



**TOURO COLLEGE &
UNIVERSITY SYSTEM**

Touro Scholar

2016

Determinants of Inconsistent Condom Use among HIV Serodiscordant Couples in Cambodia

Sovannary Tuot

Khuondyla Pal

Kouland Thin

Chrysanta Patio

Touro University California

Kelly Allbritton

Touro University California

See next page for additional authors

Follow this and additional works at: https://touro scholar.touro.edu/cehs_pubs



Part of the [Immune System Diseases Commons](#), and the [International Public Health Commons](#)

Recommended Citation

Tuot, S., Pal, K., Thin, K., Chhoun, P., Ngin, C., Ung, M., . . . Yi, S. (2016). Determinants of inconsistent condom use among HIV serodiscordant couples in Cambodia. *American Journal of Public Health Research*, 4(2), 69-74.

This Article is brought to you for free and open access by Touro Scholar. It has been accepted for inclusion in by an authorized administrator of Touro Scholar. For more information, please contact touro.scholar@touro.edu.

Authors

Sovannary Tuot, Khuondyla Pal, Kouland Thin, Chrysanta Patio, Kelly Allbritton, Christie Blondek, and Siyan Yi

Determinants of Inconsistent Condom Use among HIV Serodiscordant Couples in Cambodia

Sovannary Tuot^{1,7,*}, Khuondyla Pal¹, Kouland Thin¹, Pheak Chhoun¹, Chanrith Ngin¹, Mengieng Ung², Kolab Chhim³, Chrysanta Patio⁴, Kelly Allbritton⁴, Christie Blondek⁴, Gitau Mburu^{5,6}, Siyan Yi^{1,4}

¹KHANA Center for Population Health Research, Cambodia

²Department of Geography, Western University, Canada

³HIV/AIDS Flagship Project, KHANA, Cambodia

⁴Center for Global Health Research, Touro University California, USA

⁵International HIV/AIDS Alliance, UK

⁶Division of Health Research, Lancaster University, UK

⁷Royal University of Phnom Penh, Cambodia

*Corresponding author: tsovannary@khana.org.kh

Abstract Background: Globally, heterosexual transmission within serodiscordant relationships is a significant source of new HIV infections. In 2012, there were an estimated 1,350 incident cases of HIV in Cambodia, of which 37% were between heterosexual couples and 30% among sex workers. In combination with antiretroviral therapy (ART), consistent condom use can significantly reduce HIV transmission risk among serodiscordant couples. This study explored determinants of inconsistent condom use among serodiscordant couples in Cambodia. **Methods:** A cross-sectional study was conducted in Battambang, Pursat and Takeo provinces in September 2013. A structured questionnaire was used to collect data on condom use and other HIV-related risk behaviors from HIV-positive partners of 262 serodiscordant couples. A two-stage cluster sampling method was used to randomly select participants from a list of serodiscordant couples who were receiving care and support services from community-based organizations in the selected sites. Multivariate logistic regression analysis was conducted to identify factors associated with inconsistent condom use. **Results:** In total, 239 respondents were included in the analysis with a mean age of 41.6 years [standard deviation (SD) = 6.7 years], of whom 60.2% were male and 80.3% were consistent condom users. The mean duration of living in the serodiscordant relationship was 13.4 years (SD = 7.8 years). After controlling for other covariates, inconsistent condom users were significantly more likely to be female (OR = 2.8; 95% CI = 1.261, 6.462), to have been living in a shorter HIV serodiscordant relationship (OR = 0.89; 95% CI = 0.902, 0.998), and to be frequent alcohol users (OR = 2.9; 95% CI = 1.323, 6.483). In addition, inconsistent condom users were significantly more likely to agree that ART prevents transmission of HIV (OR = 2.7; 95% CI = 1.344, 5.443). **Conclusions:** Gender-sensitive interventions to promote consistent condom use and to mitigate alcohol-associated risky sexual behaviors, especially unprotected sex, should form part of HIV prevention interventions for serodiscordant couples in addition to early ART initiation. Further research is required to explore the role of pre-exposure prophylaxis among this population.

