Is social capital associated with HIV risk in rural South Africa?

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Total word count: 7441

Key words: South Africa, rural, social capital, HIV/AIDS, intervention study

Acknowledgements

The study has received financial support from AngloAmerican Chairman's Fund Educational Trust, AngloPlatinum, Department for International Development (UK), The Ford Foundation, The Henry J. Kaiser Family Foundation, HIVOS, South African Department of Health and Welfare, and the Swedish International Development Agency. We would like to thank the Managing Director of SEF, John de Wit, and the many staff who have made this work possible.

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Abstract

The role of social capital in promoting health is now widely debated within international public health. In relation to HIV, the results of previous observational and cross-sectional studies have been mixed. In some settings it has been suggested that high levels of social capital and community cohesion might be protective and facilitate more effective collective responses to the epidemic. In others, group membership has been a risk factor for HIV infection. However, there have been few attempts to strengthen social capital in a theoretically informed way, particularly in developing countries, and examine its effect on vulnerability to HIV. Employing data from an intervention study, we examined associations between social capital and HIV risk among 1063 14-35 year old male and female residents of 750 poor households from eight villages in rural Limpopo province, South Africa. We examined cognitive social capital (CSC) and structural social capital (SSC) separately, and included numerous aspects of HIV related psycho-social attributes, risk behaviour, prevalence and incidence. Among males, after adjusting for potential confounders, residing in households with greater levels of CSC was linked to lower HIV prevalence and higher levels of condom use. Among females, similar patterns of relationships with CSC were observed. However, while greater SSC was associated with protective psychosocial attributes and risk behaviour, it was also associated with higher rates of HIV infection. This work further emphasizes the complexity and nuance required in applying a social capital framework to understanding HIV risk in the rural African context. We suggest that not all social capital is protective or health promotive, and that getting the balance right is critical to informing HIV prevention efforts.

Introduction

Over the past decade, South Africa has witnessed one of the fastest growing HIV epidemics in the world. Between 1992 and 2005, HIV prevalence among antenatal clinic attenders has increased by more than ten-fold, from 2.4% to 30.2% (Department-of-Health, 2005). Since 2002, death from AIDS has outstripped all other causes of adult mortality combined (Dorrington et al., 2001).

There is an evolving literature that attempts to explain why some countries or communities have more HIV than others. The 'risk environment' defines aspects of social situations, structures and places that are largely outside individuals' control yet have a major effect on the level of disease in populations (Rhodes et al., 2005; G. Rose, 1985). In South Africa, major elements of the risk environment thought to fuel vulnerability to HIV include: poverty and underdevelopment in the setting of extreme social and economic inequality; the high rates of labour migration, and; entrenched gender inequalities where physical and sexual violence against women and girls are commonplace (Fenton, 2004; Garcia-Moreno C & Watts C, 2000; Gilbert & Walker, 2002; Mane et al., 1994; Parker et al., 2000; Rao Gupta, 2002; UNAIDS, 1999, 2002). The evolution, persistence and interaction of these structural factors play a powerful role in shaping networks and norms that influence sexual decisions, underpinning the severity and scale of the HIV epidemic.

The mechanisms through which structural factors interact to shape health outcomes are diverse and complex. The concept of social capital has been put forth as a framework for cutting through some of this complexity. Social capital has been defined as the "features

of social organization, such as trust, norms and networks, that can improve the efficiency of society by facilitating coordinated action” (Putnam et al., 1993). There is growing evidence suggesting social capital may be an important pathway variable, capturing important dimensions of the risk environment, and linking relationships at the structural level to a host of individual health outcomes including HIV (Berkman & Kawachi, 2001b; Szreter & Woolcock, 2004).

There are a number of mechanisms through which social capital might affect the prevalence and distribution of HIV (C. Campbell & MacPhail, 2002; C Campbell et al., 2002; Gregson et al., 2004; Veenstra, 2000). At a very basic level, non-random mixing of high risk ‘core-groups’ - such as intravenous drug users or sex workers, was demonstrated to fuel much of HIV transmission early on in the epidemic. However, well-functioning community networks and the social and material resources that flow between them may also carry protective effects. Strong social networks may exert social or cultural pressure in ways that deter high-risk sexual activity. In addition to providing avenues for the exchange of information, these networks may shape community norms around gender relations, communication and sexual negotiation. They may provide role modelling for health-promotive behaviour – such as condom use or access to HIV testing. Individuals with wider networks and deeper trust relationships may have a stronger sense of self-confidence, self esteem and may be better able to take control over decision making. The emotional support generated around these networks may reduce discrimination around HIV and create a more accepting environment for those living with the disease. Finally, more cohesive communities may be better able to take collective action and respond to common priority issues such as HIV/AIDS.

Better understanding the relationship between social capital and HIV risk thus has potential to influence and inform prevention activities (Poundstone et al., 2004). Perhaps the most compelling observational work to date comes from two very diverse contexts where epidemic control has been remarkably successful. There was an eight-fold reduction in new HIV infection rates among gay men in San Francisco over a four year period relatively early in the epidemic. Wohlfeiler notes that “most of the behaviour change took place very quickly, and to a large degree was simultaneous with the establishment of AIDS prevention agencies, rather than a result of those efforts” (Wohlfeiler, 2002). He attributes much of this decline to effective mobilization efforts, notably, among an educated, socially active and well-resourced community facing a direct and immediate threat. Furthermore, public health initiatives were formulated through substantial consultation and involvement of the gay community itself.

The second example comes from Uganda where reductions in antenatal HIV prevalence from 30% to under 10% were observed between 1990 and 2005 – reductions that were not witnessed in neighbouring countries such as Kenya where the epidemic was of similar scale and maturity (Green, 2003). It has been suggested that effective social mobilization, particularly through peer-to-peer networks, critically underpinned dramatic reductions in prevalence. The effect of such dynamics was felt to be ‘equivalent to a highly effective vaccine’ (Stoneburner & Low-Beer, 2004). Again, such efforts largely preceded widespread support for conventional prevention measures such as condom distribution, voluntary counselling and testing services, and the syndromic management of sexually transmitted diseases.

