DEMOGRAPHIC AND LIFESTYLE DETERMINANTS OF THE HIV SEROSTATUS OF CONSTRUCTION WORKERS

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Testing for HIV/AIDS is essential for determining HIV serostatus and initiating subsequent treatment for those found to be infected. Construction workers are regarded as a high-risk group in the context of the HIV/AIDS pandemic in South Africa. Factors associated with the HIV+ serostatus of construction workers are thus important. A self-administered questionnaire survey of 512 construction workers in the Western Cape explored this issue and found that HIV+ workers have poorer education levels and lower AIDS-related knowledge than non-infected workers. However, contrary to claims in the literature, lifestyle factors, while inter-related to some extent, were not found to be significant correlates of serostatus. More active, and more carefully directed, awareness, counselling and testing campaigns are advocated for construction companies as part of their HIV intervention management policies. Imparting appropriate AIDS-related knowledge and lifestyle advice at a much earlier point in school curricula is also recommended.

Keywords: construction workers, HIV serostatus, determinants, South Africa.

INTRODUCTION

The construction industry in South Africa has been identified as one of the economic sectors most adversely affected by HIV/AIDS, and also as one of the least responsive to the pandemic (Meintjes *et al.*, 2007; Bowen *et al.*, 2013). Bowen *et al.* (2008) reported that HIV prevalence amongst construction workers exceeded that of the national statistic (Shisana *et al.*, 2014). The high incidence of HIV in construction has been attributed to its formal and informal sectors; its labour employment structures; its high utilisation of migrant workers; its fragmentation of firms; its use of unskilled labour; and its geographical spread of project locations (Meintjes *et al.*, 2007). Harinarain and Haupt (2014) provide a comprehensive description of the vulnerability of the construction industry to HIV and AIDS. Small construction firms (which proliferate in the industry) generally do not have the resources to provide meaningful HIV prevention and treatment programmes. At best they tend to focus on awareness and prevention campaigns i.e., posters and dispensing condoms (Bowen *et al.*, 2013, 2014). In addition, the diversity of construction work and project locations makes it difficult to standardise or implement

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meaningful HIV interventions on construction sites. The workforce changes frequently due to the nature of the production process, the number of sites to be covered, and the use of sub-contract and temporary labour.

Voluntary counseling and testing (VCT) is an essential contributor to controlling the spread of HIV/AIDS and for initiating the provision of care to those infected (Denison *et al.*, 2008; Shisana *et al.*, 2014). VCT is also important in helping to change adverse patterns in risky sexual behavior which places individuals at risk of infection, by decreasing the number of sexual partners and by increasing condom use (Sherr *et al.*, 2007; Fonner *et al.*, 2012). HIV/AIDS testing satisfactorily clarifies both the HIV serostatus of individuals and their knowledge thereof, e.g. Tested (HIV+); Tested (HIV-); Don't know (tested but result not accessed); Don't know (not tested). This information is useful to construction organisations wishing to plan, resource and implement, HIV intervention management strategies. Knowing the demographic and lifestyle factors that correlate strongly with HIV serostatus would help to design and target interventions more appropriately.

The uptake of testing services by individuals is influenced by several demographic, lifestyle and psychosocial factors. Demographic factors positively related to testing in South Africa include gender (women), older age, higher levels of education, greater knowledge of HIV, and higher risk perception (MacPhail *et al.*, 2009; Ropelewski *et al.*, 2011; Shisana *et al.*, 2014). Lifestyle factors negatively related to testing include inconsistent condom use (Hargreaves *et al.*, 2007), excessive alcohol consumption (Parry *et al.*, 2004), and illegal drug use (Myers *et al.*, 2013). Negative psychosocial factors include attitudinal fear of testing (Venkatesh *et al.*, 2011) and stigma (Deacon *et al.*, 2009); while limited access to treatment may also be an influencing factor (Asante, 2007). Many of these factors are themselves inter-related. Despite extensive research in South Africa into HIV prevalence and its antecedents, little relates directly to the extent to which any of these factors are associated with the HIV serostatus of construction workers. This study addresses that issue and focuses on the demographic and lifestyle determinants of the HIV serostatus of workers in the South African construction industry. The aim of the study, therefore, was to better understand how demographic and lifestyle factors of construction workers are associated with HIV serostatus.

