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HIV Knowledge and Associated Factors between Black/African American and White/Caucasian Men Who Have Sex with Men in Atlanta

By

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Master of Public Health

Epidemiology

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By

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M.S., Chinese Center for Disease Control and Prevention, 2009

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An abstract of

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Abstract

HIV Knowledge and Associated Factors between Black/African American and White/Caucasian Men Who Have Sex with Men in Atlanta

By Jing Zhao

Objective: We evaluated HIV knowledge and associated factors between black/African American and white/Caucasian men who have sex with men in Atlanta.

Design: A cross sectional study that derived from the baseline data from InvolveMENt which was a prospective cohort study in Atlanta Georgia, where several locations were arranged for enrolling work. Men who have sex with men (MSM) who reported their race to be black and white, from 18 to 40 years old was recruited in this study.

Methods: MSM were interviewed and tested for HIV/STI infection. Demographic and behavioral information were collected of each participant. HIV KQ-18 was used to evaluate HIV knowledge of participants. The lowest quintile of the KQ-18 scoring was defined as the cut-point of the high and low knowledge (>14 of 18 correct and ≤ 14 correct, respectively). Bivariate analysis and multivariate analysis were conducted. For the multivariate analysis, logistic regression and backward selection procedures (α=0.05) were used to arrive at the final models.

Results: From July 2010 to December 2012, 803 MSM were recruited in this study. After data cleaning, 400 (55%) black/African American and 327 (45%) white/Caucasian MSM were included in the analysis. The median scores for HIV knowledge were 16/18 correct; 16.5% black/African American participants and 27.2% white/Caucasian participants answered all 18 knowledge questions correctly. Compared to white/Caucasian participants, black/African participants were more likely to have low HIV knowledge score (aOR=1.84, 95%CI: 1.25-2.71). There were racial disparities of HIV knowledge. Among black/African participants, low education level and not having anal sex with male partners in last six months were factors associated with low HIV knowledge. Among white/Caucasian participants, 18-19 age group was associated with low HIV knowledge.

Conclusion: Among black/African American MSM, future HIV education service might consider those who have not completed their high school degrees, by either engaging those who dropped out of school or by engaging students earlier, and not sexually active with male partners. Among white/Caucasian American MSM, knowledge interventions should focus on younger age group, and should consider before they are engaging in potentially risky sexual situations.

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Catalogue

Character I: Background/Literature Review

1 HIV/AIDS Worldwide

According to the report of UNAIDS through 2011 there were 34.0 million (31.4 million-35.9 million) people with the HIV/AIDS all over the world. The burden of the disease has a tremendous disparity in different regions, countries and populations[1]. Since 1980s, along with the emergence of HIV as a global pandemic, men who have sex with men (MSM) have a disproportionately large burden of infection in many developed countries in Western and Central Europe, Australia, and North America[2]. Because of this burden, MSM have been a target population for resources on HIV/AIDS prevention, treatment, and research in these areas[3].

2 HIV/AIDS in the U.S.

2.1 By race/ethnicity

The disparities in HIV infection rates by race/ethnicity have been significant. Black/African Americans accounted for about 12% of the U.S. population, but estimated 44% of new infections of HIV in 2010[4]. They also accounted for 44% of people living with HIV infection in 2009[5]. The HIV prevalence rate among black men was 6.9 times the rate among white men[6]. Also, compare to other racial groups, black/African Americans have less time of survival and more death due to HIV/AIDS[7,8].

2.2 By Risk Group (MSM)

By risk group, gay, bisexual, and other MSM of all races remain the population most severely affected by HIV[9]. In 2006 and 2009, about 53% [10]and 61%[9] of estimated new infections came from MSM population. CDC estimates that MSM account for 4% of the U.S. male population[11], but accounted for more than 78% among male and 63% of all new HIV infections in 2010[5].

2.3 By Race/Ethnicity and Risk Group (MSM)

In 2010, white MSM accounted for the largest number of annual new HIV infections of any group in the U.S. (11,200), followed closely by black MSM (10,600)[5]. Black/African MSM are excessively affected by HIV/AIDS[10]. They represented an estimated <1% of the U.S. population[12], however accounted for 18% of the total new HIV diagnoses from 2001–2005[6]. Also, the growth rate of HIV infection in this population was the higher than their white counterpart. From 2001 to 2006, new HIV diagnoses in black MSM increased by 1.9% per year, compared to a 0.7% annual increase for white MSM. Particularly, young, black MSM were the only risk group in the U.S. to experience statistically significant increases in new HIV infections from 2006–2009—from 4,400 infections (2006) to 6,500 infections (2009)[9].

3 HIV Related Knowledge

3.1 The Importance of the HIV Related Knowledge

The theory of information-motivation –behavioral skills (IMB) model was well established, and demonstrated efficacy of intervention in HIV risk and preventive behavior[13-16]. The “information” component of the model targets the cognitive domain

to provide knowledge to support the behavior change[17]. The IMB model would predict that HIV knowledge should be related to measures of motivation and behavioral skills, as well as better sexual health[18]. Yet, other researchers indicated that HIV knowledge was not by itself leading people to take on healthier behaviors, higher levels of cognitive and decision-making abilities, not just the most knowledge, were the ones who were most likely to take steps to protect themselves from HIV infection[19]. However, studies showed that inadequate health literacy (e.g., low HIV knowledge) reduced the probability of involve in preventative health behaviors by misunderstanding about the way of HIV transmission[20-22].

Several studies showed that HIV related knowledge is a particularly modifiable factor, although racial disparities in HIV/AIDS due to many factors[23,24]. Also, HIV related knowledge is one of indicators to the HIV-related research and prevention measurement. Identifying the knowledge about disease transmission and self-protective behaviors is taken as one of the determinants of behavior change in most HIV reduction risk models[25]. Knowledge assessments are often used as guidance for HIV educational curricula and it may provide feedback to enhance risk awareness[26]. Also, the effectiveness of HIV behavioral interventions methods are often examined through changes in HIV knowledge[26].

3.2 The Development of the HIV knowledge Questionnaire

The HIV Knowledge Questionnaire (HIV-KQ) is a self-administered instrument that was developed using formative work, item and factor analyses to assess knowledge

needed for HIV prevention[27]. KQ-45 questionnaire was used in the past few years, because of its stability and reflecting understanding of HIV knowledge of information. However, in the recent years, researchers found that compliance of KQ-45 was less than satisfactory for it is so long. So another questionnaire called KQ-18 was developed, which reduced to 18 questions. Some researchers have evaluated the psychometric properties of the HIV KQ-18[25]. The results of the study revealed that HIV KQ-18 maintains internal consistency across samples, and strong associations with a much longer, previously validated measure. It not only has the same stability consistence and sensitivity to the change resulting from intervention, but also would be used in a variety of clinical, educational and public health settings[25].

3.3 HIV Knowledge Evaluation among MSM

In the recent published papers, HIV knowledge evaluation among MSM was reviewed in 10 articles from Pubmed. These studies were conducted from 2006 to 2011 in several countries. The evaluation methods of those studies were slightly different, which included KQ-45[28], KQ-18[3], KQ-10[29] and other self-made questionnaires. Although these questionnaires were different, they basically evaluated HIV related knowledge regarding transmission, prevention and risk behaviors, and thus could be compared in some extent. Knowledge level varied between countries and in the different studies in the same country. In several studies[3,12,30,31], HIV knowledge among MSM had been reported in a high level. For instance, the average correct rate of questionnaire in those studies were more than 70%[12,30,31] or the median score of the questionnaires was 16 (full score was 18)[3]. In other studies, HIV knowledge level had

been reported in medium or low level, for example, in Sheng Yuan et al' s study from China, the range of correct rate was from 28.5% to 95.3%, with mean score with 6 (full score was 10)[32], in Maria Pando et al' s study from Argentina, the average correct rate of questionnaire was 62%[33], in Philippe et al' s study from 66 low income and middle income countries, the range of correct rate was from 10% to 89%, with 47% as its median[34].

For the associated factors with HIV knowledge, the disparities of different regions and different sub-populations were presented in those studies. Factors such as income, searching sexual partners via internet, received HIV testing before, condom using, anal sex, different age groups, different education levels, Prevalent STI infection, place of residence, number of sexual partners, acceptance of homosexuality were all shown to be significantly associated with HIV knowledge in different studies[28-35]. Among those factors, different age groups[3,29,31,32,36], education level[31,32,36], performed HIV test before[28,31,32,34] had been reported associating with HIV knowledge more frequently than other variables.

Finally, studies about HIV knowledge comparing different sub-groups of MSM were somewhat insufficient in recent published studies, especially in regards to differences by race and ethnicity. One study showed internal consistency of HIV KQ-10 among racial categories[29]. The results revealed the internal consistency was highest for Whites, slightly lower for Hispanics, and lowest for Blacks, which indicated that instability in the HIV knowledge scale for Blacks, implying the requirement for more

accurate measurement construction for this population. Another study investigated and compared the associated factors of HIV knowledge among internet-using MSM from South Africa and the U.S.[3]. For South African MSM, factors associated with low knowledge were high school education or less, not using condom-compatible lubrication during last anal sex, number of gay or bisexual acquaintances, being unemployed, and received HIV testing. For U.S. MSM, besides the factors above, other associated factors were age 18–24 or age 50+ compared to age 25–29, Hispanic ethnicity compared to white non-Hispanic[3].