In contrast, a lack of social capital may serve to exacerbate HIV infection and limit the effectiveness of control efforts. In her post-mortem of an intensive programme to reduce HIV transmission in and around a mining community in South Africa, Campbell noted how the absence of community cohesion and the transformation of social and sexual norms associated with chronic poverty and dislocation played a major role in limiting the impact of an ambitious and well-conceived intervention programme (C Campbell, 2003).

Despite its promise, the application of social capital discourse to framing and responding to public health challenges such as HIV/AIDS remains at a very early stage. Few studies have empirically examined social capital as an explicit component of the HIV risk environment. Cross-sectional research from the US drawing upon state-wide social capital measures have noted inverse associations with STI rates, including AIDS (Holtgrave & Crosby, 2003). Others have demonstrated associations between social capital proxies, such as the density of broken windows in a neighbourhood, and rates of gonorrhoea (Cohen et al., 2000). In Southern Africa, cross-sectional research from Zimbabwe and South Africa suggest that while membership in some social groups is associated with lower rates of HIV, membership in others seem to exacerbate the risk of infection (C Campbell et al., 2002; Gregson et al., 2004).

While these studies are exploratory, they raise intriguing questions regarding the temporal and causal nature of such relationships and the potential mechanisms through which social capital might affect HIV risk. In reflecting on the need to advance the rigour of this emerging evidence base, a number authors have highlighted common limitations to previous research, suggesting critical directions for future work (M. J. De Silva et al., 2004; Harpham et al., 2002; Macinko & Starfield, 2001; Szreter & Woolcock, 2004).

- Despite over a decade's experience, there is *no universally accepted way to measure social capital*. Social capital assessments have often relied upon indicators from surveys designed for a different purpose. To address these concerns, there is emerging consensus that social capital assessments should capture both structural (aspects of social group membership) and cognitive dimensions (perceptions of trust, solidarity, and reciprocity in one's community), and should attempt to ensure these measures are locally appropriate and valid.
- Research questions should be underpinned by a *clear theoretical and conceptual base*
- *Few longitudinal studies exist* to allow for a more definitive exploration of causal relationships and mechanisms of action.
- The *effects of mediating and confounding* variables have been poorly addressed.
- Finally, few intervention studies exist, alongside a paucity of research from developing countries.

In this study, we attempt to address a number of these shortcomings in examining the relationship between social capital and HIV/AIDS in a rural South African context. The research took place within the Intervention with Microfinance for AIDS and Gender Equity (IMAGE Study), a randomized trial that explored the effect of a combined microfinance and training programme on HIV risk and levels of intimate partner violence (IPV) (Pronyk et al., 2006). One aim of the intervention was to generate social capital through stimulating participation in social networks, enhancing solidarity, and mobilizing communities around priority concerns including HIV/AIDS. The dataset allows for a detailed assessment of both cognitive (reciprocity, solidarity and collective action) and structural (group membership) dimensions of social capital alongside numerous

psychosocial, behavioural and biological aspects of HIV risk. The paper examines the nature and strength of these associations, and explores wider implications for policy and practice.

Methodology

Setting and sampling frame

This study was set among eight villages in South Africa's rural Limpopo Province. The area was densely settled with a total population of approximately 60 000, and is adjacent to a platinum mining belt. Study villages were between two and 20 km from a main trading centre. Poverty was widespread (D. Rose & Charlton, 2003) with high levels of circular labour migration (Collinson et al., 2005). 40% of households were female headed and the average household size was seven people. Few households had land or livestock sufficient to support livelihoods. One third of adults were unemployed and the major source of income was government grants including pensions and child-support.

Approximately 10% of households in each village were sampled. Households enrolled in this study included those participating in a microfinance-based intervention and equivalent households from comparison villages. Membership in the intervention was voluntary, but households were all among the poorest in their village, as assessed by participatory wealth ranking (Hargreaves et al., 2007). Comparison households were selected at random and matched both by poverty level and age of the senior female respondent. Household levels of social capital were assessed through interviews with female participants (average age 42 years). As microfinance participants tend to be older, HIV risk was assessed among a largely independent group of 14-35 year old male and female household members – those at greatest risk of infection. Only follow-up data

from 2004 was employed in this analysis because it contained information on HIV incidence, and the post-intervention variation in levels of social capital allowed for more robust testing of associations.

Theoretical framework linking social capital and HIV risk

Insert figure 1 here

Insert Table 1 here

Figure 1 outlines the theoretical framework linking social capital and HIV, with exposure and outcome variables listed in Table 1.

Social capital: The assessment of social capital has been drawn from the World Bank's Social Capital Assessment Tool and related literature (Grootaert et al., 2003; Harpham et al., 2002; Krishna & Shrader, 1999). Levels of social capital were assessed as follows:

Structural social capital (SSC)

- Group membership and the level or intensity of membership

$$SSC = \beta(g1) + \beta (g2) + \beta (g3) + \dots$$

where β is the multiplier for intensity of group membership (1 = member, 2 = active/regular attendee, 3 = group leader) and gx is the specific social group (derived from a pre-coded list of 18 potential groups).

Cognitive social capital (CSC)

A variable was constructed for CSC based on responses to nine questions (Table 1) from the following thematic areas:

- Perceived levels of reciprocity and community support
- Perceived solidarity in response to a crisis event
- Participation in collective action

HIV risk: HIV-related outcomes were derived from responses to questions in Table 1 based on a number of psychosocial attributes that might influence sexual decision making and behaviour including partner number and condom use with non-spousal partners. HIV prevalence was determined using oral-mucosal transudate specimens (OraSure UCB group, Belgium) and HIV incidence was measured based on repeated sampling after two years of observation.

