement in any antenatal care (ANC) visits with their female partners during the most recent pregnancy. Further,

couples' experiences with male partner engagement during pregnancy, and their perceptions of couple relationship influences were explored in more depth in qualitative analysis. In the first quantitative phase of the study, research questions focused on examining if couple relationship factors (including couple relationship factors) differed significantly between couples who were randomized to receive the intervention and couples who were randomized to standard care. Additionally, we examined if significant differences in male partner engagement (operationalized as male ANC attendance) were observed between couples in the intervention arm and couples in standard care. Lastly, we examined if the indirect effect between being randomized to the intervention and male partner ANC engagement was mediated by couple relationship factors (relationship satisfaction, relationship trust, commitment and positive interaction). In the second qualitative phase of the study, we analyzed data from twelve couples who were purposively recruited from both study arms (8 from intervention arm and 4 from standard care arm) after follow-up questionnaires for the main study were completed. In this phase, the research question addressed perceived factors which appeared to influence male partner engagement during pregnancy including activities that were perceived as male partner engagement. Further, we explored their perceptions of how the study may have impacted their couple relationship quality. Lastly, the results from each phase were integrated to determine how the qualitative findings helped explain the results found in the first quantitative phase of the study.

CONCEPTUAL MODEL: PATERNAL INVOLVEMENT IN PREGNANCY

Alio and colleagues (2013) model of paternal involvement in pregnancy (modified from Lamb's theory (Figure 1) was used to inform exploration of the relationship between couple relationship dynamics and male involvement in antenatal care visits during the last pregnancy (Alio, et al., 2013; Lamb, Pleck, Charnov, Levine, & Lancaster, 1987). The expanded theory proposed by Alio and colleagues (2013) posits that in the context of pregnancy, an involved male partner during pregnancy is related to four elements: accessibility (physical supportive presence in the home and at prenatal activities and healthy communication between spouses), engagement (participation in prenatal activities), responsibility (financial, physical and emotional support) and maintaining a healthy relationship with his spouse (couple relationship dynamics). Further, the couple relationship element is intertwined with each of the other three components of paternal involvement, in that, the quality of couple relationship dynamics may influence a male partner's willingness to be physically present and supportive, responsible and engaged in pregnancy health (Alio, et al., 2013). The current study examined how exposure to the Jamii Bora home-based couples' intervention was related to couples' reports of couple relationship dynamics at follow-up, as well as explored whether intervention effects on male partner ANC engagement were mediated by couple relationship dynamics at follow-up (Figure 1).

Figure 1: Path Analysis of Couple Relationship Dynamics effect on Male Partner Engagement.

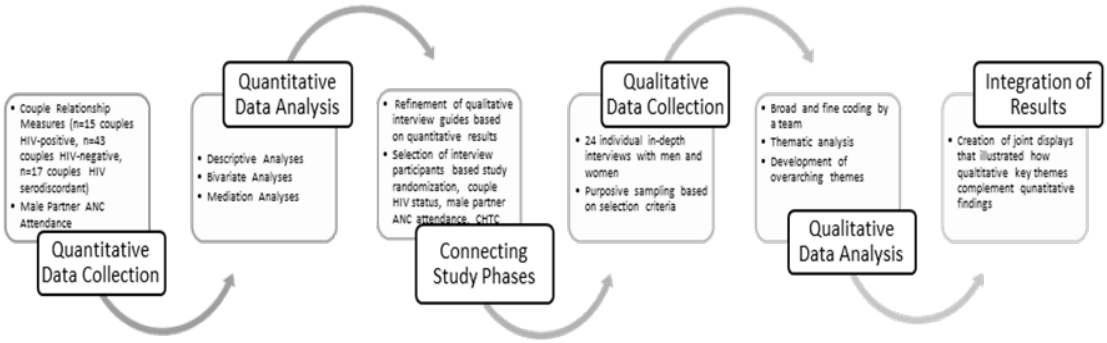


METHODS

Research Design

This study employs a mixed methods approach to studying male engagement in perinatal health (Creswell, 2013). Mixed methods research incorporates both quantitative and qualitative data collection and analytic approaches, resulting in an interpretation that involves integrating quantitative and qualitative results (Bazeley, 2012). This combined approach draws on the strengths of quantitative and qualitative approaches thereby enabling the understanding of the research problem holistically, and providing a more complete appreciation of the study interest than either approach alone (Fetters, Curry, & Creswell, 2013).

Figure 2: A visual model for mixed methods procedure (sequential explanatory mixed methods design)



The current study used a sequential explanatory mixed methods design where the quantitative phase was initially implemented and, based on descriptive findings from the first phase of the pilot randomized study (quantitative) (such as ANC utilization, CHTC engagement, male partner ANC attendance), a qualitative study was conducted to further explore these findings (Creswell, 2013). A sequential explanatory mixed methods design was chosen as the qualitative interviews were conducted, after follow-up questionnaires were completed post-intervention, to increase the meaningfulness of quantitative results by corroborating as well as by elaborating on explanations of quantitative findings (Greene, Caracelli, & Graham, 1989). Data in the quantitative phase were collected using a tablet-based interviewer-administered questionnaires implemented with men and women enrolled in the Jamii Bora Pilot Intervention Study at baseline and follow-up. The current analysis involved data collected during follow-up, three months after delivery of the infant post-intervention. In this study, the associations between receipt of the

intervention, couple relationship dynamics and male partner ANC participation during the recent pregnancy were examined quantitatively using bivariate and mediation analyses. The first point of integration occurred as the follow-up questionnaires were being completed. Descriptive analyses of the follow-up data collected were used to aid in participant selection for qualitative interviews. Specifically, participant selection for the qualitative phase involved choosing couples from each study arm, based ANC attendance and couple HIV status. We also chose couples based on whether they engaged in Couples HIV Testing and Counseling (CHTC) during the course of the study. Further, topics from the follow-up questionnaire were used to develop the semi-structured interview guides for qualitative interviews.

In the second phase, to aid in corroborating and expanding on findings from the first quantitative phase of the study, a qualitative study approach using semi-structured qualitative interviews was employed to explore the perceptions and experiences of couples enrolled in the study concerning couple relationships and male engagement in perinatal health. During recruitment, women were contacted first to ask if they would be willing to participate in qualitative interviews; further permission was sought from each woman to contact their male partners for qualitative interviews.

The second point of integration occurred after qualitative analyses and mediation analyses were completed. The findings from the two phases were integrated for final interpretations regarding study predictors, pathways, and outcomes. To accomplish this, joint displays summarizing results of the quantitative and qualitative analyses were created to examine the similarities and/or differences between the findings from qualitative and quantitative data. A pictorial model of the mixed methods study design is presented in Figure 2 above.

Study setting, population, design and sampling procedure

The Jamii Bora Study was a NIMH-funded randomized controlled pilot intervention trial for pregnant women and their male partners. The details of the parent study have been provided elsewhere (Turan, et al., 2018). In brief, it was conducted in the former Nyanza Province of Kenya, an area that continues to be severely burdened by high rates of HIV incidence and prevalence. As of 2013, HIV prevalence at the study sites was estimated to be two times higher than the national average (13.9% vs. 6%), with rates ranging from 14.7% (Migori County) to 19.3% (Kisumu County) and 25.7% (Homabay County) (NCT02403583) (NASCOP, 2014). Although rates have declined, HIV prevalence across sub-counties remained above the current national average (4.9%), ranging between 13.3% (Migori county) to 16.3% (Kisumu county) and 20.7% (Homabay county) (National AIDS Control Council of Kenya, 2019). The pilot study consisted of two randomized study arms; the intervention arm involved three couple home visits during pregnancy (2 visits) and postpartum (1 visit) that included offers of CHTC and providing education and counseling on health topics, as well as on couple relationships. The control arm received standard antenatal care services. All participants who completed a baseline questionnaire (127 women and 96 male partners) were contacted to complete the follow-up questionnaires. The follow-up questionnaires were conducted three months after the birth of the infant (114 women and 83 men). The current analyses focus on quantitative data from female and male partners who completed both baseline and follow-up questionnaires (81 couples).

Following the quantitative phase of the study, we conducted qualitative interviews with 12 couples (24 individual interviews) from both study arms to garner insight into their experiences and perceptions about participating in the study. For this analysis, we focused on exploring their experiences with and opinions about male engagement during pregnancy.

Phase I: Quantitative Phase

Data Collection Methods

The baseline questionnaires were conducted by trained interviewers. Following the questionnaire, all participants were reimbursed 400 Kenyan shillings (roughly equivalent to US $5) for travel expenses and their time. Tablet computers using the Open Data Kit (ODK) platform were used for all questionnaires. The questionnaires were conducted in either English, Dholuo (local language) or Kiswahili (national language). The baseline questionnaires consisted of socio-demographic questions, a series of couple relationship quality measures, depression measures, HIV-related stigma measures, and health care-related utilization questions (Turan, et al., 2018). The baseline questionnaire interviews were conducted at the clinic where recruitment occurred for pregnant women. A convenient time and place to conduct baseline interviews with male partners were arranged by interviewers. Similarly, the follow-up questionnaire containing the same topics previously mentioned were conducted at place of choosing convenient to the participants (postpartum mothers and their male partners). In this case, most interviews occurred at the home of participants.

One hundred and thirty-seven pregnant women were found to be eligible to participate in baseline interviews. Of the 137 pregnant women who participated, ten women were excluded from the randomized part of the study due to reports of recent severe intimate partner violence. Subsequently, 127 pregnant women were randomized to receive the intervention or standard care. At this point, male partners were contacted after gaining permission from their female partners and asked if they were willing to participate in the study. In total, 64 pregnant women who completed baseline interviews were randomized to receive the intervention; fifty-two male partners completed baseline questionnaires after receiving their consent.

At follow-up, four couples from the home visit arm, and seven from the standard care arm had been discontinued from the study due to adverse events not associated with the study. In total, 197 participants completed follow up interviews, of which 114 were women (home visit=53 (46.5%) ; standard care=52 (45.6%), not randomized 9 (7.9%)) and 83 were male partners (home visit=46 (55.4%); standard care=37 (44.6%)). However, being a couple-focused analyses, only couples with complete data were included in the quantitative analyses. Consequently, 81 couples were included in these analyses.

Quantitative Measures: Dependent Variable

Male Partner's participation in health-related visits with spouse. The outcome variable for the quantitative analyses was based on a composite of female and male partners' reports at follow-up 3 months after the birth of his participation in any ANC visits with his wife during the study period. Male partner ANC attendance was based on the proportion of female partner ANC visits attended by male partners (to create a couple-level outcome) and created into dichotomous variable. The questions asked to women

and men were “how many total visits to the ANC did you attend during your most recent pregnancy and “how many ANC visits, if any, did you attend with your partner during this pregnancy?” at follow-up, respectively; each question was self-reported by women and their male partners. A value of “1” for this variable indicated that the male partner participated in any of his wife’s ANC visits, and a value of “0” indicated that the male partner did not participate in any of her ANC visits.

Quantitative Measures: Independent Variables

Intervention. The primary exposure variable was randomization to the intervention arm (1) vs. randomization to standard care (0).

Mediating Variables

Couple Relationship Measures. We used validated couple relationship scales as mediator variables to explore pathways for the association between receipt of intervention and male partner ANC attendance. Although originally developed in the Western context, each scale was adapted to suit the context of African couples and has been used successfully within the African context (Darbes, Chakravarty, Beougher, Neilands, & Hoff, 2012; Darbes and Lewis, 2005). For all couple relationship measures, couple self-reports of relationship satisfaction, relationship commitment, dyadic trust and positive interaction scores at follow-up were explored using a dyadic analysis approach. In each case, within couple scores (differences between male partner and female partner scores) as well as between couple scores (composite sum of male partner and female partner scores) were developed and used in bivariate analyses, followed by parallel mediation (figure 4a) where both within and between couple scores were simultaneously examined as mediators.