Although previous studies of HIV knowledge among MSM have focused on levels of HIV knowledge, they have not systematically evaluated factors of racial disparities associated with low knowledge[3]. Therefore, the objectives of this study were to: 1) describe relative areas of strengths and deficits regarding low HIV knowledge of black/African American and white/Caucasian American MSM in Atlanta, 2) evaluate the associations of HIV knowledge to demographic factors and HIV-related sexual risk behaviors, and 3) investigate the racial disparities of the factors associated with low HIV knowledge between black/African American and white/Caucasian American MSM in Atlanta. We hypothesized in this study that, while controlling for demographic and behavioral factors, low HIV knowledge would be independently associated with racial group. We also hypothesized that demographic and behavioral factors were differentially associated with low HIV knowledge among black/African American and white/Caucasian American MSM.

Chapter II: Manuscript

1. Title

HIV knowledge and associated factors between black/African American and white/Caucasian men who have sex with men in Atlanta

2. Introduction

According to the report of UNAIDS in 2012, up to 2011 there are 34.0 million (31.4 million-35.9 million) people who are suffering the HIV/AIDS all over the world. The burden of the disease has a tremendous disparity in different regions, countries and populations[1].

In the U.S. the disparities in HIV infection rates by race/ethnicity have been significant. Black/African Americans accounted for about 12% of the U.S. population, but estimated 44% of new infections of HIV in 2010[4]. The HIV prevalence rate among black men was 6.9 times the rate among white men[6]. By risk group, gay, bisexual, and other MSM of all races remain the population most severely affected by HIV[9]. CDC estimates that MSM account for 4% of the U.S. male population[11], but accounted for 63% of all new HIV infections in 2010[5]. By race/ethnicity and risk group, white MSM accounted for the largest number of annual new HIV infections of any group in the U.S. (11,200), followed closely by black MSM (10,600)[5] in 2010.

HIV knowledge is important to HIV intervention and prevention. According to the information-motivation –behavioral skills (IMB) model which demonstrated the

efficacy of intervention in HIV risk and preventive behavior[13-16], the "information" component of the model targets the cognitive domain to provide knowledge to support the behavior change[17]. The IMB model would predict that HIV knowledge should be related to measures of motivation and behavioral skills, as well as better sexual health[18]. In addition, identifying the knowledge about disease transmission and protective behaviors is taken as one of the determinants of behavior change in most HIV reduction risk models[25]. Knowledge assessments are often used as guidance for HIV educational curricula and it may provide feedback to enhance risk awareness[26].

Previous studies have shown that HIV knowledge among MSM varied between countries and in the different studies in the same country. In several studies[3,12,30,31], HIV knowledge among MSM had been reported in a high level, which the average correct rate of questionnaire in those studies were more than 70%[12,30,31] or the median score of the questionnaires was 16 (full score was 18)[3]. In other studies[32-34], HIV knowledge level had been reported in medium or low level. The average correct rate of questionnaire in those studies ranges from 47% to 62% or the mean score was 6 (full score was 10). Although these questionnaires in those studies were different, they basically evaluated HIV related knowledge regarding transmission, prevention and risk behaviors, and thus could be compared in some extent.

Factors have been shown to be significantly associated with HIV knowledge in different studies[28-35], such as income, searching sexual partners via internet, received HIV testing before, condom using, anal sex, different age groups, different education

levels, Prevalent STI infection, place of residence, number of sexual partners, acceptance of homosexuality were all shown to be significantly associated with HIV knowledge in different studies[28-35]. Among those factors, different age groups[3,29,31,32,36], education level[16,17,23], performed HIV test before[16,17,19,20] have been reported associating with HIV knowledge more frequently than other variables.

Although previous studies of HIV knowledge among MSM have focused on levels of HIV knowledge, they have not systematically evaluated factors of racial disparities associated with low knowledge[3]. Therefore, the objectives of this study were to: 1) describe relative areas of strengths and deficits regarding to low HIV knowledge of black/African American and white/Caucasian American MSM in Atlanta, 2) evaluate the associations of HIV knowledge to demographic factors and HIV risk sexual behaviors, 3) investigate the racial disparities of the factors associated with low HIV knowledge between black/African American and white/Caucasian American MSM in Atlanta.

3. Methods

3.1 Study Design

The sample of this study was from InvolveMENt study which is a longitudinal HIV and STI incidence cohort of MSM with the purpose of explaining the differences in HIV prevalence and incidence between black and white MSM in Atlanta. The sampling methods were time-space venue sampling[37], and the sampling frame built upon that used in the Atlanta site for the second MSM cycle of the National HIV

Behavioral Surveillance System (NHBS)[38,39]. Facebook was also included as a virtual "venue" in the venue sampling frame.

Eligible participants were: 1) at least 18 years old, 2) male at birth, 3) at least one male sex partner in the 3 months before the baseline interview, 4) report their race to be black or white, 5) complete the survey instruments in English, and 6) live in the Atlanta metropolitan area. People were excluded from this study if were of Hispanic ethnicity or were currently in a mutually monogamous relationship with a male partner. This study was approved by the Emory University institutional review board.

Enrollment of the InvolvMENt study occurred at the study offices during which baseline surveys, and specimens for HIV, STI and drug testing were obtained. Surveys were computer-assisted and self-administered. Those who were HIV-negative were invited to continue follow-up visits approximately every 6 months through 24 months post-baseline. HIV antibody testing was performed using OraQuick rapid HIV test devices. For those persons with a preliminary positive test result by OraQuick, blood was drawn for confirmatory testing. Sexually transmitted infections such as Syphilis, Gonorrhea, Chlamydia were tested through urine and rectal swab by using polymerase chain reaction (PCR)-based methods. In this study, STI were considered positive if any of the testing was positive, or were considered to be negative.

In this study of HIV knowledge, baseline data of demographic and behavioral variables as well as HIV/STI status of each participant was used for the analysis. Missing data of each variable was deleted in the analysis.

3.2 Measures

The dependent variable in this analysis was HIV knowledge level assessed using the HIV KQ-18. HIV KQ-18 was an internally consistent and stable HIV knowledge scale using for low-literacy populations[25] (Appendix A). The main purpose of the HIV KQ-18 is aimed at elementary aspects of HIV transmission and prevention. The number of correct answers was the final score for each participant, and "don't know" were coded as incorrect. The lowest quintile on HIV KQ-18 knowledge score, 14, was used as a cut-point. A score of 14 or lower was considered as low HIV knowledge.

The independent variables in this study were collected and defined as the following. Self-reported race was classified into black/African American and white/Caucasian American. Education level was classified as three strata, 1) college, post graduate, professional school; 2) some college, associate's degree, and / or technique school; 3) high school or less. Age was divided into four levels, which were 18-19, 20-24, 25-29, and 30 or older. Prevalent HIV infection, prevalent STI infection (Syphilis, Gonorrhea, Chlamydia), employed now, poverty (monthly income less than or equal to $1250 or yearly income less than $15,000), homeless in last twelve months, arrested in last twelve months, having HIV test in past 12 months, having multiple male sexual

partners in last 6 months (the number of sexual partner greater than 1), having male anal sex partner in last six month, and having unprotected anal sex with male partners in last six months were classified into two mutual exclusive groups for the purpose of analysis. No responses and "don't know" were coded as missing value.

3.3 Data Analysis

SAS 9.3(SAS institute, Cary, NC, USA) was used for statistical analysis in the whole process. Statistical significance was assessed using an alpha value of .05 and two-tailed tests.

Participants with missing data were excluded from the data analysis after the evaluation of the potential response bias. Four variables with most missing data were poverty, having unprotected anal sex with male partners in last six months, having male anal sex with male partners in last six months, and having multiple male sex partners, with 37, 23, 15, 15 missing data respectively. Through Fisher Chi-square test, the missing value and not missing value of poverty differed between low knowledge and not low HIV knowledge ($P<0.01$), missing value and not missing value of having unprotected anal sex with male partners in last six months, having male anal sex with male partners in last six months, having multiple male sex partners, did not differ between low and not low HIV knowledge ($P=0.82$, $P=0.54$, $P=0.54$ respectively).

Descriptive analysis was conducted on included variables, number and percentage were calculated for categorical variables, while median and interquartile range (IQR) was computed for continuous variables. Bivariate analysis was conducted between

knowledge level and each dependent variable using crude odds ratio (cOR) and 95% confidence interval.

Multivariable logistic regression models were constructed, for entire data and for stratified data by race, using the dichotomous low HIV knowledge as the outcome. We included the following variables as the factors in our initial models: self-reported race, education level, age, prevalent HIV infection, prevalent STI infection, knowledge level, employed now, poverty, homeless in last twelve months, arrested in last twelve months, having HIV test in past 12 months, having male anal sex partner in last six month, having multiple male sexual partners, and having unprotected anal sex with male partners in last six months. Backward selection procedures (α=0.05) were used to arrive at the final models, with age compulsorily staying in the model to be controlled as a confounder. Wald chi-square tests were used to establish significance of individual factors. Hosmer and Lemeshow's goodness of fit test was used to determine if final models were adequate.

