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HIV Risk Reduction in a Nurse Case-managed TB and HIV Intervention among Homeless Adults

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Abstract
This study evaluated a six-month nurse case-managed intervention against a standard care control program among 295 sheltered homeless adults from Los Angeles, USA. The primary aim of the intervention was encouraging latent tuberculosis infection treatment completion. The secondary aim was reducing HIV risk, the focus of this report. A longitudinal path model revealed that the intervention impacted cognitive factors of AIDS Knowledge, Perceived AIDS Risk and Self-efficacy for Condom Use, but did not impact substance use and risky sexual behaviors. The dual intervention program for HIV and TB provided promising synergistic effects by targeting risk factors common to both infections.

Keywords
- HIV risk reduction
- homelessness
- injection drug use
- nurse-managed intervention
- randomized trial

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HOMELESS persons are a high-risk group for contracting infectious diseases such as Human Immunodeficiency Virus (HIV) and tuberculosis (TB). In the developed world, rates of HIV and AIDS are higher among homeless persons than among other populations (Culhane, Gollub, Kuhn, & Shpaner, 2001). For example, in a representative study among homeless and marginally housed adults in San Francisco, HIV seroprevalence was five times greater than in the general San Francisco population (Robertson et al., 2004). While the prevalence of active TB is approximately 4.9 per 100,000 in the general population of the United States (Centers for Disease Control and Prevention [CDC], 2005), rates in homeless populations are estimated to be 20–30-fold higher. Estimates of latent TB infection, as indicated by purified protein derivative (PPD) positive skin tests, range from 13 percent to 32 percent in shelter- and clinic-based studies of homeless populations (Griffin & Hoff, 1999).

The increased risk of HIV among homeless populations is largely attributable to a high prevalence of unhealthy behaviors such as substance use and risky sexual behaviors. Injection drug users are at greater risk for HIV infection through the utilization of contaminated equipment (Huo, Bailey, Garfein, & Ouellet, 2005; Koester, Glanz, & Baron, 2005), unprotected intercourse with multiple partners (Stein et al., 2005), heterosexual contact with other injection drug users (McCoy et al., 2005) and exchanging sex for money or drugs (Spittal et al., 2003). Non-injection drug use has also been associated with an increased risk of contracting HIV, due to increased likelihood of risky sexual behaviors (Stein et al., 2005). Drug treatment has been advocated as a key element in the prevention of HIV and AIDS (Des Jarlais, Guydish, Friedman, & Hagan, 2000, 2001). There is an indirect association between HIV and TB infection. Substance use and risky sexual behaviors place people at risk for HIV (Des Jarlais & Semaan, 2002), which in turn increases the risk for active TB as persons co-infected with HIV and TB have 20 times the overall annual risk of developing active TB (Zumla, Malon, Henderson, & Grange, 2000). Specifically, immunodeficiency due to HIV infection has emerged as the most important predisposing factor for the development of primary or reactivated TB. Also, risky drug and sexual behaviors may bring people in proximity with others that are infected with TB.

Because of the link between HIV and TB risk, interventions designed to target both HIV and TB risk reduction may be more efficient and cost-effective and have a greater impact and generalizability than interventions designed for only one health problem. Dual intervention programs for HIV and TB may provide critical synergistic effects given their common routes of infection and common risk factors. Such programs can enhance skills, knowledge and behaviors that play a key role in preventing both infections.

The current study was designed to examine the effectiveness of a nurse case-management intervention program for HIV and TB risk reduction compared to a standard care control program among sheltered homeless adults. The intervention program is conceptually derived from the Comprehensive Health Seeking and Coping Paradigm (CHSCP) (Nyamathi, 1989), which is a health psychology model that has been used in a variety of contexts among impoverished populations. Details are described more fully in the Method section. The primary aim of the intervention program was to enhance completion of a latent TB infection treatment regimen. The nurse case-management program was found to be more effective than the standard care program in increasing latent TB infection treatment completion (Nyamathi, Stein, Schumann, & Tyler, 2007). The secondary aim of the intervention program was to increase HIV/AIDS awareness and reduce HIV and AIDS risk; a focus of the present report. We evaluate whether the effects of the intervention program in enhancing latent TB infection treatment completion translates to HIV and AIDS risk reduction. We examine the impact of the intervention program on increasing AIDS knowledge and perceived risk for HIV and AIDS, increasing condom use self-efficacy, decreasing drug and alcohol use and decreasing the number of sexual partners.

