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Condom Use among Immigrant Latino Sexual Minorities: Multilevel Analysis after Respondent-Driven Sampling

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Abstract

This study explored correlates of condom use within a respondent-driven sample of 190 Spanish-speaking immigrant Latino sexual minorities, including gay and bisexual men, other men who have sex with men (MSM), and transgender person, in North Carolina. Five analytic approaches for modeling data collected using respondent-driven sampling (RDS) were compared. Across most approaches, knowledge of HIV and sexually transmitted infections (STIs) and increased condom use self-efficacy predicted consistent condom use and increased homophobia predicted decreased consistent condom use. The same correlates were not significant in all analyses but were consistent in most. Clustering due to recruitment chains was low, while clustering due to recruiter was substantial. This highlights the importance accounting for clustering when analyzing RDS data.

Introduction

HIV and condom use among Latino sexual minorities

The HIV epidemic continues to disproportionately impact sexual minorities including gay and bisexual men, men who have sex with men (MSM), and transgender persons of all races and ethnicities in the United States (US). An estimated 72% of new infections among males occur from male-to-male sexual contact, including 81% of new infections among whites, 63% among blacks, and 72% among Latinos. During their lifetimes, an estimated 1 in 36 Latino men will be diagnosed with HIV (Centers for Disease Control and Prevention, 2013).

Factors that have been identified as contributing to sexual risk among sexual minorities are numerous and include a lack of understanding of HIV transmission and prevention and of healthcare services; discomfort in discussing sex and negotiating condom use; beliefs that condoms sacrifice sensitivity and sexual spontaneity; and perceived negative peer norms toward condom use (Jarama, Kenamer, Poppen, Hendricks, & Bradford, 2005; Ramirez-Valles, Garcia, Campbell, Diaz, & Heckathorn, 2008; Rhodes, Daniel, et al., 2013; Rhodes et al., 2010; Rhodes et al., 2011). Although some Latinos may shy away from discussing sex

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and sexuality openly with others, including healthcare providers, their gender identity, sexual orientation, or same-sex behavior may further preclude discussions about sex (Jarama et al., 2005; Ramirez-Valles, Kuhns, Campbell, & Diaz, 2010; Rhodes, Daniel, et al., 2013; Rhodes et al., 2010; Rhodes et al., 2011). Moreover, taking risks may be perceived to be a way to overcome perceived negative external assumptions and internal feelings about one's behavior, orientation, and masculinity (Rhodes et al., 2010; Rhodes et al., 2011; Sandfort, Melendez, & Diaz, 2007) or result from other psychological distress (Chae & Ayala, 2009; Rhodes, Martinez, et al., 2013). Higher acculturation also has been associated with unprotected sex among immigrant Latino MSM (Warren et al., 2008); however, the interplay between changing sexual values and practices associated with immigration in relationship to sexual risk remains poorly understood, particularly when considering sexual orientation and same-sex behaviors (Diaz & Ayala, 2001; Lescano, Brown, Raffaelli, & Lima, 2009). Further, discrimination, homophobia, and substance use have been identified as increasing risk among Latino sexual minorities (Erausquin et al., 2009; Institute of Medicine, 2011; Rhodes et al., 2010; Rhodes et al., 2011).

Despite what is known about sexual risk and condom use among Latino sexual minorities, studies have focused on urban Latino MSM living in early epicenters of the HIV epidemic and on Latino MSM who are out about their sexual orientation (Arreola, Neilands, & Diaz, 2009; Carballo-Diequez et al., 2005; Fernandez et al., 2007; Flores, Bakeman, Millett, & Peterson, 2009; Ramirez-Valles, Heckathorn, Vazquez, Diaz, & Campbell, 2005; Rhodes, Daniel, et al., 2013; Rhodes et al., 2012; Sandfort et al., 2007; Wilson, Diaz, Yoshikawa, & Shrout, 2008; Zea, Reisen, Poppen, & Bianchi, 2009). Much less is known about immigrant Latino sexual minorities living in the southeastern US, which now carries disproportionate HIV and AIDS burden in the US (Rhodes et al., 2012).

Furthermore, it is well-established that Latinos immigrating to the southeastern US are very different from those who have traditionally immigrated to the US. They tend to be from southern Mexico and Central America, have lower educational attainment, are less acculturated, and have arrived more recently compared to those who traditionally immigrated to Arizona, California, New York, and Texas. These immigrants also come to communities that lack histories of immigration and developed infrastructures to meet their needs (Dockterman & Velasco, 2010; Elder, Ayala, Parra-Medina, & Talavera, 2009; Harari, Davis, & Heisler, 2008; Hayes-Bautista, 2004; Painter, 2008; Rhodes, Martinez, et al., 2013).