4. Results

4.1 Characteristics of the Study Population

From July 2010 to December 2012, 803 participants were recruited in InvolveMENt study in Atlanta Georgia. There were 76 participants with missing data excluded from the analysis. There were 727 participants included in the analysis, of which 400 (55%) were black/African American and 327 (45%) were white/Caucasian American (Table 1). Of the participants, the median of age was 27 (IQR: 23-32), 29.4% were HIV

positive, 41.7% had college or higher education level, and 41.1% had associate's degree and/or technical school education level. The median score for HIV knowledge was 16 of 18 correct, with 16.5% of black/African American participants and 27.2% of white/Caucasian participants answering all 18 knowledge questions correctly.

4.2 HIV KQ-18 by Race Groups

The following questions in HIV KQ-18 were the lowest correct rate (Table 2). Among black/African American participants, the questions were a natural skin condom works better against HIV than does a latex condom; there is a female condom can help decrease a woman's chance of getting HIV; there is a vaccine that can stop adults from getting HIV (the rate of correct were 62.7%, 74.4%, 78.9% respectively). Among white/Caucasian American participants, the questions were all pregnant women infected with HIV will have babies born with AIDS; a natural skin condom works better against HIV than does a latex condom; there is a female condom can help decrease a woman's chance of getting HIV (the rate of correct were 70.9%, 71.3%, 71.6% respectively).

4.3 Bivariate Analysis of Knowledge Level

Participants who had low HIV knowledge score accounted for 22.4%. (Table 1) Compared to white/Caucasian American participants, black/African American participants had more than twice the odds of low HIV knowledge score (28.3% among Black and 15.3% among white, OR = 2.18, 95%CI: 1.50-3.16) (Table 3). Education levels were significantly associated with HIV knowledge. Compared to

participants who had high school or less education level, those who had associate's degree and/or technical school and college or higher education were 0.48 and 0.32 times as likely to have low HIV knowledge score respectively. Participants who had anal sex with male partners in last six months were less likely to have low knowledge (OR = 0.42, 95%CI: 0.24-0.72). HIV knowledge was also associated with STI infection, 20-24 age group, poverty, and having an HIV test in past 12 months . Finally, HIV knowledge did not differ by HIV infection status, whether the participant had multiple male sexual partners in last six months, and whether the participant had unprotected anal sex with male partners in last six months.

In the bivariate analysis stratified by race, lower education level was associated with low HIV knowledge among both black/African American and white/Caucasian American participants (Table 4). Not having anal sex with male partners in last six months was associated with low HIV knowledge among black/African American participants, whereas younger age and homelessness were associated with low HIV knowledge among white/Caucasian American participants.

4.4 Multivariable Analysis of Knowledge Level

Controlling for all other factors in the final model, black/African American participants were 1.84 times as likely as white/Caucasian American participants to have low HIV knowledge (Table 6). Other factors that were significantly associated with low HIV knowledge were high school or less education level and not having anal

sex with male partners in last six months. The test of Hosmer and Lemeshow goodness-of-fit to this model showed no significant lack-of-fit ($p = 0.95$).

In stratified models, controlling for all other factors in the final model, among black/African American participants, high school or less education level and not having anal sex with male partners in last six months were associated with low knowledge (Table 6). The test of Hosmer and Lemeshow goodness-of-fit to this model showed no significant lack-of-fit ($p = 0.77$).

Among white/Caucasian American participants, only age remained in the final model after backward selection method and the results were the same as the stratified bivariate analysis.

5. Discussion

In this study, the overall correct rate and the stratified correct by race of HIV knowledge were high, which were more than 80%. These results were consistent with previous studies [3,12,30,31] of MSM populations conducted in South Africa, US, China and Vietnam. However, almost one third of the participants in both race groups did not understand the importance of condom materials, believing natural skin condoms were more effective to prevent HIV than latex condoms[40]. This issue should be paid attention to when conducting HIV health education interventions with MSM, because the misconception of condom effectiveness is a risk factor for HIV infection[41].

There existed racial disparities of HIV knowledge associated factors between black/African and white/Caucasian participants. Among black/African American participants, low education level and not having anal sex with male partners in last six months were associated with low HIV knowledge in this study. It is possible that MSM who were sexually active (e.g., having anal sex) acquired more HIV knowledge through the process of becoming sexually experienced or because the experience made sexual information more significant to them[18]. However, having unprotected anal sex with male partners in last six months was not associated with low HIV knowledge in this study. This result was consistent with a study on MSM in Estonia[42], and a study on West African Migrations in New York City[43], but was inconsistent with a study of MSM in China, which reported that low HIV knowledge was associated with unprotected anal sex with male partners in last six months[44] and a study of youth in Canada which reported that youth with higher HIV knowledge were more likely to engage in unprotected intercourse[45]. Further studies should be conducted to examine this issue.

Among white/Caucasian American participants, 18-19 age group was associated with low HIV knowledge. Bardley's research also showed that MSM 18-24 years of age in the US were at significantly increased risk for low HIV knowledge[3]. The possible reason was that young age group had less experience of sexual behavior than older age group and less likely to receive peer education for HIV knowledge. In addition, in stratified bivariate analysis, low education level and homelessness were associated with low HIV knowledge. However, the relationships were not significant in

multivariate analysis. The possible reason was that these relationships were confounded by age in this race group.

In bivariate analysis of overall race groups, sexual transmitted infection, poverty, and not having HIV tested in last 12 months were associated with low HIV knowledge. Yet these relationships were not significant in overall multivariate analysis. The possible reason was that these relationships were confounded by race and education level in this study. It was worth noting that ever been tested for HIV either positive or negative was associated with HIV knowledge in other studies[28,31,32,34]. The inconsistence of this study comparing to previous studies might indicate that it was the overall experience of testing not the testing time that is associated with HIV knowledge. The probable reason is that people who have ever been tested for HIV are likely to have been either exposed to additional HIV information materials or received professional counseling on HIV transmission as a part of routine testing practices.

Strengths and Limitations

This study had several strengths. First, this study analyzed and compared subgroups of MSM in Atlanta, which were black/African American and white/Caucasian. This study provided insightful understanding the disparities of HIV knowledge between the two groups of population.

This study also had at least six limitations. First, in this study MSM was only recruited within Metro Atlanta area, the leading economic center in the Southeast of the U. S. so the results cannot be generalized to the MSM in the U.S overall. Second,

the sampling method may have predisposed to sample MSM with higher HIV knowledge which may cause selection bias, because MSM with higher HIV knowledge may have been more likely to participate in this study. MSM recruited from Facebook may have higher socioeconomic status among the MSM overall thus potentially having higher HIV knowledge. Third, behaviors such as sexual partners and unprotected sexual behaviors may be underestimated or overestimated due to recall bias or social desirability bias, though shorter time frames and self-administered questionnaires would potentially minimize this. Fourth, this study scored KQ-18 and decided 14 as the cut-point of HIV knowledge level. This method which was empirical was referenced to the study of Bradley et al[3], and further research is required to identify the epidemiologically significant value of HIV knowledge. Fifth, the missing value of poverty was eliminated in this study, and the missing data and not missing data differed between low and not low HIV knowledge group. This might cause nonresponse bias of the evaluation of this variable. Sixth, it should be noted that this was a cross-sectional study, which limits causal inference.

In conclusion, HIV knowledge of black/African MSM in Atlanta was lower than that of white/Caucasian MSM in Atlanta. There were also racial differences in factors associated with low HIV knowledge. Among black/African American MSM, future HIV education service might consider those who have not completed their high school degrees, by either engaging those who dropped out of school or by engaging students earlier, and not sexually active with male partners. Among white/Caucasian American

MSM, knowledge interventions should focus on younger age group, and should consider before they are engaging in potentially risky sexual situations.

6. Tables

Table 1 Demographic or behavioral characteristic of 400 black/African and 327 white/Caucasian men who have sex with men (MSM)

Demographic or behavioral characteristic	N (%)	IQR
HIV knowledge (number correct/18)	16 (median)	15-17
Low HIV knowledge level		
Yes (<=14 correct)	163(22.4)	
No (>14 correct)	564(77.6)	
Prevalent HIV infection		
Positive	214(29.4)	
Negative	513(70.6)	
Prevalent sexually transmitted infection		
Yes	159(21.9)	
No	568(78.1)	
Age	27(median)	23-32
18-19	37(5.1)	
20-24	217(29.8)	
25-29	220(30.3)	
30+	253(34.8)	
Education level		
College, post graduate, or professional school	303(41.7)	
Some college, Associate's degree, and/or technical school	299(41.1)	
High school or less	125(17.2)	
Employed now		
Yes	554(76.2)	
No	173(23.8)	
Poverty		
Yes	256(35.2)	
No	471(64.8)	

Demographic or behavioral characteristic	N (%)	IQR
Homeless in last 12 months		
Yes	84(11.6)	
No	643(88.4)	
Arrested past 12 months		
Yes	77(10.6)	
No	650(89.4)	
HIV test in past 12 months		
Yes (<=12 months)	480(66)	
No (>12 months)	247(34)	
Having multiple male sexual partners in last 6 months		
Yes	633(87.1)	
No	94(12.9)	
Having anal sex with male partners in last 6 months		
Yes	668(91.9)	
No	59(8.1)	
Unprotected anal sex with male partners in last 6 months		
Yes	490(67.4)	
No	237(32.6)	

Table 2 400 black/African American and 327 white/Caucasian men who have sex with men in Involv(men)t Study answering HIV KQ-18 questions correctly, incorrectly, or "don't know "