RESEARCH METHOD

The epistemological assumptions underpinning this study were of a positivist nature. Moreover, the analysis and interpretation of the data adopted an objectivist / determinist ontological paradigm in that it is possible that the HIV status of workers is partially or completely determined by the socio-economic environment in which they find themselves.

Participants and setting

A survey questionnaire was used to collect data. Convenience sampling was used for the selection of construction firms and sites, as well as the workers interviewed. Participants (n=512) were site-based unskilled and skilled workers and site office-based staff drawn from 6 firms on 18 construction sites in the Western Cape. The sample frame consisted of all employees present when the researchers visited the sites by prior arrangement. Ethics clearance was obtained from the University of Cape Town.

Questionnaires were available in English, Afrikaans and *isiXhosa* (an indigenous African language), the most commonly spoken languages in the Western Cape. Participants were briefed on the nature of the study, assured that their participation was entirely voluntary

and anonymous, and informed that they could withdraw at any time. Workers who provided informed consent then proceeded to complete the questionnaires, usually in site-office containers. Between them, the field researchers administering the questionnaire were proficient in all three languages.

Measures

Demographic and lifestyle characteristics: Age was in measured in actual years and then converted into five discrete age categories: 20 or under; 21-30; 31-40; 41-50; and over 50 years. Ethnicity was captured in terms of the following classifications: 'Black' African; 'Coloured' (mixed race); 'Indian'; and 'White', with the latter three classes being combined as 'Others' in the statistical analysis. Level of education was categorised as 'no schooling', 'primary', 'secondary', 'tertiary', or 'postgraduate'. Employment status was classified as 'permanent', 'temporary/contract', or 'casual'. Marital and family status was categorised as either 'married or in a long-term relationship', or 'single'; and if participants had children ('yes' or 'no'). Participants also reported their lifestyle risk behaviour characteristics. Risk behaviour items included alcohol consumption and cannabis ('dagga') use, sexual intercourse with multiple partners in the preceding three months, and use of a condom at last coital act. The list of variables is given in Table 1. Participants were asked to report on their HIV testing status: HIV+ (tested), HIV- (tested), 'Don't know' (tested), and 'Not tested'. Additionally, HIV+ participants were asked whether or not they were currently taking antiretroviral (ARV) medication ('yes'; 'no'). These characteristics were drawn from Kalichman and Simbayi (2003, 2004).

AIDS-related transmission knowledge: Table 2 lists the seven items used to compile the AIDS-related transmission knowledge scale (the '*knowledge scale*'). The items were drawn from Kalichman and Simbayi (2003). Response options were 'yes', 'no' or 'do not know'. The scale was scored for the number of correct responses: 1=correct; 0=incorrect; 0='do not know' (score range 0 to 7; higher score = higher levels of knowledge).

Exploratory factor analysis (EFA) using maximum likelihood and oblimin rotation was undertaken on the knowledge scale (see Pett *et al.*, 2003). To assess the suitability of the sample for factor analysis, Bartlett's Test of Sphericity (BToS) and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were used. The Bartlett's test was significant (χ^2=934.01, *df*=21, p<0.001), and the KMO value (0.758) supported the suitability of the data for factor analysis. However, the EFA revealed two factors with eigenvalues exceeding 1. After rotation, the two-factor solution explained 47.0% of the common variance, with Factor 1 contributing 33.2% and Factor 2 contributing 13.8%. Items K1 and K2 (see Table 2) loaded strongly onto Factor 1, whilst the remaining items loaded strongly onto Factor 2. When a single factor solution was forced, 31% of the common variance was explained. All items loaded strongly onto the single factor, with the exception of item K3 (0.227). However, given that Hair *et al.* (2014) stress the need for a minimum of three items per factor for the scale to be successfully identified, a single factor was retained.