Moreover, what is known about Latino sexual minorities is not based on representative samples (Fernandez et al., 2005; Rhodes et al., 2012). Sexual minorities comprise a particularly difficult population considered to be "hard-to-access" because of the stigma associated with sexual orientation, identity, and behavior; the fear of deportation; and perceived discrimination and racism associated with being an immigrant and Latino.

Because little is known about immigrant Latinos, particularly those settling in the US Southeast, our goal was to explore factors associated with condom use among Spanish-speaking immigrant sexual minorities using respondent-driven sampling (RDS). However, given the debate about analytic approaches to model RDS data (Salganik, 2012), we

compared five commonly used approaches to multilevel analyses to identify correlates of condom use.

Regression analysis of RDS data

Analysis of RDS data in available software solutions is currently limited to prevalence estimation (Neely, 2012; Schonlau & Liebau, 2012; Voltz et al., 2012). There is currently no consensus regarding regression modeling of RDS data although it is recommended that sensitivity analyses be conducted when assessing correlates using regression (L. G. Johnston & Sabin, 2010; Schonlau & Liebau, 2012). One approach often used is to model the data without regard to the sampling design. Another approach is to assume a design effect and model after accounting for the impact of the design effect on estimates and standard errors, which in turn affect statistical inference such as p -values from hypothesis testing and confidence interval estimation. Goel & Salganik (2010) reported that the design effect from RDS may be as high as 10 (Goel & Salganik, 2010), while others suggested that the design effect may more likely be around 4 (Wejnert, Pham, Krishna, Le, & DiNenno, 2012).

Another approach is to view RDS data as multilevel (Spiller, 2009). Because respondents are recruited by earlier respondents, a respondent assumes a subsequent role as a recruiter. The sampling process begins with an initial recruiter, often referred to as a “seed”, who initiates a recruitment chain. Analytic approaches that ignore sampling effects within RDS could be troublesome, because seeds and subsequent recruits may recruit respondents like themselves. The similarity between seeds and recruits could introduce bias and/or impact variance compared to traditional random sampling. Spiller (2009) suggested a framework that is potentially useful for modeling RDS data; this framework includes considering the data as multilevel and explicitly estimating and adjusting for effects of respondents being nested within their recruiters who are also nested within the same seed’s recruitment chain. Other approaches have included variance estimation robust to misspecification of correlational structure (Villanti, German, Sifakis, Flynn, & Holtgrave, 2012) and use of RDSAT software (Voltz et al., 2012) to generate univariate weights to incorporate into multivariable regression analyses (L. Johnston et al., 2010; Silva-Santisteban et al., 2012). The latter approach has been noted to have limitations not yet fully understood so results should be interpreted cautiously (L. G. Johnston & Sabin, 2010; Schonlau & Liebau, 2012).

Methods

RDS relies on respondents to recruit a limited number of subsequent respondents who are part of their social networks (Heckathorn, 1997). Study data collection began in 2009 by recruiting 17 initial group members known as RDS seeds who met eligibility criteria and enrolling them (Rhodes et al., 2012). Eligibility criteria included self-identifying as Latino or Hispanic, being 18 years of age, reporting MSM behavior since age 18 (or identifying as transgender woman), and providing informed consent. Because characteristics of RDS seeds should be independent of those of the final sample and diversity among seeds accelerates the rate at which the sample reaches equilibrium (Heckathorn, Semaan, Broadhead, & Hughes, 2002), seeds were selected to represent the diversity of the

community, including level of “outness” about their sexual orientation and gender identity, age, country of origin, and HIV status.

Each seed also reported being from one of seven rural counties in northwestern NC. These counties were selected because each had higher percentages of persons self-identifying as Latino, had more rapid Latino community growth rates (US Census Bureau, 2010), and disproportionate HIV and sexually transmitted infection (STI) rates (NC Department of Health and Human Services, 2010) when compared to other NC counties.

Two seeds reported being HIV+ and two reported being transgender women. After participating in the assessment, each seed was trained in the RDS recruitment protocol and used the same eligibility criteria above to recruit from their social networks. Seeds subsequently initiated the chain-referral process. After recruits contacted study staff and were found to be eligible, they were enrolled and their data were collected using the same assessment used with seeds. Immediately after completing the assessment, each respondent also was trained in the RDS training recruitment protocol.