Keywords: HIV, AIDS, condom use, determinants, serodiscordant couples, Cambodia

Cite This Article: Sovannary Tuot, Khuondyla Pal, Kouland Thin, Pheak Chhoun, Chanrith Ngin, Mengieng Ung, Kolab Chhim, Chrysanta Patio, Kelly Allbritton, Christie Blondek, Gitau Mburu, and Siyan Yi, "Determinants of Inconsistent Condom Use among HIV Serodiscordant Couples in Cambodia." *American Journal of Public Health Research*, vol. 4, no. 2 (2016): 69-74. doi: 10.12691/ajphr-4-2-5.

1. Introduction

HIV globally remains a significant public health issue. In 2013, there were approximately 35 million people living with HIV (PLHIV), and an estimated 2.1 million new infections worldwide [1]. The majority of new HIV infections are acquired through unprotected sexual contacts, with heterosexual transmission accounting for a large portion of incident cases [2,3]. As a result, research focusing on serodiscordant couples, where one partner is HIV positive and the other is HIV negative, has been an

important means of gaining insights into HIV transmission dynamics in the heterosexual context [3]. One of the most prominent studies is the HIV Prevention Trials Network's randomized clinical trial (HPTN 052) conducted between 2005 and 2010 [4]. Findings from the study indicated that provision of antiretroviral therapy (ART) to HIV-positive partners with a CD4 count of between 350 and 550 cells/mm³ decreased HIV transmission to their uninfected partners by up to 96% [5].

However, even with access to ART, HIV can still be transmitted through sexual intercourse [6], partly because of sub-optimal ART adherence [7], as well as transient presence of HIV in genital fluids even with good

adherence; for example, due to co-infection with sexually transmitted infections (STIs) [6]. All of these factors place the uninfected individuals in a serodiscordant relationship at a greater risk of HIV acquisition during unprotected sexual intercourse with their HIV-positive partners. To date, ART alone, even with early initiation, has not been shown to reduce HIV transmission to uninfected individuals within serodiscordant couples by 100% [5].

Consequently, other prevention options, such as consistent condom use in combination with ART, are critical in further reducing HIV transmission, especially in heterosexual serodiscordant couples [8]. Used correctly, latex condoms provide an impermeable barrier to HIV and other STIs [8]. A study among serodiscordant couples in China showed that the effectiveness of HIV prevention is increased if ART is applied in combination with consistent condom use [9]. Among serodiscordant couples, consistent condom use with ART could reduce the one-year cumulative probability of HIV transmission to 0.05%, and the 10-year cumulative probability of HIV transmission to 0.5%, making it a more effective way to prevent HIV transmission than using either one alone [2]. Therefore, understanding and increasing the extent of condom use among serodiscordant couples are essential for overall reduction in the incidence of HIV.

In Cambodia, an estimated number of 1,350 new HIV infections occurred in 2012, of which 37% were between heterosexual couples [10]. This incidence rate was higher than the 30% reported among sex workers in the same year [10]. Recently, Cambodia 3.0, a national framework to eliminate new HIV infections by 2020 in line with the global Three Zeros goal, was unveiled [11]. Given a large number of HIV-infected heterosexual individuals are in serodiscordant relationships, decreasing HIV transmission among this population is essential if the Cambodia 3.0 goal is to be achieved.

Despite the huge benefits of consistent condom use in preventing HIV transmission among serodiscordant couples, there is limited documentation in the Cambodian context. Therefore, this study aims to explore determining factors of inconsistent condom use among serodiscordant couples in Cambodia.

2. Methods

2.1. Study Sites

A cross-sectional survey was conducted among 262 serodiscordant couples in September 2013 in Battambang, Pursat and Takeo provinces. These provinces were selected because they contained a large proportion of serodiscordant couples; that is, 37% of the total serodiscordant couples receiving KHANA services throughout Cambodia.

2.2. Study Population and Sampling

Participants recruited for this study were HIV-positive partners of serodiscordant couples who were at least 18 years of age, receiving care and treatment services from the community-based care and support programs, and able to provide informed consent to participate in the study. Based on a 95% confidence level (CI) and a $\pm 5\%$ margin of error, the required minimum sample size for this study

was 235. In order to determine the number of participants needed from each province, the probability proportional to size sampling method was used to select serodiscordant couples from the total of 606 serodiscordant couples residing in the three provinces. A two-stage cluster sampling was used, with health center catchment area as clusters at the first stage. At the second stage, a list of serodiscordant couples in each selected health center was generated, and one HIV-positive individual from each serodiscordant couple was randomly selected until the required number for each province was achieved.