Confounding factors were conceptually derived based on previous work highlighting variables with the potential to effect both social capital and HIV risk yet are not directly on the causal pathway between them. As such, the effects of age, education level, marital status, current employment or school enrolment, having had children in females, and the duration of local residence were all adjusted for in the analysis (Berkman & Glass, 2000; Bolin et al., 2003; Drukker et al., 2005; Jewkes et al., 2002). Socio-economic status (SES) was also examined as a confounder and was assessed through determining the value of a select list of non-fixed household assets.

Validity and internal reliability of social capital indicators

Extensive local piloting of survey tools was conducted over a three month period in 2001. The choice of indicators was based on an attempt to capture numerous dimensions of structural and cognitive social capital; the use of best practice tools developed for assessing social capital in the African context, and; feedback from field researchers to ensure questions and response codes were locally appropriate and well understood by interviewers and respondents.

Cronbach's alpha was used to assess internal reliability and the potential to combine responses from several survey questions into single numerical values (Bland & Altman, 1997). Reliability coefficients were: 0.55 for community support, 0.6 for solidarity, and 0.7 for collective action, which approached threshold values for internal validity. A composite variable for CSC was thus constructed including the three subcomponents above.

Internal reliability for a composite value that attempted to bring together indicators of structural and cognitive social capital was low (0.31). Further analyses therefore examined relationships with each dimension separately. Previous research has suggested SCS and CSC indeed measure different things and often have different relationships with health outcomes (De Silva et al 2004).

Statistical analysis

All data were entered into a Microsoft Access database containing a range of logic checks. Statistical analysis was conducted using Stata version 9.

Relationships between social capital and HIV risk were assessed using individual data derived from all households under study. Principle research questions pertained to whether, across the study site, associations existed between household levels of SSC/CSC and different dimensions of HIV risk among the young people living there. The hypothesis tested was that young people residing in households with higher levels of social capital would be at lower HIV risk. Furthermore, it was hypothesized that either high levels of pre-existing social capital (with potentially little room for measurable improvement) or recent strengthening of social capital stocks would both be protective. Both are reflected in the follow-up data used for this analysis as households with higher levels of CSC and/or SSC.

All variables were made binary for the purpose of analysis. For SSC, these reflect households below and above median values for the group membership score. For CSC, positive responses to all questions for each thematic area were ascribed a value of 1. A binary variable was constructed from a composite where those scoring 2/3 or greater were considered households with higher levels of CSC.

All analyses were conducted for males and females separately. Bi-variate models present crude odds ratios (OR) and 95% confidence intervals for all associations. Two multivariate logistic regression models further examined the effect of mediating and confounding. The first model examined the role of potential confounders including SES. A term for village pair was also included to adjust for potential village level clustering of associations (Model 1).

As the data employed for this analysis were collected during an intervention trial, a final model was created to adjust for the presence of the microfinance-based intervention

(Model 2). This allowed an assessment of whether relationships between social capital and HIV risk existed independent of exposure to the intervention. Also, through examining the direction and consistency of shifts in adjusted odds ratios after the inclusion of the intervention in the regression analysis, Model 2 provides some indication as to whether associations between social capital and HIV risk are strengthened or weakened by the presence of the intervention programme.

Results

Associations between Social capital and HIV risk

Males

Table 2 presents crude and adjusted models for 375 14-35 year old male members of 750 households. Numbers vary for some associations due to missing data for some indicators.

After adjusting for potential confounders (Model 1), male members of households with higher levels of CSC were less likely to be HIV positive (aOR 0.40 95% CI 0.16-1.00). They were also more likely to engage in protective risk behaviour including greater levels of condom use at last sex (aOR 1.95 95% CI 1.04-3.62) and consistent condom use (aOR 2.3 95%CI 1.12-4.63). There were also associations with protective psychosocial characteristics including a greater openness to discuss sexuality in the home (aOR 2.39 95% CI 1.38-4.11) and being less likely to consider themselves at high risk of HIV infection (aOR 0.44 95% CI 0.26-0.72).

There were no significant associations between SSC and HIV risk among males.

All significant associations with CSC from Model 1 were maintained after adjusting for the effects of the intervention in Model 2. Therefore, independent of effects of household exposure to the microfinance and training intervention, young men from households with higher levels of CSC had lower HIV prevalence, more protective patterns of condom use, were more open to talk about sex in the home, and perceived themselves to be at lower risk of HIV. The fact that there was little change in most aOR's between Model 1 and 2 further suggests limited intervention effects on associations in this group.

Insert Table 3 here

Females

Table 3 presents crude and adjusted models for 688 female members of 750 households. Within this group, 102 (14.8%) had direct exposure to the IMAGE intervention.

After adjusting for potential confounding factors (Model 1), females residing in households with greater CSC had higher levels of consistent condom use (aOR 1.95 95% CI 1.03-3.69), better communication (aOR 2.0 95% CI 1.31-3.07) were more open to discuss sex in the home (aOR 2.74 95% CI 1.81-4.13), and were more frequently involved in collective mobilization efforts (aOR 3.22 95% CI 2.18-4.76).

In contrast to males, there were a number of significant associations between SSC and HIV risk in females. After adjusting for confounders (Model 1), females residing in

households with higher levels of SSC had greater evidence of protective risk behaviour including more frequent condom use at last sex (aOR 1.75 95% CI 1.1-2.77) and consistent condom use (aOR 2.78 95% CI 1.52-5.09). There was also evidence of better communication (aOR 1.67 95% CI 1.11-2.5), openness to discuss sex (aOR 1.61 95% CI 1.08-2.41) and higher levels of collective action (aOR 1.57 95% CI 1.08-2.26). However, there was also evidence to suggest higher levels of SSC was associated with higher HIV prevalence (aOR 1.49 95% CI 0.89-2.5) and incidence (aOR 2.15 0.95-4.88).