Method

Design, setting and participants

This study was a randomized controlled intervention trial designed to examine the effectiveness of a theoretically based nurse case-management program versus a standard care control program on HIV and TB risk reduction among sheltered homeless adults. The study was conducted in eight homeless shelters and four residential drug recovery programs in the Skid Row area of downtown Los Angeles between 1998 and 2003. Initially, 16 sites were contacted and 12 agreed to participate. The sites were stratified by type (shelters vs residential drug recovery), typical length
of stay (<3 months vs ≥ 3 months) and size. Subsequently, the sites were randomized to the intervention program or control program. Recruitment of homeless adults consisted of posting flyers in the study shelters and residential drug recovery programs. Persons were eligible if they: (a) had spent the previous night in one of the study sites; (b) had no self-reported history of completing TB prevention therapy; (c) were between the ages of 18 and 55, or over the age of 55, and reported risk activation factors for active TB, which included injection drug use, diagnosis of immune compromising diseases (such as severe kidney disease) or taking immuno-suppressing medications; (d) were willing to undergo further diagnostic testing at a clinic frequented by homeless men and women in the downtown Los Angeles area; and (e) were found to be PPD positive (≥ 10 mm of induration if not HIV positive; ≥ 5 mm of induration if HIV positive) via the Mantoux method of tuberculin skin testing, with a negative chest X-ray and normal liver enzymes.

A total of 3954 homeless adults fulfilled the screening criteria (a) to (d). Of those screened, 980 (24.8%) were found to be PPD positive. Of these, 25 refused the chest X-ray, 15 were not eligible for chest X-rays and diagnostic testing, 199 refused or did not show up for the physician exam and 221 were not eligible due to various medical indications. The remaining 520 homeless adults fulfilled all inclusion criteria described above. Follow-up data, six months after baseline, were available for 494 participants, indicating 5 percent of the sample were lost to follow-up. This sample was 80 percent male, 20 percent female; had a mean age of 41.5 years (SD = 8.5); was 82 percent African-American, 9 percent Hispanic, 7 percent White, 2 percent other, and education ranged from three to 19 years with a mean of 12 years.

The sample for the present analyses consisted of participants currently at risk for HIV or AIDS, only those participants who reported that they had been sexually active in the past six months or shared needles for injecting drugs. Thus, the final sample was 295 homeless adults, 154 in the intervention group and 141 in the control group, and was demographically similar to the total sample: 235 (80%) men and 60 (20%) women; mean age 40.6 years (SD = 8.6); 82 percent African-American, 12 percent Hispanic, 3 percent White, 3 percent other; and education ranged from four to 19 years; with a mean of 12 years.

Procedure

Participants received a detailed description of the study goals and procedures before providing written informed consent as approved by the University of California, Human Subjects Protection Committee. Then baseline face-to-face interviews were conducted by trained nurses and outreach workers. During the following six months, the intervention or control programs were applied. At the end of the programs, i.e. six months after baseline, the follow-up interview was conducted. All participants were tracked for completion of the follow-up assessment using a locator guide, which indicated places that they tended to frequent and contact persons for the participants. Nurses and outreach workers contacted these references when tracking was necessary. The research nurses and outreach workers who delivered the intervention were not involved in the baseline or follow-up assessments.

Intervention

In both the intervention and control programs, homeless adults were asked to attend the research clinic twice a week over a period of six months to receive a latent TB infection chemoprophylaxis treatment regimen with isoniazid (INH) delivered by directly observed therapy. Incentives of $5 were paid to all participants for each dose of INH received.