	Black/African American			White/Caucasian		
HIV KQ-18 Question	**Correct n(%)**	**Incorrect n(%)**	**Don't know n(%)**	**Correct n(%)**	**Incorrect n(%)**	**Don't know n(%)**
Coughing and sneezing DO NOT spread HIV. (T*)	341(85.5)	45(11.3)	13(3.3)	309(94.5)	12(3.7)	6(1.8)
A person can get HIV by sharing a glass of water with someone who has HIV. (F)**	359(90)	26(6.5)	14(3.5)	313(95.7)	11(3.4)	3(0.9)
Pulling out the penis before a man climaxes/cums keeps his partner from getting HIV during sex. (F)	340(85.2)	32(8)	27(6.8)	311(95.1)	5(1.5)	11(3.4)
A woman can get HIV if she has anal sex with a man. (T)	324(81.2)	56(14)	19(4.8)	306(93.6)	14(4.3)	7(2.1)
Showering, or washing one's genitals/private parts, after sex keeps a person from getting HIV. (F)	363(91)	5(1.3)	31(7.8)	312(95.4)	2(0.6)	13(4)
All pregnant women infected with HIV will have babies born with AIDS. (F)	320(80.2)	35(8.8)	44(11)	232(70.9)	31(9.5)	64(19.6)
People who have been infected with HIV quickly show serious signs of being infected. (F)	372(93.2)	13(3.3)	14(3.5)	316(96.6)	2(0.6)	9(2.8)
There is a vaccine that can stop adults from getting HIV. (F)	315(78.9)	13(3.3)	71(17.8)	301(92)	8(2.4)	18(5.5)
People are likely to get HIV by deep kissing (putting their tongue in their partner's mouth), if their partner has HIV. (F)	324(81.2)	33(8.3)	42(10.5)	296(90.5)	14(4.3)	17(5.2)

*T means that the correct answer of this question is "True"

**F means that the correct answer of this question is "False."

Table 2 400 black/African American and 327white/Caucasian men who have sex with men in Involv(men)t Study answering HIV KQ-18 questions correctly, incorrectly, or "don't know " (continued)

	Black/African American			White/Caucasian		
HIV KQ-18 Question	**Correct n (%)**	**Incorrect n (%)**	**Don't know n (%)**	**Correct n (%)**	**Incorrect n (%)**	**Don't know n (%)**
A woman cannot get HIV if she has sex during her period. (F)	333(83.5)	14(3.5)	52(13)	302(92.4)	2(0.6)	23(7)
There is a female condom that can help decrease a woman's chance of getting HIV. (T)	297(74.4)	42(10.5)	60(15)	234(71.6)	36(11)	57(17.4)
A natural skin condom works better against HIV than does a latex condom. (F)	250(62.7)	14(3.5)	135(33.8)	233(71.3)	3(0.9)	91(27.8)
A person will NOT get HIV if he is taking antibiotics. (F)	357(89.5)	4(1)	38(9.5)	312(95.4)	0(0)	15(4.6)
Having sex with more than one partner can increase a person's chance of becoming infected with HIV. (T)	364(91.2)	23(5.8)	12(3)	316(96.6)	11(3.4)	0(0)
Taking a test for HIV one week after having sex will tell a person if she or he has HIV. (F)	358(89.7)	24(6)	17(4.3)	304(93)	8(2.4)	15(4.6)
A person can get HIV by sitting in a hot tub or a swimming pool with a person who has HIV. (F)	381(95.5)	4(1)	14(3.5)	318(97.2)	1(0.3)	8(2.4)
A person can get HIV from oral sex. (T)	332(83.2)	38(9.5)	29(7.3)	295(90.2)	20(6.1)	12(3.7)
Using Vaseline or baby oil with condoms lowers the chance of getting HIV. (F)	356(89.2)	10(2.5)	33(8.3)	295(90.2)	8(2.4)	24(7.3)

*T means that the correct answer of this question is "True"

**F means that the correct answer of this question is "False."

Table 3 Bivariate analysis of knowledge level and each covariate

	Low HIV knowledge						
	Yes (<=14 correct)		**No (>14 correct)**		**cOR***	**95%CI**	
	N	**%**	**N**	**%**			
Race							
Black/African American	113	28.3	287	71.8	2.18	1.50	3.16
White/Caucasian	50	15.3	277	84.7	Ref.		
Prevalent HIV infection							
Positive	52	24.3	162	75.7	n.s.*		
Negative	111	21.6	402	78.4	Ref.		
Prevalent sexually transmitted infection							
Yes	47	29.6	112	70.4	1.64	1.10	2.43
No	116	20.4	452	79.6	Ref.		
Age							
18-19	10	27.0	27	73.0	1.71	0.77	3.79
20-24	62	28.6	155	71.4	1.85	1.19	2.86
25-29	46	20.9	174	79.1	1.22	0.77	1.93
30+	45	17.8	208	82.2	Ref.		
Education level							
College, post graduate, or professional school	49	16.2	254	83.8	0.32	0.20	0.51
Some college, Associate's degree, and/or technical school	67	22.4	232	77.6	0.48	0.30	0.75
High school or less	47	37.6	78	62.4	Ref.		
Employed now							
Yes	123	22.2	431	77.8	n.s.		
No	40	23.1	133	76.9	Ref.		
Poverty							
Yes	74	28.9	182	71.1	1.75	1.22	2.49
No	89	18.9	382	81.1	Ref.		

Homeless in last 12 months							
Yes	22	26.2	62	73.8	n.s.		
No	141	21.9	502	78.1	Ref.		
Arrested in last 12 months							
Yes	20	26.0	57	74.0	n.s.		
No	143	22.0	507	78.0	Ref.		
HIV test in past 12 months							
Yes	95	19.8	385	80.2	0.65	0.45	0.93
No	68	27.5	179	72.5	Ref.		
Having multiple male sexual partners in last 6 months							
Yes	139	22.0	494	78.0	n.s.		
No	24	25.5	70	74.5	Ref.		
Having anal sex with male partners in last 6 months							
Yes	140	21.0	528	79.0	0.42	0.24	0.72
No	23	39.0	36	61.0	Ref.		
Unprotected anal sex with male partners in last 6 months							
Yes	104	21.2	386	78.8	n.s.		
No	59	24.9	178	75.1	Ref.		

*n.s. denotes not significant
*cOR denotes crude odds ratio.

Table 4: Bivariate analysis of knowledge level and covariates stratified by race

	Black/ African American					White/ Caucasian				
	Low (<=14correct)					Low (<=14correct)				
	N	%	cOR*	95%CI		N	%	cOR*	95%CI	
Prevalent HIV infection										
Positive	46	26.9	n.s.*			6	14.0	n.s.		
Negative	67	29.3	Ref.			44	15.5	Ref.		
Prevalent sexually transmitted infection										
Yes	41	32.0	n.s.			6	19.4	n.s.		
No	72	26.5	Ref.			44	14.9	Ref.		
Age										
18-19	5	22.7	n.s.			5	33.3	3.77	1.13	12.52
20-24	44	33.1	n.s.			18	21.4	2.05	0.97	4.35
25-29	34	28.3	n.s.			12	12.0	1.03	0.46	2.31
30+	30	24.0	Ref.			15	11.7	Ref.		
Education level										
College, post graduate, or professional school	27	21.4	0.40	0.22	0.72	22	12.4	0.34	0.14	0.81
Some college, Associate's degree, and/or technical school	49	26.8	0.53	0.31	0.91	18	15.5	0.44	0.18	1.08
High school or less	37	40.7	Ref.			10	29.4	Ref.		
Employed now										
Yes	82	28.5	n.s.			41	15.4	n.s.		
No	31	27.7	Ref.			9	14.8	Ref.		

Poverty									
Yes	57	32.2	n.s.			17	21.5	n.s.	
No	56	25.1	Ref.			33	13.3	Ref.	
Homeless in last 12 months									
Yes	15	24.6	n.s.			7	30.4	2.66	1.03	6.83
No	98	28.9	Ref.			43	14.1	Ref.	
Arrested in last 12 months									
Yes	14	29.2	n.s.			6	20.7	n.s.	
No	99	28.1	Ref.			44	14.8	Ref.	
HIV test in past 12 months									
Yes	64	26.0	n.s.			31	13.2	n.s.	
No	49	31.8	Ref.			19	20.4	Ref.	
Having multiple male sexual partners in last 6 months									
Yes	94	28.1	n.s.			45	15.1	n.s.	
No	19	29.2	Ref.			5	17.2	Ref.	
Having anal sex with male partners in last 6 months									
Yes	95	26.1	0.35	0.18	0.71	45	14.8	n.s.	
No	18	50.0	Ref.			5	21.7	Ref.	
Unprotected anal sex with male partners in last 6 months									
Yes	67	27.1	n.s.			37	15.2	n.s.	
No	46	30.1	Ref.			13	15.5	Ref.	

