

Social Structural Analysis of Street-Involved Youth in Winnipeg, Canada

Laura H. Thompson, thompsol@cc.umanitoba.ca

Research Associate, Centre for Global Public Health, University of Manitoba, Canada

John Schellenberg, schellej@cc.umanitoba.ca

Department of Medical Microbiology, University of Manitoba, Canada

Margaret Ormond, veal2@shaw.ca

Ormond Consulting, Inc., Winnipeg, Manitoba, Canada

John L. Wylie, john.wylie@gov.mb.ca

Department of Community Health Sciences, University of Manitoba; Department of Medical Microbiology, University of Manitoba; and Cadham Provincial Laboratory, Manitoba Health and Healthy Living, Winnipeg, Manitoba, Canada

Abstract

In the present study, the social linkages of street-involved youth and correlates of infection with chlamydia and gonorrhoea are explored. This is the first study to assess the social linkages of street-involved youth using RDS. Eleven street-involved youth aged 14 to 24 were selected as seeds to recruit their peers into the study using RDS (N=169). Study staff administered a questionnaire, obtained a urine specimen, and provided recruitment coupons to participants. A week later, participants were provided with test results and treatment if necessary. RDS Analysis Tool was used to assess the effectiveness of RDS and define the social linkages. A Fisher's Exact test was used to identify any correlates of infection. Gender was the only variable that correlated with infection status (22 percent of females vs. 8 percent of males). A high proportion of male participants had never been tested before. Despite the fact that most female participants had been tested before, high infection rates indicate that more accessible and frequent testing is required. Street-involved youth are connected socially to those who share similar health related behaviors. There is a need for increased testing options and opportunities for street-involved youth.

Keywords

Respondent driven sampling (RDS), street youth, sexually transmitted infections, social network analysis

Introduction

Street-involved youth represent a heterogeneous population that have been classified along a continuum spanning from “curbsiders” that bounce between the street and home to entrenched street youth with no connections to home and greater involvement in drugs, crime, and sex work.¹ For all types of street youth, some degree of separation exists between them and mainstream society. The extent of this separation is potentially greatest for those youth who are the most entrenched creating issues of access with respect to public health service delivery. Problems with health care access can range from a lack of an address and appropriate identification documents to distrust by street youth of people in positions of authority. This general description of street-involved youth is also applicable to the local street-involved youth population in Winnipeg, Canada, which is the focus of the present study.

Results from Phases I to IV of the national Enhanced Surveillance of Canadian Street Youth Study² show that the chlamydia prevalence among street-involved youth sampled from several cities across Canada increased from 8.6 percent in 1999 to 11 percent in 2003. Gonorrhea prevalence increased from 1.4 percent to 3.1 percent in this period. According to the study, these rates are 10 to 30 times higher than in the general youth population. Given the high prevalence of chlamydia and gonorrhea among this population, it is important to provide street-involved youth with targeted health care services that address and reduce access barriers to care.

In Winnipeg, street youth are notable for the large percentage that report Aboriginal ethnicity (53 percent self-reporting this ethnicity in the Manitoba portion of a Canadian Surveillance study).³ In other respects, the issues facing street youth in Winnipeg are similar to those encountered by street youth in other large urban centers. Street youth in Winnipeg show a high prevalence of STI (chlamydia and gonorrhea prevalence of 12 percent and 2 percent, respectively).⁴ In other reports from Winnipeg, almost all interviewed street youth report problems in school and symptoms of at least one mental illness. They frequently perceive no alternative to their street-involvement and feel disconnected from any social support systems, including family, school, community child protection agencies and youth corrections systems.^{5, 6}

Social contextual analysis, in terms of the extent to which different types of street youth mix and associate with each other, and the underlying basis of that association have not been conducted (e.g. are male youth more likely to associate with other males, or is assortative mixing more likely to stratify along ethnic lines?). This information is relevant, as a better understanding of contact patterns and social linkages can potentially predict how physical agents, such as infectious diseases, or verbal information, such as that related to availability of and means of access to health and health services, will flow through a population.

Respondent driven sampling (RDS)⁷ has increasingly been used for the recruitment of members of “hidden” populations such as injection drug users, sex workers, and men who have sex with men (MSM). RDS uses peer-recruitment through existing social networks and has been effectively used for recruiting and accessing female sex workers, men who have sex with men, transgender persons and injection drug users (IDUs).^{8, 9} At the time the present study was designed, no reports of the use of RDS among street youth had been published. Since then, one publication reports the successful use of RDS among street youth in the United States.¹⁰ Given the relative scarcity of RDS studies involving street youth, the present study adds data relevant to the body of literature in this area. We used a pilot study design with a relatively small sample size, as the main intention was to establish feasibility of RDS within a population of this type and to generate hypotheses for future study design.

In summary, this study validated the use of RDS among street-involved youth in Winnipeg, investigated the social linkages that existed within this population, and examined the prevalence and correlates of chlamydia and gonorrhea infection.