2.3. Questionnaire Development

A structured questionnaire was developed based on the existing tools adapted from previous studies [12,13,14]. The questionnaire was initially developed in English, translated into Khmer, and then pretested to ensure that the wording and contents were culturally suitable, acceptable and easily understood by study participants. The questionnaire was piloted among 10 participants from serodiscordant couples in Phnom Penh, following which the tool was revised. Participants in the pretest were not included in the main study.

2.4. Variables and Measurements

The socio-demographic data collected included age, gender, formal education, average weekly income, marital status, duration of relationship, and number of children. Health-related questions collected information on CD4 count, ART adherence, and perception of effectiveness of ART in preventing HIV transmission. A new variable was generated to gauge ART adherence by eliciting information on ART from the questionnaire. Participants were classified as "ART adherent" if they reported taking all medicines as instructed, without missing any doses in the past month. In terms of risk behaviors, alcohol consumption was measured using a question, "How much do you drink alcohol?" If a respondent answered, "Drink a lot of the time or sometimes", they were classified as a "frequent alcohol drinker", and if they answered "rarely or do not drink", they were classified as an "infrequent alcohol drinker." Perception of ART in preventing HIV transmission was assessed by a response "agree or disagree" to a statement, "Taking ART prevents transmission of HIV to a sexual partner." We used a question, "How often did you use condoms with your sexual partners in the past year?" to assess condom use, with response options of "always, often, rarely or never." Only respondents who answered "always" were classified as "consistent condom users," while those who answered "often, rarely or never" were defined as "inconsistent condom users." Subjects who reported not having had sex in the past year were excluded from this analysis.

2.5. Data Collection

Prior to data collection, all research team members were trained on tool and data collection techniques, tool pretesting and reflection, interview skills, data entry, and confidentiality. Interviews were conducted face to face at a private location of respondents' choice and were gender matched. All sessions were conducted in Khmer language and lasted for an average of 25 minutes.

2.6. Data entry and Analyses

Data were coded continuously or categorically according to the nature of the variables and entered into a computerized database using EpiData version 3 (Odense, Denmark). Double data entry was performed to eliminate data entry errors. The final dataset was then transferred to STATA version 12 (College Station, TX), where all analyses were performed. The descriptive statistical analyses were used to calculate frequency distribution of responses for ordinal and categorical variables and means and standard deviations (SD) for continuous variables. Bivariate analyses were performed to compare characteristics of consistent and inconsistent condom users. Student's *t*-test was used for continuous variables, and a Chi-square test or Fisher's exact test was used as appropriate for categorical variables. A multivariate logistic regression model was constructed to investigate an independent association between inconsistent condom use and associated factors, controlling for potential confounders. Variables included in the model for the multivariate analysis were age and those found to be significantly associated with inconsistent condom use in the bivariate analyses, which comprised gender, duration of living in the serodiscordant relationship, CD4 count, alcohol consumption, and perception of the effectiveness of ART. Although ART adherence was found to be significantly associated with inconsistent condom use in the bivariate analyses, it was withdrawn from the multivariate model because only two respondents were categorized as "ART non-adherent."

2.7. Ethical Considerations

This study was approved by the National Ethics Committee for Health Research (NECHR), Ministry of

Health, Cambodia (Ref no. 0173 NECHR). Participation in this study was voluntary, and all participants were informed of their rights to initially refuse or discontinue their participation in the study at any time without any consequence. Informed consent was obtained from each study participant before the interview. In order to protect informant confidentiality, none of the records contained any personally identifiable information.

