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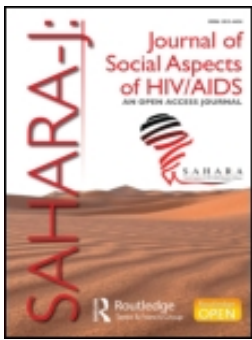
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## The association between social networks and self-rated risk of HIV infection among secondary school students in Moshi Municipality, Tanzania

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### Abstract

This study describes the social networks of secondary school students in Moshi Municipality, and their association with self-rated risk of human immunodeficiency virus (HIV) infection. A cross-sectional analytical study was conducted among 300 students aged 15–24 years in 5 secondary schools in Moshi, Tanzania. Bonding networks were defined as social groupings of students participating in activities within the school, while bridging networks were groups that included students participating in social groupings from outside of the school environs. A structured questionnaire was used to ask about participation in bonding and bridging social networks and self-rated HIV risk behavior. More participants participated in bonding networks (72%) than in bridging networks (29%). Participation in bridging networks was greater among females (25%) than males (12%,  $p < .005$ ). Of 300 participants, 88 (29%) were sexually experienced, and of these 62 (70%) considered themselves to be at low risk of HIV infection. Factors associated with self-rated risk of HIV included: type of school ( $p < .003$ ), family structure ( $p < .008$ ), being sexually experienced ( $p < .004$ ), having had sex in the past three months ( $p < .009$ ), having an extra sexual partner ( $p < .054$ ) and non-condom use in last sexual intercourse ( $p < .001$ ), but not the presence or type of social capital. The study found no association between bonding and bridging social networks on self-rated risk of HIV among study participants. However, sexually experienced participants rated themselves at low risk of HIV infection despite practicing unsafe sex. Efforts to raise adolescents' self-awareness of risk of HIV infection through life skills education and HIV/acquired immunodeficiency syndrome risk reduction strategies may be beneficial to students in this at-risk group.

**Keywords:** bonding, bridging, social network, risk behaviors, HIV, school students

### Résumé

Cette étude décrit les réseaux sociaux des élèves de l'école secondaire dans la Municipalité de Moshi, et leur association à l'auto-évaluation du risque d'infection par le VIH. Une étude analytique transversale a été menée auprès de 300 étudiants âgés de 15 à 24 ans dans 5 écoles secondaires à Moshi, en Tanzanie. Les groupements sociaux d'étudiants qui participent aux activités au sein de l'école ont été définis « bonding networks » (réseaux qui créent des liens), tandis que les groupements qui comprennent des étudiants participants à des groupes sociaux à l'extérieur des environs de l'école ont été définis « bridging networks » (réseaux qui créent des ponts). Un questionnaire structuré a été utilisé pour poser des questions sur la participation dans des réseaux sociaux « bonding » et « bridging » et l'auto-évaluation des comportements à risque pour le VIH. La plupart des participants participaient en « bonding networks » (72%) plutôt que en « bridging networks » (29%). La participation en « bridging network » était majeure parmi les femmes (25%) que parmi les hommes (12 %,  $p < .005$ ). Parmi les 300 participants, 88 (29%) ont eu des expériences sexuelles, et parmi ces derniers 62 (70%) se considéraient à faible risque d'infection par le VIH. Les facteurs associés à l'auto-évaluation du risque du VIH comprenaient : la typologie de l'école ( $p < .003$ ), la structure familiale ( $p < .008$ ), le fait d'avoir eu des expériences sexuelles ( $p < .004$ ), le fait d'avoir eu des rapports sexuelles dans les derniers 3 mois ( $p < .009$ ), la présence de plus d'un partenaire sexuel ( $p < .054$ ) et la non utilisation du préservatif pendant le

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ernier rapport sexuel ( $p < .001$ ), mais pas la présence ou la typologie des relations. Cette étude n'a pas relevé d'associations entre les réseaux sociaux « bonding » et « bridging » et l'auto-évaluation du risqué du VIH parmi les participants à cette étude. Cependant, les participants qui ont eu des expériences sexuelles se considéraient à faible risque d'infection même s'ils avaient des pratiques sexuelles à risque. Des efforts visant à augmenter parmi les adolescents la conscience du risque d'infection par le VIH par une éducation aux « life skills » et des stratégies de réduction du risque du VIH/SIDA pourraient être bénéfiques pour les étudiants dans ce groupe à risque.