Methods

Study Design

Data collection for this study took place in Winnipeg, Manitoba from December 2006 to early April 2007. For this study, the target population was defined as young people aged 14 to 24 with varying degrees of street-involvement.

Eleven individuals were selected by study staff as “seeds” for RDS recruitment. These individuals were selected as they were known to study staff, met our definition of street-involved youth and were socially well-connected to other street-involved youth. The study seeds ranged in age from 18 to 23, with an average age of 20. Three were female and eight male, with two self-identifying as MSM, one bisexual male, and one bisexual female. Two of these individuals were Caucasian and nine were Aboriginal. None of the seeds tested positive for chlamydia or gonorrhea (one was not tested). Most (73 percent) of the seeds had experienced school disruption (dropped out or were expelled).

Study participants were instructed to recruit individuals that they personally knew whom they believed to be between the ages of 14 and 24 and who were street involved. Street involvement was defined to participants as meaning a youth who had been away from a permanent home for at least three nights in the previous six months because staying at home was not an option.

Prospective participants contacted study staff by using the phone number listed on the RDS coupon and a meeting time was arranged. Interview locations included drop-in centers (50.3 percent), restaurants (26.0 percent), malls (18.3 percent), bars (1.8 percent), clinics (1.8 percent), homes (1.2 percent), and the street (0.6 percent). Informed consent was obtained, a questionnaire administered, three RDS recruitment coupons were provided for distribution to friends between the ages of 14 and 24, and a urine specimen provided. This was immediately transported to Cadham Provincial Public Health Laboratory for chlamydia and gonorrhea testing using the Becton Dickinson ProbeTec ET CT/GC diagnostic test. A second appointment was offered and arranged for all study participants for provision of test results, risk reduction counseling, and treatment as necessary. The second appointment occurred at a mutually agreed upon time and location, approximately one week after the first interview.

Upon initiation of the study, it became clear news of the study was spreading rapidly among youth by word-of-mouth, as many youth who were not in possession of an RDS coupon began to phone study staff to inquire about enrolling in the study. Rather than requiring strict recruitment through our original staff-selected seeds, we chose an alternate approach of enrolling the youth not in possession of a coupon and designating them as additional seeds. Given the overwhelming response to the study, we chose the latter approach as we felt that turning away this many youth could harm the rapport our study team had built with the community and negatively impact study recruitment. Overall, 57 participants entered the study in this way.

For all participants, an honorarium of \$20 was provided as compensation for their time. A recruitment bonus (used in some studies as an incentive for participants to recruit)¹¹ was not provided as part of this study.

At the second appointment, the participants were provided with results and, if positive, were treated with azithromycin for chlamydia and cefixime for gonorrhea. A second questionnaire was administered to gather information about the participants’ experiences in the study. An honorarium of \$10 was provided to participants at the second appointment.

Sample size

Sample size calculations incorporated a design effect of 2 as per Salganik.¹² For description of dichotomous variables, a sample size of 80 participants was chosen such that variables with an expected proportion of 0.2 or less would be estimated with a 90 percent confidence level and a total confidence interval width of 0.15.¹³ Doubling this sample size resulted in a target enrollment goal of 160. Given the pilot nature of this work, the relatively small sample size was intended to generate data that could be used for more precise hypothesis generation and sample size calculations in later studies.

Ethics

This study was approved by the University of Manitoba Health Research Ethics Board.

Study Sample

In this four month pilot, there were 169 participants, with an average age of 18, including 86 females (51 percent), 80 males (47 percent) and 3 transgender (2 percent). Two female participants identified as lesbian and 22 identified as bisexual. Among the male participants, 4 identified as gay and 9 as bisexual. Thirty-one (18 percent) participants were Caucasian, 124 (73 percent) were Aboriginal, 4 were Black, 1 was Hispanic, 1 Middle Eastern, 1 indicated “unsure”, and 7 indicated “other”. Only 16 of the participants (9.5 percent) had never been expelled or dropped out of school.

Measures

A questionnaire collected basic demographic information including gender, age (grouped as 14 to 19 and 20 to 24) and ethnicity (grouped as Aboriginal, Caucasian, and “Other.” Aboriginal included persons self-reporting as First Nations, Métis, and Inuit. “Other” included all persons who did not self-report as Caucasian or as one of the Aboriginal groups indicated above. Variables categorized as “Sexual behaviors/risk” included self-report of ever having opposite and/or same sex partners, ever having had a diagnostic test for chlamydia or gonorrhea and their current infection status based on laboratory results from the urine specimens collected as part of this study. Condom use was based on yes/no responses to an open question of currently using or having ever used condoms with current sex partners (individual sex partners were listed on a social network portion of the questionnaire and this question could be answered for each partner. The final yes/no categorization was based on “yes” for any of one or more sex partners). “Institutional contact” variables included self-report of ever being expelled or dropping out of school, ever having been in foster care, charged with a crime, or incarcerated. Specific categories of income sources associated with street life were created based on self-report in the six months prior to interview of squeegeeing/panhandling, dealing drugs or sex work. Travel patterns were based on self-report of travel within or outside of provincial boundaries in the six month period prior to interview.