The core difference between the intervention and control program was the nurse case-managed program, designed primarily to enhance completion of the TB treatment regimen. Because homeless persons at risk for active TB are oftentimes also engaging in risk factors for HIV infection, the nurse case-managed program provided basic education on reducing HIV and AIDS risk attitudes and behaviors.

Theoretical background for the nurse case-managed program was provided by the Comprehensive Health Seeking and Coping Paradigm (CHSCP) (Nyamathi, 1989). The CHSCP, originally adopted from the Lazarus and Folkman (1984) Stress and Coping Model and the Schlotfeldt (1981) Health Seeking Paradigm, provides a framework for conceptualizing coping behaviors and health outcomes of vulnerable populations. It has been applied successfully in a number of previous intervention studies targeted to reduce HIV risk activities among homeless and drug-using minority women (Nyamathi, Leake, Flaskerud, Lewis, & Bennett, 1993; Nyamathi & Stein, 1997; Stein, Nyamathi, & Kington, 1997).

Key variables from the model that guide the nurse case-managed program include cognitive factors (AIDS knowledge, perceived risk for HIV and AIDS, self-efficacy for condom use), behavioral factors (non-injection drug use, injection drug use,
alcohol use, number of sexual partners), situational factors (site of residence), and sociodemographic factors (gender, age, ethnicity, education, marital status). Participants in the intervention program attended a comprehensive educational and skills training module, delivered by research nurses and outreach workers in a culturally competent and tailored manner. The module comprised eight one-hour sessions across the six-month regimen with four to five participants at a time. Intervention components with respect to HIV and AIDS risk reduction included: (a) HIV and AIDS risk reduction education; (b) training in coping, self-management and communication skills necessary for HIV and AIDS risk reduction; (c) training in social and cognitive problem solving to implement behavior change; and (d) developing relationships and social networks to maintain behavior change. Intervention techniques included factual presentations, group discussions, role playing, presentations of culturally sensitive pictorial coping scenarios (Nyamathi & Bennett, 1997) as well as behavioral exercises and demonstrations.

**Measures**

The interview contained the same questions at baseline and follow-up. Therefore, the multiple-indicator latent variables and the single-item variables are identical at both measurement occasions and are described below.

The group membership variable indicates participation in the nurse case-managed program vs the control program. In preliminary analyses, gender, age, ethnicity, education and marital status were included as control variables but were not associated with any of the outcomes. Thus, these variables were eliminated from further analyses. Site type indicates residential drug recovery vs homeless shelter, and was included as a control variable because it was associated with the outcomes of interest and with other predictors.

**AIDS Knowledge** This was a single-item variable indicating the number of correct responses on the 21-item AIDS Knowledge Questionnaire (Leake, Nyamathi, & Gelberg, 1997).

**Perceived Risk for HIV and AIDS (AIDS Risk)** For this single-item variable, participants were asked to indicate their susceptibility to HIV/AIDS on a four-point rating scale from 1 = no chance to 4 = high chance of getting AIDS.

**Self-efficacy for Condom Use** The participant’s confidence to perform different condom use behaviors was assessed with nine items on a five-point rating scale with 1 = not at all sure to 5 = extremely sure. Typical items included ‘How sure are you that you can carry condoms around with you’, and ‘How sure are you that you can talk to your partner about using a condom before having sex’. To create the latent variable, items were combined into three parcels of three items each.

**Non-Injection Drug Use (non-IDU)** The interview contained a detailed assessment of past and present drug use. For 15 types of drugs, we assessed whether the drug had been used in the last six months (yes/no), and the frequency of use in the last six months ranging from 0 = not used to 9 = about four or more times per day. Three indicators were used for the latent variable: the frequency of crack/freebase use and the frequency of marijuana/hashish use were selected, because the highest frequencies were reported for this drug use. The third indicator was the total number of other non-injection drugs that were used.