Relationship satisfaction. A couple's level of satisfaction with the relationship reflects the extent to which an individual relies on the relationship to attain desired outcomes (Rusbult, et al., 1998). Relationship satisfaction was measured using a 5-item scale with 9-point Likert scale responses ranging from 1 indicating no agreement to 9 indicating complete agreement with each item (Rusbult, et al., 1998). The scale score had the potential of ranging from 5 to 45, with a higher score indicating higher levels of satisfaction. The scale was found to be highly reliable in both male partners (0.98) and women (0.96).

Dyadic Trust. Trust, defined by Larzelere and Huston (1998) as a belief by a person in the integrity of another individual, is recognized as integral to marital cohesion. Higher levels of trust within a couple are associated with self-disclosure and higher levels of commitment (Larzelere and Huston, 1980). This scale is composed of eight items and scored on a 7-point Likert scale (1= strongly disagree to 7=strongly agree) (Larzelere and Huston, 1980). Three items that were negatively worded were reverse coded to ensure that a high value indicated the same directionality of response on every item (Larzelere and Huston, 1980). The scale score ranged from 8 to 56; a higher score indicated high levels of trust between members of a dyad (Larzelere and Huston, 1980). The Cronbach alpha score for women was 0.83 and for male partners, 0.79.

Relationship Commitment. The commitment scale used for this study was developed by Rusbult and colleagues (1999). The adapted scale was tested for reliability in this setting, yielding a Cronbach alpha of 0.94 for women and 0.89 for male partners. The scale is composed of eight items and scored on a 9-point Likert scale (1=not at all true to

9=extremely true). The scale score had the potential of ranging from 8 to 72; a higher score indicated high levels of commitment between members of a dyad.

Communication and Conflict Resolution: Positive Interaction. The commitment and conflict resolution scale used in this study was adapted from Christensen and Heavey (1990) as well as Christensen and Shank (1991) by Furtis and colleagues to explore a couple's perception of marital interactions (Christensen and Heavey, 1990; Christensen and Shenk, 1991; Futris, Campbell, Nielsen, & Burwell, 2010). Specifically, a couple's positive interaction communication pattern (made up of the following 3 items: when an issue or problem arises, both of us try to discuss the problem; during a discussion of an issue or problem, both of us express our feelings to each other; during a discussion of an issue or problem, both of us suggest possible solutions and compromises) was examined at points when an issue or problem arose and during discussions of the issue or problem. Higher scores indicated a greater likelihood of using that form of communication during conflict interactions (Futris, et al., 2010). The Cronbach alpha was 0.85 and 0.68 for women and male partners, respectively.

Confounding Variables. Other individual-level variables that we were included as potential confounders (due to their associations with male partner participation in ANC and couple relationship stability in literature) included male partner's age greater or less than 30 years (Ezeanolue, et al., 2017), number of weeks pregnant from time at enrolment until birth (which was calculated by taking the difference between the date of child birth and date at time of study enrolment) as it could impact the number of ANC visits couples

could attend, male education (primary education or higher) (Theuring, et al., 2016), couple HIV status (concordance (similar) and discordance (dissimilar) in HIV status within couples) (yes or no) (Ezeanolue, et al., 2017), and polygamy (Ezeanolue, et al., 2017; Theuring, et al., 2016). Additionally, all covariates were transformed into couple-level variables for conducting couple-level analyses. For example, education was transformed into a couple-level variable by creating dichotomous variables that indicated whether a male partner's education level was greater than, less than or similar to his female partner's level of education.

Data Analysis

Quantitative data were analyzed using IBM SPSS Statistics, Version 23. Differences between study arm groups in male partner participation in ANC visits with his wife during the study period were analyzed using the chi-square test; all analyses were deemed meaningful if the p value is 0.1 due to the small sample size and exploratory nature of analyses (Faul, Erdfelder, Lang, & Buchner, 2007). Additionally, differences between gender groups in couple relationship factors (relationship satisfaction, trust and positive interaction (defined as a form of mutual constructive communication where both partners engage in discussions and solve problems together)) were analyzed using Wilcoxon Signed Ranks test if non-parametric or using the dependent t-test if data were found to be normally distributed. Differences between study groups were analyzed using Mann Whitney U tests. Group differences were deemed meaningful if the p-value was 0.1.

Bivariate analyses examining the relationship between the outcome (male partner ANC attendance) and being randomized to receive the intervention, as well as

relationship quality factors and additional covariates, were conducted using logistic regression. Additionally, bivariate logistic regression analyses were conducted to explore the associations between relationship quality within and between couples and male ANC attendance, as well as the relationships between selected covariates (trust (within and between couples), satisfaction (within and between couples), commitment (within and between couples), positive interaction (within and between couples), weeks pregnant during from time of enrolment, age of male partner, polygamy, first time parent, couple education and couple HIV status) and male ANC attendance.

Pairwise correlations were conducted between the outcome variable and potential confounders associated with male partner engagement; statistically significant relationships ($p<0.1$) were included in the final model. The aim was to create the most parsimonious model that considered the sample size and randomized nature of the study (Beeckman, Louckx, & Putman, 2010; Concato, Shah, & Horwitz, 2000). In this case, statistically significant associations between the outcome and covariates (age, couple education (primary education or higher), couple HIV status (concordant vs. discordant HIV status), polygamy and being first time parents) were examined; literature suggested that the aforementioned variables were associated with male engagement in ANC. Specifically, couple HIV status, being of older age, and having higher education have been positively associated with male partner engagement in antenatal care (Ezeanolue, et al., 2017; Rosenberg, et al., 2015; Theuring, et al., 2016). However, theoretically important variables were included despite no statistical significance such as number of weeks pregnant from time at enrolment until birth.

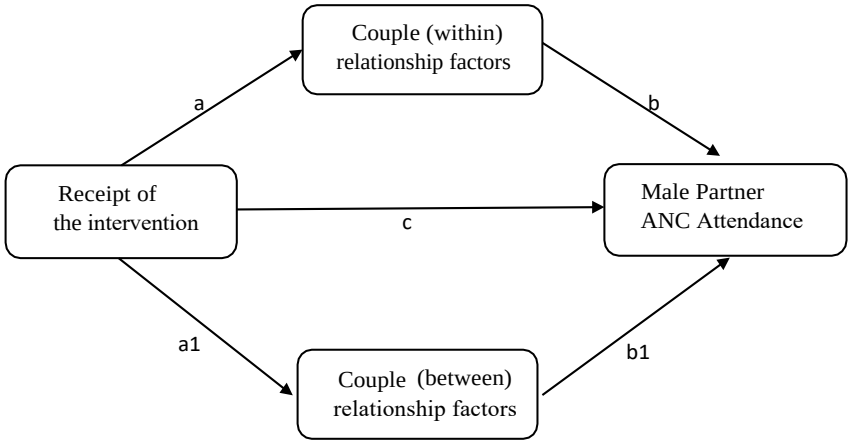
Mediation Analyses

The program used to conduct mediation analyses was PROCESS, a computational tool developed by Andrew Hayes for path analyses in a number of different software including SPSS (Hayes, 2013). The software program consists of model templates from which regression models are built to conduct analyses. However, use of PROCESS required categorical variables with two levels; consequently, categorical variables with more than two levels such as couple HIV status or education were converted into binary variables (Hayes, 2013). As such, for each relationship quality mediator (relationship satisfaction, relationship trust, relationship commitment and positive interactions), various combinations of the newly created binary categorical variables, including other covariates, were examined in order to find the best fitting model to conduct the final mediation analyses; the best fitting parsimonious models were selected based of the lowest p-value computed from the F-test in PROCESS (Wicherts et al., 2016).

The aim of these analyses was to examine if couple relationship factors described above mediated the direct effect of the intervention on male partner ANC attendance using parallel mediation (Hayes, 2013). The associations between the variables were assessed using multiple multivariate logistic regressions due to the binary nature of the outcome in parallel mediation . The purpose of conducting parallel mediation, where mediating variables were simultaneously tested, was to explore if within couple relationship quality effects as well as between couple relationship quality effects mediated the association between being randomized to the intervention arm and male partner ANC attendance. By including within and between couple relationship effects in parallel mediation analysis, we were better able to examine the impact of couple relationship influences as mediators holistically and account for the dyadic nature of the

data (Darbes, et al., 2012). Ignoring the correlated nature of the data would have resulted in biased estimates (Cook and Kenny, 2005). Three multivariate regression equations were estimated to assess the direct effect (c) of the intervention regressed on male partner ANC attendance (Figure 3) and the indirect effects (a+a1) of the intervention regressed on each of the couple relationship factors (first regression) and indirect effects of each of the couple relationship factors regressed on male partner ANC attendance (second regression) (b+b1) (Figure 3). Further, bootstrap confidence intervals derived from 5000 samples were estimated to test the hypotheses that the association between receipt of the intervention and male partner ANC attendance was mediated by relationship quality (satisfaction, trust, commitment and positive interaction). All analyses were deemed meaningful if $p<0.1$.

Figure 3: Parallel mediation



Phase II: Qualitative

Data collection

The subsequent qualitative phase of the study focused on corroborating and expanding on the results of the statistical tests obtained in the first quantitative phase. A purposive sampling technique was used to allow for the in-depth exploration of various perspectives on issues that could potentially impact many individuals. Participant selection was based on descriptive statistics from the quantitative data as described previously. In total, twelve couples participated in these qualitative interviews; each member of the couple were interviewed separately (8 couples from home visit arm and 4 couples from the standard care arm, for a total of 24 individual interviews). Except for two couples, interviews with couple members were conducted on the same day and time to minimize potential bias from influences of each member's interview experiences on each other. Following the interview, participants were reimbursed 400 Kenyan shillings (roughly equivalent to US $5) for travel expenses and their time.

After receiving their informed consent, participants were interviewed in their preferred language (Kiswahili (national language) or Dholuo (local language)) individually by a gender-matched interviewer in a convenient private location of the participant's choosing within the health facility or home, to ensure confidentiality. Interviews lasted for about one hour to an hour and a half and were digitally recorded with expressed permission from participants. Participants were informed about the risks and potential benefits of enrollment, completed a demographics questionnaire after providing informed consent, and were interviewed using a semi-structured qualitative interview guide that explored several dimensions of male involvement – including couple

relationship dynamics and influences on male engagement. The content of the interview guides was grounded in the questionnaires from the quantitative phase (Appendix 2).

The major themes explored during interviews included health care use, experiences in and perceptions of the intervention or clinic experience, male partner engagement during pregnancy, perceptions about intervention content, and couple HIV testing and disclosure experiences. Professional transcriptionists transcribed the digital interview recordings verbatim from the local language (Kiswahili or Dholuo) and subsequently translated them into English. Transcripts were checked for translation accuracy by the study coordinator and qualitative interviewers.

Data analysis

Using a thematic analysis approach (Attride-Stirling, 2001), initial broad codes developed from interview guides, literature and emerging data were applied to transcripts using NVIVO 11 Qualitative Research Software. In a subsequent round of coding, fine codes where data within broad codes were further analysed using participant language to inductively assign meaning to each emerging theme (Attride-Stirling, 2001). Spousal interviews were examined for consistencies or discrepancies within couples using memos and queries within NVivo.