Analysis

Respondent Driven Sampling Analysis Tool version 5.0.1, developed by Heckathorn and colleagues (Cornell University, 2003) was used to calculate homophily, heterophily, sample proportions, equilibrium sample proportions, estimated population proportions, and 95 percent confidence intervals for selected questionnaire-item variables. Bootstrapping was performed using 2,500 resamples. In order to determine social network size for each participant, which is incorporated in RDS analyses, participants were asked to think of the number of youth they personally knew well who were within the age range of 14 to 24. They were then asked to indicate which of these youth were street-involved using the definition noted above in ‘Study Design.’

Weighted mean absolute discrepancies between sample proportions and equilibrium sample proportions, presented in Table 1, were calculated following published procedures.¹⁴ Discrepancies that are smaller than the measure of tolerance, defined as 2 percent by Heckathorn,¹⁵ indicate that the actual sample composition approximates the equilibrium sample compositions and that the RDS was therefore successful. Once the sample composition approximated the equilibrium sample composition for a given variable, the sample has converged to equilibrium, and the inclusion of data from subsequent waves of recruitment is not expected to result in a substantial change in the sample composition for that variable.

To determine whether the sample was representative of the target population, a test statistic (Two-tailed Student's t-test) was applied to the absolute discrepancy between sample proportions and the estimated population proportions, following the method used by Wang et al.

Homophily is a measure of preference for social connections with members of one's own group for a particular characteristic, based on study recruitment patterns. Homophily can vary from -1 to +1, with 0 as random recruitment (-1 for males would indicate that males only recruited females; +1 for males would indicate that males only recruited males). Homophily can vary for different states of the same variable; for example, if males only recruit males but females recruit males and females equally. Heterophily, in contrast, measures the preference to recruit between groups (males recruiting females, for example).

The Fisher Exact test was performed in STATA 9.0 to obtain p-values for categorical variables, as a test for association with infection. In this analysis, the data were not weighted. Statistical analysis of RDS data at the multivariate level is controversial.¹⁶ Given this controversy and the pilot nature of our work, unweighted data were used for the univariate analysis.

In all of the above analyses, data originating from the RDS seeds were included. As described above, individuals volunteering for the study without an RDS coupon (57 youth; see below for more recruitment details) were designated as seeds in addition to the eleven study staff-selected seeds. We identified no significant differences between individuals who were study staff-selected seeds, those designated as seeds following presentation without a RDS coupon and those who were recruited via RDS (compared on the basis of gender, age, ethnicity, sexuality, and infection status – data not shown). Further, Gile and Handcock¹⁷ note that removing seed-related data may not dispel bias and may in fact introduce bias. Given the uncertainty of appropriate management of RDS data in this area, and the apparent similarity between the various subgroups within our sample, we chose to establish the final dataset using data from all three of these groups and note our analytic approach here for clarity.

Results

Coupon Recruitment

Of 169 participants, eleven were selected as seeds by study staff, 57 individuals were recruited into the study without a coupon and designated as seeds, and 101 were recruited via coupons distributed by study participants. A total of 448 coupons given to 156 participants resulted in the recruitment of 101 individuals (i.e. 22.5 percent of distributed coupons resulted in recruitment). Of 156 participants provided with coupons, 67 (42.9 percent) recruited at least one person to the study.

Most individuals recruited into the study by a coupon (95/105) reported they had been recruited by a friend or family member. Most of the remainder reported recruitment by an acquaintance, and only two were recruited by a stranger. This is important because RDS relies on pre-existing social relationships, termed the "reciprocity model," to estimate population compositions.¹⁸ The fact that most of the recruited individuals received a coupon from someone they knew well indicates that the