**Injection Drug Use (IDU)** Three yes/no items were used as indicators of this latent variable: whether the participant had injected cocaine in the last six months; whether the participant had injected heroin in the last six months; and whether the participant had shared needles or works in the last six months.

**Alcohol Use** Three items were used as indicators: whether alcohol had been used in the last six months (yes/no); frequency of alcohol use in the last six months ranging from 0 = not used to 9 = about four or more times per day; number of drinks on a typical day in the last six months, ranging from 0 = no drinks to 5 = 10 or more drinks.

**Number of Sexual Partners** For this single-item variable, participants were asked how many sexual partners they have had in the last six months. Responses in the sample ranged from 0–40 at baseline and from 0–50 at follow-up.

**Analyses**

Structural equation modeling (SEM) was applied to the longitudinal data using EQS for Windows (Bentler, 2006). SEM evaluates how latent variables, which are error-free constructs that explain the shared variance among multiple measured indicators, and single-item variables relate to one another and how they form a multivariate model.

Maximum likelihood estimation was used and a variety of fit statistics was employed to evaluate...
model fit. We report the Satorra-Bentler $\chi^2$ test statistic (S-B $\chi^2$), the adjusted robust comparative fit index (RCFI) and the root-mean-square error of approximation (RMSEA) with its 95% confidence interval (CI). The S-B $\chi^2$ is preferable to maximum-likelihood $\chi^2$ test statistics when the data are multi-variately kurtose; a high normalized multivariate kurtosis estimate of 104.09 was found in this study. The RCFI compares the improvement of fit of the hypothesized model to a model of independence among the measured variables while adjusting for sample size and nonnormality. It ranges from 0 to 1 with values above .95 indicating good model fit. The RMSEA evaluates model fit based on the size of the residuals. Values of less than .06 indicate a relatively good fit between the hypothesized model and the observed data.

**Confirmatory factor analysis** Confirmatory factor analyses (CFA) tested the adequacy of the hypothesized measurement model to verify that each latent variable was indicated significantly by its manifest indicators. All latent variables and single-item variables were allowed to correlate freely without inferring prediction paths. Since baseline and follow-up measures were the same, correlated errors between corresponding manifest indicators were initially included, but were later removed if found to be nonsignificant. The Lagrange multiplier (LM) test was performed to determine if any additional paths were needed for fit improvement.

**Predictive path model** In a structural path model, group membership, site type and each baseline variable predicted each follow-up outcome variable. All baseline predictors were correlated, and the residuals of the outcome variables were also correlated. The path model was trimmed gradually by removing nonsignificant paths, the reduced model was analyzed again and the robust $\chi^2$ difference test ($\Delta\chi^2_{\text{robust}}$) was performed to determine whether the paths could be removed without significant loss in model fit.

### Results

**CFA**

The measurement model showed excellent fit statistics in the CFA: S-B $\chi^2 (340, N = 295) = 378.49, p = .07$, RCFI = .99, RMSEA = 0.020, 95% CI: .007–.030. All factor loadings of the measured indicators were significant ($p < .001$). Some nonsignificant correlated errors were dropped without significant loss in model fit ($\Delta\chi^2_{\text{robust}}$($\Delta$d.f.) = 7.12(9), NS). The LM test indicated no reasonable paths to improve model fit.

Table 1 shows descriptive statistics of the study variables and factor loadings of the measured indicators in the CFA model. Difference tests comparing corresponding study variables at baseline and follow-up are also presented. AIDS Knowledge and Self-efficacy for Condom Use significantly increased while Perceived AIDS Risk, Number of Sexual Partners, Non-IDU, IDU and Alcohol Use significantly decreased over time.

