SEXUAL BEHAVIOURS AMONG A COHORT OF STREET-INVOLVED YOUTH IN VANCOUVER

by

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ABSTRACT

Background: Street-involved youth are known to be at a greatly increased risk of HIV and sexually transmitted infections (STIs); however, the role that environmental and structural factors play in driving disease transmission risk among this population has not been thoroughly examined.

Methods: The At Risk Youth Study (ARYS) is a prospective cohort of homeless and street-involved youth between the ages of 14 and 26. From September 2005 to October 2006, participants completed a baseline questionnaire which elicited information regarding sexual activity, injection and non-injection drug use, addiction treatment experience, encounters with police and security guards, and health service utilization. Environmental and structural correlates of number of recent sex partners were identified using quasi-Poisson regression. Factors independently associated with consistent condom use were also examined using logistic regression.

Results: Among 529 participants, 415 (78.4%) were sexually active during the past six months, of whom 253 (61.0%) reported multiple sex partners and 288 (69.6%) reported inconsistent condom use during this time period. In multivariate logistic regression, homelessness and self-reported structural barriers to accessing health services were inversely associated with consistent condom use. In multivariate analysis, living in a shelter, hostel, or single room occupancy hotel was positively associated with greater numbers of recent sex partners. Structural factors that were associated with number of sex partners included having a warrant or area restriction that affects access to health services, and for males, being accosted by the police.

Conclusions: Unstable housing, homelessness, and structural factors related to the criminalization and displacement of street-involved youth were associated with an increased risk of HIV and STI transmission, even after extensive adjustment for sociodemographic and individual level characteristics. These findings suggest that both environmental and structural factors influence the spread of HIV and STIs, and point to the need for environmental-structural interventions to reduce the burden of these diseases among this population.

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DEDICATION

To Michael

CO-AUTHORSHIP STATEMENT

This statement is to certify that the work presented in this thesis was conceived, conducted, written, and disseminated by Brandon Marshall (BM). The co-authors of the manuscripts, including Drs. Thomas Kerr (TK), Jean Shoveller (JS), Jane Buxton (JB), Evan Wood (EW), and Thomas Patterson (TP), made contributions only as is commensurate with committee, collegial or principal investigator duties. With substantive input from supervisors TK and JS, BM designed the studies and wrote the research protocols. With guidance and input from TK, JS, JB, and TP, BM performed the research and conducted the data analyses. The manuscripts contained in this thesis were prepared and written by BM, and were revised and submitted for publication based on the suggestions of TK, JS, JB, EW, and TP. Final drafts of the manuscripts were prepared following the inclusion of material based on comments from the co-authors, the journal editors, and external peer reviewers.

CHAPTER 1

BACKGROUND AND RESEARCH OBJECTIVES

1.1 HIV AND SEXUALLY TRANSMITTED INFECTIONS AMONG STREET-INVOLVED YOUTH

Homelessness is a growing concern in high-income nations around the world. In Canada and the United States, the number of adults who are without access to safe and stable housing has increased sharply since the 1980s, with estimates suggesting that approximately 6 - 8% have experienced some form of homelessness in their lifetimes [1-3]. Studies of homeless adolescents have suggested that the prevalence of homelessness is even higher among this age group. In one representative survey conducted in the United States, the estimated annual prevalence of homelessness among youth aged 12 to 17 was 7.6% [4]. Since the definition of "homeless youth" is often used interchangeably with "street youth" to include individuals up to age 26 who may be temporarily housed but are heavily engaged in the street culture and economy [5, 6], the actual number of street-involved young people may be much higher. In Canada, it is estimated that 150,000 youth are absolutely, temporarily, or periodically without access to safe and stable shelter, a number which closely parallels US figures [7].

Homelessness adversely impacts adolescent health. Homeless and street-involved youth are at a heightened risk for a range of negative health outcomes,

including a ten-fold increased risk of mortality [8]. Some of the most pressing health concerns reported by street-involved youth pertain to sexual and reproductive health [9, 10]. Furthermore, infectious diseases including blood-borne pathogens such as HIV, hepatitis B (HBV), and hepatitis C (HCV), and sexually transmitted infections (STIs) such as Chlamydia (CT) and Gonorrhoea (GC) are of major public health concern. Recent reports by the Public Health Agency of Canada have noted that the prevalence of CT and GC among Canadian street youth are at least ten times that of the general adolescent population (11.0% and 3.1%, respectively) [11, 12]. Studies of street-involved youth in the urban centres of Montreal and Toronto have estimated the prevalence of HIV to be approximately 2% [7, 13]. In the United States, HIV prevalence among street-involved youth has been found to vary between less than 1% to over 10% [14-17].