Integration of Qualitative and Quantitative Findings

This was presented through discussion where quantitative and qualitative results were arrayed one after the other in a parallel fashion (Creswell, 2014). With this approach, the quantitative results were discussed followed by the qualitative results, and then integrated (Creswell, 2014). Additionally, joint displays were used to display

quantitative and qualitative data side by side, where, in a table, quantitative results were presented in one column, the qualitative results in a second column and the explained integrated findings were presented in the final column (Table 8) (Creswell, 2014).

RESULTS

Quantitative Phase

Participant Characteristics

In total, 83 male partners completed follow-up interviews, however female partners of two of the male partner participants did not complete follow-up questionnaires. Consequently, 81 couples who completed follow-up questionnaires were included in the final analyses. Table 1 show the characteristics of 81 couples with both baseline (education, age, polygamy) and follow-up data (81 women and 81 men) by gender and by study arm. Participant characteristics between women and their male partners at follow-up were compared. Statistically significant differences between the groups were seen in age, education, as well as in HIV status.

Male partners tended to be of higher age (M=33.3, SD=8.7) compared to their spouses (M=33.3, SD=8.7) ($t(80) = -12.4$, $p<0.001$). In terms of highest level of education completed, about two-thirds of participants had only a primary school education where a significantly higher proportion of those were women (67.9%) compared to male partners (53.1%) (p=0.008) (Table 1). Along the same lines, a higher proportion of male partners reported completing secondary education (25.0%) as their highest level of education, compared to women (12.3%) (p=0.002). Only about 8% of participants reported attaining a tertiary education. Lastly, a significantly higher proportion of women (45.7%) reported being HIV-positive compared to male partners

(18.5%) at follow-up (p<0.001) (Table 1). No significant differences in participant characteristics including polygamy were observed between study arms among men and women at follow-up (Table 1).

Table 1: Participant characteristics by sex and by study arm

	Women (N=81)				Men (N=81)				Difference by Sex (P value)	Difference by Study Arm (P Value)	
	%(N)	Mean (SD)	Standard Care Arm (n=36) (%, N)	Home Visit Arm (n=45) (%, N)	%N	Mean (SD)	Standard Care Arm (n=36)	Home Visit Arm (n=45)		Women	Men
Age (Mean, SD)		25.0 (6.0)	26.4	23.9 (5.2)		33.3 (8.7)	34.3	32.5	**0.000****	0.127	0.478
Highest level of Schooling Completed											
Primary	67.9 (55)	-	73.3 (33)	61.1 (22)	53.1 (43)	-	53.3 (24)	52.8 (19)	**0.008****	0.242	0.960
Some Secondary	16.0 (13)	-	15.6 (7)	16.7 (6)	8.6 (7)	-	6.7 (3)	11.1 (4)	0.210	0.892	0.479
Completed Secondary	12.3 (10)	-	8.9 (4)	16.7 (6)	25.0 (20)	-	28.9 (13)	19.4 (7)	**0.002****	0.290	0.327
Post-Secondary	6.2(5)	-	4.4 (2)	8.3 (3)	11.1 (9)	-	8.9 (4)	13.9 (5)	0.219	0.470	0.477
HIV Status Positive	45.7 (37)	-	46.7 (21)	44.4(16)	18.5 (15)	-	19.0 (8)	21.2 (7)	**0.000****	0.842	0.816
Male partners less than age 30 years	-	-	-	-	48.1 (39)	-	51.1 (23)	44.4 (16)	-	-	0.551
Weeks pregnant during study (Mean, SD)	-	-	26.1(6.2)	26.0 (8.4)	-	-	-	-	-	0.860	-
Polygamy	19.8 (16)	-	17.8 (8)	22.2 (8)	19.8 (16)		17.8 (8)	22.2 (8)	-	0.618	0.618

Bivariate Analysis of Relationship Quality by Participant Characteristics at Follow-Up

Table 2 summarized differences in measures of relationship quality by sex. A Wilcoxon Signed Ranks test was used to examine median differences in relationship factors between women and their male partners at follow-up. male partners reported statistically significantly higher median scores in relationship satisfaction (mdn=43) and relationship commitment (mdn=72) compared to women' relationship satisfaction scores (mdn=40), Z=-2.500, p=0.012, and relationship commitment (mdn=64) scores, Z=-2.874, p=0.004.

Tables 2: Relationship quality by sex

	Women (N=81)	**Male partners (N=81)**	**Differences by gender**	
	Median	Median	Z Statistic	P value
Relationship Satisfaction	40 (10-45)	43 (15-45)	**-2.50**	**0.012**
Relationship Trust	36 (14-46)	37 (21-48)	-0.60	0.546
Positive Interaction	26 (5-27)	27 (8-27)	-1.48	0.138
Relationship Commitment	64 (18-72)	72 (30-72)	**-2.87**	**0.004**

Differences by gender calculated using Wilcoxon Signed Ranks; Mdn (range)
*p<0.1, **p<0.05, ***p<0.01, ****p<0.001

For women, relationship satisfaction scores were statistically significantly higher for the intervention group (mean rank=46.2) when compared to the standard care group (mean rank=34.8), U=575, z=-2.303, p=0.021 (Table 3). Similarly, for male partners, relationship satisfactions scores were higher in the intervention arm (mean rank=48.6) than the standard care arm (mean rank=31.5), U=467.5, z=-3.461, p=0.001) (Table 3). Also, male partners in the intervention arm reported statistically significantly higher relationship commitment scores (mean rank=44.1) compared to male partners in the

standard care arm (mean rank=36.1), U= 633, z=-1.697, p=0.090 (Table 3).

Table 3: Relationship quality among women and male partners by study arm

	Differences by Study Arm			
	Mean Rank	Mann-Whitney U	Z statistics	P value
Relationship Satisfaction Women				
Standard Care (n=36)	34.8	575.0	**-2.30**	**0.021****
Home Visit (n=45)	46.2			
Relationship Satisfaction Male partners				
Standard Care (n=36)	31.5	467.5	**-3.46**	**0.001****
Home Visit (n=45)	48.6			
Relationship Trust Women				
Standard Care (n=36)	39.1	740.0	-0.67	0.500
Home Visit (n=45)	45.6			
Relationship Trust Male partners				
Standard Care (n=36)	39.81	767.0	-0.42	0.675
Home Visit (n=45)	42.0			
Positive Interaction Women				
Standard Care (n=36)	37.6	686.0	-1.24	0.217
Home Visit (n=45)	43.8			
Positive Interaction Male partners				
Standard Care (n=36)	37.2	673.0	-1.45	0.146
Home Visit (n=45)	44.0			
Relationship Commitment Women				
Standard Care (n=36)	37.1	670	-1.40	0.163
Home Visit (n=45)	44.1			

Relationship Commitment Male partners				
Standard Care (n=36)	36.1	633	**-1.70**	**0.090***
Home Visit	44.1			

Differences by Study Arm calculated using Mann-Whitney U
*p<0.1, **p<0.05, ***p<0.01, ****p<0.001

Further examination in differences in relationship quality by participant characteristics (couple HIV status, first time parenthood, male age, male education, and polygamy) yielded some significant findings. There was a statistically significant difference in positive interaction scores; couples who were in concordant relationships (both members of the couple have the same HIV status) had observably statistically significantly higher positive interaction scores (mean rank=44.5) compared to couples in HIV discordant relationships (members of the couple have different HIV status) including couples with an unknown HIV status (mean rank=32.3), U=466, z=-2.35, p=0.019 (Appendix 2). Finally, couples in concordant relationships reported higher relationship commitment scores (mean rank=43.6) compared to couples in HIV discordant or unknown status relationships (mean rank=32.7), U=477, z=-1.93, p=0.053 (Appendix 1).

We found relationship satisfaction was statistically significantly higher among male partners with reportedly higher education than their spouses (mean rank=48) compared to couples in which male education was similar or lower than their partners (mean rank=36), U=564, z=-2.27, p=0.024 (Appendix 2).

When examining relationship quality among couples with at least one member who was a first-time parent, relationship trust between couples appeared to be significantly higher in couples with a first-time parent (mean rank= 54) compared to both members of the couple who were not first-time parents (mean rank=38.3), U=286.5, z=-2.29, p=0.022 at follow-up (Appendix 3).

Among couples who reported being in polygamous relationships, positive interaction within couples was reportedly lower (mean rank=28.3) compared to couples in non-polygamous relationships (mean rank=44.1), U=317.5, z=-2.44, p=0.015 (Appendix 4). Similar to positive interaction findings, differences in relationship satisfaction within couples in polygamous relationships and non-polygamous couples were observed; statistically significantly lower total relationship satisfaction scores were reported in polygamous couples (mean rank=28.8 versus mean rank=44.0), U=324.5, z=-2.34, p=0.019 (Appendix 4). Additionally, lower relationship satisfaction within couples was reported by those in polygamous relationships (mean rank=31.6) compared to couples in non-polygamous relationships (mean rank=43.3), U=369.5, z=-1.80, p=0.072 (Appendix 4). Lastly, lower relationship commitment between couples was reported by those in polygamous relationships (mean rank=28.1) compared to couples in non-polygamous relationships (mean rank=43.3), U=-2.42, p=0.016 (Appendix 4). Similar findings were noted within couples with lower reporting of relationship commitment among couples in polygamous relationships (Appendix 4).

In examining relationship quality differences among couples with male partners older than or younger than the age of 30 years, relationship trust within couples appeared to be the only variable that differed significantly by male partner age. Higher relationship trust was reported within couples with male partners less than the age of 30 years (mean

rank=46) compared to couples with male partners older than 30 years (mean rank=36.3), U=623, z=-1.87, p=0.062 (Appendix 5).

Relationship dynamics by Study Arm

Relationship satisfaction between couples was higher in the intervention arm (mean rank=49.7) compared to the standard care arm (mean rank=30.2), U=422.5, z=-3.71, p<0.001. Also, relationship commitment between couples was reportedly higher in the intervention arm (mean rank=44.9) compared to standard care (mean rank=35.2), U=600, z=-1.89, p=0.059 (Table 4). The other relationship quality measures did not differ significantly by study arm. (Table 4).

Table 4: Relationship quality by study arm

Relationship Factor		**Differences by Study Arm**		
	Mean Rank	Mann-Whitney U	Z statistics	P value
in Trust (Within Couples)				
Standard Care (n=36)	41.5	790.5	-0.17	0.852
Home Visit (n=45)	40.6			
Total Trust (Between Couples				
Standard Care (n=36)	37.9	699.0	-1.06	0.290
Home Visit (n=45)	43.5			
Difference in Positive Interaction (Within Couples)				
Standard Care (n=36)	42.0	773.5	-0.35	0.724
Home Visit (n=45)	40.2			
al Positive Interaction (Between Couples)				
Standard Care (n=36)	37.0	664.5	-1.40	0.161
Home Visit	44.2			

(n=45)				
Differences in Satisfaction (Within Couples)				
Standard Care (n=36)	41.8	780.0	-0.29	0.773
Home Visit (n=45)	40.3			
Total Satisfaction (Between Couples)				
Standard Care (n=36)	30.2	422.5	-3.71	**0.000******
Home Visit (n=45)	49.7			
ences in Commitment (Within Couples)				
Standard Care (n=36)	41.5	756	-0.35	0.723
Home Visit (n=45)	39.7			
Total Commitment (Between Couples)				
Standard Care (n=36)	35.2	600	-1.89	**0.059***
Home Visit (n=45)	44.9			

Differences by study arm calculated using Mann-Whitney U
*p<0.1, **p<0.05, ***p<0.01, ****p<0.001

Relationship Quality and Study Arm by Male Partner ANC Attendance

Among thirty-nine male partners who attended ANC visits, 61.5% were men from the intervention arm and 38.5% were men from the control arm. A chi-square test for association was conducted between study arms and male partner ANC attendance. Approximately 41.7% of male partners from standard care attended ANC visits while about 53.3% of male partners from the intervention arm attended visits. However, there was no statistically significant association between intervention exposure and male partner ANC attendance, X^2 (1) = 1.090, p=0.296.