**Mots clés:** *bonding, bridging, réseaux sociaux, comportements à risque, VIH, étudiants*

## Introduction

The human immunodeficiency virus (HIV) epidemic in Africa is largely driven by health behavior, especially among young people (Family Health International 2005). A number of factors are known to influence health behavior; these include gender, social economic status, religion, area of dwelling and age (WHO 2009). For young people, social networks often shape and constrain behavior, especially sexual behavior, and are often linked to the use of resources for mutual benefits (Bourdieu 1986; Currie, Gabhainn, Godeau, Roberts, Smith & Currie 2008; Putnam 2000). The way in which an individual relates to their social network, reflects their expectations from the network, and then may affect their perceptions of health and well-being and their awareness of health risks (Morgan & Haglund 2009).

Social networks are an important way for individuals to participate in political life and community meetings (Organization for Economic Co-operation and Development [OECD] 2001). Networks which are wholly contained within a homogeneous grouping, such as a school, have been described as 'bonding networks' as they build bonds within the group (OECD 2001; Putnam 2000). Conversely, 'bridging networks' refer to social ties across heterogeneous groups, which build links between different groups (Healy 2002; Putnam 2000).

Behavioral studies in Africa have shown that social networks can reinforce good health behaviors and contribute to improving health in adolescents (Ferlander 2007; Kawachi 2006). School children are able to develop new social networks, and through these networks, become more active socially, and engage in fewer risk-taking behaviors (Zambon, Morgan, Vereecken, Colombini, Boyce, Mazur, *et al.* 2009). However, other studies have shown that adolescents who make friends outside of their own grouping had more risky sexual behavior, resulting in greater risk of teenage pregnancy (Blakely, Atkinson, Ivory, Collings, Wilton & Howden-Chapman 2006; Crosby & Holtgrave 2006). However, Helliwell and Putnam showed that social networks have a positive effect on the health of those who participate in them (Helliwell & Putnam 2004). Students participate in different in-school groups with characteristics of social networks. Participation in school-based groups or in out of school activities (such as sports, debates, youth groups, etc.) provides developmental opportunities in the form of leisure and refreshment. Some scholars suggest that extracurricular activities provide more protection against experimentation with problematic activities such as drug, sexual practice and alcohol use

(Darling, Linda & Caldwell 2005). At the simplest level, bonding and bridging social networks components can be, respectively, characterized as what people 'do' and what people feel in terms of their social relations (Woolcock 2001). Therefore, studying social networks and their members provides a way to understand how social relations can interact with individual health behavior.

While we have seen many advances in HIV/acquired immunodeficiency syndrome (AIDS) over the past decade, it remains a critical development issue of particular relevance to young people. Worldwide, people aged 15–24 years account for 40% of all new HIV infections, often have poor knowledge about HIV and transmission, and lack access to good reproductive health services (UNAIDS 2010). In Tanzania, 20% of the population are aged 15–24 years (United Republic of Tanzania 2002), of this group, approximately 5.6% are infected with HIV (TACAIDS 2008). Comprehensive knowledge about HIV/AIDS is generally low among young people, whereby women account for 39% and 42% for men (TACAIDS, ZAC, National Bureau of Statistics, Office of the Chief, Government Statistician, Macro International 2008). Given the fact that the main route of HIV transmission in Tanzania is through heterosexual contact, age at first sexual intercourse marks the time at which most individuals become at risk of being exposed to HIV. Generally, 11% of young women and 10% of young men age 15–24 in Tanzania had sex before the age of 15 years. Additionally, of sexually active people in this age group, 32% of women and 80% of men engaged in higher-risk sexual activity such as multiple sexual partners, use of drugs and alcohol and non-condom use (THIS 2007–2008). A study in Kilimanjaro region, Tanzania showed that school students engaged in high-risk sexual behavior, including early sexual debut, multiple sexual partnerships, inconsistent condom use, and this was mixed with substance abuse and excessive alcohol use (Omari 2007).