1.2 STREET YOUTH AND HIV/STI EPIDEMIOLOGY

A large body of epidemiological research indicates that street-involved youth engage in an array of sexual and drug-related HIV risk behaviours, including injection drug use and syringe sharing, inconsistent condom use, multiple sexual partnerships, sexual activity with higher-risk sex partners (e.g., injection drug users [IDU], men who have sex with men [MSM]), and survival sex work (i.e., sex in exchange for money, drugs, shelters, or gifts) [18-28]. The rates of sexual abuse,

sexual assault, and involuntary sexual activity are also considerably higher than those observed among the general adolescent population [29-31].

Although the prevalence of sexual risk behaviour among street-involved youth has been relatively well characterized, few studies explicitly describe how these behaviours impact the population level transmission dynamics of HIV and other STIs. Classic models of STI epidemiology suggest that the reproductive rate (R_0) is a key determinant in the spread of an infectious disease, particularly during the early stages of an epidemic [32]. This value is dependent on three components: 1) the transmissibility of a pathogen between discordant partners (β), 2) the average rate of partner change within the population (c), and 3) the average duration of infectiousness (D) [33]. Despite recognition in the literature that these factors have distinct and complex influences on transmission dynamics, few studies of sexual risk behaviour among street-involved youth adequately measure and model them as such. For example, since individuals who have higher-risk or casual sex partners tend to use condoms more consistently [34], studies that measure condom use in the absence of other factors such as relationship status or rate of partner change often fail to find a significant protective effect [35, 36]. Several authors have argued that the often observed failure of behavioural interventions that target a specific behaviour (e.g., condom use) to reduce population level STI incidence can be explained by the interdependent and nonlinear relationship between sexual activity

and STI transmission [36, 37]. Although the relative ineffectiveness of behavioral interventions among adult populations has been established in the literature, the majority of HIV prevention programs for adolescents in the United States continue to consist of education sessions that emphasize personal agency and decision making with regard to engagement in abstinence, monogamy, and protected intercourse [38, 39].

1.3 ENVIRONMENTAL-STRUCTURAL FACTORS AS DETERMINANTS OF HIV/STI TRANSMISSION

It is well-known that individual level models (e.g., health belief models, social learning theory) that emphasize knowledge, behavioural intentions, self-esteem, and self-efficacy to engage in risk reduction strategies are unable to account for the full variability in HIV and STI risk across populations [40, 41]. In response to these concerns, several authors have argued that the production of HIV and STI vulnerability among marginalized populations, including MSM, IDU and commercial sex workers, is driven predominately by social, structural, and environmental factors [41-43]. Structural factors, defined as the economic, social, policy, and organizational environments that "structure" the context in which HIV and STI risk production occurs, are increasingly thought to be major drivers of susceptibility to and spread of these diseases [44, 45]. Similar "environmental-

structural" frameworks have recently been adapted to describe the multi-level factors associated with HIV/STI risk production among marginalized and homeless youth [46, 47].

Reviews of HIV and STI prevention interventions for adolescents have shown that individualistic programming generally does not result in sustained behaviour change and does not improve population health outcomes [39, 48, 49]. Although it is recognized that the goal of intervention efforts should be to reduce the empirical values of R_0 by addressing the social, structural and environmental conditions in which HIV/STI risk behaviour takes place [50], few studies of street-involved youth have been able to demonstrate quantitatively that changes to these conditions result in improved outcomes. However, several studies of marginalized adult populations have shown that structural interventions can improve HIV/STI-related population health outcomes; for example, needle exchange programs have resulted in reduced HIV transmission among populations of IDUs [51], while changes to government sex work policy have been associated with reductions in STI prevalence among sex workers [52].

In order to inform the development of effective policies, programs and interventions that reduce the burden of HIV and STIs among street-involved youth, epidemiological research must seek to identify relationships between environmental-structural factors and risk behaviours that result in the sustained and

elevated transmission of HIV and STIs [40]. Although environmental-structural frameworks such as risk environment theory are used primarily to characterize vulnerabilities associated with the risk of *acquisition* of disease, classic models of STI epidemiology suggest that population prevalence and incidence depend heavily on the characteristics associated with disease *transmission* [36]. Therefore, a synthesis of transmission and contextual models appears to be necessary to further the objectives of evidence-based HIV and STI reduction interventions.

1.4 STUDY OBJECTIVES, SETTING AND OUTLINE

The primary objectives of this thesis are to describe and examine the environmental-structural factors that are associated with increased engagement in sexual behaviours that drive the transmission of HIV and other STIs. This research was conducted as part of a larger project of street-involved youth in Vancouver, entitled the At Risk Youth Study (ARYS).