*cOR denotes crude odds ratio. n.s. denotes not significant

Table 5 Multivariable logistic regression models for black/African and white/Caucasian men who have sex with men (MSM) scoring low knowledge level on HIV KQ-18 knowledge scores as outcome

Covariate	aOR*	95% CI	
Race			
Black/African American	1.84	1.25	2.71
White/Caucasian	Ref.		
Age			
18-19	1.17	0.50	2.70
20-24	1.57	0.99	2.48
25-29	1.15	0.72	1.84
30+	Ref.		
Education level			
College, post graduate, or professional school	0.41	0.25	0.69
Some college, Associate's degree, and/or technical school	0.55	0.34	0.88
High school or less	Ref.		
Having anal sex with male partners in last 6 months	0.43	0.24	0.76

*aOR denotes adjusted odds ratio.

Table 6 Multivariable logistic regression models for black/African and white/Caucasian men who have sex with men (MSM) scoring low knowledge level on HIV KQ-18 knowledge scores as outcome stratified by race

	Black/African American			White/Caucasian		
Covariate	aOR	95% CI		aOR*	95% CI	
Age						
18-19	0.67	0.22	2.06	3.77	1.13	12.52
20-24	1.46	0.83	2.56	2.05	0.97	4.35
25-29	1.23	0.69	2.21	1.03	0.46	2.31
30+	1(Ref.)			1(Ref.)		
Education level						
College, post graduate, or professional school	0.39	0.21	0.73			
Some college, Associate's degree, and/or technical school	0.58	0.33	0.99			
High school or less	1(Ref.)					
Having anal sex with male partners in last 6 months	0.35	0.17	0.72			

*aOR denotes adjusted odds ratio.

Chapter III: Public Health Implications and Possible Future Directions

Black Americans accounted for about ten percent of U.S. population, but more than half new HIV/AIDS diagnoses, and the HIV prevalence rate among black men was 6.9 times the rate among white men[6]. In recent years, more than half of estimated new infections came from MSM population[10], and one fifth of new HIV infections were among Black MSM[6]. The population of Black MSM had double burden of HIV, so our study had special meaning for this population. Through evaluating the associated demographic and behavioral factors with HIV knowledge, and explaining disparities of HIV knowledge between Black and White MSM, the findings of this study would be applicable to target of existing interventions and development of new HIV prevention interventions for this vulnerable group of men.

HIV related knowledge is one of the indicators to the HIV-related research and prevention measurement[25]. Identifying the knowledge about disease transmission and self-protective behaviors is taken as one of the determinants of behavior change in most HIV-risk models[25]. In this study, the response rate of KQ-18 was 100% and KQ-18 basically reflected the status of HIV knowledge of the participants. The results of this study satisfied the hypothesis that black/African American MSM had relatively lower HIV knowledge than white/Caucasian American MSM. Thus, health education regarding HIV knowledge should be focused more on black/African American MSM.

There were racial disparities of HIV knowledge associated factors. Among black/African American MSM, lower education level and no anal sex with male in last six months were associated with HIV knowledge. The association with education was consistent with studies in other populations and regions[3,31,32,36] and indicated that in this race group, HIV knowledge improvement intervention should focus on those who have not completed their high school degrees, by either engaging those who dropped out of school or by engaging students earlier (e.g. middle school ages). For the findings regarding anal sex, it implied that to those MSM who didn't have anal sex (e.g., oral sex) with male partners, health education would be conducted. Among white/Caucasian American MSM, age was associated with HIV knowledge. This finding implied that young age group should be focused on when implementing health education for example through mass media, peer education, and HIV counseling. Also, a study showed that the median age when MSM first engaged in same-sex sexual intercourse was 17 years[46], so knowledge interventions should be implemented before they are engaging in potentially risky sexual situations. However, the deeper context of racial disparities were not investigated in this study. Further studies should be designed to analyze the distribution of social demographics (e.g., education level, age group) and the pattern of sexual behaviors among different race and demographic groups to explain these disparities in HIV knowledge.

Other findings of this study was prevalent HIV infection, not having HIV test in last 12 months, unprotected anal sex with male in last six months, multiple male sexual partners in last six months were not associated with low HIV knowledge. Concerning

that studies evaluated these factors were insufficient in some extent, further studies should be conducted and evaluated these factors among different race groups of MSM. If results are consistent with this study, it will imply that these factors were not the target characteristics of population that health education should focus on.

In conclusion, black/African race, low education level and not having anal sex with male partners in last 12 months were factors that associated with low HIV knowledge overall MSM population. Among black/African MSM, low education and not having anal sex with male partners in last 12 month were associated with low HIV knowledge, while among white/Caucasian MSM, younger age was associated with low HIV knowledge. Further health education and HIV counseling would be targeted those characteristics of populations to improve HIV knowledge and then promote HIV prevention.

Future studies might enlarge the scale of sampling for analysis. For example, more states and more races would be included in the study to have a better understanding of the associated factors with HIV knowledge. What is more, further studies comparing the social demographic and sexual behavior characteristics related to HIV knowledge among different racial groups would be conducted to have a deep understandings of the reason why these racial disparities exists.

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Appendices

Appendix A: The Content of HIV KQ-18

involve[men]t - Baseline survey

HIV Knowledge

59. The next set of questions ask about your HIV knowledge. For each statement, please click "True", "False", or "I don't know." If you do not know, please do not guess; instead, please click the button: "I don't know."

	True	False	Don't Know
Coughing and sneezing DO NOT spread HIV.	○	○	○
A person can get HIV by sharing a glass of water with someone who has HIV.	○	○	○
Pulling out the penis before a man climaxes/cums keeps his partner from getting HIV during sex.	○	○	○
A woman can get HIV if she has anal sex with a man.	○	○	○
Showering, or washing one's genitals/private parts, after sex keeps a person from getting HIV.	○	○	○
All pregnant women infected with HIV will have babies born with AIDS.	○	○	○
People who have been infected with HIV quickly show serious signs of being infected.	○	○	○
There is a vaccine that can stop adults from getting HIV.	○	○	○
People are likely to get HIV by deep kissing (putting their tongue in their partner's mouth), if their partner has HIV.	○	○	○
A woman cannot get HIV if she has sex during her period.	○	○	○
There is a female condom that can help decrease a woman's chance of getting HIV.	○	○	○
A natural skin condom works better against HIV than does a latex condom.	○	○	○
A person will NOT get HIV if he is taking antibiotics.	○	○	○
Having sex with more than one partner can increase a person's chance of becoming infected with HIV.	○	○	○
Taking a test for HIV one week after having sex will tell a person if she or he has HIV.	○	○	○
A person can get HIV by sitting in a hot tub or a swimming pool with a person who has HIV.	○	○	○
A person can get HIV from oral sex.	○	○	○
Using Vaseline or baby oil with condoms lowers the chance of getting HIV.	○	○	○

Appendix B: Cross-sectional studies of HIV knowledge in MSM

Investigators	Location	Time period and design	Sample	Major focus	Results/Conclusions
Bradley Wagenaar et al.	South Africa and U.S.	South Africa: from June 1 to June 30, 2010; U.S.: from October1 to November 2010 cross-sectional study	1154 internet-using MSM in U.S. and 439 in South Africa	Compare factors associated with low HIV knowledge among MSM in the two countries	HIV knowledge levels were high among MSM in both countries (median score 16/18). Factors associated with low HIV knowledge were different in the two countries.
Shengyuan Liu et al.	Four cities, Heilongjiang Province, China	From August to September 2008, cross-sectional study	1353 MSM	Assess knowledge levels and risk behaviors related to HIV and explore the associated factors	Fair level of knowledge in study population. Those with income 2000-3000 RMB/month, those searching sexual partners via internet and those received HIV testing over 1 year ago associated with high HIV knowledge
Jian Dan et al.	Clinic based, Hunan Province, China	From January to December 2009, cross-sectional study	200 MSM patients	MSM sexual behaviors,condom service sondition HIV related knowledge and STD	High AIDS knowledge; no relation between the HIV knowledge and condom using frequency; there is association between anal sex and HIV knowledge.

Appendix B: Cross-sectional studies of HIV knowledge in MSM (Continue)

Investigators	Location	Time period and design	Sample	Major focus	Results/Conclusions
Willie H. Oglesby	Urban Midwestern city, U.S.	From 2008 to 2011, cross-sectional study	5027 in total, including 263 MSM	HIV knowledge differ by gender, sexual orientation, race/ethnicity, and age.	HIV knowledge scale performed poorly for MSM, but very well for transgender, similar for Blacks, Hispanics, and Whites, very poor for 30- to 39-year-olds, but very well for 60+.
Maria Pando et al.	Buenos Aires, Argentina	From 2006 to 2008, cross-sectional study	500 MSM through respondent driven sampling	knowledge and beliefs about HIV transmission and prevention among MSM and HIV knowledge and beliefs varied according to HIV status of the respondent	62 % of HIV correct knowledge answers; Men with previous HIV testing experience had higher HIV knowledge.
Joyce E. et al.	Dares Salaam, Tanzania.	From 2009 to 2010, cross-sectional study	271 MSM	Demographics and HIV-associated attitudes and behaviors (specifically condom use and HIV testing)	Relatively accurate HIV information but moderate condom use, HIV testing and ability to refuse unsafe sex.
Philippe C. G. Adam et al.	147 Low-Income and Middle-Income Countries	2008	66 countries represent 52% of the estimated total MSM population in	Hold correct knowledge regarding HIV transmission and prevention, and used condoms the last time	<50% MSM held correct HIV knowledge the weighted estimates of HIV knowledge among MSM were lower in South and Southeast Asia and in Eastern Europe and Central Asia compared with Latin America