Secondary education is the time when new social networks are formed, and this coincides with age at which sexual activity starts (Weller 2005). As peer pressure and sexual networks are strong predictors for risk behaviors for HIV, it is important to explore how these social networks affect perceived risk among secondary school students (Agardh, Emmelin, Muriisa & Östergren 2010; Ferlander 2007; Kawachi 2006). This paper reports on social networks of secondary school students in Moshi Municipal, and their association with self-rated risk of HIV infection.

## Method

### Sample

A cross-sectional analytical study was conducted among secondary school students aged 15–24 years in May 2011. Multistage sampling was used to select 5 schools from the 26 secondary schools (14 public and 12 private) in Moshi Municipality. Within the selected schools, 13 students were randomly selected from each class (year of school enrolment).

The conceptual framework for the study came from the social ecological model (SEM) described by Bronfenbrenner (1994) and shown in Fig. 1. A survey questionnaire was developed to collect data on demographic and family characteristics, social networks, sexual behaviors, and self-rated risk of HIV infection. Questions were based on the self-administered questionnaire

used by Agardh in Uganda among university students (Agardh *et al.* 2010), which was adapted for younger adolescents, translated into Swahili which is the official Tanzania language, and pre-tested in 30 students of both genders in one secondary school outside the study. In each school, a list of school clubs and activities were obtained (including sports, religious and academic activities), and student responses were used to define participation in bonding social networks. Students were also asked about participation in other group activities, outside of the school environ, which were defined as bridging networks. Confidentiality was assured by providing a private room for the completion of the questionnaire. Two young research assistants (1 male; 1 female) of the same age with the study participants supervised the data collection and checked the completed questionnaires for errors and missing data.