Table 2 reports the correlations among all latent variables and single-item variables. Nurse case-management group membership was significantly associated with the outcome variables of AIDS Knowledge, Perceived AIDS Risk and Self-efficacy for Condom Use. Note that there were no significant associations with these variables at baseline. Group membership was also significantly associated with site type, indicating that randomization did not yield a perfectly balanced site application. In turn, site type was highly correlated with Non-IDU, IDU and Alcohol Use at baseline, and Non-IDU and Alcohol Use at follow-up. This is not surprising given that one site type was residential drug recovery.

**Predictive path model**

Figure 1 depicts the results of the path analysis. This model had excellent fit statistics: S-B $\chi^2 (424, N = 295) = 454.20, p = .15$, RCFI = .99, RMSEA = 0.016, 95% CI: .000–.026. It was not significantly different from the model that included all possible prediction paths from the baseline to the follow-up variables, indicating that no important paths had been dropped during model fitting: $\Delta\chi^2_{\text{robust}}$($\Delta$d.f.) = 74.43(84). In the final model, participation in the nurse case-managed program predicted higher AIDS Knowledge, lower Perceived AIDS Risk and higher Self-efficacy for Condom Use, while controlling for the association of group membership with site type and for associations with earlier drug and alcohol use. These associations explained 14 percent of the variance in AIDS Knowledge, 15 percent of the variance in Perceived AIDS Risk and 3 percent of the variance in Self-efficacy for Condom Use.

Note that no direct stability paths were significant between the baseline variables of AIDS Knowledge, Perceived AIDS Risk and Self-efficacy for Condom Use to their analogous outcome variables. This indicates significant change in the outcome variables due in large part to the influence of...
Discussion

Our evaluation of a nurse case-managed program aimed at reductions in TB and HIV risk in a vulnerable population of homeless adults indicated that participation in the nurse-managed program was associated with improvement particularly in the cognitive features of the CHSCP. Participants in the intervention program had higher AIDS knowledge, lower perceived AIDS risk and higher self-efficacy for condom use at follow-up than participants in the standard care program. Interestingly, for these variables there were no significant direct paths from their analogous baseline variables, i.e. no stability over time. This is surprising since in most longitudinal applications of structural equation modeling, variables over time tend to be predicted strongly by the preceding same variables. In this study, however, these outcome variables were only predicted by membership in the intervention program. This unusual finding indicates very powerful effects of the intervention program and a great deal of change over time.

Significant changes occurred in AIDS knowledge and attitudes, which are the cognitive factors in the CHSCP framework. Behavioral factors related to HIV risk, however, such as drug and alcohol use and the number of sexual partners, were not influenced by the intervention program. Diverse previous intervention studies have been able to show reductions in HIV behaviors (Crepaz et al., 2006). The fact that our intervention program was associated with cognitive changes but not behavioral changes may be due to the fact that the primary target of the intervention program was TB risk reduction, not HIV risk reduction. Indeed,

Table 1. Descriptive statistics and difference tests* for study variables, and factor loadings in the CFA