3. Results

3.1. Characteristics of Respondents

Table 1 shows characteristics of the respondents. In total, 239 participants were included in the analysis. Participants' age ranged from 25 to 58 years, with a mean of 41.6 years (SD=6.7 years). Of the total, 144 (60.2%) were male. The average duration of schooling was approximately five years (SD=3.8 years), with a wide range from no schooling to 17 years of schooling. The majority of respondents were married or living together with a partner (86.5%), with the mean number of children being two (SD=1.3). The mean duration of living in a serodiscordant relationship was 13.4 years (SD=7.8). On average, the study respondents earned 27.8 US dollars per week (SD=55.7). Of the total, 60 (25.1%) participants were frequent alcohol drinkers, and almost all of them (99.2%) adhered to ART. Regarding their perception of the effectiveness of ART, 95 (39.7%) respondents believed that ART could prevent HIV transmission. The majority (80.3%) used condoms consistently.

Table 1. Characteristics of serodiscordant couples (n=239)

Variables	n (%)
Age (in years, ± SD)	41.6 (6.7)
Sex	
Male	144 (60.2)
Female	95 (39.8)
Formal education (in years, ± SD)	5.0 (3.8)
Weekly income (in USD, ± SD)	27.8 (55.7)
Marital status (n=237)	
Married and living together	205 (86.5)
Married and not living together	12 (5.1)
Not married but cohabitating	20 (8.4)
Duration of living in serodiscordant relationship (in years, ± SD)	13.4 (7.8)
Number of children (in persons, ± SD)	1.9 (1.3)
Frequent alcohol consumption	60 (25.1)
CD4 count (cells/mm ³)	448.15 (252.1)
ART adherent	237 (99.2)
Agreed that ART prevents transmission of HIV to HIV-negative partner	95 (39.7)
Consistent condom users	192 (80.3)

Abbreviations: ART, antiretroviral treatment; SD, standard deviation; USD, United States dollar.

3.2. Bivariate Associations

Table 2 shows comparisons of socioeconomic characteristics and health status between consistent and inconsistent condom users. Inconsistent condom users were significantly more likely to be female compared to consistent users (53.2% versus 36.5%, $p=0.03$). Inconsistent condom users had a significantly shorter duration of living in a serodiscordant relationship (11.1 years versus 13.9 years; $p=0.02$) and were significantly

more likely to be frequent alcohol users (38.3% versus 21.9%, $p=0.02$) compared to consistent condom users. The ART adherence rate was high in both groups, and it was significantly higher among consistent condom users (95.7% versus 100%, $p=0.004$). Self-reported CD4 count was significantly lower among inconsistent condom users (381.4 cells/mm³ versus 464.4 cells/mm³, $p=0.04$). When asked about the effectiveness of ART, inconsistent condom users were significantly more likely to believe that ART could prevent HIV transmission to their partners (59.6%).

Table 2. Comparisons of socioeconomic characteristics and health status between consistent and inconsistent condom users

Variables	Inconsistent condom users (n=47)	Consistent condom users (n=192)	p-value*
	Mean (SD) or n (%)		
Age (years)	41.1 (7.2)	41.7 (6.6)	0.53
Sex			0.03
Male	22 (46.8)	122 (63.5)	
Female	25 (53.2)	70 (36.5)	
Formal education (years)	4.7 (3.6)	5.1 (3.8)	0.60
Weekly income (USD)	18.9 (19.6)	28.9 (61.2)	0.27
Marital status			0.19
Married and living together	36 (78.3)	169 (88.5)	
Married and not living together	4 (8.7)	8 (4.2)	
Not married but cohabitating	6 (13.0)	14 (7.3)	
Duration of living in serodiscordant relationship (years)	11.1 (7.4)	13.9 (7.8)	0.02
Number of children	1.6 (1.2)	1.9 (1.3)	0.16
Frequent alcohol consumption	18.0 (38.3)	42.0 (21.9)	0.02
CD4 count (cells/mm ³)	381.4 (262.9)	464.4 (247.3)	0.04
ART adherence	45 (95.7)	192 (100.0)	0.004
Agreed that ART prevents HIV transmission to HIV-negative partner	28 (59.6)	67 (34.9)	0.002

Abbreviations: SD, standard deviation; USD, United States dollar.

* Chi-square or Fisher's exact test was used as appropriate for categorical variables and Student's t-test was used for continuous variables.