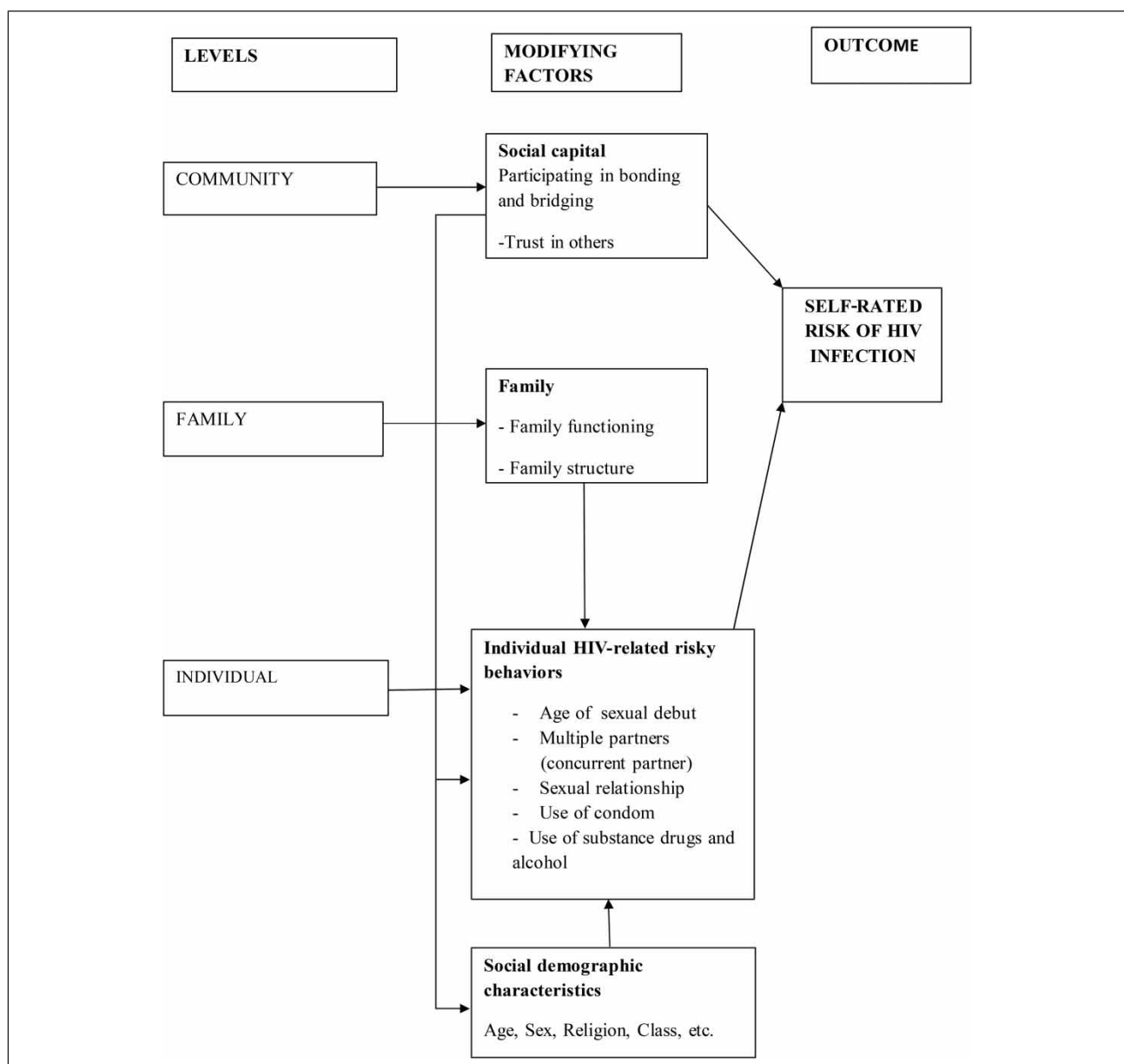


Fig. 1. SEM.

Source: Adapted and modified from Bronfenbrenner (1994).

**Table 1. The distribution of socio-demographic characteristics and number of groups' involvement by gender (n = 300).**

Groups involved	N = 300	Sex n (%)		p-Trend
		Male 154 (51.3)	Female 146 (48.7)	
<i>Age (years)</i>				
< 18	219 (73.0)	93 (60.4)	126 (86.3)	<.001*
18	81 (27.0)	61 (39.6)	20 (13.7)	
<i>Family structure</i>				
233 (77.7)	233 (77.7)	37 (24.0)	30 (20.5)	.47
67 (22.3)	67 (22.3)	117 (76.0)	116 (79.5)	
<i>Parental status</i>				
254 (84.7)	254 (84.7)	124 (80.5)	130 (89.0)	.05
46 (15.3)	46 (15.3)	30 (19.5)	16 (11.0)	
<i>Number of total group involvement</i>				
None	68 (22.7)	42 (27.3)	26 (17.8)	.146
One	51 (17.0)	25 (17.2)	26 (17.8)	
Two or more	181 (60.3)	87 (56.5)	94 (64.4)	
<i>Number of bonding group involvement</i>				
None	85 (28.3)	50 (32.4)	35 (24.0)	0.24
One	55 (18.3)	28 (18.2)	27 (18.5)	
Two or more	160 (53.3)	76 (49.4)	84 (57.5)	
<i>Number of bridging group involvement</i>				
None	214 (71.3)	115 (74.7)	99 (67.8)	.006*
One	30 (10.0)	20 (13.0)	10 (6.8)	
Two or more	56 (18.7)	19 (12.3)	37 (25.4)	
<i>Sexual experienced</i>				
Yes	88 (29.3)	60 (39.0)	28 (19.2)	.000*
No	212 (70.7)	94 (61.0)	118 (80.8)	
<i>Self-rated risk of HIV infection</i>				
High	68 (22.7)	40 (26.0)	28 (19.2)	.161
Low	232 (77.3)	114 (74.0)	118 (80.8)	

Self-rated risk of HIV was assessed as High, or Low, through categorization of the responses to the question 'How do you rate your risk of getting HIV infection' (Expected response to this question was 1 = Low, 2 = High). Age was categorized into two groups (15–18 years and 19–24 years), and sexual debut defined as a positive response to the question: 'Have you ever had sex?' (Expected response to this question was: 1 = yes, 2 = no). Risky sexual behavior was assessed using the responses to the following questions: 'How many people have you ever had sex with?' (Expected response to this question was: 1 = One, 2 = Two, 3 = More than two, 4 = None). 'At what age did you do sexual intercourse for the first time?' (Expected response was to mention the actual age at first sexual intercourse). 'Did you use a condom during first sexual intercourse?' (Expected response was: 1 = yes, 2 = no). 'Did you use a condom during the last sexual intercourse?' (Expected response was: 1 = yes, 2 = no), 'Have you had sex in the past three months?' (Expected response was: 1 = yes, 2 = no) (Agardh *et al.* 2010).