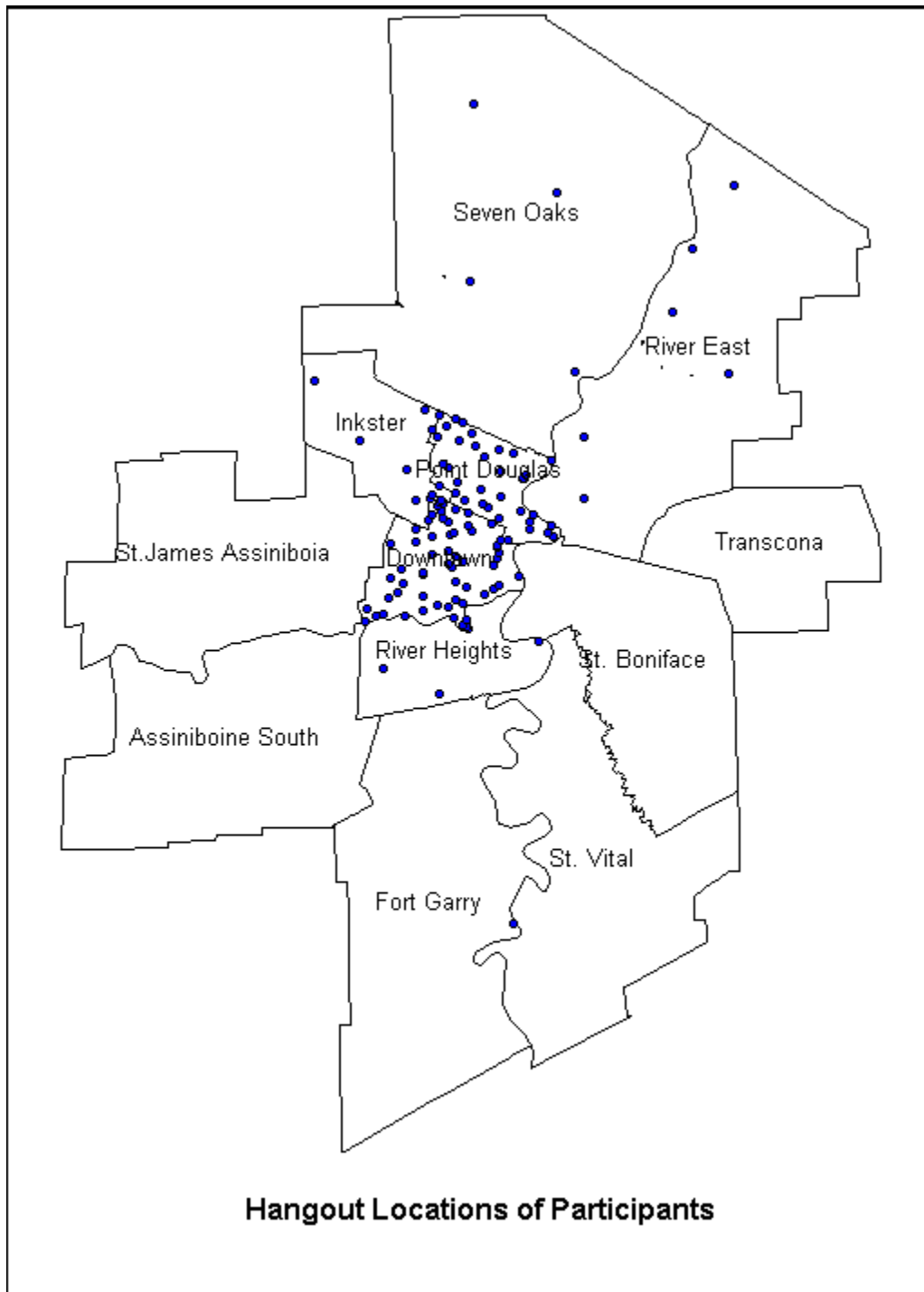
assumptions of the reciprocity model were not broken. Although recruitment by a family member could suggest that recruitment patterns did not occur peer to peer, some families may be sufficiently large such that recruitment by family members implies sibling to sibling recruitment if more than one sibling is street-involved.

Of the 68 “seeds” that had potential to start chains, 33 did not recruit anyone. In total, there were 27 chains with at least one recruitment wave. The number of waves in each chain is indicative of the success of respondent driven sampling. RDS assumes the existence of a connected social network within the target population. In systematic reviews of RDS, the existence of social connectedness has been defined as the observation that at least one RDS chain reaches three waves of recruitment.^{19, 20} In our study this definition was met, as 17 chains contained one wave (41 participants), five contained two waves (19 participants), two contained three waves (15 participants), one contained four waves (ten participants), one contained seven waves (17 participants), and one contained nine waves (26 participants).

The geographic dispersion patterns shown in Figure 1 further suggest the existence of social connectedness within the Winnipeg street youth population. This figure illustrates the areas in Winnipeg where youth reported they typically hang out (youth were queried for the nearest intersection to this location). Figure 1 indicates that study participants typically hung out in the central core of Winnipeg and areas immediately north of the core. These areas reflect the main areas in which street youth in Winnipeg are known to congregate suggesting that RDS was effective in reaching youth throughout these neighborhoods.

A third indication of the social connectedness of Winnipeg street youth is the observation noted above regarding the rapidity with which news of the study spread by word of mouth within the population. In the absence of any study advertisements, this phenomenon suggests extensive communication networks within the population of street youth in Winnipeg.

Figure 1. Map of Winnipeg showing the areas in which study participants report they "hang out." Youth identified these areas by stating the nearest main intersection to these locations.



Convergence to Equilibrium

Sample convergence was reached for many variables, including age group, ethnicity, infection status, traveling within or outside of Manitoba in the past six months, drug dealing, history of foster care, criminal charges, and squeegeeing or panhandling (Table 1). As indicated by a weighted mean discrepancy greater than the measure of tolerance, 0.02, sample convergence was not reached for gender, sexual orientation, history of sex work, school problems, incarceration, past STD infection, testing and condom use. Therefore, results may be less accurate for these variables than results for variables that did converge to equilibrium.