Appendix B: Cross-sectional studies of HIV knowledge in MSM (Continue)

Investigators	Location	Time period and design	Sample	Major focus	Results/Conclusions
Taryn Vian et al.	Four provinces in Vietnam	From November 2007 to January 2008, cross-sectional-study	2199 in total, MSM 337, CSW 1367, IDU 694	Evaluate HIV/AIDS knowledge and behaviors of most-at-risk populations.	Overall levels of HIV/AIDS knowledge are high, but MSM had significantly less knowledge of treatment compared to non-MSM.
Heather Fay et al.	Malawi, Namibia, and Botswana	Not reported, cross-sectional study	A total 537 men, MSM 264	Health care services, HIV knowledge and the prevalence of HIV.	93% percent knew HIV is transmitted through anal sex with men, however, only 67% know how to prevent it.
Scott Geibel et al.	Mombasa, Kenya	From October to December 2006, two independent cross-sectional surveys using a pre and post-intervention design	510 MSW in 2006, and 516 MSW in 2008	Analyze the impact of peer education exposure on HIV knowledge and condom use.	Peer outreach program resulted in significant, but limited improvements in HIV knowledge and prevention behaviors. Improved peer coverage and additional prevention initiatives are needed to sufficiently mitigate HIV transmission.
Zohar Mor et al.	Tel Aviv, Israel	From July to December 2007, cross-sectional study	Male sex workers (MSWs) 87, MSM 635	Explore knowledge, attitudes and sexual practices of MSW in comparison with MSM	MSW similar to high risk MSM, had comparable sexual practices and had no difference in their STI/HIV knowledge
Williams PB et al.	Urban and rural community, Mississippi,	2005 and 2007, cross-sectional study	466 African American men	Compare knowledge, attitude, etc. that influence HIV infection in urban and rural communities.	The level of HIV/AIDS knowledge and education were lower among urban than rural participants