The At Risk Youth Study:

ARYS is an open prospective cohort of street-involved, drug-using youth that began enrolment in September, 2005 [53]. Individuals are eligible for participation in the study if they are: 1) between the ages of 14 and 26, 2) have used illicit drugs other than or in addition to cannabis in the last 30 days, and 3) provided informed

consent. Snowball and extensive street-based recruitment methods were used in an attempt to obtain a representative sample of street-involved youth in Vancouver. Recruitment was conducted from a wide variety of the city's street, youth agencies, youth shelters, hostels, and other relevant service organizations. At baseline, participants completed a lengthy interviewer-administered questionnaire and provided blood samples for HIV and HCV serology. The ARYS baseline survey elicited information regarding sociodemographics, drug use history and current patterns of use, childhood and current abuse, sexual activity including involvement in survival sex work, and health service utilization, including addiction treatment. The survey also includes standardized measures of depression (Centre for Epidemiologic Studies Depression [CES-D] Scale) [54], alcohol dependence (Perceived-Benefit-of-Drinking Scale) [55], and the Self-Efficacy for Limiting HIV Risk Behaviours (LHRB) Scale [56]. The study has received ethical approval from the Providence Health Care/University of British Columbia's Research Ethics Board (REB). The research conducted as part of this dissertation was also approved by the REB as a sub-study to the larger ARYS project (see Appendix 1).

This thesis will seek to address three objectives:

1) **To characterize the prevalence and distribution of sexual risk behaviours among a cohort of street-involved youth in Vancouver.** Chapters 3 and 4

contain analyses of recent sexual activity reported by all ARYS participants who completed a baseline survey between September 1, 2005 and October 31, 2006. Specifically, the distribution of recent sex partners and condom use patterns are described. It is hypothesized that street youth in Vancouver will have on average a greater number of recent sex partners and less frequent condom use than the school-based youth population in BC. Since the factors associated with sexual risk behaviour have been shown to be moderated by gender among some samples of homeless and street-involved youth [21, 57], it is hypothesized that the distribution of these outcomes will differ by gender. Finally, since street youth who identify as lesbian, gay, bisexual, transgendered, or transsexual (LGBTT) have been shown to engage in a greater number of sexual and drug-related HIV risk behaviours as compared to their heterosexual peers [58, 59], it is hypothesized that similar trends will be observed among the LGBTT participants enroled in ARYS.

2) **To examine the environmental factors associated with increased risk for HIV and STI transmission among ARYS participants.** Using multivariate analytic techniques, the study presented in Chapter 3 identifies the environmental factors associated with an increased number of recent sex partners and inconsistent condom use — two behaviours which together lead

to an increased risk of elevated HIV and STI transmission. Confounding models are constructed to identify the independent contribution of environmental factors as correlates of sexual risk behaviour after adjustment for other known sociodemographic, individual- and drug-related risk factors. Given that housing and residential conditions are well-established environmental factors associated with HIV risk behaviours among other marginalized populations including people living with HIV/AIDS and IDU [60, 61], it is hypothesized that street-involved youth who reside in safe and stable housing environments will report fewer sexual risk behaviours than those living with no fixed address, in temporary residences, or on the street.

3) **To examine the structural factors associated with increased risk for HIV and STI transmission among ARYS participants.** Research presented in Chapter 4 identifies the structural factors associated with sexual risk behaviour among street-involved youth in Vancouver. Statistical techniques similar to those presented in Chapter 3 are used to determine which structural factors are independently associated greater numbers of recent sex partners and inconsistent condom use. Although there exists a paucity of knowledge to guide *a priori* variable selection, other studies of IDU and street-based sex workers have shown that the criminalization, displacement, and

enforcement-based efforts directed at these populations determine both access to health and harm reduction services and an individual's ability to mitigate HIV risk [43, 62, 63]. Therefore, it is hypothesized that similar structural mechanisms will be associated with engagement in sexual risk behaviours among homeless and street-involved youth in Vancouver.

This thesis is divided into 5 chapters, including three manuscripts (Chapters 2, 3 and 4), an introductory section (Chapter 1), and a concluding discussion section (Chapter 5). The first manuscript is a literature review of the individual, social, environmental, and structural determinants of HIV and STI transmission among street-involved youth. Chapters 3 and 4 are research papers that identify the environmental and structural factors associated with sexual risk behaviours that lead to increased risk for HIV and STI transmission. Finally, Chapter 5 offers a discussion of important results and contextualizes these findings within the state of knowledge regarding HIV and STI risk among marginalized and at-risk youth. This chapter also summarizes the unique contribution of this work to the literature, and highlights important implications for policies, programs, and interventions that seek to address population level sexual health outcomes for marginalized youth in British Columbia.

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CHAPTER 2[1]

THE CONTEXTUAL DETERMINANTS OF SEXUALLY TRANSMITTED INFECTIONS AMONG STREET-INVOLVED YOUTH

2.1 INTRODUCTION

Street-involved adolescents are increasingly common in North American cities [1]. In the United States, it has been estimated that more than 7% of adolescents, approximately 1.6 million youth, have spent at least one night in a homeless shelter or on the street [2]. In Canada, upwards of 150,000 youth are absolutely, periodically, or temporarily without shelter [3]. Since this definition of "street youth" is often extended to include those who may be temporarily housed but are heavily engaged within the street economy [4], the total number is likely much greater. Although no standard definition of homelessness among youth exist, many include adolescents who have left home either voluntarily (i.e., "runaways") or involuntarily (i.e., "throwaways") [5].