Mann-Whitney U tests revealed differences between within and between couple measures of relationship quality (satisfaction, commitment, trust and positive interaction) and the main dependent variable of male partner ANC attendance (Table 5). Within couples, less difference in positive interaction scores were reported among couples who reported no male ANC attendance (mean rank=36.1) compared to couples who reported male attendance (mean rank=46.3), U=612, z=-1.99, p=0.047 (Table 5). In other words, among male partners who reported more positive interaction than their wives, male partners reporting higher use of positive interactions seemed to report higher male partner ANC attendance compared to male partners who reported less positive interaction. Interestingly, for couple trust, among male partners who seemed to report higher trust than their wives, male partners reporting higher trust appeared to report no male partner ANC attendance (mean rank=45.5) compared to male partners reporting lower trust and any male partner ANC attendance (mean rank=36.2), U=631, z=-1.79, p=0.074 (Table 5).

Table 5: Relationship quality by ANC male attendance

Relationship Factor		**Differences by ANC Male Attendance**		
	Mean Rank	Mann- Whitney U	Z statistics	P value
in Trust (Within Couples)				
No male ANC attendance (n=42)	45.5	631.0	-1.79	**0.074***
Any male ANC attendance (n=39)	36.2			
Total Trust (Between Couples				
No male ANC attendance (n=42)	43.4	718.5	-0.95	0.341
Any male ANC attendance (n=39)	38.4			
Difference in Positive Interaction (Within Couples)				

No male ANC attendance (n=42)	36.1	612.0	-1.99	**0.047****
Any male ANC attendance (n=39)	46.3			
al Positive Interaction (Between Couples)				
No male ANC attendance (n=42)	40.5	797.0	-0.21	0.833
Any male ANC attendance (n=39)	41.6			
rences in Satisfaction (Within Couples)				
No male ANC attendance (n=42)	42.4	760.5	-0.56	0.576
Any male ANC attendance (n=39)	39.5			
Total Satisfaction (Between Couples)				
No male ANC attendance (n=42)	38.8	726.0	-0.89	0.376
Any male ANC attendance (n=39)	43.4			
ences in Commitment (Within Couples)				
No male ANC attendance (n=42)	39	735	-0.62	0.537
Any male ANC attendance (n=39)	42.2			
Total Commitment (Between Couples)				
No male ANC attendance (n=42)	37.7	681.5	-1.14	0.255
Any male ANC attendance (n=39)	43.6			

Differences by study arm calculated using Mann-Whitney U
*p<0.1, **p<0.05, ***p<0.01, ****p<0.001

Bivariate logistic regression findings are summarized in Table 6. In these models, only positive interaction within couples was significantly associated with male partner ANC attendance. In this instance, couples where male partners reported higher positive interactions than their female partners (differences in positive interactions), couples had higher odds of male ANC attendance (OR=1.13, 95% CI 0.99-1.29, p=0.083).

Table 6: Bivariate associations between relationship qualities and sociodemographic covariates and male partner ANC attendance

	Attendance (no proportion of visits vs. any proportion of visits)					
Independent Variable	B	SE	df	p-value	Odds Ratio	90% CI
Study arm	0.470	0.451	1	0.298	1.60	0.76- 3.36
Difference in Trust (within couples)	-0.060	0.044	1	0.172	0.94	0.87 - 1.03
Total trust (between couples)	-0.035	0.035	1	0.315	0.97	0.91 - 1.02
Difference in Positive Interaction (within couples)	**0.119**	**0.069**	**1**	**0.083***	**1.13**	**1.01 - 1.26**
Total Positive interaction (between couples)	0.008	0.040	1	0.839	1.01	0.94 – 1.07
Difference in Satisfaction (within couples)	-0.008	0.043	1	0.859	0.99	0.93 – 1.07
Total satisfaction (between couples)	0.006	0.021	1	0.766	1.01	0.97 - 1.04
Difference in Commitment (within couples)	0.037	0.029	1	0.206	1.04	1.0-1.09
Total Commitment (between couples)	0.015	0.016	1	0.361	1.02	1.0-1.04
Weeks pregnant from enrolment to birth	0.014	0.026	1	0.589	1.01	0.96 – 1.07

Male partner greater or less than age 30	0.044	0.445	1	0.921	0.96	0.50 – 2.17
Polygamy	-0.542	0.573	1	0.344	0.58	0.23 – 1.49
First time parent	0.798	0.609	1	0.191	2.22	0.81 – 6.05
Male higher education than female	0.536	0.454	1	0.238	1.71	0.81 – 3.61
Male lower education than female	-0.618	0.609	1	0.310	0.54	0.20 – 1.47
Male same education than female	-0.182	0.453	1	0.688	0.83	0.40 – 1.76
HIV Discordancy	-0.357	0.553	1	0.519	0.70	0.28 – 1.74
HIV Concordance Status	0.767	0.511	1	0.133	2.15	0.93 – 4.99

*p<0.1, **p<0.05, ***p<0.01, ****p<0.001

Parallel Mediation Analysis

As discussed previously, three multivariate regression equations for each couple relationship quality were estimated to assess the direct effect (c) of the intervention regressed on male partner ANC attendance (Figure 3) and the indirect effects (a and a1) of the intervention regressed on each of the couple relationship factors (first regression) and indirect effects of each of the couple relationship factors regressed on male partner ANC attendance (second regression) (b and b1) (Figure 3). Table 7 provides details of the coefficients, standard errors and statistical significance from the regression models.

In exploring relationship satisfaction as a mediator (controlling for number of weeks pregnant from time of enrolment, polygamy, similar education within couples and HIV concordance status), the first ordinary least squares (OLS) regression model (figure

3: a) found that receiving the intervention was not significantly related to differences in relationship satisfaction within couples at follow-up (Table 7). However, the second OLS regression model (figure 3: a1) showed couples randomized to receive the intervention were more likely to report significantly higher total relationship satisfaction scores at follow-up (Table 7). In the logistic regression model where the outcome of interest was male partner ANC attendance and within and between couple relationship satisfaction scores at follow-up were included (figure 3: b and b1), neither receipt of the intervention (OR = 2.081, 90% CI -0.108, 0.054) nor average differences in relationship satisfaction within couples at follow-up (OR = 0.976, 90% CI -0.102, 0.054) as well as average total sum in relationship satisfaction between couples (OR = 0.977, 90% CI -0.067, 0.020) were significantly independently associated with male partner ANC attendance (Table 7). The indirect effects were not significant for relationship satisfaction within couples (beta coefficient = 0.009, SE=0.086, 90% CI -0.107, 0.151) at follow-up nor relationship satisfaction between couples (beta coefficient = -0.169, SE=0.282, 90% CI -0.545, 0.325). The hypothesis that the relationship between being in the intervention arm and male partner ANC attendance was mediated by couple relationship satisfaction was not supported.

Next, relationship trust was investigated as a mediator (controlling for number of weeks pregnant from time of enrolment, first time parent, age of male partner). In the first and second ordinary least squares regression models, receiving the intervention was not significantly associated with the average difference in relationship trust score within couples and average total sum of relationship trust scores between couples at follow-up (Table 7). Similarly, in the logistic regression model with male partner ANC attendance was the outcome of interest, neither receipt of the intervention (OR = 1.844, 90% CI -

0.183, 1.407) (figure 3:c) nor average total sum of relationship trust between couples at follow-up (OR = 0.948, 90% CI -0.116, 0.008) (figure 3:b1) were significantly independently associated with male partner ANC attendance (Table 7). However, among couples whose male partners were more trusting (average difference in trust) (figure 3: b), male partners had lower odds of attending ANC with their spouses at follow-up (OR=0.926, 90% CI -0.154, -0.003) (Table 7). The bootstrap findings indicated that the indirect effect (ab) was not significant for relationship trust within couples (b = -0.055, SE=0.145, 90% CI -0.320, 0.122) at follow-up or relationship trust between couples (b = -0.047, SE=0.137, 90% CI 0.336, 0.085). The hypothesis that the relationship between being in the intervention arm and male partner ANC attendance was mediated by couple relationship trust was not supported.

When exploring relationship commitment between and within couples as mediators (controlling for number of weeks pregnant from time of enrolment, polygamy, and HIV concordance status), the first OLS regression model (figure 3: a) indicated that average differences in relationship commitment within couples yielded no statistically significant associations with receipt of the intervention (Table 7). However, in the second OLS regression (figure 3: a1), couples randomized to receive the intervention were more likely to report significantly higher total relationship commitment scores at follow-up (on average) compared to couples randomized to standard care (beta coefficient=8.463, SE=3.162, p=0.0091, 90%CI 3.197, 13.728). Finally, the logistic regression model where male partner ANC attendance was our outcome of interest and between (sum) and within (differences) in couples' relationship commitment were included (figure 3: b and b1, c), neither receipt of the intervention, differences in relationship commitment nor total sum of relationship commitment between couples at

follow-up were significantly independently associated with male partner ANC attendance. Lastly, based on the bootstrap confidence intervals, no significant indirect effects were observed; we were unable to support the hypothesis that the association between being in the intervention arm and male ANC attendance was mediated by differences in relationship commitment (beta coefficient=-0.047, SE=0.132, 90%CI -0.313, 0.094) and total relationship commitment (beta coefficient= 0.093, 0.248, 90%CI-0.161, 0.604).

In the last parallel mediation analysis, positive interaction was investigated as a mediator (controlling for number of weeks pregnant from time at enrolment, polygamy, male partners having higher education than spouses and HIV concordance status). In the first OLS regression model, receiving the intervention was not significantly related to differences in positive interaction within couples at follow-up (b=-0.767, SE=0.811, ns, 90% CI -2.118, 0.585) (figure 3:a). The second OLS regression model indicated that receiving the intervention was significantly associated with total positive interaction scores between couples (b=2.377, SE=1.136, p=0.0398, 90% CI 0.485, 4.268) (figure 3: a1). In the logistic regression model where male partner ANC attendance was our outcome of interest and between (sum) and within (differences) in couples' positive interaction were included, neither receipt of the intervention (b=0.825, SE=0.072, ns, OR = 2.282, 90% CI - 0.0125, 1.663) (figure 3: c) nor total sum of positive interaction between couples at follow-up (b=-0.050, SE=0.049, ns, OR = 0.951, 90% CI -0.131, 0.031) (figure 3: b1) were significantly independently associated with male partner ANC attendance. However, average differences in positive interaction was significantly independently associated with male partner ANC attendance (figure 3: b1). Among couples whose male partners had more positive interactions than their wives, male

partners had higher odds of attending antenatal care with their spouses (b = 0.133, SE=0.072, p=0.0662, OR=1.142, 90% CI 0.014, 0.251). Finally, the bootstrap confidence intervals indicated that the indirect effect was not significant for positive interaction within couples (b = -0.102, SE=0.185, 90% CI -0.461, 0.108) or positive interaction between couples (b = -0.120, SE=0.212, 90% CI -0.477, 0.185) at follow-up. As such, we were unable to support the hypothesis that the relationship between being in the intervention arm and male partner ANC attendance was mediated by positive couple interaction.