SAS Code

```
************************************************;
* Program: "H:\thesis\11 using data\dataset"    *;
* Date:Mar.24,2013  (2/26 revised)             *;
* Programmer: Jing Zhao                       *;
*                                            *;
* Purpose: prepare dataset for involvement      *;
************************************************;

libname J "H:\thesis\11 using data\dataset";
libname library "H:\thesis\11 using data\dataset";   * so datasets can
find formats;

proc format;
    value race 1="1-Black/African American"
               0="2-White/Caucasian";
    value knowledge_level 1="1-Low (<=14 correct)"
                      2="2-High (>14 correct)";
    value baseline_hiv 1="2-Negative"
                   2="1-Positive";
    value sti   0="2-No"
              1="1-Yes";
    value age_b 1="18-19"
            2="20-24"
            3="25-29"
            4="30+";
    value educ_a 1="1-College, post graduate, or professional school"
              2="2-Some college, Associate's degree, and/or technical
school"
              3="3-High school or less";
    value poverty_a  0="2-No"
                1="1-Yes"
                2="3-Don't know";
    value multiple_a 0="2-No"
                1="1-Yes";
    value male_aip6m_a 0="2-No"
                   1="1-Yes";
    value hiv_testp12m_a 0="2-No"
                     1="1-Yes";
    value hiv_testp12m_b 0="2-No (>12 months)"
                     1="1-Yes (<=12 months)"
```

```
                    2="3-Never tested";
    value yesno 0="2-No"
                1="1-Yes";


run;


/*Step1: prepare the dataset by merging "status" and
"participants_survey_baseline"*/
data j.survey;
    set j.participants_survey_baseline (drop=ARVnegever ARVnegnow
arvnegmonth
       ARVnegdaily arvnegtimingN0 arvnegtimingN1 arvnegtimingN2
arvnegwhyN0
       arvnegwhyN1 arvnegwhyN2 arvneghowget);/*Cannot solve the format
problem so drop those variables*/
run;
proc sort data = j.status ;  by study_id; run;
proc sort data = j.survey;   by study_id; run;
data j.merge;
       merge  j.status
              j.survey;
       by study_id;
       if (met_behav_crit = 1) & (double_enroll = 0) then output;
run;

/*merge sti into dataset in use*/
data j.sti(keep=study_id visit chlamydia gc tvaginalis syphilis_rpr
         syphilis_titer chlamydia_rectal gc_rectal new_syph);
    set j.sti_baseline;
run;
proc sort data=j.sti out=j.sti nodup;
    by  study_id;

run ;

data j.merge1;
    merge j.merge (in=a)
          j.sti (in=b);
    by study_id;
    if a;
run;
```

```
/**********************************/
/***recode variables for analysis***/
/**********************************/

data j.merge2;
    set j.merge1;
/*Step 2: Calculate scores for each question of participants*/
    score=0;
    if HIVedu_sneeze=1    then score+1;
    if HIVedu_water=0     then score=score+1;
    if HIVedu_pullout=0   then score=score+1;
    if HIVedu_ladyanal=1  then score=score+1;
    if HIVedu_douche=0    then score=score+1;
    if HIVedu_pregnant=0  then score=score+1;
    if HIVedu_quickill=0  then score=score+1;
    if HIVedu_vaccine=0   then score=score+1;
    if HIVedu_french=0    then score=score+1;
    if HIVedu_period=0    then score=score+1;
    if HIVedu_femalecon=1 then score=score+1;
    if HIVedu_skin=0      then score=score+1;
    if HIVedu_antibio=0   then score=score+1;
    if HIVedu_multiple=1  then score=score+1;
    if HIVedu_window=0    then score=score+1;
    if HIVedu_hottub=0    then score=score+1;
    if HIVedu_oral=1      then score=score+1;
    if HIVedu_babyoil=0   then score=score+1;

    /*classify the score to "high knowledge" and "low knowledge"*/
    if score gt 14 then knowledge_level=2;
    else knowledge_level=1;
    label knowledge_level="HIV knowledge level";

    /*creating answer variable for table2*/
    if HIVedu_sneeze=1    then answer1="1r";
    if HIVedu_sneeze=0    then answer1="2w";
    if HIVedu_sneeze=9    then answer1="3don";
    else if HIVedu_sneeze=. then answer1="3don";

    if HIVedu_water=0     then answer2="1r";
    if HIVedu_water=1     then answer2="2w";
    if HIVedu_water=9     then answer2="3don";
    else if HIVedu_water=. then answer2="3don";
```

```
if HIVedu_pullout=0   then answer3="1r";
if HIVedu_pullout=1   then answer3="2w";
if HIVedu_pullout=9   then answer3="3don";
else if HIVedu_pullout=.   then answer3="3don";

if HIVedu_ladyanal=1  then answer4="1r";
if HIVedu_ladyanal=0  then answer4="2w";
if HIVedu_ladyanal=9  then answer4="3don";
else if HIVedu_ladyanal=.  then answer4="3don";

if HIVedu_douche=0    then answer5="1r";
if HIVedu_douche=1    then answer5="2w";
if HIVedu_douche=9    then answer5="3don";
else     if HIVedu_douche=.    then answer5="3don";


if HIVedu_pregnant=0  then answer6="1r";
if HIVedu_pregnant=1  then answer6="2w";
if HIVedu_pregnant=9  then answer6="3don";
else     if HIVedu_pregnant=.  then answer6="3don";


if HIVedu_quickill=0  then answer7="1r";
if HIVedu_quickill=1  then answer7="2w";
if HIVedu_quickill=9  then answer7="3don";
else     if HIVedu_quickill=.  then answer7="3don";


if HIVedu_vaccine=0   then answer8="1r";
if HIVedu_vaccine=1   then answer8="2w";
if HIVedu_vaccine=9   then answer8="3don";
else     if HIVedu_vaccine=.   then answer8="3don";

if HIVedu_french=0    then answer9="1r";
if HIVedu_french=1    then answer9="2w";
if HIVedu_french=9    then answer9="3don";
else     if HIVedu_vaccine=.   then answer8="3don";


if HIVedu_period=0    then answer10="1r";
if HIVedu_period=1    then answer10="2w";
if HIVedu_period=9    then answer10="3don";
else     if HIVedu_period=.    then answer10="3don";
```

```
if HIVedu_femalecon=1 then answer11="1r";
if HIVedu_femalecon=0 then answer11="2w";
if HIVedu_femalecon=9 then answer11="3don";
else     if HIVedu_femalecon=. then answer11="3don";


if HIVedu_skin=0      then answer12="1r";
if HIVedu_skin=1      then answer12="2w";
if HIVedu_skin=9      then answer12="3don";
else     if HIVedu_skin=.      then answer12="3don";


if HIVedu_antibio=0   then answer13="1r";
if HIVedu_antibio=1   then answer13="2w";
if HIVedu_antibio=9   then answer13="3don";
else     if HIVedu_antibio=.   then answer13="3don";


if HIVedu_multiple=1  then answer14="1r";
if HIVedu_multiple=0  then answer14="2w";
if HIVedu_multiple=9  then answer14="3don";
else     if HIVedu_multiple=.  then answer14="3don";


if HIVedu_window=0    then answer15="1r";
if HIVedu_window=1    then answer15="2w";
if HIVedu_window=9    then answer15="3don";
else     if HIVedu_window=.    then answer15="3don";


if HIVedu_hottub=0    then answer16="1r";
if HIVedu_hottub=1    then answer16="2w";
if HIVedu_hottub=9    then answer16="3don";
else     if HIVedu_hottub=.    then answer16="3don";

if HIVedu_oral=1      then answer17="1r";
if HIVedu_oral=0      then answer17="2w";
if HIVedu_oral=9      then answer17="3don";
else     if HIVedu_oral=.      then answer17="3don";

if HIVedu_babyoil=0   then answer18="1r";
if HIVedu_babyoil=1   then answer18="2w";
if HIVedu_babyoil=9   then answer18="3don";
```

```
    else     if HIVedu_babyoil=.   then answer18="3don";

/*********************************************************/
/*********************************************************/

/*Step3-1: recode race variable for calculation*/
    if race_inc=4 then race=0; *white;
    if race_inc=1 then race=1; *black;
/*Step3-2: create sti variable indicating the status of sti*/
    sti2=0;
    array sti1 {6} chlamydia gc tvaginalis syphilis_rpr chlamydia_rectal
gc_rectal;
    do i=1 to 6;
        if sti1{i}=1 then sti2=sti2+1;
        if sti1{i}=0 then sti2=sti2+0;
        if sti1{i}=. then sti2=sti2+0;
    end;
    if sti2=0 then sti=0;
    else if sti2 gt 0 then sti=1;
    label sti="Prevalent sexually transmitted infection";

/*Step4: classify age*/
    if age_baseline=. then age=.;
    else if age_baseline le 19 then age=1;
    else if age_baseline le 24 then age=2;
    else if age_baseline le 29 then age=3;
    else  age=4;
    label age="Age";

/*Step5: classify education*/
    if educ=. then educ_a=.;
    else if educ=1 then educ_a=1;
    else if educ=2 then educ_a=2;
    else if educ ge 3 then educ_a=3;
    label educ_a="Education level";

/*Step6: classify income*/
    if income=. then poverty_a=.;
    else if income le 2 then poverty_a=1;
    else if income le 8 then poverty_a=0;
    else poverty_a=.;*set "do not know" as missing;
    label poverty_a="Poverty";

/*step7:set missing value for homeless*/
```

```
    if homeless=9 then homeless=.;

/*Step 8-1: Classify HIV test in past 12 months -- two categories*/
    if HIVtest_ever=0 then hiv_testp12m_a=0;
    else if last_hiv_days ne . and last_hiv_days gt 365 then
hiv_testp12m_a=0;
    else if last_hiv_days ne . and last_hiv_days le 365 then
hiv_testp12m_a=1;
    else if last_hiv_days = . then hiv_testp12m_a=.;
    label hiv_testp12m_a="HIV test in past 12 months";

/*Step 8-2: Classify HIV test in past 12 months -- three categories*/
    if last_hiv_days ne . and last_hiv_days gt 365 then hiv_testp12m_b=0;
    else if last_hiv_days ne . and last_hiv_days le 365 then
hiv_testp12m_b=1;
    else if HIVtest_ever=0 then hiv_testp12m_b=2;
    else if last_hiv_days = . then hiv_testp12m_b=.;
    label hiv_testp12m_b="HIV test in past 12 months";

/*Step9: classify sexual partner numbers--Multiple sexual partners*/
    if male_howmanyp6m gt 1 then multiple_a=1;
    else if male_howmanyp6m=1 then multiple_a=0;
    else if male_howmanyp6m=. then multiple_a=.;
    label multiple_a="Having multiple male sexual partners in last 6
months";

/*Step10: Classify anal sex partners in past 6 months*/
    if male_aip6m=. then male_aip6m_a=.;
    else if male_aip6m<2 then male_aip6m_a=0;
    else male_aip6m_a=1;
    label male_aip6m_a="Male anal sex partner in last 6 months";

/*Step11: Other label*/
    label baseline_HIV="Prevalent HIV infection";
    label race="Race";
    label homeless="Homeless in last 12 months";
    label arrested_p12m_final="Arrested in last 12 months";
    label employed_now="Employed now";
    *label condom_p6m="Condom use in last 6 months";
    label HIVtest_ever="Ever been tested for HIV";
    label male_aip6m_bin="Having anal sex with male partners in last 6
months";
    label male_UAIp6m_bin="Unprotected anal sex with male partners in last
6 months";
```

```
run;


/*Step12: Evaluate missing data*/
data a;
    set j.merge2;
    if poverty_a =. then poverty_b=1;
        else poverty_b=2;
    if multiple_a=. then multiple_b=1;
        else multiple_b=2;
    if male_AIp6m_bin=. then male_AIp6m_bin_b=1;
        else male_AIp6m_bin_b=2;
    if male_UAIp6m_bin=. then male_UAIp6m_bin_b=1;
        else male_UAIp6m_bin_b=2;
run;
proc freq data=a;
    tables poverty_b*knowledge_level/chisq;
    tables multiple_b*knowledge_level/chisq;
    tables male_aip6m_bin_b*knowledge_level/chisq;
    tables male_uaip6m_bin_b*knowledge_level/chisq;
run;

data j.merge3;
    set j.merge2;
    if educ_a  =. then delete;
    if employed_now=. then delete;
    if poverty_a=. then delete;
    if homeless=. then delete;
    if arrested_p12m_final=. then delete;
    if HIV_testp12m_a=. then delete;
    if multiple_a=. then delete;
    if male_aip6m_bin=. then delete;
    if male_UAIp6m_bin =. then delete;
run;


/*Step2-1: finding the lowest quintile of knowledge score*/
proc univariate data=j.merge3 noprint;
  var score;
  output pctlpre=P_ pctlpts=20 out=b;
run;
proc print data=b;
run;
```

```
************************************************;
* Program: "H:\thesis\11 using data\dataset"    *;