As with other marginalized and oppressed persons in industrialized societies, street youth are at a significantly increased risk of a host of negative health outcomes, including heightened risk of mortality [6]. Of major public health concern is that street-

[1] A version of this chapter has been accepted for publication. Marshall, B.D.L. (2008) The contextual determinants of sexually transmissible infections among street-involved youth in North America. Cult Health Sex.

involved adolescents are disproportionately affected by sexually transmitted infections (STIs), human immunodeficiency virus (HIV), and other blood borne diseases such as hepatitis B (HBV) and hepatitis C (HCV) [7-9]. In Montreal [10] and Toronto [4], the prevalence of HIV infection among street youth is estimated to be approximately 2%. This proportion is similar to those observed among street youth populations in the United States [11-13]; however, prevalence estimates over 8% are not uncommon [14, 15]. Although the prevalence of HIV has been observed to be approximately two times higher among males in some studies [10, 16], others have noted no significant difference across genders [17, 18].

The prevalence of STIs among populations of street youth are also strikingly high. In a variety of street-based and shelter settings, the proportion of homeless youth who report ever being diagnosed with at least one STI ranges from 13% to over 40% [12, 19, 20]. The prevalence of *Chlamydia trachomatis* (CT) and *Neisseria gonorrhoeae* (GC) among cross-sectional samples of street youth in the United States have been observed to fluctuate between 4.2% - 18% and 0.9% - 4.2%, respectively [21-24]. Similar studies in major Canadian cities have observed the prevalence of CT among street youth to be between 6.6% and 11.1%, while rates of GC up to 6% have also been reported [25, 26]. A recent report by the Public Health Agency of Canada noted that the incidence of both CT and GC among street-involved youth are increasing, and the current prevalence of these infections are at least ten times that of the general adolescent population [27].

Street-involved adolescents report higher rates of sexual activity and engage in a greater number of sexual risk behaviours than their non-homeless peers. The vast majority (84 to 98%) are sexually active, of whom inconsistent condom use (i.e., not always using condoms with regular, casual and sex trade partners) is commonly reported [12, 19, 28-30]. The median age of sexual debut is often as low as 13 [31-33]. Street youth who identify as lesbian, gay, bisexual, transgendered or transsexual (LGBTT) report even earlier ages of sexual debut as compared to their heterosexual peers [34, 35]. Studies assessing the overall impact of age on sexual risk behaviour have observed a cumulative effect that appears to result in greatly increased risk of HIV and HCV infection among youth aged 18 or older [16]. Although older age is often observed to be a risk factor for a range of sexual risk behaviours among homeless youth [8, 36], its effect is likely confounded by length of exposure to homelessness and severity of deprived living conditions [37].

Street youth are also more likely than their non-homeless peers to have multiple sex partners. For example, a study of teenage homeless youth in the United States and Australia observed that almost two thirds report having had four or more sexual partners in their lifetimes [38]. In contrast, only 14% of high school students reported this many lifetime sexual partners in the most recent CDC National Youth Risk Behaviour Survey [39]. Studies in Canada and the United States suggest that between 20 to 30% of street-involved youth report at least 4 partners in the past year [40, 41].

Among subgroups of homeless youth such as LGBTT adolescents and young sex trade workers, the average number of sexual partnerships has been reported to be up to 11 in the past 30 days [42].

A significant proportion of street youth have engaged in survival sex work (i.e., sex in exchange for money, shelter, gifts or drugs). In the United States, most estimates suggest that approximately one quarter of street youths have participated in the sex trade [43-45]. Similar proportions have been observed among populations of Canadian street youth [1, 46]. Reported rates of survival sex are generally similar or slightly higher among males than among females [32, 33]. Male street youth also tend to report higher numbers of sexual partners but more consistent patterns of condom use than their female peers [28, 30]. Other direct and indirect HIV risk behaviours that are reported by street-involved adolescents include: engaging in sexual activity while intoxicated or high [35, 42], having unprotected sex with an HIV positive or injection drug-using partner [46, 47], and injecting and borrowing syringes from a sex partner [48]. Sexual victimization and involuntary sexual encounters are also common, particularly among youth who are coerced, manipulated, or forced into survival sex [49-51].

Given the disproportionate burden of HIV and other STIs among street-involved youth in Canada, relevant and effective multi-level interventions must be developed in order to prevent further transmission of disease and to support and treat those youth

who are already infected. Although epidemiological research has added greatly to these efforts by describing and assessing the sexual behaviours of street youth in various settings, there are numerous theoretical, methodological, and empirical gaps that hinder the research community's ability to contribute to the development of evidence-based interventions. For example, few studies provide an *a priori* rationale for the selection and operationalization of behaviours which may or may not be relevant determinants of sexual transmission at a population level. Furthermore, a reliance on behavioural risk factors to explain HIV or STI-related outcomes ignores the social and structural environments within which adolescent sexual behaviour takes place, and privileges interventions that seek to alter the knowledge, attitudes, and beliefs of "risky" individuals [52]. In response to these concerns, a growing body of evidence indicates that epidemiological research concerning sexual behaviour should situate, identify, and measure all interrelated sexual behaviours in an appropriate context [53-55].