Table 7. Model coefficients from multivariate regression models

	M (Relationship Satisfaction Difference)			**M (Total Relationship Satisfaction)**			**Y (Male ANC Participation)†**		
	C	**SE**	**P value**	**C**	**SE**	**P value**	**C**	**SE**	**P value**
X (Receipt of Intervention)	-0.388	1.192	0.746	7.175	2.182	**0.002*** **	0.733	0.511	0.152
M (Relationship Satisfaction Difference)	-			-			-0.024	0.047	0.613
M (Total Relationship Satisfaction)	-			-			-0.024	0.026	0.372
	M(Relationship Trust Differences)			**l Relationship Trust)**			**Y (Male ANC Participation)‡**		
	C	**SE**	**P value**	**C**	**SE**	**P value**	**C**	**SE**	**P value**
X (Receipt of Intervention)	0.704	1.215	0.564	0.879	1.480	0.555	0.612	0.483	0.206
M (Relationship Trust Difference)	-			-			-0.077	0.047	**0.099***
M (Total Relationship Trust)	-			-			-0.054	0.038	0.153
	M (Relationship Commitment Differences)			**Total Relationship Commitment)**			**Y(Male ANC Participation)§**		

	C	SE	P value	C	SE	P value	C	SE	P Value
X (Receipt of Intervention)	-1.133	1.820	0.536	8.463	3.162	**0.009*** **	0.483	0.497	0.331
M(Relationship Commitment Difference)	-			-			0.041	0.033	0.216
M (Total Relationship Commitment)	-			-			0.011	0.020	0.582
	I (Positive Interaction Differences)			**M (Total Positive Interactions)**			**Y (Male ANC Participation)¶**		
	C	**SE**	**P value**	**C**	**SE**	**P value**	**C**	**SE**	**P Value**
X (Receipt of Intervention)	-0.766	0.811	0.348	2.377	1.136	**0.040****	0.825	0.509	0.105
M(Positive Interaction Difference)	-			-			0.133	0.072	**0.066***
M (Total Positive Interaction)	-			-			-0.050	0.049	0.306

*p<0.1, **p<0.05, ***p<0.01

† Controlling for number of weeks pregnant from time of enrolment, polygamy, similar level of education within couples and HIV concordance status

‡ Controlling for number of weeks pregnant from time of enrolment, first time parent, age of male partner

§ Controlling for number of weeks pregnant from time of enrolment, polygamy, and HIV concordance status

¶ Controlling for number of weeks pregnant from time at enrolment, polygamy, male partners having higher education than spouses and HIV concordance status

To summarize, couples in the intervention arm reported significantly higher satisfaction and relationship commitment at follow-up. Interestingly, male partners appeared to report higher satisfaction and relationship commitment than their female spouses. Further, findings from parallel mediation suggested that among couples whose male partners reported higher relationship trust than their female partners, male partners appeared to be less likely to attend ANC visits. However, male partners who reported higher positive interaction than their female partners appeared to be more likely to attend ANC visits with their female partners. Despite these trends, we were unable to support our hypotheses that couple relationship factors mediated the relationship between being in the intervention arm and male partner ANC attendance.

Qualitative Phase

Participant Characteristics

The median age among women who participated in qualitative interviews was 25.5 years, with an age range of 18 years to 39 years. For male partners, the median age was 39.5 years with an age range of 24 years to 60 years. Four couples recruited for IDIs from the home visit arm (out of 8 couples) and 2 couples from the standard care arm (out of 4 couples) reported no male partner ANC engagement at follow-up. Two couples in the home visit arm and one couple in the standard care arm were in HIV discordant relationships. One couple from the standard care arm reported being unaware of each other's HIV status.

Qualitative Findings

To complement and expound on quantitative findings, we explored couples' perceptions of how the intervention impacted their relationship dynamics, as well as male partner engagement during pregnancy. Similar to quantitative findings, thematic analyses indicated that most couples who were randomized to receive the intervention reported improved couple relationship dynamics. Couples described improved trust after participating in couple HIV testing and counseling (CHTC) and improved communication after engaging in couple communication exercises. Participants also described improved male partner engagement in PMTCT- and pregnancy health-related activities. However, a few couples described continued challenges with male partner engagement, demonstrating the continued support couples require in learning how best to mutually support each other in realizing common health goals.

Perceptions about the intervention and influence on couple relationship dynamics

We explored perceptions of how the intervention appeared to influence couple relationship dynamics among couples randomized to receive the home-based intervention. Overall, couples had a positive impression of their experiences. Some male partners viewed the intervention as a tool they could learn and benefit from in terms of improving relationships. For example, this male partner's motivation was learning ways he could keep his wife safe and happy,

> "…The study [discouraged] a pregnant woman [from] be[ing] involved in domestic violence. That was one of the things that we were told that made me happy. I was informed that when a woman is pregnant, she needs peace. You can help her with house chores if she is not able to perform her duties…So those are

the things that motivated me to participate in this study," (Participant 10012, Male Partner, HIV Negative Discordant, Intervention).

In other cases, not only did some couples feel their relationships improved because of the intervention, the education and encouragement they received from the home counsellors increased their confidence to implement and sustain learned health behaviors. As this male reported confidently, "I am confident. I have a lot of confidence. I am not afraid. I am so strong," (Participant 20262, HIV Positive Concordant, Male Partner, Intervention). This quote illustrated the willingness of male partners to engage in pregnancy health-related activities, and the importance of empowering them not only by improving relationship dynamics, although important, but also by improving their own efficacy to initiate and sustain health-enhancing behaviors. Establishing balance between education and addressing couple relationship dynamics to improve male partner engagement seemed well received, and even prompted this participant to advocate for more such studies that could not only provide care for families during pregnancy but help couples through conflict and rebuild healthy relationships,

> "The study was great and wonderful to us…If another study comes, I can mobilize other people to also join a similar study...You know there [is] a lot of conflict in the families within this community that when one or an institution would bring peace in marriages, it would be so nice and wonderful," (Participant 10012, HIV Negative Discordant, Male Partner, Intervention).

Another aspect of CHTC that emerged from the shared stories was the issue of reestablishing trust within couples. By testing and disclosing their HIV status, this male partner felt more secure in his relationship, describing feelings of adoration and open and positive interactions with his spouse,

> "This enhanced our relationship since we now knew each other's HIV status. I felt like I knew my wife right to her heart; for her faithfulness to me. I feel at peace and free with my spouse to date. She is also free to me..."
>
> (Participant 20332, Male Partner, HIV Negative Concordant, Intervention).

Couples also seemed to enjoy the privacy of engaging in CHTC in their homes. As these experiences were deemed personal and deeply meaningful, engaging in CHTC in their homes provided a safe and supportive environment where male partners could engage without perceived undue pressure and fear of judgement. As this male partner explained, "…Many people access services… Some people have fear... At home you are all alone as the couple and the counselors… At home, you are more comfortable," (Participant 20062, Male Partner, HIV Negative Concordant, Intervention). Similarly, this female partner reiterated the importance of testing at home. She described experiences that could frighten and dissuade patrons from testing at the clinic due to the negative experiences of others. Within the home, couples could feel encouraged and empowered to engage in HIV testing and disclosure; the haven afforded by the home allowed for private experiences without the pressure of judgment from onlookers,

> "The one at home is good because even if am found to be positive I will just cry and no one will come out saying that so and so was found positive, nobody will announce, but when I start crying in hospital and scream because that thing has terrified me people will go round announcing that do you know the wife to so and so came to clinic and was tested and found positive, that woman screamed and even made the counselors loose network, she refused to be calmed down and she was making people not to have peace because that news came abruptly and got

the results that you were not expecting so it will spoil your mind and deny you peace for you to return to normal it will require a lot of counseling."

(Participant 40151, Female Partner, HIV Positive Concordant, Intervention)

The influence of the intervention on male engagement in family health and impact of male engagement

Engaging in home visits seemed to create a supportive environment in which couples felt empowered to engage in HIV prevention activities with their spouses and maintain healthy behaviors. In this instance, engaging in CHTC was also seen as an opportunity to assure that the family remained healthy. After disclosing their HIV status, planning ways to stay healthy was at the forefront of this couple's mind. As this female partner explained, "…Given that my husband is not on drugs…And with me am taking drugs…So when I take the drugs as required…He can't contract HIV." She went on to explain that she received encouragement and support from her male partner to adhere to her treatment regimen and stay healthy, "…He told me to try and keep on taking the drugs as required," (Participant 10011, Female Partner, HIV Positive Concordant, Intervention). By disclosing their HIV status, her male partner further explained that he would be better able to protect himself from HIV as well as ensure that his wife stayed healthy by practicing safe sex,

"I: …You also stated that knowing your status helped you to practice safer sex. P: Yes.

I: You mentioned that you are currently using condoms. P: Yes, we use condoms for sexual intercourse."

(Participant 10012, Male Partner, HIV Negative Discordant, Intervention).

From this example, we appreciate that positive mutual influences within couples could certainly impact how health-enhancing behaviors are adopted and maintained. In the couple above, encouragement from her husband was empowering and her male partner, to assure the health of his family, engaged in HIV prevention behaviors, demonstrating how healthy relationships enabled this couple to stay motivated and engaged in healthy behaviors. Such experiences could be leveraged in couple-focused intervention development in HIV prevention, for impactful and sustainable positive outcomes.

However, in one instance, male partner engagement in pregnancy health appeared to create conflict between members of a couple. This male partner seemed to view the intervention as an opportunity to exert his opinions and directives. He complained that post-intervention, his wife's respect for his opinions and direction deteriorated compared to when the couple was receiving the study home visits,

> "Home visits have [been] helpful to us. During the time that the home visits were reduced… We realized some challenges…I don't know whether if she had those doctors [the home visit counselors] that made her respect me by that time…As we are moving ahead I am just seeing that I am pushing her by force… Even for her to go to the hospital she is just being pushed by force to go." (Participant 20262, Male Partner in Polygamous Relationship, HIV Positive Concordant, Intervention).

His wife's description of her experiences were different than her male partners. She explained that she was regularly taking their child to the clinic as prescribed as well as taught by the home visit counselors and was up-to-date with his immunizations,

> "…I have taken the baby to well-baby clinic…I took the baby to the clinic for checkups and immunizations. The last time we were at the well-baby clinic, blood sample was taken from the baby on the 24th November 2016. The baby was healthy," (Participant 20261, Female Partner in Polygamy, HIV Positive Concordant, Intervention).

She went on to explain that she and her male partner continuously had conflicts about infant care visits. She complained that her male partner tried to enforce his will by trying to dictate when she should attend clinic visits. She felt disheartened being unable to attend the educational sessions offered by her clinic and instead changed her working schedule to accommodate the educational sessions thereby ignoring her male partner's wishes,

> "…We have always had issues and misunderstandings with my husband concerning taking the baby to the clinic. Well baby clinic visits need to be done early in the morning…My husband on the other side wants me to go to the farm until 10 am before leaving to the health facility...At times I am forced to go to the well-baby clinic visits in the morning and go to the farm at 2 pm after coming back," (Participant 20261, Female Partner in Polygamous Relationship, HIV Positive Concordant, Intervention).

This exchange about their relationship history highlights the importance of helping couples build healthier relationships and empowering them to work more effectively and respectfully towards a common goal.