Representativeness

Representativeness was considered to have been reached for variables for which the test statistic was not significant, with $p > 0.05$ (Table 1). Of the variables listed above, the only variable for which representativeness was not achieved was having tested positive for chlamydia and/or gonorrhea in the past ($p = 0.044$), as individuals who had tested positive in the past were under-represented in the sample.

Table 1. RDS Analysis Tool output indicating sample and population proportions of key variables and indicators of convergence and representativeness.

	N Used by RDS	Sample Proportion	Equilibrium Sample Proportion	Weighted Mean Discrepancy (Sample-Equilibrium)	Estimated Population Proportion	Confidence Interval with $\alpha=0.05$, 90 percent CI	T-test (Sample - Estimated)	p-value for t-test
Demographic Variables								
Gender				0.047				
Male	44	0.481	0.434		0.413	0.22-0.497	0.903	0.372
Female	56	0.518	0.565		0.586	0.503-0.779	-1.018	0.313
Age				0.005				
14-19	67	0.663	0.658		0.556	0.465-0.756	1.853	0.068
20-24	34	0.337	0.342		0.444	0.244-0.535	-1.320	0.196
Ethnicity				0.010				
Aboriginal	75	0.733	0.742		0.73	0.509-0.799	0.059	0.953
Caucasian	18	0.183	0.167		0.174	0.08-0.362	0.099	0.922
Other	8	0.082	0.089		0.095	0.032-0.269	-0.134	0.897
Sexual Behaviors/Risk				0.021				
Type of sex partner								
Opposite Sex Partners Only	76	0.758	0.778		0.733	0.591-0.855	0.509	0.612
Opposite and Same Sex Partners	19	0.188	0.209		0.245	0.120-0.379	-0.636	0.533
Same Sex Partners Only	3	0.055	0.012		0.023	0.014-0.069	0.243	0.831
Previous CT or GC test				0.083				
No	28	0.339	0.256		0.245	0.183-0.417	1.051	
Yes	73	0.661	0.744		0.755	0.584-0.817	-1.697	

Current CT or GC				0.000				
No	82	0.850	0.850		0.855	0.792-0.955	-0.127	
Yes	15	0.150	0.149		0.144	0.044-0.207	0.065	
Condom Use				0.039				
No	34	0.728	0.767		0.769	0.554-0.955	-0.537	
Yes	11	0.272	0.233		0.231	0.046-0.452	0.306	
Institutional Contact								
Expelled or dropped out of school				0.030				
No	7	0.094	0.064		0.060	0.014-0.114	0.308	
Yes	94	0.906	0.936		0.940	0.885-0.985	-1.130	
Previous foster care				0.001				
No	41	0.408	0.407		0.415	0.361-0.597	-0.091	
Yes	60	0.592	0.593		0.585	0.403-0.640	0.110	
Previous criminal charge				0.002				
No	32	0.317	0.319		0.369	0.337-0.576	-0.632	0.532
Yes	68	0.683	0.681		0.631	0.424-0.664	0.922	0.360
Previous incarceration				0.031				
No	41	0.432	0.401		0.419	0.368-0.644	0.168	0.867
Yes	60	0.568	0.599		0.581	0.356-0.633	-0.203	0.840
Types of Income								
Squeeeeeeing, Panhandling, Flagging				0.014				
No	86	0.846	0.860		0.892	0.861-0.966	-1.182	0.241
Yes	15	0.154	0.140		0.108	0.034-0.139	0.494	0.629
Drug Dealing				0.003				
No	66	0.650	0.653		0.702	0.661-0.842	-0.886	0.379
Yes	35	0.349	0.346		0.297	0.157-0.339	0.645	0.523
Sex Work				0.038				
No	83	0.786	0.824		0.739	0.624-0.860	1.044	0.300
Yes	18	0.213	0.175		0.26	0.139-0.375	-0.487	0.632
Travel Patterns								
Travel Within Manitoba				0.003				
No	37	0.360	0.363		0.408	0.253-0.469	-0.608	0.547
Yes	64	0.639	0.636		0.591	0.531-0.746	0.800	0.427
Travel Outside of Manitoba				0.009				
No	79	0.786	0.777		0.772	0.666-0.854	0.303	0.763
Yes	22	0.213	0.222		0.227	0.145-0.333	-0.160	0.874

Homophily and Heterophily as Indicators of Social Linkage

The affiliation matrix presents both homophily and heterophily values (Table 2). In general, individuals in this sample recruited others with similar demographic characteristics. Positive homophily values were found for gender, ethnicity, and age group, and among individuals with opposite sex partners. A moderate tendency towards in-group affiliation was found for those with both same and opposite sex partners, those with same sex partners only, and also among individuals who travel to other parts of Manitoba.

Individuals also appear to group socially based on health-related behaviors. A tendency towards in-group affiliation was found based on condom use behaviors, among individuals who had never been tested for chlamydia or gonorrhea and among individuals who had tested positive for chlamydia or gonorrhea in the past. A moderate tendency for in-group affiliation was found for individuals who had been tested in the past for chlamydia or gonorrhea, and for individuals who had tested negative for chlamydia or gonorrhea in the past.