The objectives of this paper are to review current research concerning the sexual behaviours of street-involved youth, and to examine critically the construction and operationalization of these behaviours as they pertain to the sexual transmission of HIV and STIs at a population level. We begin with a brief review of some of the models and conceptual frameworks that have been used to explain and understand the sexual activity of street-involved adolescents. We then focus on the psychosocial determinants

that are thought to influence the sexual behaviours of street youth, and follow with a review of literature concerning the intersections of illicit drug use and sexual activity. Given the increasingly apparent limitations of sexual health interventions that focus solely on individual characteristics and qualities [56, 57], the bulk of this paper will concentrate on the social, structural, and environmental factors that influence sexual behaviour and sexual transmission of infections at a population level. We conclude with a discussion regarding the future directions of STI-related epidemiological research involving street youth populations, and argue for a shift away from a dependence on the utilization of individual level behavioural risk factor analysis to predict and therefore prevent HIV and STI infections. Ultimately, improving our understanding of the multifactorial influences on youth sexual behaviour is a necessary precursor to the implementation of interventions that reduce the burden of HIV and STIs among populations of street-involved adolescents.

2.2 METHODS

Published studies were identified through electronic searches of MEDLINE, Science Citation Index (Expanded), and the Social Sciences Citation Index. A variety of terms were used to find relevant peer-reviewed articles, including "sexual (risk) behaviour", "homeless youth", "homeless adolescent", "street(-involved) youth", and "at-risk youth". Additional articles were obtained through reference lists of

published manuscripts and through cited reference searches within Web of Science®. We concentrated primarily on peer-reviewed published literature; however, internet-based searches of relevant government documents and other reports were also conducted. A broad definition of "street youth" (i.e., any adolescent who is absolutely, temporarily, or periodically without access to safe and stable shelter) was used in order to include all literature on street-based, shelter-based, homeless, runaway, and throwaway youth. To be consistent with other reviews of homeless youth [58, 59], we chose to focus our review on individuals aged 12 to 25. We also restricted our search to peer-reviewed and grey literature published in English between the years 1980 and 2008.

2.3 DISCUSSION

2.3.1 A Synthesis of STI Transmission and Contextual Models

The risk of HIV or STI acquisition is dependent upon a complex interplay of pathogen characteristics, host factors, partner factors, sexual behaviours, and the social, structural, and environmental context in which these activities take place [60]. However, STI transmission at a population level depends primarily on the reproductive rate (R_0), which in turn is determined by three components: 1) the transmissibility between infected and uninfected persons (β), 2) the average rate at which new sexual partners are acquired (c), and 3) the average duration of

infectiousness (D) [61]. Despite recognition in the literature that these components have distinct and important influences on STI transmission dynamics, few studies investigating the relationship between sexual risk behaviour and HIV or STI acquisition adequately differentiate between them [53]. For example, the well-documented failure to find a significant protective effect of condom use on reducing STI incidence has been attributed partially to greater numbers of sexual partners and other risk behaviours among condom users compared to non-users [62].

Anderson and May's transmission equation ($R_0 = \beta cD$) has important implications in terms of understanding the relationship between sexual risk behaviour and elevated rates of HIV and STIs among street youth. In order to decrease the incidence of HIV and STIs, prevention and education programs must result in sustained reductions of one or more of these three parameters. For example, abstinence only programs, which substantial evidence suggests are ineffective [63], are of limited impact because they are unable to decrease the transmissibility, rate of partner change, or duration of infectiousness among the targeted groups of adolescents. A similar argument could be levied upon conceptual models and corresponding interventions that focus exclusively on individual level behaviours, characteristics, and qualities. While interventions based on such frameworks have shown to be moderately effective in some (primarily school-based) settings [64], recent evidence suggests that individual level sexual

health programs do not result in sustained behaviour change or improved population health outcomes [57]. One likely explanation for the limited success of these interventions is that they do not address the macro-level factors and other underlying determinants that indirectly impact the transmission dynamics of HIV and STIs. Several researchers have recently argued that the production of HIV risk (and in a quantitative sense the dynamics of HIV transmission) is predominantly social, structural, and environmental [65-67]. For example, risk environment theory posits that macro-level factors such as policies, laws, economic conditions, and societal inequities structure micro-level factors which produce and reproduce HIV risk [68]. Although such approaches have been used primarily to conceptualize the risk of *acquisition* of disease, we argue that risk environment theory and other ecological models are equally appropriate in terms of understanding the *transmission* of disease at a population level.