<table>
<thead>
<tr>
<th>Group membership (% intervention program)</th>
<th>Baseline statistics</th>
<th>Follow-up statistics</th>
<th>Difference test*</th>
</tr>
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<tr>
<td>Site type (% residential drug recovery)</td>
<td>52.2</td>
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<tr>
<td>AIDS Knowledge (Mean/SD, range 0–21)</td>
<td>16.06 (4.98)</td>
<td>18.41 (3.81)</td>
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<td>Perceived AIDS Risk (Mean/SD, range 1–4)</td>
<td>1.99 (0.96)</td>
<td>1.70 (0.81)</td>
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<td>Self-efficacy for Condom Use</td>
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<tr>
<td>SE1 (Mean/SD, range 1–5)</td>
<td>3.53 (1.29)</td>
<td>3.75 (1.19)</td>
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<td>SE2 (Mean/SD, range 1–5)</td>
<td>3.58 (1.22)</td>
<td>3.76 (1.12)</td>
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<tr>
<td>SE3 (Mean/SD, range 1–5)</td>
<td>3.39 (1.28)</td>
<td>3.60 (1.23)</td>
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<tr>
<td>Non-IDU</td>
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<tr>
<td>Frequency of crack/freebase use (Mean/SD, range 0–9)</td>
<td>2.67 (3.62)</td>
<td>1.87 (3.37)</td>
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<tr>
<td>Frequency of marijuana/hashish use (Mean/SD, range 0–9)</td>
<td>1.71 (2.81)</td>
<td>1.04 (2.53)</td>
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<td># other drugs not injected (Mean/SD, range 0–13)</td>
<td>0.22 (0.55)</td>
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<td>IDU</td>
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<td>Cocaine injection (% yes)</td>
<td>4.4</td>
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<td>Heroin injection (% yes)</td>
<td>8.1</td>
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<td>Needle sharing (% yes)</td>
<td>6.1</td>
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<td>Alcohol Use</td>
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<td>Alcohol use (% yes)</td>
<td>73.9</td>
<td>49.8</td>
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<td>Frequency of alcohol use (Mean/SD, range 0–9)</td>
<td>3.82 (2.88)</td>
<td>2.68 (3.14)</td>
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<td># drinks (Mean/SD, range 0–5)</td>
<td>1.38 (1.19)</td>
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<tr>
<td>Number of Sexual Partners (Mean/SD)</td>
<td>0.26 (0.38)</td>
<td>0.19 (0.46)</td>
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</table>

* Dependent $\chi^2$ tests (McNemar) for dichotomous variables, dependent $t$-tests for all other variables with d.f. = 294.

$p < .05; **p < .01; ***p < .001; All factor loadings significant at p < .001
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*p < .05; **p < .01; ***p < .001
with respect to the TB treatment area, our intervention program was able to induce cognitive and behavioral changes (Nyamathi et al., 2007). Simultaneous changes in two different treatment areas can appear overwhelming, especially for populations with many co-existing health risks. Therefore, participants may have focused on TB risk reduction. In the future, they might be able to translate their knowledge and skills to HIV risk reduction.

A competing explanation for the finding is that changes in knowledge and attitudes are expected to precede changes in behaviors (Bentler & Speckart, 1981). Thus, cognitive changes could lead to behavioral changes in the future. The time frame of this study with a six-month follow-up might have been too short to capture behavioral changes in this challenging population. On the other hand, research on the relation between HIV and AIDS attitudes and

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**Figure 1.** Final predictive path model. Circles denote latent variables, rectangles denote measured variables. See Table 1 for measured indicators of latent variables. Correlations among variables at baseline and among residuals of variables at follow-up not shown.

*p < .05; **p < .01; ***p < .001. Fit statistics: S-B $\chi^2(424, N = 295) = 717.71, p = .15, RCFI = .99, RMSEA = 0.016, 95\% \text{ CI: .000–.026}$
behaviors suggests that there may be a small correlation between attitudes and behaviors (Liverpool, McGhee, Lollis, Beckford, & Levine, 2002) and that attitudes influence behaviors under certain conditions (Somlai, Kelly, Wagstaff, & Whitson, 1998). Further research is needed to examine to what extent changes in cognitive factors can trigger changes in behavioral factors in the context of HIV risk reduction in homeless adults.

While the intervention program did not impact substance use, we observed a decrease in non-injection drug use and alcohol use for the participants in the residential drug recovery programs as one might expect. The primary focus of the intervention program was completion of a TB treatment regimen, which required being inclusive and accepting of all participants; thus abstinence from substance use was encouraged but not required for participation in the program. Specialized treatment facilities, such as the residential drug recovery programs, seem to be more appropriate to target substance use than an intervention program focused primarily on latent TB infection treatment completion.