Following on from the EFA, the observed factorial structure was specified and subject to a CFA using structural equations modelling. No correlated errors were specified in this initial model. In considering factor loadings, a threshold of 0.50 was determined to be acceptable for individual items (Hair *et al.*, 2014). Four critical fit indices were applied to determine the degree of fit of the structural equation model as follows (indices reflecting good model fit indicated in parenthesis): $\chi 2/df$ ratio (less than 4) Bentler CFI (comparative fit index (0.95 and greater)); RMSEA (root mean square error of approximation (0.05 and less)); and Hoelter (critical N (CN) index) (200 and greater).

The initial model was a very poor fit to the data ($\chi 2$ */df* ratio=18.975, CFI=0.736, RMSEA=0.188, and Hoelter (95%)=46). The modification indices indicated the need for the error terms of items K1 and K2 to be permitted to co-vary. With this path specified, the resultant model proved an excellent fit ($\chi 2$ */df* ratio=1.431, CFI=0.994, RMSEA=0.029, and Hoelter (95%) =615). All factor loadings in this model were statistically significant ($p<0.001$). Internal consistency was good, $\alpha=0.76$. A 1-factor model of AIDS knowledge was retained.

Statistical analysis

Table 1. Demographic and lifestyle risk characteristics of HIV+ and HIV-construction workers participating in the survey (n=354)

Characteristics	**HIV+ (*n*=34)**		**HIV- (*n*=320)**		**χ^2**
	n	**%**	***n***	**%**	***p*-value**
Demographic characteristics					
Age[+]	*M*=38.5	*SD*=10.4	*M*=37.0	*SD*=10.7	**0.458[++]**
20 and younger	3	9	8	3	
21 to 30	3	9	99	32	
31 to 40	9	28	96	31	
41 to 50	13	41	60	20	
51 and over	4	13	43	14	
Gender					0.555[§]
Male	31	94	282	89	
Female	2	6	35	11	
Race / ethnicity					0.854[§]
'Others'	14	41	123	39	
'Black' African'	20	59	194	61	
Level of education					**0.027***
No schooling	4	12	10	3	
Primary	6	18	67	21	
Secondary	21	64	163	52	
Tertiary	2	6	61	20	
Postgraduate	0	0	12	4	
Nature of employment					0.575
Permanent	22	65	210	67	
Temporary / Contract	12	35	96	31	
Casual	-	-	8	2	
Lifestyle characteristics					
Alcohol use in the past 3 months					0.654
No	13	38	147	46	
Once only	4	12	35	11	
More than once	17	50	135	43	
'Dagga' (Cannabis) use in the past 3 months					0.482
No	28	85	288	91	
Once only	2	6	9	3	
More than once	3	9	20	6	
Use of condoms: Did you use a condom the last time you had sex?					0.857[§]
Yes	19	56	166	53	
No	15	44	149	47	
Sex partners: Have you had ≥ 2 sex partners in the last 3 months?					0.349[§]
Yes	8	24	54	17	
No	26	76	261	83	
AIDS-related transmission knowledge (scale)	***Mean***	***SD***	***Mean***	***SD***	**0.006[**++]**
Knowledge score (Range 0-7)	4.09	2.18	5.05	1.90	

*Notes: [+]Age measured in years, but presented here in intervals. [§]Fisher's Exact Test used rather than Chi-square test for independence. [++]Independent Samples 't' Test. *p<0.050; **p<0.010.*

Table 2. Scale items and Cronbach's alpha reliability coefficient for HIV/AIDS transmission knowledge scale (n=354)

Factors	Items	(α)
HIV/AIDS transmission knowledge		0.758
Correct response=1 Incorrect response=0 Don't know=0 Range: 0-7	K1. Can men give AIDS to women? (Yes) K2. Can women give AIDS to me? (Yes) K3. Must a person have many different sex partners to get AIDS? (No) K4. Does washing after sex help protect you against getting AIDS? (No) K5. Can a pregnant woman give AIDS to her baby? (Yes) K6. Can the use of vitamins and healthy foods cure AIDS? (No) K7. Can traditional African medicines cure AIDS? (No)	

Note: Correct responses indicated in parentheses against each knowledge question.