3.3. Multivariate Analysis

Table 3 displays the determining factors of inconsistent condom use among serodiscordant couples after controlling for other covariates in a multivariate logistic regression model. Inconsistent condom users remained significantly more likely to be female (AOR = 2.8; 95%

CI = 1.261, 6.462), to have been living in a shorter serodiscordant relationship (AOR = 0.9; 95% CI = 0.902, 0.988), and to be frequent alcohol users (AOR = 2.9; 95% CI = 1.323, 6.483). In addition, inconsistent condom users were significantly more likely to agree that ART prevents HIV transmission to their HIV-negative partners (OR = 2.7; 95% CI = 1.344, 5.443).

Table 3. Multivariate logistic regression analysis of inconsistent condom use among serodiscordant couples

Variable	Adjusted odds ratio	95% CI	p-value
Age (years)	1.1	0.970–1.089	0.35
Sex			
Male	Reference		
Female	2.8	1.261–6.462	0.01
Duration of relationship	0.9	0.902–0.988	0.04
Frequency of alcohol use			
Infrequent	Reference		
Frequent	2.9	1.323–6.483	< 0.001
CD4 count	1.0	0.999–1.002	0.09
Agreed that ART prevents transmission of HIV to partner			
No	Reference		
Yes	2.7	1.344–5.443	< 0.001

Abbreviations: CI, confidence interval; ART, antiretroviral therapy; USD, United States dollar.

4. Discussion

This paper provides important findings related to the determinants of inconsistent condom use among heterosexual serodiscordant couples in Cambodia. Specifically, our results from the multivariate logistic regression analysis showed that inconsistent condom use is related to the gender of the HIV-positive partner, duration of living in the serodiscordant relationship, frequency of alcohol use, and perception of the effectiveness of ART in preventing HIV transmission to their partners.

We found that approximately 80% of the respondents reported consistent condom use in the past 12 months, and over 99% reported having been adhered to ART in the past month. It has been recommended that to suppress HIV replication, avoid treatment-resistant variants of the

virus, and reduce infectiousness, the most forgiving ART regimens require at least 85% adherence to the treatment [15,16,17]. However, although the rate of consistent condom use is relatively high among these serodiscordant couples compared to the rate in regular relationships among other populations in Cambodia [18,19], room remains for improvement in the program implementation for the prevention of the transmission to their HIV-negative partners.

To succeed, the use of HIV treatment as prevention, or so-called test and treat strategies, will require a comprehensive approach that encompasses adherence support, sexual risk reduction, and the amelioration of risk compensation [20]. Studies have shown that even under optimal ART adherence, persons with undetectable peripheral blood viral loads will be highly infectious in their genital secretions when they have co-occurring STIs [21], while co-occurring STIs are prevalent among PLHIV [22,23] causing HIV shedding in genital fluids [24].

Individuals who are co-infected with HIV and other STIs are therefore far more infectious than their blood plasma viral load indicates. Moreover, the interplay between treatment, viral load, and sexual transmission is further complicated by risk compensation; individuals who believe they are less infectious take fewer precautions against infecting partners [25,26,27].

In contrast to results of previous studies [28,29], we found that female HIV-positive partners were significantly less likely to report consistent condom use compared to male HIV-positive partners. One possible explanation is that male HIV-positive partners in serodiscordant couples may feel a greater sense of obligation to use condoms in order to protect their partners. Another possible explanation may be that female HIV-positive partners in serodiscordant couples may not feel empowered to insist that their partners use a condom for every act of sexual intercourse, which is consistent with previous literature regarding condom negotiation [30]. This finding suggests that female HIV-positive partners in serodiscordant couples may require additional support, education, and counseling related to sexual risk reduction, including efforts to involve and negotiate condom use with their HIV-negative male partners.

Serodiscordant couples were more likely to use condoms inconsistently when they had been in a shorter serodiscordant relationship, and the consistency of condom use increased as the duration of their serodiscordant relationship had progressed. This could be due to the increased effect of HIV prevention programs among PLHIV on ART [31]. It can be reflected that the impact of continual exposure to secondary prevention messages increases as time progresses.