Each seed and subsequent respondent received three recruitment coupons to give recruits; if a potential recruit was not eligible, respondents could choose another recruit. The coupons included low-literacy Spanish-language information about the study, including the study’s toll-free telephone number. The coupons were coded to match the recruiter to the respondents and collected by the interviewer from each respondent (a key step in the RDS process in order to link respondent to seeds and chains). This chain-referral process continued until the *a priori* sample size was obtained. Each respondent was compensated \$50 for participation in the assessment and received \$20 (for a maximum total of \$60) for each recruited peer who met eligibility criteria and participated.

Measurement

The assessment was iteratively developed based on local formative studies (Bowden, Rhodes, Wilkin, & Jolly, 2006; Rhodes et al., 2007; Rhodes et al., 2010; Rhodes et al., 2011; Rhodes, Yee, & Hergenrather, 2006) and literature review. Validated Spanish-language measures were used. The assessment was interviewer-administered to overcome poor literacy and vision status, was based on self-report, and took 45–90 minutes to complete, depending on the skip patterns of the respondent. Items had predefined binary, categorical, or Likert-type response options.

We assessed demographic characteristics including age in years, country of origin, length of time in the US, sexual identity, educational attainment, employment status, past year’s income, and age at first intercourse. We assessed financial hardship with three items each asking if “Within the past year, have you:” “Run out of money for basic necessities”; “Had to borrow money to get by”; and “Had to look for work”. Responses options ranged from “Never” to “Always”.

We assessed knowledge of HIV/STIs using ten true-false items (Knipper et al., 2007; Rhodes, Hergenrather, Bloom, Leichter, & Montano, 2009). A sample item included, “Oral-anal sexual contact (riming) can spread Hepatitis A infection”. Knowledge scores

were constructed by summing correct responses, with higher values indicating greater knowledge.

Psychosocial variables—We assessed acculturation using the Short Acculturation Scale for Hispanics (G. Marin, Sabogal, Marin, Otero-Sabogal, & Perez-Stable, 1987). We assessed level of “outness” using a four-item scale; a sample item included “I feel accepted by my mother concerning my sexuality”. Response options ranged from “Not at all” to “Always”. We used the Sense of Mastery scale to assess how much control an individual feels over life’s circumstances (Pearlin & Schooler, 1978) and the six-item Rosenberg Self-Esteem Scale to assess self-esteem (Rosenberg, 1965).

We assessed adherence to traditional notions of masculinity using an eight-item scale. A sample item included: “A man will lose respect if he talks about his problems” (Rhodes, Hergenrather, Bloom, et al., 2009). We used revised versions of the Reactions to Homosexuality Scale to assess homo-negativity (Ross & Rosser, 1996) and adapted an existing scale to assess homophobia (Diaz & Ayala, 2001).

We assessed perceived day-to-day racial discrimination using items adapted from the MacArthur Foundation Midlife Development in the US survey (Kessler, Mickelson, & Williams, 1999). Respondents were asked “During your time in North Carolina, in your day-to-day life, how frequently have any of the following things happened to you because of your race,” followed by a ten-item scale of experiences (e.g., “Others acted like you were dishonest”). The response options ranged from “Never” to “Very frequently”.

We assessed condom use self-efficacy and expectancies using the Condom Use Self-Efficacy Scale (B. V. Marin, Tschann, Gomez, & Gregorich, 1998) and the Condom Outcome Expectancy Scale (DiIorio, Maibach, O’Leary, Sanderson, & Celentano, 1997). We also assessed sexual compulsivity (Kalichman & Rompa, 1995; Rhodes, Martinez, et al., 2013).

Behavioral variables—We assessed frequency of condom use during insertive and receptive anal sex with male partners during the past 3 months (dependent variable). Response options ranged from “Never” to “Always”. Consistent condom use was defined as reporting “always” using condoms in the past three months during insertive or receptive anal sex with a man.

We assessed history of STIs using an item that assessed whether the respondent had ever been told that they had chlamydia; gonorrhea; hepatitis A, B, or C; herpes; HIV/AIDS; HPV/Genital warts; or syphilis. Respondents also had the option of an “other” category in which they could offer a different STI or a vernacular name of an STI.

We assessed use of amulets to protect against STIs using a single-item measure. This item was based on reports that some Latinos use amulets worn around the wrist to protect the uninfected who wear them from acquiring STIs, including HIV (Bowden et al., 2006). We also assessed frequency of using the internet. Response options were “Never”, “Very rarely”, “Monthly”, and “Weekly”. We also assessed past 12-month use of alcohol (Daniel-

Ulloa et al., 2014) and of illicit and prescription drugs (used recreationally), specifically, marijuana, cocaine, crack, Viagra, Cialis, Levitra, and pain killers.