After including a term for the intervention in Model 2, thus removing its effect on observed associations, only the associations between CSC and greater openness and collective action maintained significance. For SSC, protective relationships with consistent condom use were maintained, as were associations with higher HIV prevalence and incidence.

Some indication of the overall effect of the intervention on the relationship between social capital and HIV in females can be made through examining the size and consistency of the pattern of changes in aOR between Model 2 (when its effect is removed) and Model 1. For nearly all associations the shift in aOR suggests the intervention enhances the protective relationship between social capital and lower HIV risk. For example, the relationship between SSC and HIV incidence is further strengthened once the effect of the intervention is removed from Model 1 to Model 2 (from aOR 2.15 to 2.9). In a similar way the relationship between SSC and protective patterns of condom use at last sex weakens after including a term for the intervention in the model (from aOR 1.75 to 1.45).

Insert Table 4 here

Discussion

This study suggests that in a rural South African context social capital has important bearing on HIV risk in ways that are both complex and nuanced. Among males, residing in households with greater levels of cognitive social capital (CSC) was largely HIV protective. These men felt more open to discuss sex in the home, reported more protective patterns of condom use, and HIV prevalence was significantly reduced compared to their counterparts from households with lower levels of CSC. Household levels of structural social capital (SSC) played a less important role in this group.

The relationship between social capital and HIV risk were somewhat different for female household members. In this group, CSC and SSC were both associated with protective psychosocial attributes – including better communication, openness and participation in collective action. However, SSC seemed to play a much more important role in shaping overall HIV risk. After adjusting for potential confounders, while young women with greater SSC reported more protective patterns of condom use, they conversely had higher levels of both HIV prevalence and incidence.

The strengths of our analysis were that careful attention was given to the design and validation of measures of both cognitive and structural dimensions of social capital; that the effects of potential confounders were addressed; that numerous aspects of HIV risk were assessed, and; that biological measures of HIV incidence were used to capture recent infections. Nonetheless, this study also had a number of limitations that are important to draw attention to. Indicators used to assess social capital were derived from interviews with a non-random selection of poor households who participated in a

microfinance intervention and a group of matched comparison households. Observed relationships may therefore not adequately reflect dynamics in the community as a whole. In addition, measures of social capital were derived from senior females in the households – generating a proxy for household level dynamics. HIV risk was then assessed among a largely independent group of younger ‘at-risk’ household members. These measurement issues are very likely to account for observed gender differences in associations with SSC - with levels of SSC derived from senior females likely to have more direct influence on associations in younger women than in men. While the research did employ a clear theoretical framework, this approach was rather novel its appropriateness needs to be carefully weighed.

This study reaffirms findings from previous research from Southern Africa suggesting social capital does have the potential to influence vulnerability to HIV (C Campbell et al., 2002; Gregson et al., 2004; Nyanzi et al., 2005; Poundstone et al., 2004). However, this work further emphasizes that not all social capital is protective or health promotive, and getting the balance right is critical to informing intervention efforts. Our data suggest that strong community relations, characterized by a sense of mutual support, reciprocity, and collective mobilization around common concerns, are uniformly linked to lower levels of HIV risk for both men and women. However, our findings that higher levels SSC (expanded social group membership) may have the capacity to be detrimental to HIV risk in females are in line with the few other studies that have examined both SSC and CSC in developing countries. In these studies, contrary to expectations, high levels of SSC has been linked to *poorer* health outcomes, possibly as a consequence of overburdened social roles (M. De Silva & Harpham, 2007).

In our setting, that SSC may be associated with elevated HIV risk in young women suggests that expanding social networks on its own, particularly in the face of competing material needs and in an environment where the exchange of sex for resources is a survival strategy, may serve to increase vulnerability to infection. This is echoed in research from elsewhere in sub-Saharan Africa examining geographic differences in HIV infection rates. For example, numerous surveillance sites have reported four to six fold variations in HIV prevalence within the same local area (Barongo et al., 1992; Bloom et al., 2002; Boerma et al., 1999; Killewo et al., 1994; Kipp et al., 1995; Soderberg et al., 1994). This pattern captures disparities between low prevalence isolated rural areas and higher prevalence more accessible trading centres. These gradients reflect enhanced opportunities for social and sexual networking that prevail along development corridors. In our setting, expanded social networks might facilitate greater contact between younger more mobile women and high risk groups such as truck drivers and migrant workers who support local industry in the area.

There are important implications of this work for policy and practice in relation to HIV prevention in Africa. Firstly, working directly with and through new and existing social capital stocks may assist in the design and delivery of intervention programmes. Our data suggests the overall effect of an intervention which combined group-based microfinance (structural) with a training and community mobilization programme (cognitive) was to strengthen the protective dimensions of the relationship between social capital and HIV. There are additional lessons from elsewhere. For example, experience from 'community-level interventions' in developing countries that contain a component of social capital strengthening as a way of addressing HIV has been encouraging (CDC, 1999; Kelly, 1999; Kelly et al., 1997; Sikkema et al., 2005). Operating in high-risk environments such as gay bars or low-income housing

developments, a number of innovative programmes have reduced vulnerability to HIV by working through role models, opinion-leaders and established social networks to stimulate community awareness and mobilization around the disease. While not explicitly examined in these studies, gaining insights into how social capital might mediate intervention effects has the potential to carry important implications for programme sustainability, replicability and transfer to other contexts.