Alcohol use is a well-known risk factor for engaging in risky sexual behaviors, including inconsistent condom use [32]. In this study, frequent alcohol users were more likely to report inconsistent condom use after controlling for other covariates in the multivariate logistic regression model. Based on this finding, intervention is needed among serodiscordant couples to mitigate their alcohol use and abuse and in particular to reduce alcohol-associated risky sexual behaviors, especially unprotected sex.

A perception that ART could prevent HIV transmission to their HIV-negative partners increased the likelihood of inconsistent condom use. When people view their risk as low or believe that they are protected, they tend to be less careful and engage in risky behaviors, including, as this study shows, inconsistent condom use. The finding is in line with that of a meta-analytic review which concluded that the prevalence of unprotected sex increased in people who believed that receiving ART protects against transmitting HIV [25]. This kind of perception about ART promoted inconsistent condom use. Therefore, the messages about preventing HIV transmission through ART should be carefully delivered in treatment as prevention programs, and the importance of consistent condom use as part of HIV prevention should be highlighted. Additional interventions for HIV-negative partners, such as pre-exposure prophylaxis, may also have a future role in this context.

Although it was not possible to be included in the multivariate analysis, the bivariate association between self-reported ART adherence and the consistency of condom use should not be ignored. Participants who

reported being adhered to ART were less likely to report inconsistent condom use. This is not surprising given that ART adherence and consistent condom use are positive health behaviors, which may reinforce each other or be reinforced by similar social factors. Nevertheless, this finding suggests that ART non-adherent individuals may require broad-based support to help them to comply with the treatment, adopt safer sexual practices and, in particular, explore individual, social, and structural barriers that may prevent both ART adherence and consistent condom use, such as lack of disclosure, among others.

There were several limitations in this study that should be noted. First, only three provinces in Cambodia were chosen as the study sites as it was not possible to draw a random sample of serodiscordant couples from all provinces in Cambodia. Therefore, the results from this study may not be generalizable to serodiscordant couples living in other provinces in the country. Second, our results relied on self-reported data that could be subject to recall biases. The final limitation concerns gender representativeness of the data as approximately 60% of the study participants were male, while the national data indicate that 54% of PLHIV who are on ART are female [33]. The oversampling of males may diminish the generalizability of the results since factors related to HIV risk differ significantly between males and females.

5. Conclusions

Gender-sensitive interventions to promote consistent condom use and to mitigate alcohol-associated risky sexual behaviors among serodiscordant couples should be integrated into HIV programs in Cambodia. Focus should be on empowering HIV-positive females to insist their HIV-negative male partners to use condoms during sexual intercourse. Also, educational material about risky sexual behaviors, such as unprotected sex, resultant from alcohol over-consumption should be promoted among serodiscordant couples. These interventions should complement early ART initiation for HIV-positive partners in stable serodiscordant relationships. Further research is required to better estimate the incidence of HIV among serodiscordant couples in Cambodia, and to explore the potential role of pre-exposure prophylaxis for HIV-negative partners among this at-risk population.

Statement of Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

Principal investigator: ST. Drafted the manuscript: ST. Developed the protocol and tools: ST and KT. Performed the statistical analysis: ST, KP and KT. Led data collection: MU. Reviewed literature and wrote the manuscript: KP, CP, PC, KA and CB. Provided comments and inputs on the manuscript: CN, MU, PC, KP, KC, GM and SY.

Acknowledgments

We thank KHANA's Senior Management Team and the Programs Division for providing guidance and technical support for this study. We thank our community-based implementing partners, research team and local coordinators who facilitated data collection. We are grateful to the participants in this study.