Our study has implications for practice and research. For practical contexts, our study indicates that successful intervention programs to reduce cognitive aspects of HIV risk among homeless adults are possible. Similar programs to reduce HIV risk have been successfully applied among homeless and drug-using minority women (Nyamathi, Flaskerud, Bennett, Leake, & Lewis, 1994; Nyamathi et al., 1993; Nyamathi & Stein, 1997; Stein et al., 1997), as well as homeless and drug-using men and women of all ethnicities (Nyamathi, Bayley, Anderson, Keenan, & Leake, 1997; Nyamathi, Flakerud, Keenan, & Leake, 1998). These studies provide evidence that the intervention program represents a portable program that can be adapted to various vulnerable populations and a variety of treatment areas. Current reviews of HIV interventions indicate the need for efficacious interventions among populations at greatest risk of HIV infection or transmission (Lyles et al., 2007).

The current study evaluated a program for two treatment areas, TB and HIV risk reduction, and found it to be beneficial for reducing certain aspects of HIV risk in addition to its powerful effect on TB prophylaxis. The program seems to provide synergistic effects by impacting common risk factors for HIV and TB.

The success of these programs appears to lie in the comprehensive approach used, including nurse case management, educational and skills training, delivered in a culturally competent, accepting manner. The current study shows the importance of these strategies when working with homeless adults to reduce HIV risk. These strategies may also be essential in other treatment areas, in other settings or other populations. Thus, programs aimed at reducing health risk in vulnerable populations that do not use these strategies may not succeed.

Our study contributes to an advancement of research and theory. With its subject area of HIV and AIDS risk reduction, this study addresses an important topic of health psychology research. Further with its conceptual framework of the CHSCP, this study draws on major empirical findings from the health psychology domain. The CHSCP achieves an integration of core health psychology approaches such as stress, coping behaviors and health outcomes, in a new theoretical approach. A unique contribution of the CHSCP is the extension of health psychology models and theories to vulnerable populations. In its current form, the program is delivered by nurses and outreach workers. The program represents an effort to support the adoption of health psychology concepts by different professional groups, thus promoting interdisciplinary work.

Some limitations of the present research warrant mentioning. The setting was a limited number of homeless shelters and residential drug recovery programs in downtown Los Angeles, USA. The sample may not be representative of homeless individuals in other regions and in other countries, thus lessening the generalizability of the findings. The assessment of drug and alcohol use is based on self-reports and is thus subject to response bias. However, previous studies found strong correlations between objective measures of substance use and self-report data in homeless populations (Nyamathi, Leake, Longshore, & Gelberg, 2001). The study employed a six-month follow-up, but an additional follow-up would have been desirable to examine the long-term stability of the effects and to determine whether the intervention is able to also induce behavioral changes that may take longer to surface.

Regarding HIV risk reduction, condom use would have been a key behavioral variable to include. In the present study, condom use with regular sexual partners and condom use with other sexual partners were assessed as core outcome variables. However, the items referring to condom use with regular or other sexual partners were not applicable to many participants, resulting in high proportions of missing values. At follow-up 22.7 percent of the participants reported...
that they did not have a regular sexual partner, and 58.3 percent reported that they did not have other sexual partners. Therefore, condom use had to be omitted as an outcome variable from the present analysis. Tentative findings pertaining to participants who had sexual contact with either regular or other partners can be presented: from baseline to follow-up, the frequency of condom use with regular partners and other partners increased significantly (dependent t-tests p < .001 and p < .05, respectively), but these increases were not significantly influenced by group membership (repeated measures ANOVAs p > .05).

In summary, we conclude that our comprehensive nurse case-managed intervention program, which was primarily targeted at reducing TB risk, has been partially successful in reducing HIV risk through increased knowledge and awareness of risk reduction behaviors. Future research should focus on advancing efforts to achieve behavioral changes. The impact of the intervention on core cognitive factors is encouraging, particularly in this high-risk population of homeless adults that struggle with so many co-existing problems. HIV risk reduction can be achieved by combining intervention efforts for both HIV and TB in homeless populations. Based upon the impact of cognitive changes, dual-purpose interventions for both HIV and TB risk reduction may be efficient and cost-effective in homeless populations.

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