Data were double entered, edited, cleaned, coded, and analyzed using SPSS version 16 (SPSS, Chicago, USA). Descriptive analyses used chi-squared tests with 5% significance to compare categorical variables, and mean and standard deviation for continuous variables. Logistic regression was used to obtain odds ratios (ORs) and 95% confidence interval (CI) for associations with perceived risk of HIV. The sample size of 300 was used to achieve a power of 80%, to detect a difference of 10%, in the perceived risk of HIV between those with different types of social network, as statistically significant at the 5% level.

Approval for this study was obtained from the Kilimanjaro Christian Medical University College Ethics committee. Permission to conduct the study was received from the Moshi Municipal Education Officer, and from school authorities. Informed consent was obtained from all students who participated in the study. For students under 18 years of age, consent was also obtained from the head of school/or teacher on duty on behalf of the students.

**Table 2. Socio-demographic, family characteristics and sexual behavior by social network groups (n = 300).**

	Social network				p-Value
	None	Bonding only	Bridging only	Bonding and bridging	
Total	68	146	17	69	
Sex					
Male	42 (61.8)	73 (50.0)	8 (47.1)	31 (44.9)	
Female	26 (38.2)	73 (50.0)	9 (52.9)	38 (55.1)	.23
Age					
< 18	49 (72.1)	106 (72.6)	12 (70.6)	52 (75.4)	
18	19 (27.9)	40 (27.4)	5 (29.6)	17 (24.6)	.96
Sexual experience					
Yes	29 (42.6)	41 (28.1)	4 (23.5)	14 (20.3)	
No	39 (57.4)	105 (71.9)	13 (76.5)	55 (79.7)	.03
Sexual intercourse in past three months					
Yes	8 (11.8)	10 (6.8)	2 (11.8)	5 (7.2)	
No	21 (30.9)	31 (21.2)	2 (11.8)	8 (11.6)	
No sex	39 (57.4)	105 (71.9)	13 (76.5)	55 (79.7)	.08
Number of partners					
One	16 (23.5)	21 (14.4)	0 (0)	5 (7.2)	
More than one	13 (19.1)	18 (12.3)	4 (23.5)	7 (10.1)	
No sex	39 (57.4)	105 (71.9)	13 (76.5)	55 (79.7)	.07
Used condom at first sex intercourse					
Yes	12 (17.6)	15 (10.3)	3 (17.6)	4 (5.8)	
No	18 (26.5)	26 (17.8)	1 (5.9)	9 (13.0)	
No sex	39 (57.4)	105 (71.9)	13 (76.5)	55 (79.7)	.69
Used condom at last sexual intercourse					
Yes	15 (22.1)	18 (12.3)	3 (17.6)	6 (8.7)	
No	14 (20.6)	23 (15.8)	1 (5.9)	7 (10.1)	
No sex	39 (57.4)	105 (71.9)	13 (76.5)	55 (79.7)	.08
Self-reported risk of HIV					
Low	52 (76.5)	115 (78.8)	11 (64.7)	54 (78.3)	.619
High	16 (23.5)	31 (21.2)	6 (35.3)	15 (22.7)	

## Results

### Characteristic of respondents

A total of 385 secondary school students were selected, and 300 of them agreed to participate in the study, providing a response rate of 78%. More (73%) participants were 18 years or under compared with fewer (27%) who were above 18 years of age, with female participants significantly ( $p < .001$ ) younger (Mean 17.3 years, standard deviation 1.6 years) than male participants (Mean 18.2 years, standard deviation 2.1 years). The majority of participants (85%) had both of their parents alive and 78% were living with both parents (Table 1).