References

- [1] Joint United Nations Programme on HIV/AIDS (UNAIDS). *World AIDS Day 2014 Report – Fact Sheet*. Geneva, Switzerland: UNAIDS, Nov. 2014.
- [2] Lasry, A., Stephanie, L., Sansom, R.J., Wolitski, T.A., Green, C.B., Borkowf, P., et al. "HIV sexual transmission risk among serodiscordant couples: assessing the effects of combining prevention strategies." *AIDS*, 28(10). 1251-9. Jun. 2014.
- [3] Eyawo, O., Damien, D.W., Nathan, F., Gloria, G., Richard, T.L., and Edward, J.M. "HIV Status in Discordant Couples in Sub-Saharan Africa: A Systematic Review and Meta-analysis." *The Lancet Infectious Diseases*, 10(11). 770-777. Nov. 2010.
- [4] National Institute of Allergy and Infectious Diseases. *The HIV Prevention Trials Network (HPTN) 052 Study: Preventing Sexual Transmission of HIV with Anti-HIV Drugs*. U.S. National Institute of Allergy and Infectious Diseases, Jul. 2015.
- [5] Cohen, M.S., Chen, Y.Q., McCauley, M., Gamble, T., Hosseinipour, M.C., Kumarasamy, N., et al. "Prevention of HIV-1 Infection with Early Antiretroviral Therapy." *The New England Journal of Medicine*, 365. 493-505. Aug. 2011.
- [6] U.S. Department of Health and Human Services. *Understand Your Test Results: Viral Load*. U.S. Department of Health and Human Services, Sep. 2014.
- [7] Seth, C., Chauncey, C., Kalichma, M., Amaral, C.M., White, D., Pope, H., et al. "Integrated Behavioral Intervention to Improve HIV/AIDS Treatment Adherence and Reduce HIV Transmission." *American Journal of Public Health*, 101(3). 531-538. Mar. 2011.
- [8] United States Agency for International Development (USAID). *Technical Issue Brief: Condom Use: How it Relates to HIV and STI Prevention*. Washington DC, United States: USAID, Sep. 2013.
- [9] Liu, H., Su, Y., Zhu, L., Xing, J., Wu, J., and Wang, N. "Effectiveness of ART and Condom Use for Prevention of Sexual HIV Transmission in Serodiscordant Couples: A Systematic Review and Meta-Analysis." *PLOS ONE*, 9(11). e111175. Nov. 2014.
- [10] National Center for HIV/AIDS, Dermatology and STD (NCHADS). *Concept Note on Treatment as Prevention (TasP) as a Strategy for Elimination of New HIV Infections in Cambodia*. Phnom Penh, Cambodia: NCHADS, Dec. 2012.
- [11] Vun, M.C., Fujita, M., Rathavy, T., Eang, M. T., Sopheap, S., Sovannarith, S., et al. "Achieving universal access and moving towards elimination of new HIV infections in Cambodia." *Journal of the International AIDS Society*, 17(1).18905. Jun. 2014.
- [12] Sopheab, H., and Tuot, S. Mid-term review of the sustainable action against HIV and AIDS in communities (SAHACOM) program 2013. Phnom Penh, Cambodia: KHANA, Jun. 2013.
- [13] Sopheab, H. and Tuot, S. End Project Evaluation: Changes in HIV Integrated, Prevention, Care and Impact Mitigation Efforts from 2009-2011. Phnom Penh, Cambodia: KHANA, May. 2012.
- [14] Sopheab, H., Chhea, C., and Tuot, S. Midterm review of the integrated care and prevention project regarding PLHIV and OVC. Phnom Penh, Cambodia: KHANA, Jan. 2010.
- [15] Bangsberg, D.R., Kroetz, D.L., and Deeks, S.G. "Adherenceresistance relationships to combination HIV antiretroviral therapy." *Current HIV/AIDS Reports*, 4(2). 65-72. May. 2007.
- [16] Parienti, J.J., Das-Douglas, M., Massari, V., Guzman, D., Deeks, S.G., Verdon, R., et al. "Not all missed doses are the same: sustained NNRTI treatment interruptions predict HIV rebound at low-to-moderate adherence levels." *PLOS ONE*, 3(7). e2783. Jul. 2008.
- [17] Parienti, J.J., Ragland, K., Lucht, F., de la Blanchardière, A., Dargère, S., Yazdanpanah, Y., et al. "Average adherence to boosted protease inhibitor therapy, rather than the pattern of missed doses, as a predictor of HIV RNA replication." *Clinical Infectious Diseases*, 50(8). 1192-1197. Apr. 2010.