* Date:Mar.24,2013  (2/26 revised)             *;
* Programmer: Jing Zhao                       *;
*                                            *;
* Purpose: prepare dataset for involvement     *;
************************************************;

libname J "H:\thesis\11 using data\dataset";
libname library "H:\thesis\11 using data\dataset";   * so datasets can
find formats;

proc format;
    value race 1="1-Black/African American"
               0="2-White/Caucasian";
    value knowledge_level 1="1-Low (<=14 correct)"
                          2="2-High (>14 correct)";
    value baseline_hiv 1="2-Negative"
                       2="1-Positive";
    value sti   0="2-No"
              1="1-Yes";
    value age_b 1="18-19"
             2="20-24"
             3="25-29"
             4="30+";
    value educ_a 1="1-College, post graduate, or professional school"
              2="2-Some college, Associate's degree, and/or technical
school"
              3="3-High school or less";
    value poverty_a  0="2-No"
                1="1-Yes"
                2="3-Don't know";
    value multiple_a 0="2-No"
                1="1-Yes";
    value male_aip6m_a 0="2-No"
                    1="1-Yes";
    value hiv_testp12m_a 0="2-No"
                      1="1-Yes";
    value hiv_testp12m_b 0="2-No (>12 months)"
                      1="1-Yes (<=12 months)"
                      2="3-Never tested";
    value yesno 0="2-No"
              1="1-Yes";
```

```
run;


/*Step1: prepare the dataset by merging "status" and
"participants_survey_baseline"*/
data j.survey;
    set j.participants_survey_baseline (drop=ARVnegever ARVnegnow
arvnegmonth
       ARVnegdaily arvnegtimingN0 arvnegtimingN1 arvnegtimingN2
arvnegwhyN0
       arvnegwhyN1 arvnegwhyN2 arvneghowget);/*Cannot solve the format
problem so drop those variables*/
run;
proc sort data = j.status ;  by study_id; run;
proc sort data = j.survey;   by study_id; run;
data j.merge;
       merge  j.status
              j.survey;
       by study_id;
       if (met_behav_crit = 1) & (double_enroll = 0) then output;
run;

/*merge sti into dataset in use*/
data j.sti(keep=study_id visit chlamydia gc tvaginalis syphilis_rpr
         syphilis_titer chlamydia_rectal gc_rectal new_syph);
    set j.sti_baseline;
run;
proc sort data=j.sti out=j.sti nodup;
    by  study_id;

run ;

data j.merge1;
    merge j.merge (in=a)
         j.sti (in=b);
    by study_id;
    if a;
run;


/**********************************/
/***recode variables for analysis***/
/**********************************/
```

```
data j.merge2;
    set j.merge1;
/*Step 2: Calculate scores for each question of participants*/
    score=0;
    if HIVedu_sneeze=1    then score+1;
    if HIVedu_water=0     then score=score+1;
    if HIVedu_pullout=0   then score=score+1;
    if HIVedu_ladyanal=1  then score=score+1;
    if HIVedu_douche=0    then score=score+1;
    if HIVedu_pregnant=0  then score=score+1;
    if HIVedu_quickill=0  then score=score+1;
    if HIVedu_vaccine=0   then score=score+1;
    if HIVedu_french=0    then score=score+1;
    if HIVedu_period=0    then score=score+1;
    if HIVedu_femalecon=1 then score=score+1;
    if HIVedu_skin=0      then score=score+1;
    if HIVedu_antibio=0   then score=score+1;
    if HIVedu_multiple=1  then score=score+1;
    if HIVedu_window=0    then score=score+1;
    if HIVedu_hottub=0    then score=score+1;
    if HIVedu_oral=1      then score=score+1;
    if HIVedu_babyoil=0   then score=score+1;

    /*classify the score to "high knowledge" and "low knowledge"*/
    if score gt 14 then knowledge_level=2;
    else knowledge_level=1;
    label knowledge_level="HIV knowledge level";

    /*creating answer variable for table2*/
    if HIVedu_sneeze=1    then answer1="1r";
    if HIVedu_sneeze=0    then answer1="2w";
    if HIVedu_sneeze=9    then answer1="3don";
    else if HIVedu_sneeze=. then answer1="3don";

    if HIVedu_water=0     then answer2="1r";
    if HIVedu_water=1     then answer2="2w";
    if HIVedu_water=9     then answer2="3don";
    else if HIVedu_water=. then answer2="3don";


    if HIVedu_pullout=0   then answer3="1r";
    if HIVedu_pullout=1   then answer3="2w";
    if HIVedu_pullout=9   then answer3="3don";
```

```
else if HIVedu_pullout=.   then answer3="3don";

if HIVedu_ladyanal=1  then answer4="1r";
if HIVedu_ladyanal=0  then answer4="2w";
if HIVedu_ladyanal=9  then answer4="3don";
else if HIVedu_ladyanal=.  then answer4="3don";

if HIVedu_douche=0    then answer5="1r";
if HIVedu_douche=1    then answer5="2w";
if HIVedu_douche=9    then answer5="3don";
else     if HIVedu_douche=.    then answer5="3don";


if HIVedu_pregnant=0  then answer6="1r";
if HIVedu_pregnant=1  then answer6="2w";
if HIVedu_pregnant=9  then answer6="3don";
else     if HIVedu_pregnant=.  then answer6="3don";


if HIVedu_quickill=0  then answer7="1r";
if HIVedu_quickill=1  then answer7="2w";
if HIVedu_quickill=9  then answer7="3don";
else     if HIVedu_quickill=.  then answer7="3don";


if HIVedu_vaccine=0   then answer8="1r";
if HIVedu_vaccine=1   then answer8="2w";
if HIVedu_vaccine=9   then answer8="3don";
else     if HIVedu_vaccine=.   then answer8="3don";

if HIVedu_french=0    then answer9="1r";
if HIVedu_french=1    then answer9="2w";
if HIVedu_french=9    then answer9="3don";
else     if HIVedu_vaccine=.   then answer8="3don";


if HIVedu_period=0    then answer10="1r";
if HIVedu_period=1    then answer10="2w";
if HIVedu_period=9    then answer10="3don";
else     if HIVedu_period=.    then answer10="3don";

if HIVedu_femalecon=1 then answer11="1r";
if HIVedu_femalecon=0 then answer11="2w";
if HIVedu_femalecon=9 then answer11="3don";
```

```
    else     if HIVedu_femalecon=. then answer11="3don";


    if HIVedu_skin=0      then answer12="1r";
    if HIVedu_skin=1      then answer12="2w";
    if HIVedu_skin=9      then answer12="3don";
    else     if HIVedu_skin=.      then answer12="3don";


    if HIVedu_antibio=0   then answer13="1r";
    if HIVedu_antibio=1   then answer13="2w";
    if HIVedu_antibio=9   then answer13="3don";
    else     if HIVedu_antibio=.   then answer13="3don";


    if HIVedu_multiple=1  then answer14="1r";
    if HIVedu_multiple=0  then answer14="2w";
    if HIVedu_multiple=9  then answer14="3don";
    else     if HIVedu_multiple=.  then answer14="3don";


    if HIVedu_window=0    then answer15="1r";
    if HIVedu_window=1    then answer15="2w";
    if HIVedu_window=9    then answer15="3don";
    else     if HIVedu_window=.    then answer15="3don";


    if HIVedu_hottub=0    then answer16="1r";
    if HIVedu_hottub=1    then answer16="2w";
    if HIVedu_hottub=9    then answer16="3don";
    else     if HIVedu_hottub=.    then answer16="3don";

    if HIVedu_oral=1      then answer17="1r";
    if HIVedu_oral=0      then answer17="2w";
    if HIVedu_oral=9      then answer17="3don";
    else     if HIVedu_oral=.      then answer17="3don";

    if HIVedu_babyoil=0   then answer18="1r";
    if HIVedu_babyoil=1   then answer18="2w";
    if HIVedu_babyoil=9   then answer18="3don";
    else     if HIVedu_babyoil=.   then answer18="3don";

/*********************************************************/
/*********************************************************/
```

```
/*Step3-1: recode race variable for calculation*/
    if race_inc=4 then race=0; *white;
    if race_inc=1 then race=1; *black;
/*Step3-2: create sti variable indicating the status of sti*/
    sti2=0;
    array sti1 {6} chlamydia gc tvaginalis syphilis_rpr chlamydia_rectal
gc_rectal;
    do i=1 to 6;
        if sti1{i}=1 then sti2=sti2+1;
        if sti1{i}=0 then sti2=sti2+0;
        if sti1{i}=. then sti2=sti2+0;
    end;
    if sti2=0 then sti=0;
    else if sti2 gt 0 then sti=1;
    label sti="Prevalent sexually transmitted infection";

/*Step4: classify age*/
    if age_baseline=. then age=.;
    else if age_baseline le 19 then age=1;
    else if age_baseline le 24 then age=2;
    else if age_baseline le 29 then age=3;
    else  age=4;
    label age="Age";

/*Step5: classify education*/
    if educ=. then educ_a=.;
    else if educ=1 then educ_a=1;
    else if educ=2 then educ_a=2;
    else if educ ge 3 then educ_a=3;
    label educ_a="Education level";

/*Step6: classify income*/
    if income=. then poverty_a=.;
    else if income le 2 then poverty_a=1;
    else if income le 8 then poverty_a=0;
    else poverty_a=.;*set "do not know" as missing;
    label poverty_a="Poverty";

/*step7:set missing value for homeless*/
    if homeless=9 then homeless=.;

/*Step 8-1: Classify HIV test in past 12 months -- two categories*/
    if HIVtest_ever=0 then hiv_testp12m_a=0;
```

```
    else if last_hiv_days ne . and last_hiv_days gt 365 then
hiv_testp12m_a=0;
    else if last_hiv_days ne . and last_hiv_days le 365 then
hiv_testp12m_a=1;
    else if last_hiv_days = . then hiv_testp12m_a=.;
    label hiv_testp12m_a="HIV test in past 12 months";

/*Step 8-2: Classify HIV test in past 12 months -- three categories*/
    if last_hiv_days ne . and last_hiv_days gt 365 then hiv_testp12m_b=0;
    else if last_hiv_days ne . and last_hiv_days le 365 then
hiv_testp12m_b=1;
    else if HIVtest_ever=0 then hiv_testp12m_b=2;
    else if last_hiv_days = . then hiv_testp12m_b=.;
    label hiv_testp12m_b="HIV test in past 12 months";

/*Step9: classify sexual partner numbers--Multiple sexual partners*/
    if male_howmanyp6m gt 1 then multiple_a=1;
    else if male_howmanyp6m=1 then multiple_a=0;
    else if male_howmanyp6m=. then multiple_a=.;
    label multiple_a="Having multiple male sexual partners in last 6
months";

/*Step10: Classify anal sex partners in past 6 months*/
    if male_aip6m=. then male_aip6m_a=.;
    else if male_aip6m<2 then male_aip6m_a=0;
    else male_aip6m_a=1;
    label male_aip6m_a="Male anal sex partner in last 6 months";

/*Step11: Other label*/
    label baseline_HIV="Prevalent HIV infection";
    label race="Race";
    label homeless="Homeless in last 12 months";
    label arrested_p12m_final="Arrested in last 12 months";
    label employed_now="Employed now";
    *label condom_p6m="Condom use in last 6 months";
    label HIVtest_ever="Ever been tested for HIV";
    label male_aip6m_bin="Having anal sex with male partners in last 6
months";
    label male_UAIp6m_bin="Unprotected anal sex with male partners in last
6 months";

run;
```

```
/*Step12: Evaluate missing data*/
data a;
    set j.merge2;
    if poverty_a =. then poverty_b=1;
        else poverty_b=2;
    if multiple_a=. then multiple_b=1;
        else multiple_b=2;
    if male_AIp6m_bin=. then male_AIp6m_bin_b=1;
        else male_AIp6m_bin_b=2;
    if male_UAIp6m_bin=. then male_UAIp6m_bin_b=1;
        else male_UAIp6m_bin_b=2;
run;
proc freq data=a;
    tables poverty_b*knowledge_level/chisq;
    tables multiple_b*knowledge_level/chisq;
    tables male_aip6m_bin_b*knowledge_level/chisq;
    tables male_uaip6m_bin_b*knowledge_level/chisq;
run;

data j.merge3;
    set j.merge2;
    if educ_a  =. then delete;
    if employed_now=. then delete;
    if poverty_a=. then delete;
    if homeless=. then delete;
    if arrested_p12m_final=. then delete;
    if HIV_testp12m_a=. then delete;
    if multiple_a=. then delete;
    if male_aip6m_bin=. then delete;
    if male_UAIp6m_bin =. then delete;
run;


/*Step2-1: finding the lowest quintile of knowledge score*/
proc univariate data=j.merge3 noprint;
  var score;
  output pctlpre=P_ pctlpts=20 out=b;
run;
proc print data=b;
run;
```