Although structural determinants that influence the transmission of HIV have been examined in some populations (most notably among men who have sex with men [MSM] and injection drug users [IDU]) [65, 69, 70], there exists a dearth of research considering similar influences among street-involved adolescents. Since the predominant thinking with regard to both the risk factors and transmission dynamics of STIs among street youth has been overwhelmingly individual-based [56], historically researchers and policy makers were slow to advocate for relevant

policy level and other structural changes [71]. Structural interventions and the ecological models that inform such programs may possess the capacity to resolve these inequities and inadequacies. Given the many vulnerabilities and poor health outcomes associated with street-involved populations, further research is urgently needed to elucidate the multi-level determinants of sexual risk behaviour among at-risk and street-involved youth.

2.3.2 Psychosocial Determinants of Sexual Risk Behaviour

Extensive research has documented an array of psychosocial factors that are correlated with engagement in sexual risk behaviour among street-involved youth. Initial studies suggested that knowledge, attitudes, and beliefs regarding HIV moderately influence sexual behaviours such as condom use; however, greater associations were generally observed among gay and school-based youth as compared to street-involved populations [72, 73]. High self-efficacy to use condoms has been associated with condom use at last intercourse in both street and shelter-based studies [11, 28, 74]. However, one of the largest multi-centre studies examining the use of condoms among street youth to date concluded that the majority of psychosocial influences, including stressful life events, parental neglect, meaninglessness, and self-esteem, are poor predictors of condom use, particularly after adjustment for sociodemographic covariates [30]. Furthermore, high HIV

knowledge, although a prerequisite to making informed choices and decisions [75], is not generally observed to be a strong determinant of engagement in safer sexual behaviour [30, 74]. Other personal characteristics that have been associated with various measures of sexual risk behaviour among street youth include depression [76], LGBTT orientation [44, 77], and childhood abuse [78-80]. Early childhood sexual abuse, in particular that involving penetration or force, has been independently associated with several sexual risk behaviours in adulthood, including: sex trade work [78, 81], engagement in unprotected sex [82], and an increased number of recent sex partners [83]. A history of sexual abuse has also been associated with earlier initiation into injection drug use [84] and a range of injection-related HIV risk behaviours, including syringe sharing [85, 86].

These studies have undoubtedly made significant contributions to sexual behaviour research and STI epidemiology. However, interventions based exclusively on psychosocial frameworks such as self-esteem, social cognitive theory, and health belief models are increasingly believed to be ineffective at reducing rates of HIV and STI infection among street youth [63, 87]. One possible explanation for their ineffectiveness among street youth is that they do not address the unique social, structural, and environmental context in which street-involved youth sexual behaviours are situated. Such programs fail to incorporate underlying determinants such as culture, poverty, and systemic oppression, all of which are established

factors that influence the transmission dynamics of STIs [56, 60]. One widely cited intervention that was shown to be effective at reducing the sexual risk behaviours of street youth involved a comprehensive program of skill building, creative activities, individual counseling, and access to physical and mental health services [88]. However, it is not known whether the psychosocial components or the removal of barriers to access to health care contributed most greatly to the reductions in sexual risk behaviours observed among this sample of runaway youth.

2.3.3 Substance Use and Sexual Activity

Street-involved youth report significantly higher rates of substance use than their non-homeless peers [89-91]. Of particular concern is the fact that injection drug use is typically reported by 30 to 45% of street youth in Canada and the United States [28, 42, 92, 93]. Most studies suggest that initiation into injection drug use occurs between the ages of 18 and 20, often during periods of homelessness [84, 94]. The incidence rate of initiation into IDU among a cohort of street youth in Montreal has been estimated to be 8.2 per 100 person-years [95]. Given that injecting drugs is one of the strongest known predictors of HIV infection among street youth populations [16, 95], such high rates of initiation into IDU are alarming. Injection drug use among street youth has also been associated with sexual HIV risk

behaviours, including survival sex work [46, 96], unprotected sex [97], and STI infection [98].

Of further concern is the increasing prevalence of crystal methamphetamine use among street youth and young IDU [99]. One recent study of street-involved youth in British Columbia reported that over 70% had ever used methamphetamines in their lifetime [100]. Although the use of methamphetamines during or directly prior to sex has been associated with engagement in a wide variety of sexual risk behaviours among MSM [101], less is known about the event-specific relationships between methamphetamine use and sexual activity among street youth. However, one study observed that the majority (56%) of street youth reported not using a condom the last time they had had sex under the influence of alcohol or drugs [32].

Although illicit drug use can affect HIV or STI transmission by altering the probability of infection during coital events (i.e., drug-related disinhibition and increased desire for higher risk activities such as unprotected intercourse), drug use has also been shown to influence transmission dynamics through other mechanisms. For example, the use of heroin, cocaine, crack, and speed, along with a history of injection drug use, have all been associated with an increased number of sexual partners [20, 92, 102]. Since the intersections of sex- and drug-related risk occur within the deprived economic circumstances and resource poor living conditions that are characteristic of youth homelessness, interventions that attempt to reduce

risk activity (both sexual and drug-related) may be ineffective unless they are able to address the economic conditions, educational barriers, and social inequities that structure the survival strategies and risk taking behaviours common in the lives of street-involved youth.