The data were analysed using IBM SPSS Ver. 23.0 For Macintosh (IBM Corporation, 2015a). The CFA was undertaken using IBM Amos Ver. 23.0 For Macintosh (IBM Corporation, 2015b). Chi-square ($\chi 2$) tests were used to examine bivariate relationships between HIV serostatus and categorical demographic and lifestyle factors. The independent samples't' test was used to compare the mean scores for age and transmission knowledge of HIV+ and HIV- participants. Logistic regressions were used to calculate unadjusted and adjusted odds ratios (ORs) for the determinants of HIV serostatus. Variable selection for the regression analyses was based on the literature (Kalichman and Simbayi, 2003, 2004) and the bivariate analyses. Unless otherwise stated, frequencies and percentages provided relate to the number of valid responses to individual questions.

RESULTS

Participant characteristics

Most participants in the full dataset (*n*=512) were male (91%; *n*=461). Ages ranged from 18 to 69 years (mean = 36, SD = 10.9), with most being in the 21-30 year age group (34%; *n*=168). Almost two-thirds (62%; *n*=313) of participants were 'Black' African (as distinct from the other ethnic groupings). Over a quarter (29%; *n*=144) had at most primary level education, whilst 52% (*n*=260) had secondary level education. Permanent employees accounted for 62% (*n*=304) of the survey participants; while 34% (*n*=167) were contract workers (employed on a project basis); and 4% (*n*=22) occasional (casually hired) workers. Sixty-five per cent (*n*=320) were either married or in long-term relationships, and 76% (*n*=380) had children.

Sixty-three per cent (*n*=320) claimed to be HIV- (tested); 7% (*n*=34) reported being HIV+ (tested); 26% (*n*=131) had never been tested; 4% (*n*=20) had been tested but claimed not to know the results; and 1% (*n*=7) failed to respond to this question. Of the 34 HIV+ participants, 14 (42%) reported taking their ARV medication, 10 (29%) claimed not to be taking ARV medication, and 10 (29%) did not answer this question. Public health clinic policies relating to treatment delay (based on CD4 count) could explain the results for HIV+ workers (Bowen *et al.*, 2014).

Unless otherwise stated, the remainder of the analyses were performed on the serostatus sub-samples of HIV+ (*n*=34) and HIV- (*n*=320) participants, the demographic characteristics of which are shown in Table 1.

In comparing the two sub-samples, significant differences between them occurred with respect to level of education (*p*=0.027) and AIDS-related knowledge scores (*p*=0.006). Proportionately less-educated workers were encountered more frequently in the HIV+

group than in the HIV- group; while the HIV- group demonstrated a significantly higher level of AIDS knowledge than did the HIV+ group (HIV+: mean score=4.09; HIV-: mean score=5.05). However, the considerable discrepancy in size of the two-sub samples renders these comparisons subject to caution in interpretation.

Correlates of demographic and behavioural variables

The correlation coefficients between HIV serostatus and all demographic, lifestyle and knowledge variables were determined (statistics not shown here). For the key associations:

- Level of education was found to be significantly negatively correlated with age and positively correlated with gender. Older workers, and male workers, recorded significantly lower levels of education than did females and younger co-workers. Additionally, 'Black' African workers reported significantly lower levels of education than did their counterparts in the combined ethnic group (all $p<0.01$).
- AIDS-related knowledge was significantly positively correlated with gender, level of education, and alcohol consumption, and significantly negatively correlated with age and race (all $p<0.01$); older, male, 'Black' African, and poorer educated workers possessed lower levels of AIDS-related knowledge than did females and other groups.
- Alcohol consumption was significantly positively correlated with both level of education and extent of AIDS-related knowledge (both $p<0.01$). Better-educated and more knowledgeable workers reported greater alcohol consumption than did their counterparts.
- Alcohol consumption and dagga smoking were significantly positively associated ($p<0.01$).
- Better education was significantly positively associated with higher levels of AIDS-related knowledge. Better-educated and more knowledgeable workers were significantly less likely to report HIV+ serostatus.

Correlates of HIV serostatus

While the research objective was not to undertake comparisons across multiple reference categories for every variable, Table 3 indicates the unique and relative significance of the relationship between HIV serostatus and the various participant characteristics (unadjusted and adjusted). The reference category for the dependent variable (HIV serostatus) is HIV+.