Education was another component of couples' motivation for engaging in the home visits. In some cases, male partners were unsure of ways to engage during pregnancy. By participating in the home visits, they were able to learn how to support

their female partners and more importantly, also garnered support from the home visit counsellors to implement some of the activities previously thought too effeminate to engage in. They felt empowered to overcome their discomfort in breaking a few of these traditional gender norms and engaging in supportive activities,

"I: You mentioned helping her with cooking.

P: Fetching water.

I: Fetching water for your wife. P: Mmm.

I: Yes. Any other task that you supported her to do?

P: About helping my wife?

I: Mmm.

P: Yes. After fetching her water …Making for her fire and even cooking for her…At times even her clothes …I soaked for her in the water.

I: That was nice. You said this was attributed by the study topics and discussions?

P: The health education that I received from the study."

(Participant 10012, Male Partner, HIV Negative Discordant, Intervention)

Other factors influencing male partner engagement during pregnancy: persistent barriers and overcoming challenges

What also emerged from the qualitative findings were the continued challenges couples faced that still hindered male partner engagement. Structural barriers continued to burden some couples, making it difficult for male partners to attend ANC. In this case, not beingable to gain permission from his work place, this female partner explained that it was difficult for him to attend ANC,

"I: That day, we worked overnight in the mines. I: So he was not given such permission?

P:mm (No),"

(Participant 10011, Female Partner, HIV Positive Discordant, Intervention)

Couples faced with inflexible work schedules, inflexible ANC hours and the necessity to travel far from the home to find work, emphasizes the need of taking a multi-pronged approach to addressing such challenges to male partner engagement. For this couple, using a home-based approach may have provided one avenue in which they were able to engage, learn and actualize HIV prevention strategies; by tailoring the intervention, the needs of the couple were met.

In other cases, despite the education received during home visits, and encouragement to attend ANC, some male partners in the intervention arm continued to view ANC attendance as their female partners' duty and saw little reason to attend unless emergencies arose,

"…We did not have any interaction with them because the health providers at the hospital did not call me…My spouse attended clinic alone as other women do."

(Participant 20332, Male Partner, HIV Negative Concordant, Intervention)

Not uncommon to this male partner, is the expression of traditional gender norms that some couples subscribe to within this community. In such cases, adding strategies like peer to peer mentoring using key influential mentors, could aid in dispelling harmful traditional gender norms, and empowering male partners to feel more comfortable in engaging in pregnancy health. In the example below, itappeared that peer to peer experiences positively influenced male partner engagement in this couple.

One male partner's motivation for engaging in ANC visits was driven by other male partners in his community. Having learned from his brother about his experiences at ANC, this wife shared how her male partner, overcoming his own apprehensions, felt inspired to accompany her to ANC,

> "…I told him that every pregnant woman had to go with her spouse…He heard that and one of his brother's wives was also pregnant. He heard that the brother accompanied his wife to the clinic. He decided to accompany me to hear what he was wanted for. He told him that he was asked some questions. They were not hard questions. That is why he decided to go," (Participant 20211, Female Partner, HIV Negative Concordant, Standard Care).

Further, this couple's experience with CHTC at the clinic led to improved couple dynamics. She described having less conflict in the relationship after participating in CHTC at the clinic,

> "…Many things have changed…Even when one says something…You can be able to convince him. When conflict arise, when there is misunderstanding, one can decide to leave…You know his status and he knows yours, so you live in harmony. Everyone knows the other's status. This will promote harmony in the marriage," (Participant 20211, HIV Negative Concordant, Female Partner, Standard Care).

It is not surprising that some couples may seek CHTC as a safe method for couple HIV status disclosure, based on these shared experiences. In this instance, this participant, who was randomized to the standard care arm, had not disclosed her HIV status to her male partner at follow-up out of fear of conflict. She explained that through CHTC she would find the courage to disclose her status in the future.

"P: …I wanted him to go and test first, I feared that if I tell him right away, he could get annoyed and quarrel.

I: Would you have any fears in testing together with your spouse?

P: Yes, there are fears but I would do it..."

(Participant 20051, Female Partner, HIV Positive Discordant, Standard Care)

Disclosing known HIV positive status in this way could help prevent conflict among couples by teaching coping strategies, and empowering couples to safely address challenges within their relationships that could arise, especially in serodiscordant situations.

Integration of qualitative and quantitative findings

The quantitative phase of the study showed a promising positive impact of the intervention on couple relationship dynamics. Couples randomized to receive the intervention reported significantly higher scores in relationship satisfaction and positive interactions. Additionally, analyses found that among couples who experienced positive interactions, male partners were more likely to engage in ANC with their spouses. On the other hand, among couples where male partners appeared more trusting than their female partners, male partners appeared less likely to attend ANC with their female partners. However, we failed to quantitatively support the hypothesis that couple relationships mediated the association between receipt of the intervention and male partner ANC attendance.

The qualitative phase of the study appeared to complement findings from the quantitative phase, by illustrating that couple relationship dynamics improved after engaging in home visits as well as appeared to influence male partner's willingness to engage in pregnancy-related activities including ANC visits (Table 8). However, exploration of the perceptions and experiences of the participants painted a more complex interaction between couple relationship quality and male engagement not captured in the mediation analysis. For instance, qualitative data indicated that improved quality in a couple's relationship was an influential precursor to male engagement.

However, engaging male partners in pregnancy health appeared to also improve the quality of relationships within couples. When viewed together, findings suggested that the intervention's impact on relationship quality was evident as well as a couple's relationship dynamics on male engagement, but the association was complex and nuanced. It seemed, for instance, that a bidirectional relationship may exist between relationship quality and male partner ANC attendance. For some male partners, they engaged in ANC because of their affection for the female partners, and in other instances, engaging in ANC helped improve trust within couples. These findings together elucidated a complex picture, more so that could have been achieved by using qualitative or quantitative methodologies alone. Indeed, findings also suggested that more complex quantitative methods would be needed to further explore these associations. As such, using a mixed methods research approach was justified, and was further evidence for adopting such approaches when developing efficacious and sustainable male partner engagement interventions.

Table 8. Integration of quantitative and qualitative phases

Quantitative Findings *	**Qualitative Results: Example of Quotes illustrating changes in relationship quality among couples randomized to receive the intervention**	**Integration**
Influence of the intervention on couple relationship dynamics		
Receipt of the intervention was significantly associated with improved couple relationship quality among couples: Receipt of the intervention was significantly associated with improved total satisfaction scores between couples (b=6.968, SE=2.102, p=0.0014) Receipt of the intervention was significantly associated with improved positive interaction scores between couples (b=2.422, SE=1.149, p=0.039)	"I saw a difference…the feeling he changed…I late saw him with [a] good heart. I as just seeing him as a short-hearted man. If you tell him something, whether it is good for him or bad, there was no answer he can give you. He just keep time (quiet). After the teaching, if something is not pleasing, he would tell me. Something that pleases, he would tell me." So what helped me was that I was used to his behavior…I was not telling him too but when he cha[n]ged his attitude and became open, I also became open. Even if I had something bother me, I could tell him point blank." - Participant 40151, Female Partner, HIV Positive Concordant, Intervention	Supporting findings from quantitative analysis, some couples described improved relationships with their partners due to the intervention in qualitative interviews. As this couple explained, their interaction greatly improved after participating in couple communication exercises
	"The topic that I enjoyed most was how to be friendly to your wife when she is pregnant. You can ask her what she would like to eat. I used to do that. Also to inquire how she is fairing. This made is close and free with each other. What she liked the most was being open with each other and agreeing on things together as a couple during pregnancy…This made us close and we were talking all the time. When I am away, I call her." -Participant 40152, Male Partner, HIV Positive Concordant, Intervention	

	"I: How did the topics discussed during home visits affect how you handle conflicts as a couple? P: The home visit discussions have really helped us. P: We can say that we do not engage in conflicts and fights." - Participant 20062, Male Partner, HIV Negative Concordant, Intervention	Aligning with quantitative findings, some participants expressed learning how to positively interact during disagreements in the intervention sessions. Participating in the couple relationship exercises during home visits enabled this male partner to engage in positive communication.
Influence of couple communication on male partner ANC engagement		
Bivariate analysis showed that couple relationship quality was significantly associated with male partner engagement. In particular, among couples who experienced positive interactions, male partners appeared to be more likely to engage in ANC with their spouses. Being able to discuss pregnancy-related matters as a couple "enabled" some male partners to engage in ANC when able. • Differences in Positive Interaction by male ANC attendance : No male ANC attendance: Mean Rank=36.1 vs. Any male ANC attendance: Mean Rank=46.3 (p=0.047)	"Ooh depending on how I loved my spouse…when she explained it to me, I accepted quickly, given that we had not stayed for so long." -Participant 20262, Male Partner, HIV Positive Concordant, Intervention	Confirming findings from quantitative analysis, some couples experienced male partner engagement in ANC and PMTCT as their relationships allowed for positive interactions.
Influence of the intervention on male partner ANC attendance		

Although receipt of the intervention was not significantly associated with male partner ANC attendance, qualitative findings illustrated that receiving the intervention helped some male partners engage in ANC visits (Table 7)	"…Yes when I heard [of] the study staff…I was very happy. I was informed that my wife would be going to the clinic…The doctor who tested us wanted to see if I could accompany my spouse to the clinic. I did it to confirm to them that I could do it. So, every time when she was going for ANC visits, I accompanied her." -Participant 10012, Male Partner, HIV Discordant, Intervention	Although no significant associations were seen between receipt of the intervention and male partner ANC attendance, an encouraging trend indicated that male partners of couples randomized to receive the intervention were more likely to engage in ANC.

*b=Beta Coefficient

DISCUSSION

In our investigation the main aim of the quantitative phase of the study was to examine the associations between the receipt of the intervention, couple relationship dynamics, and male partner ANC attendance at follow-up. Further, we examined whether couple relationship dynamics mediated the relationship between receipt of the intervention and male partner ANC attendance. Initial bivariate analysis indicated that those randomized to receive the intervention reported significantly higher relationship satisfaction compared to couples in the standard care arm. Indeed, couples qualitatively interviewed described increased feelings of relationship quality, with some male partners describing how they enjoyed learning how to be 'friendly" with their spouses. These findings were similar to studies investigating the impact of home visits on couple HIV testing and counseling as well as on couple relationship dynamics (Krakowiak, et al., 2016; Osoti, et al., 2014; Takah, et al., 2017).

We also observed differences in couple relationship factors by gender. Male partners appeared to report significantly higher relationship satisfaction at follow-up. It appears this phenomenon is not unique; another study, albeit conducted among Western couples, found similar results where male partners were reportedly more satisfied on average than their spouses (Jackson, et al., 2014). However, this small but significant difference in marital satisfaction within spouses was attributed to selection bias in that study; this effect diminished when this phenomenon was examined in community-

recruited couples- little to no difference existed in marital satisfaction. They argued that in their sample, dissatisfied women may have been more willing to engage in the survey with the intent of voicing their experiences compared to dissatisfied husbands; such may be the case among our study couples (Jackson, et al., 2014). Additionally, male partners wishing to present themselves in a favorable way may have reported more positive experiences. As such, biases from social desirability could not be ruled out in our study population.