2.3.4 Social and Peer-Group Influences on Sexual Activity

While the psychosocial and drug-related influences on street youth sexual behaviour have been relatively well-studied, more recent research has turned to social characteristics and peer-group affiliations as potential determinants of sexual risk-taking activity. At a population level, factors such as social network composition and sexual mixing patterns, concurrency, and degree of interaction with "core" groups all play an important role in determining the spread of HIV and STIs [103]. Therefore, it is likely that the unique composition of street youth's social sexual networks [104] and their interaction with other high-risk groups such as older populations of MSM and IDU [10, 105], may partially explain the observed elevated incidence of HIV and other STIs [9, 22]. Research among IDU has also suggested that the structure of social networks and the shared norms within them have the ability to shape both risk perception and risk behaviour [65, 106]. A common hypothesis is that the social environment of youth homelessness encourages participation in sexual risk activity [17, 107]; however, few studies have empirically

examined such relationships. Several studies have shown that members of a social network can either sustain or mitigate involvement in specific sexual risk behaviours [36, 44, 108]. For example, having an active illicit drug user in a network has been associated with lifetime involvement in survival sex, while having a close friend or family member present in the network tends to reduce the likelihood of such events [36]. Having friends who sell or trade sex has also been highly correlated with a range of sexual risk behaviours [109]. Some evidence suggests that street youth who have friend(s) who are employed or attending school are less likely to engage in unprotected sex [108]. Young street-involved women have been found to be more likely than males to have networks that consist of both sexual partners and injection drug users [110], and have also been found to be more likely to report injecting with and borrowing syringes from a sex partner [48].

The size of social networks may also influence the transmission dynamics of HIV and STIs among street-involved populations. Youth who report small social networks are more likely to have experienced abuse prior to leaving home [104], and are significantly more likely to use illicit drugs, have multiple sex partners, and engage in survival sex [36]. Since larger, supportive social networks appear to act as a positive and protective resource during episodes of homelessness for many street-involved youth [111], several authors have argued that interventions should identify "pro-social" peers and promote these relationships as peer-mentoring and skill-

building opportunities [108, 112]. Although such interventions may be successful among some populations of street youth, health professionals and harm reduction workers implementing these programs must be cognizant of the cultural, economic, gender and sexual identity constructs that shape social sexual roles. For example, among women and non-heterosexual IDU engaged in the street and drug economies, gender inequality and homophobia has been shown to promote vulnerability to HIV and increase susceptibility to violence [113-115]. Therefore, peer-based interventions should be sensitive to the unique circumstances and social networks of young females and LGBTT street-involved adolescents. Since youth who identify as transgendered are disproportionately represented among homeless populations (often between 1 and 3% of study samples) [94, 116], further investigation of the sexual behaviours, social networks, and systemic barriers facing transgendered and transsexual street youth is also required [117].

2.3.5 Sexual Activity and the Physical Environment

A large body of evidence indicates that homelessness negatively impacts adolescent health [118]. Periods of homelessness among street-involved or at-risk youth has been associated with: CT infection [25], pregnancy [119], survival sex work [43, 120], hard drug use [89, 94], initiation into injection drug use [95], public injection [121], shooting gallery use [122], HIV infection [116, 123, 124], and

mortality [6]. Although many negative sexual health outcomes associated with youth homelessness have been well described, less is known about how specific qualities of the physical environment characteristic of youth homelessness impact sexual behaviour and overall health. Several studies have demonstrated that the length of time spent homeless or on the street predicts engagement in sexual risk behaviour; for example, the non-use of condoms [30], a reliance on sex work for income generation [38, 43], and sexual partnerships with IDU or HIV positive individuals [107] have all been associated with longer periods of time spent without a permanent home. It is not known whether the association between length of time spent homeless and engagement in sexual risk behaviour is mediated by factors more related to the physical environment (i.e., living in deprived conditions), or through social interactions with experienced homeless peers, as has been suggested by some authors [125].

Adolescents without a permanent home are known to sleep in a diverse number of environments, including abandoned buildings, public spaces such as subway stations, in vehicles, youth hostels, friend's dwellings (e.g., "couchsurfing"), and in shelters [126, 127]. Currently, limited evidence suggests that youth who have ever slept overnight in a public place or on the street report a higher number of HIV risk behaviours [37] and are more likely to be active users of street drugs such as crystal methamphetamine [128]. Although more research is required to elucidate