- [18] Yi, S., Tuot, S., Chhoun, P., Pal, K., Tith, K., and Brody, C. "Factors Associated with Inconsistent Condom Use among Men Who Have Sex with Men in Cambodia." *PLOS One*, 10(8). e0136114. Aug. 2015.
- [19] Yi, S., Tuot, S., Chhoun, P., Brody, C., Tith, K., and Oum, S. "The impact of a community-based HIV and sexual reproductive health program on sexual and healthcare-seeking behaviors of female entertainment workers in Cambodia." *BMC Infectious Diseases*, 15. 221. Jun. 2015.
- [20] Kalichman, S.C. "Co-occurrence of treatment nonadherence and continued HIV transmission risk behaviors: implications for positive prevention interventions." *Psychosomatic Medicine*, 70(5). 593-597. Jun. 2008.
- [21] Ping, L.H., Cohen, M.S., Hoffman, I., Vernazza, P., Seillier-Moiseiwitsch, F., Chakraborty, H., et al. "Effects of genital tract inflammation on human immunodeficiency virus type 1 V3 populations in blood and semen." *Journal of Virology*, 74(19). 8946-8952. Oct. 2000.
- [22] Brewer, T.H., Metsch, L.R., and Zenilman, J.M. "Use of a public sexually transmitted disease clinic by known HIV-positive adults: decreased self-reported risk behavior and increased disease incidence." *Journal of Acquired Immune Deficiency Syndromes*, 29(3). 289-294. Mar. 2002.
- [23] Kalichman, S.C., Rompa, D., and Cage, M. Sexually transmitted infections among HIV seropositive men and women. *Sexually Transmitted Infections*, 76(5). 350-354. Oct. 2000.
- [24] Pilcher, C.D., Tien, H.C., Eron, J.J.Jr., Vernazza, P.L., Leu, S.Y., Stewart, P.W., et al. "Brief but efficient: acute HIV infection and the sexual transmission of HIV." *Journal of Infectious Diseases*, 189(10). 1785-1792. May. 2004.
- [25] Crepaz, N., Hart, T.A., and Marks, G. "Highly active antiretroviral therapy and sexual risk behavior: a meta-analytic review." *JAMA*, 292(2). 224-36. Jul. 2004.
- [26] Eaton, L.A., and Kalichman S. "Risk compensation in HIV prevention: implications for vaccines, microbicides, and other biomedical HIV prevention technologies." *Current HIV/AIDS Reports*, 4(4). 165-72. Dec. 2007.
- [27] Kalichman, S.C., and Rompa, D. "HIV treatment adherence and unprotected sex practices in people receiving anti-retroviral therapy." *Sexually Transmitted Infections*, 79(1). 59-61. Feb. 2003.
- [28] Mohr, S., Thin, K., and Tuot, S. Characteristic of Sero-discordant couple in Cambodia. Phnom Penh, Cambodia: KHANA, Feb. 2014.
- [29] Serwadda, D., Wawer, M.J., Stallings, R.Y., Sewankambo, N.K., Konde-Lule, J.K., Lainjo, B., et al. "The social dynamics of HIV transmission as reflected through discordant couples in rural Uganda." *AIDS*, 9(7). 745-50. Jul. 1995.
- [30] Ngunjiri, K., Mugo, N., Celum, C., Baeten, M.J., Morris, M., Olungah, O., et al. "Qualitative Study of Barriers to Consistent Condom Use among HIV-1 Serodiscordant Couples in Kenya." *AIDS Care*, 24(4). 509-516. Jan. 2012.
- [31] Shewamene, Z., Legesse, B., Tsega, B., Bhagavathula, A.S., and Endale, A. "Consistent condom use in HIV/AIDS patients receiving antiretroviral therapy in northwestern Ethiopia: implication to reduce transmission and multiple infection." *HIV/AIDS - Research and Palliative Care*, 7: 119-124, 2015.
- [32] Kalichman, S.C., Kaufman, M., Cain, D., and Jooste, S. "Alcohol use and sexual risks for HIV/AIDS in sub-Saharan Africa: systematic review of empirical findings". *Prevention Science*, 8 (2):141-51, 2007.
- [33] National Center for HIV/AIDS, Dermatology and STI (NCHADS). *Comprehensive Annual Report on HIV/AIDS and STI Prevention and Care Programme in Phnom Penh: National Center for HIV/AIDS, Dermatology and STD*. NCHADS 2011.