Out of 300 participants, 232 (77%) reported involvement in one or more social network. More participants participated in bonding social networks (72%) compared to bridging networks (29%). Females were more likely to participate in two or more

of bridging groups compared to their male counterparts (25% vs. 12%;  $p = .006$ ). Few students reported sexual debut, with more males (39%) reporting sexual debut than females (19%,  $p < .001$ ). A high proportion (77%) of participants rated themselves at a low risk of HIV infection (Table 1).

### Participation in social capital networks

There was no significant difference in the age or sex of those participating in the bonding or bridging groups (Table 2). There was no significant association between the involvement in bonding or bridging groups and self-rated risk of HIV (Table 2). However those who reported sexual debut were significantly more likely to participate in both bonding and bridging social networks ( $p = .03$ ). No significant association was seen between variables of sexual behavior and participation in bonding or bridging social

**Table 3. Selected risk behaviors of sexually experienced participants associated with self-rated risk of HIV infection (n = 88).**

Risk behavior	Total 88 (%)	Self-rating n (%)		p-Value
		High 26 (29.5%)	Low 62 (70.5%)	
<i>Age of first sexual intercourse</i>				.826
< 15	19	6 (31.6)	13 (68.4)	
15+	69	20 (29.0)	49 (71.0)	
<i>Had sexual intercourse in the past three months</i>				.051*
Yes	25	12 (48.0)	13 (52.0)	
No	63	14 (22.2)	49 (77.8)	
<i>Number of lifetime sexual partners</i>				.032*
One	46	9 (19.6)	37 (80.4)	
More than one	42	17 (40.5)	25 (59.5)	
<i>Have other/extra sexual partner</i>				.173
Yes	11	7 (63.6)	4 (36.4)	
No	77	19 (24.7)	58 (75.3)	
<i>Used condom during first sexual intercourse</i>				.692
Yes	34	9 (26.5)	25 (73.5)	
No	54	17 (31.5)	37 (68.5)	
<i>Used condom in the last sexual intercourse</i>				.201
Yes	42	9 (21.4)	33 (78.6)	
No	46	17 (37.0)	29 (63.0)	

\*p < .05.

networks, although among those participating in bridging social networks, 23% reported more than one sexual partner.

### Behavioral risk factors

Out of 300 participants, 88 (29%) reported that they were sexually experienced, and of these 62 (70%) reported a perceived low risk of HIV, compared to 170 (80%) of those who did not report sexual debut ( $p < .001$ ). Among the selected HIV-related risky behaviors, being sexually active (measured as 'had sex in the past three months') and having more than one lifetime sexual partner were associated with higher self-assessment of the risk of HIV infection  $p = .051$  and  $p = .032$ , respectively. The age of sexual debut, having an extra sexual partner, and condom use during the first and last sexual intercourse was not significantly associated with self-rated risk of HIV infection (Table 3).

### Predictors of self-rated risk of HIV infection

Separate models for each gender were used to determine the predictors for self-rated risk of HIV infection (Table 4). In the male model, no significant association was found between the independent variables and self-rated risk of HIV infection. In the female model, six variables (type of school, family structure, had sexual experience, had sex in the past three months, have more than one lifetime sexual partner and condom use in last sex) were significantly associated with higher self-reported risk of HIV infection. Females who were not living with their parents were three

times more likely to rate themselves as having a high risk of HIV infection in comparison to females who lived with both of their parents (OR = 3.37; 95% CI = 1.37–8.32;  $p < .005$ ). Additionally, females who were sexually experienced were three times more likely to rate themselves as having high risk of HIV infection compared to females who were sexually inexperienced (OR = 3.84; 95% CI = 1.54–9.61;  $p < .005$ ). Moreover, females reported higher self-reported risk of HIV if they had had sex in the past three months (OR 5.94, 95% CI 1.55–22.7), or who had not used a condom at their last sexual intercourse (OR 6.79, 95% CI 2.18–21.2).

### Discussion

Overall, participating in bonding or bridging social networks was not associated with self-rated risk of HIV infection among students. However, the study showed gender differences in frequencies of participation in social networks and on predictors for self-rated risk of HIV infection.