Second, a social capital discourse may deepen our understanding of risk environments—providing a theoretical bridge to connect relationships between structural factors and ill-health that might otherwise seem abstract and unapproachable. This is important as structural interventions for HIV are increasingly recognized as a necessary yet underdeveloped component of the response to the HIV epidemic in Africa and elsewhere (Blankenship et al., 2006; Parker et al., 2000; Sumartojo et al., 2000). Unlike working more directly with individual behaviour or biology, structural interventions are rooted in qualities of place and populations (Hawe & Shiell, 2000; Lochner et al., 1999) and are said to alter the ‘context in which health is produced or reproduced’ (Blankenship et al., 2006). By shifts in laws, policies, institutional or environmental change, these interventions are an attempt to generate more effective community responses to public health priorities, including HIV. Interventions at the structural level often demand bringing diverse disciplinary perspectives to bear on the epidemic. Employing a social capital framework permits a common conversation among representatives from these different disciplines, methodologies, and sectoral backgrounds (Woolcock, 2002). Finally, a social capital discourse has the potential to highlight key entry points, opportunities and pathways for maximizing the relevance and effect of these approaches.

In summary, we suggest that social capital has the potential to play an important role in supporting livelihoods and generally buttressing health, social and economic vulnerabilities in rural South Africa. The relationship between social capital and HIV risk observed in this study are encouraging and exploratory, and should provide an impetus for further research. At its most basic level, deepening our understanding of social capital is about 'getting social relations right' (Woolcock, 2002). In the face of HIV in Africa, these relations underpin both vulnerability to the disease and the capacity to effectively respond to it. Finally, the results of this work suggest a balanced and cautious application of social capital is warranted, and that better understanding where and how to work with communities is essential for effective policy and programme development.

References

- Barongo, L. R., Borgdoff, M. W., Mosha, F. F., Nicoll, A., Grosskurth, H., Senkoro, K. P., et al. (1992). The epidemiology of HIV-1 infection in urban areas, roadside settlements and rural villages in the Mwanza Region, Tanzania. *AIDS*, 6, 1521-2528.
- Berkman, L. F., & Glass, T. (2000). Social integration, social networks, social support and health. In L. F. Berkman & I. Kawachi (Eds.), *Social Epidemiology* pp. 137-173). Oxford: Oxford University Press.
- Berkman, L. F., & Kawachi, I. (2001b). *Social Epidemiology*. Oxford: Oxford University Press.
- Bland, J. M., & Altman, D. G. (1997). Cronbach's alpha. *British Medical Journal*, 314, 572.
- Blankenship, K. M., Friedman, S. R., Dworkin, S., & Mantell, J. E. (2006). Structural Interventions: Concepts, challenges and opportunities for research. *Journal of Urban Health*, 83(1), 59-72.
- Bloom, S. S., Urassa, M., Isingo, R., Ng'washerni, J., & Boerma, J. T. (2002). Community effects on the risk of HIV infection in rural Tanzania. *Sexually Transmitted Infections*, 78, 261-266.
- Boerma, J. T., Urassa, M., Senkoro, K. P., Klokke, A. H., & Ng'weshemi, J. Z. L. (1999). Spread of HIV infection in a rural area of Tanzania. *AIDS*, 13(10), 1233-1240.
- Bolin, K., Lindgren, B., Lindstrom, M., & Nystedt, P. (2003). Investments in social capital - implications for the production of health. *Social Science and Medicine*, 56, 2379-2390.
- Campbell, C. (2003). Letting them die: how HIV/AIDS prevention programmes often fail. Cape Town: Double Storey Books.
- Campbell, C., & MacPhail, C. (2002). Peer education, gender and the development of critical consciousness: participatory HIV prevention by South African youth. *Social Science and Medicine*, 55(2), 331-345.
- Campbell, C., Williams, B., & Gilgen, D. (2002). Is social capital a useful conceptual tool for exploring community level influences on HIV infection? An exploratory case study from South Africa. *AIDS Care*, 14(1), 41-54.
- CDC (1999). Community-level HIV intervention in 5 cities: final outcome data from the CDC AIDS community demonstration projects. *American Journal of Public Health*, 89, 336-345.
- Cohen, D., Spear, S., Scibner, R., & al, e. (2000). "Broken windows" and the risk of gonorrhoea. *American Journal of Public Health*, 90, 230-236.
- Collinson, M. A., Tollman, S. M., Kahn, K., Clark, S. J., & Garenne, M. (2005). Highly prevalent circular migration: households, mobility and economic status in rural South Africa. In E. Preston-Whyte (Ed.), *African Migration in Comparative Perspective* (p. in press). Johannesburg: Wits University Press.
- De Silva, M., & Harpham, T. (2007). Maternal social capital and child nutrition in four developing countries. *Journal of Health and Place*.
- De Silva, M. J., McKenzie, K., Harpham, T., & Huttly, S. R. A. (2004). Social capital and mental illness: a systematic review. *Journal of Epidemiology and Community Health*, 59, 619-627.