Characteristics that indicate a higher degree of street-involvement also influenced social affiliation. A preference for recruiting similar individuals was found based on whether or not a person had ever been in jail, whether a person had been charged with a crime, and among individuals who squeegee, panhandle and flag, and among non-sex workers.

Characteristics that had little influence on social affiliation included whether or not a person sold drugs or had been in foster care. Similarly, participants who had never been charged with a crime, never had school system problems, and had not squeegeed, panhandled, or flagged were just as likely to associate with individuals who had been involved in these activities as individuals who had not.

Table 2. Affiliation matrix indicating homophily and heterophily values for key variables obtained from RDS Analysis Tool output.

Variable, N	Characteristic of recruiter	Characteristic of recruited individual, affiliation values		
Demographic Variables				
Age		14-19	20-24	
67	14-19	0.503	-0.503	
34	20-24	-0.237	0.237	
Gender		Male	Female	
44	Male	0.347	-0.347	
56	Female	-0.289	0.289	
Ethnicity		Aboriginal	Caucasian	Other
75	Aboriginal	0.456	-0.423	-0.518
18	Caucasian	-0.387	0.426	-0.724
8	Other	-0.480	-0.719	0.526
Sexual Behaviors/Risk				
Type of sex partner				
		Opposite Sex Partners Only	Opposite and Same Sex Partners	Same Sex Partners Only
76	Opposite Sex Partners Only	0.352	-0.335	-0.530
19	Opposite and Same Sex Partners	-0.174	0.185	-0.562
3	Same Sex Partners Only	-0.090	-0.319	0.147

Previous CT or GC test		No	Yes	
28	No	0.243	-0.243	
73	Yes	-0.195	0.195	
Condom Use		No	Yes	
34	No	0.231	-0.213	
11	Yes	-0.220	0.220	
Current CT or GC infection		No	Yes	
82	No	-0.002	0.002	
15	Yes	-0.026	0.026	
Institutional Contact				
Expelled or dropped out of school		No	Yes	
	No	0.113	-0.113	
	Yes	-0.078	0.078	
Previous foster care		No	Yes	
41	No	-0.008	0.008	
60	Yes	-0.029	0.029	
Previous criminal charge		No	Yes	
32	No	0.048	-0.048	
68	Yes	-0.239	0.239	
Previous incarceration		No	Yes	
41	No	0.303	-0.303	
60	Yes	-0.353	0.353	
Types of Income				
Squeegeeing, Panhandling, Flagging		No	Yes	
86	No	-0.001	0.001	
15	Yes	-0.253	0.253	
Drug dealing		No	Yes	
66	No	-0.094	0.094	
35	Yes	-0.023	0.023	
Sex Work		No	Yes	
83	No	0.484	-0.484	
18	Yes	-0.146	0.146	
Travel Patterns				
Travel within provincial borders		No	Yes	
37	No	0.029	-0.027	
64	Yes	-0.197	0.197	
Travel beyond provincial borders		No	Yes	
79	No	0.111	-0.111	
22	Yes	-0.086	0.086	

Prevalence and Correlates of Chlamydia and Gonorrhea Infection

Of the 169 participants, six refused to provide a urine sample and three provided samples in insufficient quantities for the test. Of the 160 participants who did receive laboratory testing, 136 were uninfected (85 percent), 20 were infected with chlamydia only (13 percent), three were infected with gonorrhea only (2 percent), and one was co-infected with both chlamydia and gonorrhea. The overall prevalence of chlamydia and/or gonorrhea infection was 15 percent.

There were 116 individuals who provided a urine sample and returned for the second appointment. Therefore, the return rate of participants was 116/160, or 73 percent.

The only study variable significantly correlated with present infection was gender ($p=0.025$), with 22 percent of female participants testing positive, compared to only 8 percent of male participants (Table 3). Only 47 percent (35/75) of male participants had been tested for chlamydia and/or gonorrhea in the past, compared to 84 percent (68/81) of females.

Table 3. Univariate associations between street-involved youth variables and chlamydia and/or gonorrhea infection using the Fisher's Exact Test, N=160*