The findings in this study differ from those done in Uganda, where participating in bridging networks led to less risky sexual behavior. In our study, most of respondents were below 18 years of age, unlike the Uganda study of university students, where a third was over the age of 23 years. Most students are living with their parents and both parents were alive. These findings reflect the national situation as demonstrated in the Tanzania



**Table 4. Predictors of self-rated risk of HIV infection by sex of study participants (n = 300).**

Characteristics	Male			Female		
	OR <sup>a</sup>	95% CI	p-Value	OR <sup>a</sup>	95% CI	p-Value
<i>School</i>						
Government	Reference					
Private	0.83	0.59–1.18	0.298	1.48	1.14–1.91	.003*
<i>Family structure</i>						
Living with both parents	Reference					
Living without parents	0.73	0.30–1.77	0.49	3.37	1.37–8.32	.008*
<i>Social networks</i>						
None	Reference					
Bonding only	0.86	0.36–2.05	0.73	1	0.32–3.10	.99
Bridging only	2.82	0.60–13.2	0.19	1.2	0.19–7.62	.84
Bridging and bonding	0.98	0.34–2.82	0.97	0.95	0.27–3.39	.93
<i>Had sexual experience</i>						
No	Reference					
Yes	0.92	0.44–1.93	0.83	3.84	1.53–9.61	.004
<i>Had sex past 3 months</i>						
NA	Reference					
No	0.62	0.26–1.52	0.3	2.97	0.98–8.98	.054
Yes	2.45	0.81–7.45	0.11	5.94	1.55–22.7	.009
<i>Have extra sexual partner</i>						
NA	Reference					
No	0.77	0.34–1.73	0.53	2.61	0.98–6.96	.054
Yes	2.8	0.65–12.04	0.17	N/A		
<i>Used condom last sex</i>						
NA	Reference					
No	1.2	0.49–2.97	0.69	6.79	2.18–21.2	.001
Yes	0.73	0.27–2.00	0.54	1.78	0.44–7.15	.42

<sup>a</sup>Unadjusted odds ratio.  
\*p < .001.  
\*\*p < .05.

Demographic Health Survey (2010) report, whereby 59% of youths aged 15–24 years live with their parents and 60% had both parents alive.

We found more students participated in bonding groups within schools compared to bridging groups involving people outside of the school. Most secondary schools in Tanzania promote extra-curricular activities such as sports clubs, debates, and religious groups within schools (Ministry of Education and Vocational Training 2011), and students are encouraged to participate in these groups. Females had a higher frequency of participation in bridging groups compared to their male counterparts, which is similar to findings observed elsewhere (Huang 2008). This observation could be due to females establishing social relationships with peers outside of school, more easily than males of a similar age (Huang 2008; Iwase, Suzuki, Fujiwara, Takao, Doi & Kawachi 2010).

Generally, a low proportion of participants reported to be sexual experienced, which is consistent with studies done in other settings (Abebe & Mitkie 2006; Njau, Mtweve, Barongo, Manongi, Chugulu, Msuya, *et al.* 2006). This observation should be interpreted with caution as studies on sexuality have shown that males over-report, and females under-report their sexual experiences (Jonason 2007). Moreover, most participants rate themselves at low risk of HIV, which accords with results from another study from Kilimanjaro region of Tanzania (Mgoshia, Kweka, Mahande, Barongo, Shekalaghe, Nkya, *et al.* 2009), and with the lower than average, adult HIV prevalence (1.9%) in Tanzania (UNAIDS 2010). This observation may reflect a problem, in that adolescents may disregard, or not understand the risk of HIV infection, despite engaging in risk behavior and practices that are related to HIV (Eggleston, Leitch & Jackson 2000). Alternatively it might reflect effective intervention programs designed to prevent high-risk, pre marital sex, particularly as schools are regarded as

suitable social institutions where a large number of young people can be reached with important health messages (UNAIDS 2010). Efforts to raise adolescent's self-awareness of risk of HIV infection through life skills education and HIV/AIDS risk reduction strategies may be beneficial to this at risk group, although a large trial in Tanzania showed that adolescent sexual health education in school change knowledge and reported attitudes, but showed no impact on behavioral outcomes (Ross, Chagalucha, Obasi, Todd, Plummer, Cleophas-Mazige, *et al.* 2007).