Our bivariate analyses examining differences in couple relationship quality by ANC male partner attendance yielded promising trends worthy of further investigation. Male partner ANC attendance in our study population was significantly higher in couples where male partners reported higher positive interactions. Corroborated by our qualitative findings, couples who described male partner experiences at ANC also described open communication, characterized as positive interactions. The association between positive interaction or communication and male engagement was observed in previous studies among couples (Conroy, et al., 2017; Conroy, et al., 2016; Daniele et al., 2018; Tokhi et al., 2018). Further, the influences of gender on health care access and utilization studied revealed significant impact of male partner perceptions and attitudes on women's access and use of health care services during pregnancy (Conroy, et al., 2017). However, unlike this study, prior studies have rarely examined the impact of both the female and the male partners' reporting of perceptions on couple relationship dynamics on male ANC engagement. Indeed, examining a male partner's perceptions and experiences on couple relationship dynamic could shed light on impact that could be further studied to establish a causal inference and later emphasized and addressed with couples as part of an intervention.

Another interesting bivariate analysis finding was the association between differences in reports of dyadic trust and male partner ANC engagement. It appeared that in couples where male partners were less trusting compared to male partners who were more trusting, there was a significant inverse association with any male partner ANC attendance. In other words, the less trusting male partners appeared, the more likely they were to attend ANC with their spouses. There is little in past studies that have directly examined this association and provided explanations for this finding (Conroy, 2015; Matseke et al., 2017; Wamoyi et al., 2017). One possible explanation may have been related to disclosure of HIV status. Studies have illustrated that among most couples, motivation for male partner engagement in ANC was couple HIV testing and counseling and disclosure of HIV status (Matseke, et al., 2017; Nyondo-Mipando, Chimwaza, & Muula, 2018). As such, ensuring that they indeed had the same HIV status, couples now felt able to be open and trusting- male partners therefore saw little need to attend ANC except in emergencies or spousal illness (Musoke, et al., 2018). This was evident among a few couples in our qualitative phase of the study where couples engaging in CHTC and disclosure described increased trust in their relationship. Indeed, for some, the motivations for engaging in CHTC and disclosure was to improve trust in the relationship. Another possible interpretation for this finding may have been related to couple relationship dynamics; among couples where power was shared (Conroy, 2015; Conroy, et al., 2016), trust in each other's motives, actions, and the presence of positive interactions may have inversely influenced male partner ANC engagement, as the male partners did not feel the need to attend ANC as they trusted their spouses to handle this responsibility (Conroy, 2015). Similar relationship dynamics have been attributed to the association between couple relationship stability and less likelihood of engaging in HIV

prevention strategies such as couple HIV testing and disclosure. These assumptions, however, require further study to establish a causal association between male engagement and male partner trust.

Although our mediation analyses yielded no significant findings, the multivariate logistic regressions yielded interesting trends (Table 7). These analyses illustrated that receipt of the intervention was significantly associated with increased relationship satisfaction and positive interaction between couples. However, definitively demonstrating that high relationship satisfaction and high positive interaction scores mediated the association between receipt of the intervention and male partner ANC attendance was more difficult. A suggestion for this lack of mediation may have been that couple relationship dynamics may not have necessarily been the primary pathway to male partner ANC attendance as well as whether male partner ANC attendance was indeed a good measure of male engagement in pregnancy health to begin with.
Qualitative findings did elicit other motivations for male partner ANC attendance beyond couple relationship dynamics; this included education, and couple HIV testing and disclosure for instance.

Our findings also add to the ongoing debate about how best to define and measure male partner engagement in pregnancy; arguments have been made that male partner engagement may be perceived in various ways by male partners and may indeed take various forms of activities (Maman, et al., 2011; E. Montgomery, et al., 2011; Nyondo-Mipando, et al., 2018). Montgomery and colleagues (2011) explained that male engagement is a broad and multifaceted concept that takes multiple forms. Further, the authors discussed that to reduce male partner engagement to mere physical presence during ANC may diminish the value of male partner engagement, and the impact it could

have (E. Montgomery, et al., 2011; Nyondo-Mipando, et al., 2018). However, ascertaining the impact and relevance of these other forms of engagement, especially within the home environment, on infant and maternal outcomes is challenging (Tokhi, et al., 2018).

Our qualitative findings further elucidated the relationship between receipt of the intervention, couple relationship dynamics and male engagement. Compared to the simple bivariate and mediation analysis employed in this study, qualitative findings suggested that the associations were most likely more complex- possibly multidirectional and interwoven (Wamoyi, et al., 2017). For instance, positive couple relationship quality appeared to positively impact a male partner's willingness to engage in pregnancy health-related activities, while engaging in such activities also appeared to improve couple relationship quality. These qualitative findings illustrate that further study of these complicated associations is warranted .

STRENGTHS AND LIMITATIONS

The study highlighted some important trends that speak to the positive impacts of a home-based couples intervention on couple relationship dynamics, specifically couple satisfaction and positive interaction among couples, and taking a dyadic approach to study these phenomena provided a holistic outlook of couple influences (Cook and Kenny, 2005). However, the small sample size of the study hindered the ability to establish causal links between the intervention and male partner engagement, including the mediating effects of couple relationship dynamics. Further, the analyses may not have fully captured the associations, and the presence of epiphenomenal associations in which the mediators may have been correlated with other variables the intervention was

affecting, including the outcome, may have influenced the analyses. The intervention did contain various activities including CHTC, disclosure, couple relationship building and pregnancy-health related education. A more sophisticated analysis may be warranted with added mediation and moderation and multiple mediators and moderators with multiple outcomes- such an undertaking would require larger sample sizes; it may be that the combination of both social and structural support such as education or CHTC would be of value to examine as mediators (Omonaiye, Nicholson, Kusljic, & Manias, 2018). Furthermore, we cannot discount that bias may have been introduced in two couples during qualitative interviews as their interviews were conducted on separate days. Couple members may have had the opportunities to share experiences, possibly changing the narrative of their spouses and consequently their shared stories. Lastly, the generalizability of the study findings to populations beyond our study cohort would be limited due to our exclusion criteria and small sample size. Further, because couple relationship factors were self-reported, social desirability bias could not be ruled out.

Because these analyses were based on follow-up results only, the cross-sectional nature of these analyses prevented examining behavioral changes experienced by the participants during pregnancy to parenthood (especially for first time parents), and impact of those changes on couple relationship dynamics as well as our outcome. Further studies exploring associations between couple relationship dynamics and male partner engagement in pregnancy would need to include studying how changes in relationship perspectives and experiences during such a life-changing event act as mediators in these study communities (B. D. Doss and Rhoades, 2017; Brian D. Doss, Rhoades, Stanley, & Markman, 2009; Mitnick, Heyman, & Smith Slep, 2009).

Transferability of qualitative findings, due to the nature of the recruitment as well as social desirability in responses during interviews, were the main limitations of the qualitative phase of the study. Further, although we employed purposive sampling to recruit a range of couples with varied experiences based on quantitative findings, we recruited fewer couples in a few categories than we desired due to lack of availability at end of the study intervention period. For example, we hoped to recruit more couples in the standard care arm with serodiscordant HIV status who were able to engage in CHTC or with male partners who readily engaged in ANC; deeply exploring their perceptions and experiences of how couple relationship dynamics impacted their decision to test as a couple as well as motivate male partners to engage in ANC, would have offered further insight into the importance of couple relationship influence. However, data attained from the included couples were rich and informative and lent well to informing our quantitative findings.

Undertaking mediation analysis to examine pathways related to couple relationship dynamics and male partner ANC attendance after engaging in a home visit intervention dyadically was a novel approach aimed at expounding the nuances of this complex concept. Furthermore, using a mixed methods approach drew on the strengths of quantitative and qualitative methods, triangulating and validating the outcomes of each phase and elucidating complex associations.

CONCLUSION

The study's efforts to explore and examine the relationships between couple relationship dynamics and male partner ANC attendance brought to light important concepts that would be worthy of further study. For example, when looking at the overall trends of the couple relationship dynamic effect on male partner ANC attendance, couples reporting seemingly higher relationship satisfaction, relationship trust and positive interaction appeared less likely to report male partner ANC attendance but may have been involved in ways that went beyond ANC visits based on our qualitative data. Larger randomized controlled trials using a well-developed mixed methods approach are needed to further examine such phenomena, to understand the relevance and establish causal links to infant and maternal outcomes. Such evidence is needed in order to develop effective, relevant and tailored couple-based interventions that aim to increase male partner engagement and improve health-outcomes in communities burdened by HIV.

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APPENDIX 1

RELATIONSHIP QUALITY BY COUPLE HIV STATUS CONCORDANCE

Relationship Factor	**Concordant Couples (N=81)**	**Differences by Concordance**		
	Mean Rank	Mann-Whitney U	Z statistics	P value
Difference in Trust (Within Couples)				
All Other	40.5	656.5	-0.11	0.912
Concordant Couples	41.2			
Total Trust (Between Couples				
All Other	38.4	607.0	-0.63	0.528
Concordant Couples	42.0			
Difference in Positive Interaction (Within Couples)				
All Other	39.7	636.00	-0.33	0.741
Concordant Couples	41.5			
Total Positive Interaction (Between Couples)				
All Other	31.4	445.0	-2.36	**0.018****
Concordant Couples	44.8			
Differences in Satisfaction (Within Couples)				
All Other	42.4	635.0	-0.34	0.735
Concordant Couples	40.5			
Total Satisfaction (Between Couples)				
All Other	34.9	527.0	-1.48	0.140
Concordant Couples	43.4			
Differences in Commitment (Within Couples)				
All Other	36.3	560	-1.03	**0.302**
Concordant Couples	42.2			
Total Commitment (Between				

Couples)				
All Other	32.7	477	-1.93	**0.053**
Concordant Couples	43.6			

Differences by concordance calculated using Mann-Whitney U
*p<0.1, **p<0.05, ***p<0.01, ****p<0.001

APPENDIX 2

RELATIONSHIP QUALITY BY MALE EDUCATION HIGHER THAN SPOUSES

Relationship Factor		**Differences by Male Education Higher**		
	Mean Rank	Mann- Whitney U	Z statistics	P value
Differences in Trust (Within Couples)				
All Other (n=47)	43.2	695.0	-1.00	0.317
Male Education Higher than female (n=34)	37.9			
Total Trust (Between Couples				
All Other (n=47)	38.5	683.5	-1.11	0.268
Male Education Higher than female (n=34)	44.4			
Difference in Positive Interaction (Within Couples)				
All Other (n=47)	42.0	754.5	-0.43	0.665
Male Education Higher than female (n=34)	39.7			
Total Positive Interaction (Between Couples)				
All Other (n=47)	33.8	461.5	-3.28	**0.001******
Male Education Higher than female (n=34)	50.9			
Differences in Satisfaction (Within Couples)				
All Other (n=47)	41.0	797.5	-0.02	0.988
Male Education Higher than female (n=34)	41.0			
Total Satisfaction (Between Couples)				
All Other (n=47)	36.0	564.0	-2.27	**0.024****
Male Education Higher than female (n=34)	48.0			
Differences in Commitment (Within Couples)				

All Other (n=47)	40.5	783	0.00	**1.000**
Male Education Higher than female (n=34)	40.5			
Total Commitment (Between Couples)				
All Other (n=47)	37.3	632.5	-1.48	**0.140**
Male Education Higher than female (n=34)	44.9			

Differences by Male education higher than female calculated using Mann-Whitney U
*p<0.1, **p<0.05, ***p<0.01, ****p<0.001