- Department-of-Health. (2005). National HIV and Syphilis prevalence survey: South Africa 2005. Pretoria: Department of health, South Africa.
- Dorrington, R., Bourne, D., Bradshaw, D., Laubscher, R., & Timaeus, I. (2001). The impact of HIV/AIDS on adult mortality in South Africa. Tygerberg, South Africa: Medical Research Council.
- Drukker, M., Buka, S. L., Kaplan, C., McKenzie, K., & Van Os, J. (2005). Social capital and young adolescents' perceived health in different sociocultural settings. *Social Science and Medicine*, 61, 185-198.
- Fenton, L. (2004). Preventing HIV/AIDS through poverty reduction: the only sustainable solution. *The Lancet*, 364, 1186-1187.
- Garcia-Moreno C, & Watts C (2000). Violence against women: It's importance for HIV/AIDS. *AIDS*, 14 (Suppl 3), S253-S265.
- Gilbert, L., & Walker, L. (2002). Treading the path of least resistance: HIV/AIDS and social inequalities - a South African case study. *Social Science and Medicine*, 54, 1093-1110.
- Green, E. (2003). Rethinking AIDS Prevention: Learning from success in developing countries. Westport, CT: Praeger.
- Gregson, S., Terceira, N., Mushati, P., Nyamukapa, C., & Campbell, C. (2004). Community group participation: Can it help young women to avoid HIV? An exploratory study of social capital and school education in rural Zimbabwe. *Social Science and Medicine*, 58, 2119-2132.
- Grootaert, C., Narayan, D., Jones, V. N., & Woolcock, M. (2003). Integrated Questionnaire for the Measurement of Social Capital (SC-IQ). Washington: World Bank Social Capital Thematic Group.
- Hargreaves, J. R., Morison, L. A., Gear, J. S. S., Makhubele, M. B., Porter, J. D. H., Busza, J., et al. (2007). "Hearing the Voices of the Poor": Assigning poverty lines on the basis of local perceptions of poverty. A quantitative analysis of qualitative data from participatory wealth ranking in rural South Africa. *World Development*, 35(2), 212-229.
- Harpham, T., Grant, E., & Thomas, E. (2002). Measuring social capital within health surveys: key issues. *Health Policy and Planning*, 17(1), 106-111.
- Hawe, P., & Shiell, A. (2000). Social capital and health promotion: a review. *Social Science and Medicine*, 51, 871-885.
- Holtgrave, D. R., & Crosby, R. A. (2003). Social capital, poverty, and income inequality as predictors of gonorrhoea, syphilis, chlamydia and AIDS case rates in the United States. *Sexually Transmitted Infections*, 79, 62-64.
- Jewkes, R., Levin, J., & Penn-Kekana, L. (2002). Risk factors for domestic violence: Findings from a South African cross-sectional study. *Social Science and Medicine*, 55(9), 1603-1617.
- Kelly, J. A. (1999). Community-level interventions are needed to prevent new HIV infections. *American Journal of Public Health*, 89, 299-301.
- Kelly, J. A., Murphy, D., Sikkema, K. J., McAuliffe, T. L., Roffman, R. A., Solomon, L. J., et al. (1997). Randomized, controlled, community-level HIV prevention for sexual risk behaviour among homosexual men in U.S. cities. *Lancet*, 35, 1500-1504.
- Killewo, J. Z., Dahlgren, L., & Sandstrom, A. (1994). Socio-geographical patterns of HIV-1 transmission in Kagera Region, Tanzania. *Social Science and Medicine*, 38(1), 129-134.
- Kipp, W., Kabwa, P., Verbeck, A., Fischer, P., Eggert, P., & Buttner, D. W. (1995). Prevalence and risk factors of HIV-1 infection in three parishes in western Uganda. *Tropical Medicine and Parasitology*, 46, 141-146.

- Krishna, A., & Shrader, E. (1999). Social Capital Assessment Tool. pp. 1-16). Washington DC: World Bank.
- Lochner, K., Kawachi, I., & Kennedy, B. (1999). Social capital: a guide to its measurement. *Social Science and Medicine*, 5, 259-270.
- Macinko, J., & Starfield, B. (2001). The utility of social capital in research on health determinants. *Milbank Quarterly*, 79(3), 387-428.
- Mane, P., Gupta, G. R., & Weiss, E. (1994). Effective communication between partners: AIDS and risk reduction for women. *AIDS*, 8 (suppl 1), s325 - s331.
- Nyanzi, B., Nyanzi, S., Wolff, B., & Whitworth, J. A. G. (2005). Money, men and markets: Economic and sexual empowerment of market women in southwestern Uganda. *Culture, Health and Sexuality*, 7(1), 13-26.
- Parker, R. G., Easton, D., & Klein, C. H. (2000). Structural barriers and facilitators in HIV prevention: A review of international research. *AIDS*, 14 (suppl1), S22-S32.
- Poundstone, K. E., Strathdee, S. A., & D.D, C. (2004). The Social Epidemiology of Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome. *Epidemiologic Reviews*, 26, 22-35.
- Pronyk, P. M., Hargreaves, J. R., Kim, J. C., Morison, L. A., Phetla, G., Watts, C., et al. (2006). Effect of a structural intervention for the prevention of intimate partner violence and HIV in rural South Africa: a cluster randomized trial. *The Lancet*, 368, 1973-1983.
- Putnam, R., Leonardi, R., & Nanetti, R. (1993). Making Democracy Work: Civic Traditions in Modern Italy. Princeton, NJ: Princeton University Press.
- Rao Gupta, G. (2002). How men's power over women fuels the HIV epidemic. *BMJ.*, 324, 183-184.
- Rhodes, T., Singer, M., Bourgois, P., Friedman, S. R., & Strathdee, S. A. (2005). The social structural production of HIV risk among injecting drug users. *Social Science and Medicine*, 61(5), 1026-1044.
- Rose, D., & Charlton, K. E. (2003). Prevalence of household food poverty in South Africa: results from a large, nationally representative survey. *Public Health Nutrition*, 5(3), 383-389.
- Rose, G. (1985). Sick individuals and sick populations. *International Journal of Epidemiology*, 14(1), 32-38.
- Sikkema, K. J., Anderson, E. S., Kelly, J. A., Winett, R. A., Gore-Felton, C., Roffman, R. A., et al. (2005). Outcomes of a randomized, controlled community-level HIV prevention intervention for adolescents in low-income housing developments. *AIDS*, 19, 1509-1516.
- Soderberg, S., Temihango, W., Kadete, C., Ekstedt, B., Masawe, A., Vahlne, A., et al. (1994). Prevalence of HIV-1 infection in rural, semi-urban and urban villages in southwest Tanzania: estimates from a blood-donor study. *AIDS*, 8, 971-976.
- Stoneburner, R., & Low-Beer, D. (2004). Population-level HIV declined and behavioural risk avoidance in Uganda. *Science*, 304(5671), 714-718.
- Sumartojo, E., Doll, L., Holtgrave, D., Gayle, H. D., & Merson, M. H. (2000). Enriching the mix: incorporating structural factors into HIV prevention. *AIDS*, 14 (suppl 1), S1-S2.
- Szreter, S., & Woolcock, M. (2004). Health by association? Social capital, social theory, and the political economy of public health. *International Journal of Epidemiology*, 33(4), 650-667.
- UNAIDS. (1999). Gender and HIV/AIDS: Taking stock of research and programmes. Best Practice Collection. Geneva: UNAIDS.