	N	Not Infected (percent)	Infected (percent)	OR	95 percent CI	p-value
Demographic Variables						
Gender						
Male	75	69 (92.0)	6 (8.0)	ref		
Female	82	64 (78.0)	18 (22.0)	3.23	1.24-8.40	0.025
Age						
14-19	106	91 (85.8)	15 (14.2)	ref		
20-24	54	45 (83.3)	9 (16.7)	1.21	0.50-2.93	0.649
Ethnicity						
Aboriginal	117	99 (84.6)	18 (15.4)	ref		
Non-Aboriginal	43	37 (86.0)	6 (14.0)	1.12	0.42-2.95	1.000
Sexual Behaviors/Risk						
Type of sex partner						
Opposite Sex Partners Only	119	101 (84.9)	18 (15.1)	ref		
Same Sex Partners	37	32 (86.5)	5 (13.5)	0.87	0.31-2.47	1.000
Previous CT or GC test						
No	53	49 (92.5)	4 (7.5)	ref		
Yes	106	86 (81.1)	20 (18.9)	2.85	0.96-8.39	0.065
Condom Use						
No	19	16 (84.2)	3 (15.8)	ref		
Yes	56	47 (83.9)	9 (16.1)	0.98	0.26-3.83	1.000
Institutional Contact						
Expelled or dropped out of school						
No	16	15 (93.8)	1 (6.2)	ref		
Yes	144	121 (84.0)	23 (16.0)	2.85	0.454-***	0.470
Previous foster care						
No	66	58 (87.9)	8 (12.1)	ref		
Yes	94	78 (83.0)	16 (17.0)	1.49	0.61-3.63	0.502
Previous criminal charge						
No	49	41 (83.7)	8 (16.3)	ref		
Yes	109	93 (85.3)	16 (14.7)	0.88	0.36-2.17	0.813
Previous incarceration						
No	68	59 (86.8)	9 (13.2)	ref		
Yes	92	77 (83.7)	15 (16.3)	1.28	0.53-3.06	0.659
Types of Income						
Squeegeeing, Panhandling, Flagging						
No	135	113 (83.7)	22 (16.3)	ref		
Yes	25	23 (92.0)	2 (8.0)	0.45	0.00-1.84	0.374

Drug Dealing						
No	103	87 (84.5)	16 (15.5)	ref		
Yes	57	49 (86.0)	8 (14.0)	0.89	0.36-2.18	1.000
Sex Work						
No	125	108 (86.4)	17 (13.6)	ref		
Yes	35	28 (80.0)	7 (20.0)	1.59	0.62-4.12	0.421
Travel Patterns						
Travel Within Manitoba						
No	104	90 (86.5)	14 (13.5)	ref		
Yes	56	46 (82.1)	10 (17.9)	1.40	0.59-3.33	0.491
Travel Outside Manitoba						
No	126	106 (84.1)	20 (15.9)	ref		
Yes	34	30 (88.2)	4 (11.8)	0.71	0.24-2.14	0.787

* The maximum sample size for univariate analyses is 160, as the 9 participants for which a lab test result was not obtained are not included. The actual sample size used for some variables may be less than 160 because some participants refused to provide answer the particular question.

** No upper confidence limit was defined in the analysis.

Discussion

Effectiveness of RDS

Overall, street-involved youth responded well to RDS recruitment methods. Nearly all non-seed participants (98 percent) were recruited by someone who was at the least an acquaintance, satisfying the requirement that RDS follow preexisting social networks. The majority of individuals returning for the second interview reported they had distributed recruitment coupons (85 percent), suggesting that the major barrier to recruitment is not lack of coupon distribution. The fact that nearly one third (31.4 percent) of participants did not return for the second interview indicates that it is important to provide street-involved youth with information and services when contact is first made.

The practice of allowing participants to enter the study without recruitment coupons resulted in the start of many new chains. However, despite this methodological practice, two large RDS chains with seven and nine waves of recruitment still formed. Further, the approach of allowing additional seeds to enter also avoided the co-modification of coupons as a means to enter the study, as has been demonstrated among IDUs in Chicago.²¹

Although not directly related to RDS effectiveness, it is worth noting that, since study recruitment took place in winter, this study is focused on local youth. Youth “travelers,” who migrate from community to community via trains and/or hitchhiking, tend to spend the winters in cities with warmer wintertime temperatures in comparison to Winnipeg (e.g. Vancouver). Repeating a study of this kind in summer would be necessary to determine whether RDS would be an effective means of recruiting this subgroup of youth, as they were not likely included in the present study.

Recruitment and Social Linkage Patterns

Study participants characterized by particular demographics tended to recruit others with similar characteristics. These characteristics include gender, ethnicity, age group, and being heterosexual. From a practical perspective, these patterns would indicate that seeds for future studies should be selected so that these groups are all represented, to ensure that a representative RDS sample is obtained. Selection of seeds with diverse backgrounds has been suggested as leading to the success of RDS among illicit drug users.²²

The fact that individuals who have traveled to other communities within the provincial boundaries of Manitoba recruit similar individuals indicates the potential for RDS to readily reach beyond the

boundaries of an urban center where the study is based to adjoining communities. This pattern is not as apparent for individuals who reported traveling beyond provincial borders in the six months prior to interview. As noted above, given our local climatic conditions, the fact that the study took place in the winter months may influence these results, as many street-involved youth may leave for warmer cities in winter. The youth that remain may be more likely to have local family connections, including family connections to many smaller rural and First Nation reserve communities. Intraprovincial travel may reflect trips to visit family and friends, and would explain why travel did not extend outside of the province.

Sex workers in this sample did not show a tendency to recruit other sex workers, possibly due to the fact that there were relatively few sex workers in the sample, or that many sex workers are older and would have been ineligible for recruitment into this study.