APPENDIX 3

RELATIONSHIP QUALITY BY FIRST TIME PARENTHOOD

Relationship Factor		**Differences by First Time Parent**		
	Mean Rank	Mann- Whitney U	Z statistics	P value
Difference in Trust (Within Couples)				
All Other (n=67)	39.2	349.5	-1.50	0.133
Firs time parent (n=14)	49.5			
Total Trust (Between Couples				
All Other (n=67)	38.3	286.5	-2.29	**0.022****
Firs time parent (n=14)	54.0			
Difference in Positive Interaction (Within Couples)				
All Other (n=67)	39.8	390.5	-0.10	0.319
Firs time parent (n=14)	46.6			
Total Positive Interaction (Between Couples)				
All Other (n=67)	40.8	459.5	-0.12	0.904
Firs time parent (n=14)	41.2			
Differences in Satisfaction (Within Couples)				
All Other (n=67)	41.3	451.0	-0.28	0.820
Firs time parent (n=14)	39.7			
Total Satisfaction (Between Couples)				
All Other (n=67)	39.6	373.5	-1.21	0.230
Firs time parent (n=14)	47.8			
Differences in Commitment (Within Couples)				
All Other (n=67)	37.3	632.5	-1.48	0.140
Firs time parent (n=14)	44.9			
Total Commitment (Between Couples)				
All Other (n=67)	38.9	353	-1.40	0.161

Firs time parent (n=14)	48.3			

Differences by first time parent calculated using Mann-Whitney U
*p<0.1, **p<0.05, ***p<0.01, ****p<0.001

APPENDIX 4

RELATIONSHIP QUALITY BY POLYGAMY

Relationship Factor		**Differences by Polygamy**		
	Mean Rank	Mann- Whitney U	Z statistics	P value
Difference in Trust (Within Couples)				
All Other (n=65)	40.4	478.0	-0.50	0.616
Polygamy (n=16)	43.6			
Total Trust (Between Couples				
All Other (n=65)	40.8	509.0	-0.13	0.896
Polygamy (n=16)	41.7			
Difference in Positive Interaction (Within Couples)				
All Other (n=65)	44.1	317.5	-2.44	**0.015****
Polygamy (n=16)	28.3			
Total Positive Interaction (Between Couples)				
All Other (n=65)	42.8	406.5	-1.37	0.172
Polygamy (n=16)	33.9			
Differences in Satisfaction (Within Couples)				
All Other (n=65)	44.01	324.5	-2.34	**0.019****
Polygamy (n=16)	28.8			
Total Satisfaction (Between Couples)				
All Other (n=65)	43.3	369.5	-1.80	**0.072***
Polygamy (n=16)	31.6			
Differences in Commitment (Within Couples)				
All Other (n=65)	42.7	374.5	-1.68	**0.093***
Polygamy (n=16)	31.9			
Total Commitment (Between Couples)				
All Other (n=65)	43.6	314	-2.42	**0.016****
Polygamy (n=16)	28.13			

Differences by history of male testing calculated using Mann-Whitney U
*p<0.1, **p<0.05, ***p<0.01, ****p<0.001

APPENDIX 5 RELATIONSHIP QUALITY BY MALE AGE

Relationship Factor		**Differences by Male Age 30**		
	Mean Rank	Mann- Whitney U	Z statistics	P value
Difference in Trust (Within Couples)				
Male age >30 years (n=42)	36.3	623.0	-1.87	**0.062***
Male age ≤ 30 years (n=39)	46.0			
Total Trust (Between Couples				
Male age >30 years (n=42)	40.0	776.0	-0.41	0.684
Male age ≤ 30 years (n=39)	42.1			
Difference in Positive Interaction (Within Couples)				
Male age >30 years (n=42)	38.8	726.0	-0.89	0.372
Male age ≤ 30 years (n=39)	43.4			
Total Positive Interaction (Between Couples)				
Male age >30 years (n=42)	40.0	771.0	-0.46	0.645
Male age ≤ 30 years (n=39)	42.2			
Differences in Satisfaction (Within Couples)				
Male age >30 years (n=42)	41.9	781.5	-0.36	0.720
Male age ≤ 30 years (n=39)	40.0			
Total Satisfaction (Between Couples)				
Male age >30 years (n=42)	40.1	781.5	-0.36	0.721
Male age ≤ 30 years (n=39)	42.0			
Differences in Satisfaction (Within Couples)				

Male age >30 years (n=42)	39.1	740.5	-0.56	0.573
Male age ≤ 30 years (n=39)	42.0			
Total Satisfaction (Between Couples)				
Male age >30 years (n=42)	38.7	722.5	-0.74	0.460
Male age ≤ 30 years (n=39)	42.5			

Differences by history of male testing calculated using Mann-Whitney U
*p<0.1, **p<0.05, ***p<0.01, ****p<0.001

CONCLUSION AND FUTURE DIRECTIONS

There is evidence to suggest that male partner engagement in perinatal health and PMTCT improves maternal, neonatal and child health (MNCH) outcomes (Aluisio, et al., 2016; Audet, et al., 2016; Dunlap, et al., 2014; Morton et al., 2017). However, the field still struggles with how best to define male partner engagement, and how to examine specific aspects that appear to influence MNCH outcomes. Further, understanding what drives male partner engagement is important for designing effective and sustainable interventions that aim to leverage the positive aspects of male partner engagement. Couple relationship dynamics may provide insight into how relationship perspectives and mutual influences affect male partner engagement (Betancourt, Abrams, McBain, & Fawzi, 2010; Conroy, 2015; Conroy, et al., 2017). Accordingly, for this dissertation, we sought to explore the interplay between perceived couple relationship quality and male partner engagement.

Our first aim was to better understand how male partners perceived involvement during pregnancy, their willingness as well as their fears or barriers of engaging, using qualitative methods. We learned that male partners had the willingness to engage in pregnancy health, however logistical challenges including health care facility-level obstacles, and traditional gender norm expectations and those influences on couple relationship dynamics appeared to hinder male partner engagement. For interventions aimed at improving male partner engagement to succeed, understanding the nature of

gender role expectations in the local context, and how such expectations mutually affect couples' health behaviors, is key.

To further explore how perceived couple relationship qualities influenced a couple's mutual confidence (couple efficacy) and mutual ability (communal coping) to reduce HIV risk, we employed a novel dyadic analytic approach in paper two. We examined these associations using a form of dyadic analysis, the actor-partner interdependence model (APIM), of data from pregnant couples in a sub-Saharan African context. In these analyses, we found that working together to address an HIV threat was driven by each member's own perceived value of their relationship and consequently, their own confidence and ability to work with their spouses to address HIV risk. This effect appeared to be stronger for husbands than wives. Additionally, for partner effects, the influence of a partner's perception of relationship quality on their spouse's confidence and ability appeared to be stronger from husbands to wives. This highlighted the importance of safely and effectively engaging male partners in HIV prevention strategies to empower couples to jointly engage in keeping their families healthy.

Lastly, in paper 3, we had a unique opportunity to use a mixed methods design, including use of dyadic data for quantitative path analysis along with qualitative interviews with couples. We explored if perceived couple relationship quality mediated the effect of being randomized to receive a home-based couples' intervention on male partner ANC attendance. Few have undertaken path analyses using this approach to explore what drives male partner engagement in this context. Further, using qualitative data, we were able to explore how couple relationship perceptions influenced male partner engagement. These findings were integrated with quantitative findings for a more holistic appreciation of findings. Some of the findings from this last aim appeared to be

contrary to what was hypothesized. In fact an interesting trend emerged that suggested couples who perceived themselves to be in high quality couple relationships appeared to experience lower male partner ANC attendance. But from our qualitative data, we learned that male partner engagement took many forms beyond just ANC clinic attendance, often driven by how male partners perceived the quality of their relationships. For most, their affection for their spouses appeared to influence their willingness to engage in keeping their wives and families healthy. Although we were unable to detect statistically significant mediation by couple relationship factors between intervention exposure and male partner ANC engagement, "the absence of evidence is not evidence of absence", (Altman and Bland, 1995, p. 485). Our qualitative findings suggested that the relationship between perceived couple relationship qualities and male partner engagement is more complex and bidirectional in terms of influences. The way in which we define and methodologically explore pathways will undoubtedly require more complex analyses. By undertaking more complex analyses, findings may better inform intervention development and implementation and perhaps target couples and families who may benefit most, especially in the context of low-resource settings.

When considering findings from each paper, we find that male partners in our study population had a willingness to engage in pregnancy health, and desire to keeping their families safe and healthy. Additionally, they engaged in ways that have yet to be measured objectively and the effects of these types of engagement on MNCH outcomes have yet to be elucidated.

Finally, couple relationship dynamics appeared to influence male partner engagement in ways that were unexpected in male partner ANC engagement, but also in ways that mattered- relationship quality seemed to influence male partners' willingness to engage communally with their spouses in keeping their families healthy. Further study is needed to determine how such relationship experiences can be leveraged in improving male partner engagement, as defined by couples, and determine impact on MNCH outcomes is under way.

The findings from this dissertation should be viewed in light of several limitations. The cross-sectional nature of the quantitative analyses hindered establishing causality. Additionally, the small sample size made it difficult to demonstrate the mediating effects of couple relationship quality, as well as generalize findings to the general population. Given this limitation, stratifying couples by HIV status to further investigate possibly differing views and impact on male partner engagement was not possible. Also, transferability of qualitative findings was limited due to the parent study inclusion and exclusion criteria and the focused recruitment of women in stable couple relationships from ANC clinics where couples' experiences and perceptions may have differed from women who do not frequent ANC clinics.

Lastly, we introduced use of the communal coping scales (couple efficacy and communal coping) in this population to explore a couple's coping mechanisms in the context of HIV prevention in an sub-Saharan African setting. Further evaluation of the validity, relevance, and impact of these scales on MNCH outcomes in this context is needed.

There were advantages to using a dyadic approach in our analyses, despite our small sample size. With couple members being highly correlated, using dyadic analyses

prevented violation of the assumption non-independence. More interestingly, use of the APIM elucidated partner effects that could further aid in developing more tailored interventions. For instance, strong actor effects would require addressing individual needs (in this case confidence and ability), to empower them to initiate, implement and maintain healthy behaviors. Further, the presence of partner effects may have indicated that each couple member's perceived relationship quality could certainly impact the partner's outcome either positively or negatively. Because the partner effects appeared stronger for husbands to wives than wives to husbands, couple-focused interventions may need to consider including gender transformative concepts when designing, in order to empower couples to jointly implement and sustain healthy behaviors (C. M. Montgomery, et al., 2006; E. Montgomery, et al., 2011). The results from this dissertation indicate that male partners have the will to engage in pregnancy health and that their safe and effective engagement has the potential for positive effects on MNCH outcomes. As part of multifaceted initiatives, engaging male partners by improving couple relationship quality, as well as empowering them through educational and social support, could enable couples to mutually work towards establishing and maintaining healthy families.

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APPENDIX 1

UAB IRB APPROVAL

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM
Office of the Institutional Review Board for Human Use

470 Administration Building 701 20th Street South
Birmingham, AL 35294-0104
205.934.3789 | Fax 205.934.1301 | irb@uab.edu

NHSR DETERMINATION

TO: Musoke, Pamela Leah

FROM: University of Alabama at Birmingham Institutional Review Board Federal wide Assurance Number FWA00005960
IORG Registration # IRB00000196 (IRB 01) IORG Registration # IRB00000726 (IRB 02)

DATE: 17-Nov-2017

RE: IRB-300000799
Examining the impact of couple relationship factors on male engagement in pregnancy health and communal coping

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The Office of the IRB has reviewed your Application for Not Human Subjects Research Designation for the above referenced project.

The reviewer has determined this project is not subject to FDA regulations and is not Human Subjects Research. Note that any changes to the project should be resubmitted to the Office of the IRB for determination.

If you have questions or concerns, please contact the Office of the IRB at 205-934-3789.