RDS network variables—For respondent's networks, we assessed personal network size, how many persons the respondent knew who fit the inclusion criteria, and how well the respondent knew his recruiter RDS-specific (Rhodes et al., 2012). These account for network effects of recruiters' tendency to recruit others like themselves respondents recruiting other respondents. Links from recruiter to respondent were captured by coupon tracking.

Human subject review and study oversight were provided by the Institutional Review Board (IRB) of Wake Forest School of Medicine.

Data analysis

Descriptive statistics, including frequencies and percentages or means, standard deviations, ranges, and Cronbach's alpha coefficients were calculated to estimate reliability via internal consistency. Cronbach's alpha coefficients for scales are reported in Table 2. Multiple logistic regressions were performed to assess correlates with various models for consistent condom use, and odds ratios (ORs) and 95% confidence intervals were estimated. Only post-seed data were used in regression modeling; thus, data from 173 respondents were used for analysis. We modeled consistent condom use using five approaches:

- Model 1: Logistic regression assuming independent observations and using complete-case data.
- Model 2: Model 1 after performing multiple imputation with 20 imputations (Royston, 2004, 2009; see below for more details).
- Model 3: Model 2 after additional variance inflation under a design effect=10 assumption. This model was based on findings in which variance under RDS in simulations was observed to be approximately 5 to 10 times larger than that from simple random sampling (i.e., design effect ranged from approximately 5 to 10) (Goel & Salganik, 2010).
- Model 4: A three-level mixed-effects logistic regression with seeds as clusters, recruiters within seeds as sub-clusters and with a small cluster set size adjusted empirical sandwich estimator after performing multiple imputation. This sandwich covariance estimator of the parameter estimates covariance matrix was used when running SAS Proc GLIMMIX with the EMPIRICAL=FIRORES option. This covariance estimator was used because the number of identified clusters (i.e., seeds) at level 3 (17 seeds) was small (Mancl & DeRouen, 2001). In this multilevel model, random intercepts for seeds and random intercepts for recruiters within seeds were specified.
- Model 5: A two-level mixed-effects logistic regression with recruiters as clusters and with a classical empirical sandwich estimator (Huber, 1967; White, 1980) after performing multiple imputation. Here, random intercepts for recruiters were specified.

Analyses with multiple imputation for missing data were performed using the chained equation methods (MICE) of Royston (2004) and Royston (2009). All multiple imputation was performed with 20 imputations. Azur et al. (2011) provide an overview of MICE methods as we applied them.

Intra-class correlation coefficients (ICC) from Model 4 and Model 5 were estimated using methods provided in Rabe-Hesketh and Skrondal (2005). The seed ICC represents the ICC for the same seed but different recruiters, while the recruiter ICC represents the ICC for the same recruiter and same seed (Rabe-Hesketh & Skrondal, 2005). Because there were only 17 seeds among the 173 respondents for which the analysis was performed, the Mancl and DeRouen based empirical robust sandwich covariance estimator (FIRORES) was used instead of the classical estimator, which constituted the highest level of clustering in the model (Mancl & DeRouen, 2001). All analyses were performed in SAS v9.2 (SAS Institute, Cary, NC) and in Stata v11.2 (StataCorp LP, College Station, TX). A two-sided $p < 0.05$ was considered statistically significant.

Results

Sample Description

A total of 190 respondents participated. Of those, 17 were seeds and three seeds did not recruit any subsequent respondents. Figure 1 illustrates recruitment patterns.

Mean respondent age was 25.2 years old ($SD=5.1$) and ranged from 18 to 45 years. Almost 80% reported being from Mexico; 67.6% reported multiple male sexual partners in the past 3 months. Select characteristics of seeds and respondents are outlined in Table 1.

Table 2 presents descriptive statistics for consistent condom use and its potential correlates. Half of respondents reported past three-month consistent condom use, the study outcome of this report.

Correlates of condom use

Table 3 provides multiple logistic regression results for modeling consistent condom use. In Model 1, correlates associated with consistent condom use were decreased homophobia, increased condom use self-efficacy, and past 12-month drinking. In Model 2, after performing multiple imputations for missing data, correlates associated with consistent condom use were increased HIV/STI knowledge, decreased homophobia, increased condom use self-efficacy, no history of STIs, and disbelief that amulets provide STI protection. In Model 3 that explicitly inflated variances of effects under an assumption of a design effect=10, no significant correlates associated with consistent condom use emerged. In *post-hoc* analyses, we used a design effect=5 and had the same results as with a design effect=10.

Table 3 also provides results from multilevel multiple logistic regression, in which respondents were clustered within both recruiters and seeds (Model 4) and clustered within recruiters (Model 5). In Model 4, correlates associated with consistent condom use were: increased HIV/STI knowledge, decreased homophobia, and increased condom use self-efficacy. In Model 5, correlates associated with consistent condom use were increased

HIV/STI knowledge, decreased homophobia, increased condom use self-efficacy, and no history of STIs.