Demographic factors: Of all the demographic variables, only level of education (OR=1.69; 95% CI 1.09-2.62; $p<0.05$) was significantly associated with HIV serostatus in the unadjusted model. The odds ratio for level of education (aOR=1.93; 95% CI 1.09-3.42; $p<0.05$) remained significant and increased in the adjusted model when controlling for all the other correlates (see Table 3).

Lifestyle and knowledge factors: AIDS-related transmission knowledge (OR=1.25; 95% CI 1.06-1.47; $p<0.01$) was significantly associated with HIV serostatus in the unadjusted model and slightly increased in the adjusted model (aOR=1.26; 95% CI 1.03-1.53; $p<0.05$). No other lifestyle factors were associated with HIV serostatus in either the unadjusted or adjusted models (see Table 3).

Table 3. Simple and multiple logistic regression models for the relationship between HIV serostatus and characteristics of construction workers (n=354)

Characteristics	Unadjusted OR	Unadjusted 95%CI	Adjusted++ OR	Adjusted++ 95%CI
Demographic characteristics				
Age	0.99	0.96 - 1.02	0.99	0.95 - 1.03
Gender	1.92	0.44 - 8.39	0.68	0.14 - 3.45
Race / ethnicity	1.10	0.54 - 2.27	1.63	0.63 - 4.22
Level of education	**1.69***	1.09 - 2.62	**1.93***	1.09 - 3.42
Nature of employment	1.01	0.52 - 1.99	1.06	0.49 - 2.26
Lifestyle and knowledge characteristics				
Alcohol use+	0.84	0.58 - 1.22	0.69	0.43 - 1.09
Dagga (Cannabis) use+	0.76	0.42 - 1.37	0.70	0.36 - 1.38
Condom use at last coital act	0.88	0.43 - 1.79	0.57	0.24 - 1.33
Multiple sex partners (>=2)+	0.67	0.29 - 1.57	0.63	0.25 - 1.60
AIDS-related transmission knowledge	**1.25****	1.06 - 1.47	**1.26***	1.03 - 1.53

*Notes: +Reported for the past three months; ++Model adjusted for all covariates; *p<0.050; **p<0.010. The reference category for the dependent variable (HIV serostatus) is HIV+.*

Multivariate analysis

To examine the demographic, lifestyle and knowledge determinants of HIV serostatus, binary logistic regression was performed (see Table 4). Listwise deletion of cases with missing values resulted in 312 cases for the binary logistic regression.

Table 4. Multivariate logistic regression analysis of predictors of HIV/AIDS serostatus (n=312)

HIV/AIDS serostatus	Odds Ratio	*p*-value	95.0% C.I. for Odds Ratio Lower	Upper
Demographic characteristics				
Age	.989	.614	.949	1.031
Gender	.682	.643	.135	3.445
Race / ethnicity	1.625	.319	.625	4.220
Level of education	1.928	**.025***	1.087	3.417
Nature of employment	1.056	.889	.493	2.262
Lifestyle & knowledge characteristics				
Alcohol use+	.686	.107	.434	1.085
Dagga (Cannabis) use+	.700	.302	.355	1.379
Condom use at last coital act	.568	.193	.243	1.332
Multiple sex partners (>=2)+	.630	.330	.249	1.596
AIDS-related transmission knowledge	1.258	**.022***	1.033	1.532
Constant	1.195	.929	-	-

*Notes: +Reported for the past three months; *p<0.050; **p<0.010.*
The reference category for the dependent variable (HIV serostatus) is HIV+.

A test of the full model against a constant-only model was statistically significant, indicating that the predictors as a set reliably distinguished between HIV+ and HIV- workers ($\chi^2 = 20.21$, $p < 0.05$ with $df = 10$). The -2 Log Likelihood was 181.76. The Nagelkerke's R^2 of 0.132 indicated that 13.2 per cent of the variability in HIV serostatus was explained by this set of variables. The Hosmer and Lemeshow Goodness-of-Fit test ($\chi^2 = 7.23$, p=0.512 with $df = 8$) indicated a good-fitting model.