- UNAIDS. (2002). Summary of the Declaration of Commitment on HIV/AIDS: United National General Assembly Special Session on HIV/AIDS. 25-27 June 2001, New York. Geneva: UNAIDS.
- Veenstra, G. (2000). Social capital, SES and health: An individual level analysis. *Social Science and Medicine*, 50, 619.
- Wohlfeiler, D. (2002). From community to clients: the professionalisation of HIV prevention among gay men and its implications for intervention selection. *Sexually Transmitted Infections*, 78(2 (supplement 1)), 176-182.
- Woolcock, M. (2002). Social Capital in Theory and Practice: Reducing Poverty by Building Partnerships between States, Markets and Civil Society. In UNESCO (Ed.), *Social capital and poverty reduction: which role for civil society organizations and the state*. Geneva: UNESCO.

Table 1: Outcome variables

SOCIAL CAPITAL	
Social Capital Theme	Question
<u>Structural/SSC</u>	
Social networks	Comprehensive list of community groups Membership status as a group leader, regular attender or member
<u>Cognitive/CSC</u>	
Perceived Reciprocity and Community support	Feels neighbour would contribute time to a community project that does not directly benefit them but has benefits for others in the village/neighborhood Feels neighbour would contribute money to a community project does not directly benefit them but has benefits for others in the village/neighborhood If there were a problem that affected the entire village/neighborhood , for instance lack of water or electricity or a major flood, which scenario feels the entire village would work together to deal with the situation.
Perceived Solidarity in a Crisis	If your house has been destroyed by fire, could turn to a complete stranger for shelter for 2 weeks If your house has been destroyed by fire who could turn to a complete stranger for (money) R50 (\$7US) to help you buy clothes after the fire Are very confident that you alone could raise enough money to feed your family for four weeks? – this could be for example by working, selling things that you own, or by borrowing money (from people you know or from a bank or money lender) Would you say that your household's ability to survive this kind of crisis is better than it was 2 years ago?
Collective action	In the past 2 years, participated in a meeting, march, rally or gathering around HIV/AIDS awareness Have played a role in the organization of such a meeting or gathering
HIV RISK	
<u>Psycho-social Attributes</u>	
Knowledge	A healthy looking person can be HIV positive
Openness	You feel free and open to discuss sex and sexuality in your household.
Communication	In the past year, you have communicated with parents/household members about sex or sexuality
Risk perception	You consider yourself to be at high/ medium, risk of acquiring HIV infection
Collective Action in young people	In the past 3 years you have participated in a meeting, march, rally or gathering on HIV/AIDS. You have been involved in the organization of such a meeting or gathering.
<u>Sexual Behaviour</u>	Condom use the last time you had sex with [a non-spousal partner]?(up to 3 listed) In the last 12 months, you always or more than half the time use condoms when having sex with this [a non-spousal partner] Numbers of partners in the past year
<u>Biological Outcomes</u>	HIV prevalence at follow-up HIV incidence

Table 2 Associations between Social Capital and HIV risk – MALES

Associations with Cognitive Social Capital/CSC (exposure)									
Outcomes ¹		r/n (%)				Model 1*		Model 2**	
Health/behavioural outcome	N	Greater CSC	Less CSC	OR	95% CI	aOR	95% CI	aOR	95% CI
HIV prevalence	311	12/172 (7)	17/139 (12.2)	0.54	0.24-1.17	0.4	0.16-1.00	0.39	0.15-0.99
HIV incidence	264	5/150 (3.3)	9/114 (7.9)	0.40	0.12-1.23	0.52	0.15-1.83	0.51	0.14-1.76
Condom use last sex	234	66/139 (47.5)	34/95 (35.8)	1.62	0.95-2.77	1.95	1.04-3.62	2.15	1.11-4.14
Consistent condom use	234	46/139 (33.1)	18/95 (19)	2.11	1.13-3.94	2.3	1.12-4.63	2.4	1.13-5.06
Low partner number(0-2)	340	167/194 (86.1)	134/146 (92)	0.55	0.27-1.13	0.59	0.26-1.31	0.58	0.25-1.35
Psychosocial Attributes									
Greater knowledge	340	154/194 (79.4)	107/146 (73.2)	1.4	0.84-2.32	1.13	0.62-2.05	0.89	0.47-1.67
Better Communication	327	73/191 (38.2)	40/136 (29.4)	1.48	0.92-2.37	1.23	0.72-2.11	0.93	0.51-1.68
Greater openness	329	107/188 (56.9)	47/141 (33.3)	2.64	1.67-4.15	2.39	1.38-4.11	2.18	1.24-3.82
Higher self-perceived risk	337	64/191 (33.5)	76/146 (52.1)	0.46	0.30-0.72	0.44	0.26-0.72	0.44	0.26-0.74
More collective action	340	99/194 (51)	61/146 (41.8)	1.45	0.94-2.23	1.15	0.7-1.87	1.02	0.61-1.69
Associations with Structural Social Capital/SSC (exposure)									
Outcomes ¹		r/n (%)				Model 1*		Model 2**	
Health/behavioural outcome	N	Greater SSC	Less SSC	OR	95% CI	aOR	95% CI	aOR	95% CI
HIV prevalence	312	16/183 (8.7)	13/129 (10.1)	0.85	0.36-1.84	0.66	0.26-1.70	0.65	0.24-1.7
HIV incidence	265	8/161 (4.98)	6/104 (5.7)	0.85	0.28-2.5	0.6	0.15-2.4	0.57	0.13-2.38
Condom use last sex	234	58/143 (40.6)	42/91 (46.2)	0.80	0.47-1.35	0.89	0.49-1.63	0.91	0.48-1.74
Consistent condom use	234	39/143 (27.3)	25/91 (27.5)	0.99	0.54-1.78	0.95	0.49-1.85	0.89	0.44-1.82
Low partner number (0-2)	341	176/200 (88)	126/141 (89.4)	0.87	0.44-1.73	0.78	0.36-1.66	0.8	0.34-1.82
Psychosocial attributes									
Greater knowledge	341	159/200 (79.5)	103/141 (73.1)	1.43	0.86-2.37	1.24	0.68-2.24	0.87	0.46-1.67
Better Communication	328	65/194 (33.5)	49/134 (36.6)	0.87	0.55-1.39	1.02	0.61-1.72	0.7	0.38-1.26
Greater openness	330	97/196 (49.5)	58/134 (43.3)	1.28	0.82-2.0	1.46	0.86-2.5	1.21	0.67-2.17
Higher self-perceived risk	338	82/198 (41.4)	59/140 (42.1)	0.97	0.63-1.5	0.84	0.51-1.39	0.92	0.52-1.57
More collective action	341	100/200 (50)	61/141 (43.3)	1.31	0.85-2.02	1.41	0.86-2.32	1.2	0.70-2.1