ICC estimates

From the three-level modeling in Model 4, the estimated seed ICC was 0.059 and the estimated recruiter ICC was 0.233. From the two-level modeling in Model 5, the estimated recruiter ICC was 0.074. ICC results for Models 4 and 5 are presented in Table 3.

Discussion

Correlates consistent across analytic approaches

Three correlates were consistently associated with increased odds of condom use across most analytic approaches: increased HIV/STI knowledge, decreased frequency of experiences with homophobia, and increased condom use self-efficacy. The magnitudes of the estimated odds ratios for each effect were similar across models. Other variables associated with increased odds of condom use that were identified by multiple models were: decreased history of STI infection and decreased use of amulets to prevent STIs. Increased condom use was associated with increased past-year drinking only in Model 1. These findings suggest that individual-level or group-level interventions designed to reduce risk among Latino sexual minorities may benefit from increasing HIV/STI knowledge and increasing condom use self-efficacy.

In addition, reducing risk through decreased homophobia would require community-level interventions, as opposed to individual- or group-level. However, few programs have been developed or proposed to transform community through some type of socio-political or cultural intervention (Institute of Medicine, 2011; Rhodes, Hergenrather, Griffith, et al., 2009; Rhodes, Martinez, et al., 2013). An example of this type of intervention to reduce homophobia may include social marketing campaigns to reduce negative notions held about same-sex sexual orientation, attraction, desire, and behavior or transgender identity. These interventions would not target Latino sexual minorities but would be designed to change broader community member perceptions and attitudes that lead to homophobia, homonegativity, transphobia, and stigma.

Furthermore, several variables were not associated with condom use in any model including acculturation. Research has been somewhat contradictory about whether HIV risk increases or decreases as immigrants adopt norms and values of communities in the US. Some research has suggested that less acculturated Latinos are less likely to engage in risk behaviors because of their adherence to traditional Latino values (Flaskerud, Uman, Lara, Romero, & Taka, 1996; Newcomb et al., 1998; Norris & Ford, 1994), while other research suggests that higher levels of acculturation and the resulting acquisition of mainstream values have a protective effect because they increase a sense of individualism and self-determination (Marín & Flores, 1994). The broader health literature has suggested two additional contradictory views: immigrants may be more vulnerable than US-born Latinos because of demands related to adaptation, poverty, harsh working conditions and immigrants may be more resilient to health risks and disease because of the self-selection processes

associated with migration as well as certain culture-based practices. In relation to HIV risk, the latter view implies that HIV risk factors may be mitigated by strengths and protective factors that immigrants bring with them, which may be associated with their drive and desire to succeed economically and socially (Escobar, 1998; Escobar, Hoyos Nervi, & Gara, 2000). However, the interplay between changing Latino sexual values and practices associated with immigration in relationship to sexual risk is poorly understood especially when considering sexual orientation and same sex behaviors. Among gay men, research is mixed and no clear pattern has been identified (Diaz & Ayala, 2001); however, our findings suggest that despite modeling, acculturation (like financial hardship, level of “outness”, sense of mastery, self-esteem, masculinity, homo-negativity, sexual compulsivity, internet use, and past-year drug use) is not associated with condom use.

Modeling RDS data—RDS continues to be innovative approach to sampling and estimating prevalence of behaviors and risks among populations for whom no sampling frame exists (e.g., sexual minority men). However, to-date there has been little agreement on how to model RDS data. This analysis offers insights into various modeling approaches.

Early on, RDS literature emphasized that the greater degree to which seed characteristics were diverse, the more successful the sampling was assumed to be. Design effects would be lower, and the sample was believed to better approximate a random sample, overcoming homophily (Heckathorn, 1997). Thus, we were careful to select diverse seeds to reduce clustering; however, this also may lead to reduced clustering by recruitment chain. If clustering can be quantified through estimated ICCs from multilevel modeling, it can be linked to the outcome of interest (e.g., condom use) as opposed to respondent characteristics or demographics which may or may not be related to outcome. Thus, we adjusted for the potential lack of independence among RDS respondents using a multilevel modeling approach in Models 4 and 5. Because variation inflation under RDS is a concern and probabilities of inclusion into the sample are not explicitly obtained (Gile, 2011; Goel & Salganik, 2010; Heckathorn et al., 2002; L. G. Johnston & Sabin, 2010; Wejnert et al., 2012), only heuristics for analysis under RDS have been proposed in literature to date. Considering respondents nested within recruiters and recruiters nested within seeds in multilevel modeling may not reflect every design aspect of RDS. Thus, an additional aspect of the multilevel modeling analysis considered was to use empirical sandwich estimators of the variance-covariance matrices of estimates (in Models 4 and 5), which are robust to misspecification of the clustering structure. When the seed and his/her recruitment chain is considered a cluster, then correlations among responses of the respondents linked by the same recruitment chains are explicitly taken into account through this method, even if the association structure is mis-specified. However, if clustering due to seed is empirically observed to be low, then one might argue that it is trivial in that particular case. A confounding issue in estimating and testing for low degrees of clustering is if design effects of RDS have truly been taken into account sufficiently, for which there is no current agreement by researchers. Thus, specifying and testing for clustering using existing methods might not accurately reflect equilibrium among respondents in their recruitment chains.