Sexually experienced participants were more likely to participate in social networks. This differed from the study in Uganda, where no association was seen between social networks and 'ever had sex', which may be due to the lower age of the school students in our study (Agardh *et al.* 2010). No association was seen between participation in social networks and self-rated risk of HIV infection. These findings differed from other studies conducted in USA, Japan and UK, which reported that bonding social networks were associated with good health and positive health behaviors among students (Iwase *et al.* 2010; Markham, Tortolero, Escobar-Chaves, Parcel, Harrist & Addy 2007; Morgan & Haglund 2009). Other studies have shown that participation in bridging groups was associated with perceived low risk of HIV infection (Campbell, Williams & Gilgen 2002; Iwase *et al.* 2010). This may be due to the operational definition of bridging social capital in developed and developing countries, and implies the need to explore further the composition of group membership and involvement in bridging groups (Currie *et al.* 2008; Fichtenberg, Muth, Brown, Padian, Glass & Ellen 2009).

Females who were in private schools, and female participants who were not living with their parents, were more likely to consider themselves at high risk of HIV. According to the SEM conceptual model used for this study, the way an individual interacts with others in different settings affects his/her behavior, but it is difficult to directly attribute the behavior to the type of school, or living conditions, as this may be confounded by other socio-economic factors. However, the presence or absence of one or both parents has a significant influence on an individual's behavior, with a major impact on health-related outcomes. This observation underscores the importance of strong family connectedness and commitment from the parents in the behavior of their children (Markham *et al.* 2007; Njau, Mtweve, Manongi & Jalipa 2009).

Being sexually experienced, or sexually active, having multiple sexual partners and non-condom use in the last sexual intercourse were significantly associated with self-rated higher risk of HIV infection among female. Similar findings have been observed in other studies in Tanzania (Ikamba 2002; Mgosha *et al.* 2009; Njau *et al.* 2009). There are many external forces which influence the individual's internal determinants of behavior such as social economic status, efficacy in condom use, and skills on sex negotiation, and it is important to address such external forces in any behavior change program (Family Health International 2005).

### Study limitation

The study is limited by the lack of comparable studies from similar settings in Africa and Tanzania, which may influence

reliability of the findings. Like in most studies on sexuality, this study relied on the respondents' self-reports of their sexual behaviors, and hence information bias may resulted due to either under/or over-reporting of their true risk behaviors. We did not measure the intensity of the participation in the different social networks, and so the involvement may have differed by individuals, and across schools. However, efforts were made to maintain privacy and confidentiality to ensure freedom of participation and respond to questions to minimize this bias. Cross-sectional studies are not adequate for measuring the directionality of associations found, and this study may be subject to several unmeasured, potential confounders. Further investigation using focus group discussion may elicit greater understanding of the association between social networks and perceived risk of HIV. Finally, the sampling technique used to select eligible participants from the selected schools may have affected the findings.

## Conclusion

In conclusion, the study did not find any differential effect on participating in either bonding or bridging social networks on self-rated risk of HIV infection among the study participants, as a whole or in either sex separately. However, the study did observe gender differences in frequencies of participation in bonding and bridging group involvements and on predictors of self-rated risk of HIV infection. The majority of respondents participated more in bonding groups than in bridging groups. Females were more likely to be in bridging groups than males. However, sexually experienced participants rated themselves at low risk of HIV infection despite practicing unsafe sex. The predictors significantly associated with self-rated high risk for HIV infection observed were: type of school, family structure, sexual experience, having sex in the past three months, have an extra sexual partner and condom use in last sex among female participants. The study suggests that HIV prevention messages should emphasize personal susceptibility to HIV/AIDS. Qualitative studies on the reasons for low levels of HIV risk perception and how this interacts with participation in social networks could be useful. Efforts to raise adolescents' self-awareness of the risk of HIV infection through life skills education and HIV/AIDS risk reduction strategies may be beneficial to this at risk group.

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