¹ numbers vary due to missing data for some outcomes

* adjust for age group, village pair, SES, marriage, local residence, education level, current work/study status

** adjust for Model 1 plus presence of the IMAGE intervention

Table 3: Associations between social capital and HIV risk - FEMALES

Outcomes ¹	Associations with Cognitive Social Capital/CSC (exposure)								
	r/n (%)					Model 1*		Model 2**	
	N	Greater CSC	Less CSC	OR	95% CI	aOR	95% CI	aOR	95% CI
Health/behavioural outcome									
HIV prevalence	565	64/349 (18.3)	39/216 (18.1)	1.01	0.65-1.58	0.84	0.52-1.41	0.97	0.57-1.65
HIV incidence	473	24/289 (8.3)	17/184 (9.2)	0.89	0.46-1.71	0.88	0.44-1.82	1.03	0.48-2.25
Condom use last sex	427	102/268 (38.1)	3/159 (33.3)	1.23	0.81-1.85	1.09	0.68-1.79	0.82	0.48-1.40
Consistent condom use	427	65/269 (24.2)	21/158 (13.3)	2.07	1.21-3.56	1.95	1.03-3.69	1.23	0.60-2.56
Low partner number (0/1)	638	359/396 (90.7)	223/242 (92.2)	0.83	0.46-1.47	0.94	0.48-1.83	0.93	0.45-1.9
Psychosocial attributes									
Greater knowledge	638	333/396 (84.1)	188/242 (77.7)	1.52	1.01-2.27	1.27	0.79-2.04	1.22	0.74-2.02
Better Communication	598	176/374 (47.1)	72/224 (32.1)	1.87	1.32-2.65	2	1.31-3.07	1.45	0.92-2.31
Greater openness	626	278/391 (71.1)	109/235 (46.4)	2.84	2.03-3.98	2.74	1.81-4.13	2.43	1.57-3.76
Higher self-perceived risk	630	197/393 (50.1)	132/237 (55.7)	0.8	0.58-1.10	0.87	0.60-1.27	0.83	0.56-1.26
More collective action	638	241/396 (60.9)	80/242 (33.1)	3.14	2.25-4.4	3.22	2.18-4.76	2.6	1.72-3.9
Outcomes ¹	Associations with Structural Social Capital/SSC (exposure)								
	r/n (%)					Model 1*		Model 2**	
	N	Greater SSC	Less SSC	OR	95% CI	aOR	95% CI	aOR	95% CI
Health/behavioural outcome									
HIV prevalence	566	66/320 (20.6)	37/246 (15)	1.46	0.94-2.28	1.49	0.89-2.5	1.83	1.04-3.2
HIV incidence	474	30/270 (11.1)	11/204 (5.4)	2.19	1.07-4.49	2.15	0.95-4.88	2.9	1.2-7.1
Condom use last sex	429	97/239 (40.6)	58/190 (30.5)	1.55	1.03-2.32	1.75	1.1-2.77	1.45	0.87-2.44
Consistent condom use	429	60/239 (25.1)	25/190 (13.2)	2.21	1.33-3.69	2.78	1.52-5.09	2.04	1.02-4.06
Low partner number (0-1)	642	320/351 (91.2)	265/291 (91.1)	1.01	0.58-1.75	1.08	0.57-2.05	1.09	0.55-2.17
Psychosocial attributes									
Greater knowledge	642	288/351 (82.1)	235/291 (80.8)	1.09	0.73-1.62	0.92	0.58-1.46	0.84	0.51-1.37
Better Communication	602	151/337 (44.8)	99/265 (37.4)	1.36	0.98-1.89	1.67	1.11-2.5	1.13	0.71-1.77
Greater openness	630	226/347 (65.1)	165/283 (58.3)	1.33	0.96-1.85	1.61	1.08-2.41	1.32	0.85-2.04
Higher self-perceived risk	634	175/349 (50.1)	157/285 (55.1)	0.81	0.60-1.12	0.74	0.52-1.07	0.67	0.46-1.01
More collective action	642	192/351 (54.7)	130/291 (44.6)	1.50	1.09-2.04	1.57	1.08-2.26	1.12	0.75-1.68

¹ numbers vary due to missing data for some outcomes

* adjust for age group, village pair, SES, marriage, local residence, education level, current work/study status

** adjust for Model 2 plus presence of the IMAGE intervention

Figure: Theoretical framework: Social capital and HIV risk

Confounders: age, education, marital status, current employment or school enrolment, duration of local residence, had children (females only)