Limitations

First, the sample size was modest. Future studies with larger sample sizes could explore the differences in condom use and correlates among subgroups of immigrant Latino sexual minorities, including comparisons by self-identified sexual orientation (e.g., gay and bisexual), gender identity, sexual behavior (e.g., sex with men exclusively or with men and women), country of origin, and years living in the US.

Furthermore, the observed associations are based on cross-sectional data; cohort studies are warranted to evaluate the significance and stability of these findings over time. Although the demographics of Latinos immigrating to NC represent those coming to the southern US more generally, generalization of the findings to other Latino populations or contexts (e.g., urban settings) may not be appropriate.

Implications

Future studies should assess effects of assessing the way in which respondents recruit their peers. For example, besides asking the respondent how well he knows the recruiter, the recruiter could be asked retrospectively about his process, e.g., did he choose three respondents conveniently, systematically, or randomly? This may impact response propensities. Moreover, methodological work regarding analytic approaches for RDS studies should continue, including weighting for regression and multilevel modeling approaches. Future work also should examine whether seed and recruiter ICCs provide a basis for establishing representativeness after RDS; if the seed ICC is small in magnitude, then one could argue that the impact of recruitment trees are reduced (i.e., the sample has “stabilized” or reaching equilibrium). Estimating ICCs could provide a strategy to empirically investigate the impact of recruitment clusters, doing so with respect to the actual outcome of interest, rather than to other respondent characteristics or demographics. One might even monitor these iteratively for select outcomes to determine whether additional RDS sampling waves are warranted. Simulation studies under realistic RDS conditions could potentially be performed to investigate this.

Volz and Heckathorn (2008) call for use of sample weights as well as methodology accounting for clustering between respondents. Appropriate methods of weighting for regression modeling after performing RDS are still crucially needed to properly account for sample inclusion probabilities and for the correlated/clustered features potentially inherent in RDS data. Some authors, such as Szwarcwald (2011), have offered approaches to weighting after RDS which merit future study. Gile (2011) has offered an alternative framework through which to consider RDS methods as a form of successive sampling. This is promising as methods for regression analysis under successive sampling have been offered previously (Singh & Talwar, 1991). More study of this intriguing approach is warranted.

Bootstrapping and other approaches—Also, there were other approaches not attempted in here that merit study. For example, Neely (2009) proposes Bayesian Bootstrap methods, in which RDS recruitment is viewed as a branching process from Markov models. The main aspects of these proposed methods are that they (1) account for dependencies of

outcomes between observations and (2) model the relationship between sample inclusion probabilities and the respondent self-reported network sizes (Neely, 2009). In essence, the current analyses provided results from some alternative approaches for (1), and while making some typical but strong assumptions for (2). For the latter, the degree to which these assumptions are satisfied will impact whether results are generalizable to the population of Latino sexual minorities.

Conclusions

Analyses suggested that increased HIV/STI knowledge and increased condom use self-efficacy are associated with higher odds of consistent condom use, while increased frequency of experiences with homophobia and perception that amulets provide STI protection are associated with lower odds of consistent condom use. Significance of correlates was consistent using multiple analytic approaches, and warrant further study for possible intervention. Challenges remain in assessment of data after RDS, but future studies could provide insight into various modeling approaches.