High homophilies among individuals who squeegee, panhandle or flag, have dropped out or been kicked out of school, or have been charged with a crime—compared to individuals who have not had these experiences—suggest social linkages among highly street-involved youth. Participants reporting shelter in places suggestive of a higher degree of street-involvement, such as foster homes, group homes, hotels, shelters and jail, also showed relatively high homophily. Conversely, type of most frequent hangout did not show the same pattern, as individuals of both high and low degrees of street-involvement hangout in the same places. This may reflect the differences between more street-involved individuals who are physically close to each other for much of the day and need to support each other to survive, compared to individuals who are less street-involved, consistent with findings that length of time on the street is correlated with increased social connectedness with a ‘street family.’²³ These results suggest that RDS is an effective method to reach youth with a high degree of street-involvement, even if seeds have a lower degree of street-involvement.

Characteristics such as drug dealing and infection status appear to be randomly distributed among street-involved youth. The fact that no social characteristics aside from gender correlated with infection status suggests the importance of designing STI-related interventions for diverse groups of street-involved youth. Although some studies have found chlamydia infection in street youth to be associated with female gender, Aboriginal ethnicity,²⁴ sexual abuse, sex work and infrequent condom use,²⁵ others are similar to our study where no correlates of infection were found.²⁶

This sample of street youth had a high overall prevalence of 15 percent infected with chlamydia and/or gonorrhea. This is considerably higher than the average prevalence of 8.6 percent among street-involved youth across Canada in 1999,²⁷ 6.6 percent in Montreal,²⁸ and 11.6 percent in Denver.²⁹ As this study was not intended to be directly comparative to research that has been conducted in other areas, it is not clear whether the higher prevalence we observed would be related to differences in sampling methodologies or to true differences in disease prevalence. However, it is notable that Manitoba, and the neighboring province of Saskatchewan, consistently report the highest rates of chlamydia and gonorrhea in Canada, and it is not unexpected that street youth in Winnipeg would show this same pattern. Winnipeg has taken part in the most recent phase of ESYS, the Enhanced Street Youth Surveillance program implemented in several Canadian cities by the Public Health Agency of Canada. The intention of this program is to collect data on sexually transmitted infections and associated behaviors in street youth. By using standardized sampling methodologies and questionnaires, data from ESYS may reveal whether STI disease prevalence is consistently higher amongst Winnipeg street youth and whether any specific behavioral patterns correlate with prevalence differences.

Among the female participants in our study, 22 percent were infected with chlamydia and/or gonorrhea, despite the fact that 84 percent of the female participants had been tested in the past. This suggests that there is a need for frequent testing among females. As only 47 percent of males had been

tested in the past, there is a clear need to encourage testing among males. This is consistent with testing habits of street youth identified in a California study, where 63 percent of females and 81 percent of males had not been tested for chlamydia in the previous year.³⁰

The use of RDS was a feasible and acceptable method to recruit among this population of street-involved youth and effectively recruited a representative sample, though convergence was not achieved for some variables. Individuals with similar demographic characteristics tended to recruit each other. Youth with a high degree of street involvement appear to show social linkages, however those with a lesser degree of street involvement do make contact with and recruit them. These are the individuals that may be less likely to enter a clinic and therefore can best be reached using methods such as RDS and word of mouth. Furthermore, these are the individuals who would benefit the most from services designed for them, accessible in non-clinical venues, where barriers to healthcare such as lack of awareness of services, location, trust, judgmental practitioners, wait times and appointments, transportation, lack of ability to pay for prescriptions, and homelessness can be mitigated.³¹ ³²This indicates the value of RDS as a method to reach the most marginalized street-involved youth, as youth who are more accessible will recruit those who are more difficult to reach.

Since very few correlates of current infection with chlamydia or gonorrhea were identified and very low homophily was found among infected individuals, street-based prevention programs should be directed towards diverse groups of street youth. However, moderately high homophily among individuals who do not use condoms, those who have never been tested before, and those who have received positive test results in the past, regardless of current infection status, indicates the possibility that higher-risk networks may exist within the general street youth population.

This study was implemented as a pilot to establish the feasibility of RDS amongst a street-involved youth population and to begin to understand social linkage patterns within a population of this type (by examining homophily patterns of recruitment). Our previous research involving sociometric sexual networks of chlamydia- and/or gonorrhea-infected cases and contacts revealed the existence of distinct types of sexual networks.³³ Each type of network appeared to represent distinct types of ecological habitats for STI in which the transmission success of different pathogens varied. The administrative databases used for that research contained no behavioral or social norm data and we hypothesized that the underlying determinant of pathogen success would be linked to these types of variables and, more specifically, that individuals with similar normative actions and/or related behavioral patterns were socially linked. These linkages would create subgroups within a population and it is these subgroups that could become the focus for targeted interventions.

Our observation that homophily is associated with some behavioral patterns is meant to generate hypotheses in this area that can be used as the basis for future study design. Understanding the broader social linkages that occur above the level of personal social networks may be key to both an understanding of how pathogens differentially spread within a population and how intervention messaging and social norms are communicated and maintained within different population subgroups.

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