Education (OR=1.93; 95% CI 1.09-3.42; $p<0.05$) and AIDS-related transmission knowledge (OR=1.26; 95% CI 1.03-1.53; $p<0.05$) were statistically significant determinants of HIV serostatus (see Table 4). The Likelihood Ratio Test statistics (obtained using the multinomial logistic regression routine in SPSS; $n=312$) provided an indication of the *unique* contribution of each independent variable to the prediction of HIV serostatus. A statistically significant *unique* contribution was made by education ($\chi^2 = 5.27$, $p<0.05$ with $df = 1$) and AIDS-related transmission knowledge ($\chi^2 = 5.09$, $p<0.05$ with $df = 1$).

DISCUSSION

The survey results are tempered somewhat by the limitations of the study. These include the cross sectional nature of the survey, the geographical bias of the sample (Western Cape), the convenience sample (workers from six willing construction companies), and any potential deliberate misreporting of risky lifestyle behaviors and HIV serostatus by the survey participants.

In this study, 73% of participants reported prior testing for HIV. This testing rate exceeds the 66% population-level testing rate reported by Shisana *et al.* (2014). Nevertheless, it is cause for concern that, given the reality of the pandemic, more than a quarter of participants reported never having been tested. A more alarming result is that less than half of the HIV+ sub-sample (42%) reported taking ARV medication. Possible reasons for this include poor family support, depression, and internalised stigma (see Nsimba *et al.*, 2010), but conclusive explanations will require deeper investigation.

Alcohol consumption and 'dagga' use were significantly positively associated, as was the use of these substances and multiple sex partners. Thus risky lifestyle behaviour is rarely a single factor phenomenon. However, none of the lifestyle factors (alcohol and 'dagga' use, condom use, and multiple sex partners) was significantly associated with reported HIV serostatus. This conflicts with much of the literature (see, for example, Shisana *et al.*, 2014). Possible reasons to explain this anomaly could relate to the small sample of HIV+ participants, language issues, low education/literacy levels, and deliberate misreporting of risky lifestyle behaviours and HIV serostatus. This will be explored more fully in future research.

Construction workers' level of formal education is clearly linked to the extent of their AIDS-related transmission knowledge, and their reported HIV serostatus. Better-educated workers, and more knowledgeable workers, were 1.9 and 1.3 times more likely, respectively, to be HIV- when compared to HIV+ workers. Level of education and AIDS-related knowledge were significantly positively associated, with better-educated workers possessing greater levels of transmission knowledge. These results align with the literature (see Ropelewski *et al.*, 2011; Shisana *et al.*, 2014).

None of the other demographic characteristics were associated with HIV serostatus, a finding that is at odds with studies relating to age, gender, ethnicity, and nature of employment (see MacPhail *et al.*, 2009; Shisana *et al.*, 2014). A possible explanation could lie in the more proactive interventions offered by the companies participating in the survey (see Bowen *et al.*, 2013).

CONCLUSIONS

The demographic and lifestyle determinants of the HIV serostatus of workers in the South African construction industry were explored. HIV+ construction workers were found to have significantly lower levels of education and AIDS-related knowledge than HIV-

workers. Level of education and AIDS-related knowledge were strongly and positively associated. Alcohol consumption, dagga use, condom use and multiple sex partners were significantly positively associated, but were found to be unrelated to HIV serostatus. Age, gender, ethnicity and level of employment were also unrelated to HIV serostatus.

The link between workers' level of formal education, the extent of their AIDS-related transmission knowledge, and their HIV serostatus has important implications for HIV/AIDS interventions implemented by construction firms. It suggests a need for more carefully structured interventions specifically designed to actively 'reach' workers possessing lower levels of education and poorer AIDS-related knowledge. Such interventions need to move beyond the passive approaches of posters and similar general communication media, and engage workers in a more active and targeted way that recognises language and cultural differences and educational shortfalls. If construction workers continue to enter the industry before completing (or even reaching) high school, then national education policies should incorporate AIDS-related knowledge (and lifestyle advice) much earlier than the later high school years, possibly at a point where the onset of puberty and adequate literacy intersect.

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