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Figure 1.
Recruitment tree for the HOLA study ($n = 190$, including 17 seeds)

Table 1

Participant Characteristics of Seeds and Respondents

Characteristic	Seed (n=17)	Respondent (n=173)
Mean $\pm$ SD (Min, Max) or n (%)		
Age (years)	28.3 $\pm$ 7.4 (18, 48)	25.2 $\pm$ 5.1 (18, 45)
Country of origin		
Mexico	14 (82)	135 (78)
Guatemala	0	4 (2)
El Salvador	0	3 (2)
Honduras	1 (6)	2 (1)
Other	2 (12)	23 (13)
Missing	0	6 (3)
Length of time in US (years)	8.4 $\pm$ 3.8 (4, 19)	9.3 $\pm$ 5.3 (2, 25)
Sexual identity		
Gay/Homosexual	13 (76)	136 (79)
Bisexual	1 (6)	17 (10)
Transgender	2 (12)	14 (8)
Heterosexual	0	3 (2)
Missing	1 (6)	1 (<1)
Acculturation	2.1 $\pm$ 0.6 (1.1, 3.6)	2.3 $\pm$ 0.7 (1.0, 3.7)
Education		
Less than high school diploma or equivalent (GED)	0	24 (14)
High school diploma or equivalent (GED)	12 (71)	110 (64)
Some college or above	3 (18)	29 (18)
Missing	2 (12)	10 (6)
Employment status		
Employed year round	13 (76)	157 (91)
Employed in seasonal work but not year round	3 (18)	10 (6)

Characteristic	Seed (n=17)	Respondent (n=173)
	Mean ± SD (Min, Max) or n (%)	
Unemployed	0	4 (2)
Missing	1 (6)	2 (1)
Past year's income in US dollars		
< \$20,000	5 (29)	51 (29)
\$20,000 – \$29,999	7 (41)	87 (50)
\$30,000 – \$39,999	2 (12)	24 (14)
\$40,000 – \$49,999	1 (6)	4 (2)
Missing	2 (12)	7 (4)

Table 2

Study measures of respondents ($n = 173$)

Characteristic with α , as appropriate	N	Mean $\pm$ SD or n (%)
Consistent condom use	167	86 (51.5%)
Age at first sex (in years)	138	16.8 $\pm$ 3.6
Financial hardship ($\alpha=.83$)	149	1.2 $\pm$ 0.5
HIV/STI knowledge	169	4.3 $\pm$ 1.7
Acculturation ($\alpha=.96$)	173	2.3 $\pm$ 0.7
"Outness" ($\alpha=.88$)	141	3.0 $\pm$ 0.8
Sense of mastery ($\alpha=.77$)	167	2.4 $\pm$ 0.4
Self-esteem ($\alpha=.76$)	171	3.8 $\pm$ 0.4
Traditional masculinity ($\alpha=.94$)	173	3.3 $\pm$ 0.6
Homo-negativity ($\alpha=.87$)	172	2.5 $\pm$ 1.4
Homophobia ($\alpha=.75$)	173	1.4 $\pm$ 0.4
Day-to-day discrimination ($\alpha=.95$)	170	1.2 $\pm$ 0.4
Condom use self-efficacy ($\alpha=.95$)	173	4.4 $\pm$ 0.9
Condom use expectancies ($\alpha=.92$)	168	82.1 $\pm$ 15.0
Sexual compulsivity ($\alpha=.92$)	173	1.7 $\pm$ 0.5
History of STI	164	45 (27.4%)
Use of amulets to prevent STIs	173	34 (19.7%)
Search Internet weekly	162	78 (48.2%)
Past 12-month drinking	173	76 (43.9%)
Past 12-month drug use	167	114 (68.3%)

Table 3

Multiple logistic regression modeling of consistent condom use across 5 modeling approaches and intra-class correlation (ICC) coefficients

Covariate	Single-level multiple logistic regression modeling of consistent condom use			Multilevel multiple logistic regression modeling of consistent condom use		
	Model 1	Model 2	Model 3	Model 4	Model 5	
	AOR* (95% CI); p-value	AOR (95% CI); p-value	AOR (95% CI); p-value	AOR (95% CI); p-value	AOR (95% CI); p-value	AOR (95% CI); p-value
Age at first sex	1.33 (0.84, 2.12); 0.23	1.17 (0.89, 1.56); 0.25	1.17 (0.50, 2.77); 0.72	1.17 (0.83, 1.65); 0.35	1.18 (0.89, 1.56); 0.25	
Financial hardship($\alpha=83$)	2.30 (0.20, 26.2); 0.50	0.61 (0.16, 2.31); 0.46	0.61 (0.01, 38.8); 0.82	0.61 (0.15, 2.59); 0.50	0.61 (0.19, 1.98); 0.41	
HIV/STI knowledge	1.74 (0.82, 3.68); 0.15	1.57 (1.08, 2.29); 0.02	1.57 (0.48, 5.09); 0.46	1.62 (1.06, 2.47); 0.03	1.59 (1.06, 2.38); 0.03	
Acculturation ($\alpha=96$)	0.50 (0.07, 3.75); 0.50	1.65 (0.63, 4.32); 0.31	1.65 (0.08, 33.8); 0.75	1.73 (0.56, 5.33); 0.34	1.69 (0.70, 4.08); 0.24	
"Outness" ($\alpha=88$)	0.88 (0.28, 2.79); 0.83	0.80 (0.35, 1.84); 0.59	0.80 (0.06, 10.5); 0.87	0.80 (0.28, 2.30); 0.67	0.78 (0.32, 1.92); 0.59	
Sense of mastery ($\alpha=77$)	1.19 (0.06, 22.9); 0.91	2.04 (0.41, 10.2); 0.38	2.04 (0.01, 309.7); 0.78	2.21 (0.21, 23.4); 0.51	2.06 (0.39, 10.8); 0.39	
Self-esteem ($\alpha=76$)	0.24 (0.01, 4.75); 0.35	1.32 (0.32, 5.48); 0.70	1.32 (0.02, 113.7); 0.90	1.48 (0.32, 6.94); 0.61	1.37 (0.31, 5.95); 0.68	
Traditional masculinity($\alpha=94$)	0.95 (0.12, 7.23); 0.96	1.24 (0.38, 4.02); 0.72	1.24 (0.03, 49.5); 0.91	1.14 (0.26, 5.00); 0.86	1.21 (0.30, 4.86); 0.79	
Homo-negativity ($\alpha=87$)	0.78 (0.33, 1.83); 0.57	1.01 (0.65, 1.58); 0.97	1.01 (0.25, 4.09); 0.99	1.05 (0.63, 1.77); 0.85	1.01 (0.66, 1.57); 0.95	
Homophobia ($\alpha=75$)	0.06 (<0.01, 0.85); 0.04	0.22 (0.06, 0.75); 0.02	0.22 (<0.01, 10.8); 0.45	0.19 (0.05, 0.69); 0.01	0.21 (0.05, 0.78); 0.02	
Day-to-day discrimination ($\alpha=95$)	1.20 (0.03, 43.0); 0.92	3.12 (0.64, 15.1); 0.16	3.12 (0.02, 437.2); 0.65	2.34 (0.21, 26.0); 0.48	3.01 (0.55, 16.6); 0.21	
Condom use self-efficacy ($\alpha=95$)	27.9 (1.49, 519.3); 0.03	4.05 (1.35, 12.2); 0.02	4.05 (0.13, 126.9); 0.43	3.92 (1.20, 12.8); 0.02	4.16 (1.37, 12.6); 0.01	
Condom use expectancies ($\alpha=92$)	1.06 (0.96, 1.17); 0.28	1.03 (0.97, 1.09); 0.27	1.03 (0.86, 1.24); 0.73	1.03 (0.97, 1.11); 0.31	1.03 (0.98, 1.09); 0.23	
Sexual compulsivity ($\alpha=92$)	6.37 (0.44, 93.0); 0.18	3.38 (0.89, 12.8); 0.07	3.38 (0.05, 218.6); 0.57	3.04 (0.61, 15.1); 0.17	3.42 (0.92, 12.7); 0.07	
History of STI vs. no history	0.21 (0.02, 1.86); 0.16	0.24 (0.06, 0.98); 0.05	0.24 (<0.01, 18.7); 0.53	0.24 (0.04, 1.52); 0.13	0.24 (0.06, 0.94); 0.04	
Use of amulets to prevent STIs vs. no use	0.78 (0.04, 14.4) 0.87	0.15 (0.03, 0.72); 0.02	0.15 (<0.01, 19.2); 0.45	0.22 (0.02, 2.69); 0.23	0.16 (0.03, 0.77); 0.02	
Search internet weekly vs. not weekly	0.78 (0.07, 8.44) 0.84	0.58 (0.14, 2.41); 0.45	0.58 (0.01, 48.8); 0.81	0.53 (0.07, 4.05); 0.54	0.56 (0.13, 2.46); 0.45	
Past year drinking vs. no past year	6.82 (1.10, 42.1) 0.04	2.65 (0.86, 8.13); 0.09	2.65 (0.08, 88.5); 0.59	2.91 (0.72, 11.7) 0.13	2.76 (0.84, 9.01); 0.09	
Past-year drug use vs. no use past-year	0.12 (0.01, 2.30) 0.16	0.49 (0.15, 1.61); 0.24	0.49 (0.01, 20.6); 0.71	0.55 (0.09, 3.22); 0.50	0.49 (0.16, 1.55); 0.22	
ICC						
Recruiter ICC	-	-	-	0.23304214	0.07409436	
Seed ICC	-	-	-	0.05942297	-	

* AOR=Adjusted odds ratio; CI=Confidence interval; **Bold** if $p < 0.05$;