the impact of specific characteristics of the physical environment on the sexual behaviours of homeless youth, the environmental determinants of sexual risk behaviour among other street-involved and high HIV prevalence populations are better understood. For example, in a review of the urban environment and sexual risk behavior among MSM, Frye et al. [66] propose an integrated conceptual model that includes both physical characteristics such as neighbourhood disorder and social characteristics such as the level of homophobia in a community to explain the impact of the urban environment on behavioural outcomes among MSM populations. Limited empirical evidence exists to support a multi-pathway model: high levels of neighbourhood physical disorder, including vacant buildings, garbage accumulation, and public school deterioration, have been associated with GC rates [129], while low levels of attachment to gay communities have been associated with sexual risk behaviour among young MSM [130]. Urban gentrification, reductions in public urban spaces, and the loss of social housing and support services have been linked to increased vulnerability to HIV among socially disadvantaged populations [131]. Several recent studies have also shown how characteristics of the physical environment influence sexual risk and HIV vulnerability among indoor and street-based sex workers [132-134]. Street-based, dilapidated settings are known to offer the least amount of opportunity for reducing the harms associated with sex work, which include exposure to violence and STIs [135]. High levels of violence and

police presence have also been found to displace sex workers from areas with high concentrations of health and social support services into more dangerous industrial and isolated settings [132]. Future research is required to examine whether similar environmental-structural factors influence sexual risk behaviour, HIV/STI vulnerability, and access to harm reduction program and services among street youth populations who engage in survival sex work.

Research is lacking on effective interventions to alter the physical environment in which HIV and STI risk behaviour among street-involved youth takes place. Although several individual level interventions targeted at sheltered youth have been shown to have minor to moderate impacts on short-term sexual risk behaviours [136-138], a major limitation of shelter-based interventions is their inability to reach street youth who are not in contact with the shelter system. Such interventions are problematic, since youth who are absolutely homeless and are deeply entrenched within the street culture and economy exhibit more HIV risk behaviours than their unstably housed or sheltered peers [122], and may also be less amenable to health-based interventions [139]. More importantly, an emphasis on changing individual level factors such as knowledge and self-esteem fails to acknowledge the importance of place and the physical environment in the production of HIV risk among street-involved populations [131, 132, 140]. While research examining the effectiveness of environmental-based interventions to

mitigate the harms associated with sexual risk behaviour among street youth is sparse, studies examining the impact of such interventions on injection-related risk behaviour are increasingly common. "Safer environment interventions", including drug consumption rooms, supervised injecting facilities, and peer-based interventions to alter the existing physical environment in which public or semi-public injecting takes place (e.g., provision of safe disposal boxes in alleys) have all been shown to reduce the risks associated with public injecting [131, 141-144]. Managed sex work zones that encourage harm reduction practices as opposed to law enforcement strategies have also been shown to promote sex worker's ability to mitigate the risks associated with street-based prostitution [132]. Future studies should investigate whether similar "safer environment interventions" for street-involved youth, including youth-focused supervised injecting facilities and drug consumption rooms, provide effective, long-term strategies to reduce sex- and injection-related HIV risk behavior and prevent the transmission of HIV and STIs.

2.3.6 Structural Factors and Sexual Risk Activity

In public health and health-related research, structural factors are defined as the social, economic, legal, policy, and institutional practices that "structure" the context in which HIV risk and HIV prevention behaviours are situated [65, 145]. One of the primary structural factors known to influence risk behaviour and disease

transmission among homeless youth is homelessness itself. A lack of access to safe, affordable and stable housing is inextricably linked with poverty, HIV vulnerability, and HIV infection among both street youth and other marginalized populations [95, 146-149]. A recent study has also suggested that unstable housing conditions serve as a foundational structural context that greatly impedes an individual's ability to change or reduce HIV risk behaviour, irrespective of psychosocial and psychological characteristics [150]. Although much of this research has been conducted among older homeless individuals and drug users, similar factors are suspected to play a major role in the behavioural patterns and population-level HIV and STI burden among street-involved youth.

Other structural factors that influence street youth sexual behaviour and HIV vulnerability pertain to the policies and laws that govern income generation activities, particularly prohibited work such as sex work and drug dealing. Since street-involved youth often rely on informal employment and illegal activities to meet basic needs [151, 152], policies and laws that structure the risk environment associated with such activities may indirectly impact sexual risk and HIV and STI transmission among this population. For example, the criminalization of sex work has been shown in a number of settings to exacerbate sexual risk behaviour, while decriminalization and policies that emphasize the health and safety of sex workers have shown positive impacts [135, 153, 154]. Prohibitionist and enforcement-based

policies that target drug trafficking and consumption have also been shown to increase HIV risk behaviour and disease transmission among IDU, while at the same time deterring drug users from accessing harm reduction programs and primary medical care [155-157]. Although the majority of this research has focused on older homeless or unstably housed populations, there is evidence to suggest that similar factors moderate disease transmission among street-involved youth. For example, since incarceration has been associated with both HIV and HCV positivity among street youth [4, 158], policies and laws that privilege enforcement-based practices and thus increase the likelihood of incarceration may negatively impact the sexual and overall health of street-involved youth. Furthermore, recent research also suggests that street youth's frequent and often negative interactions with police may pose significant barriers to accessing emergency health and social services [159, 160]. Other structural factors that may prevent street youth from accessing health services include: the inability of health care professionals to manage or understand drug use and its side effects [161]; a lack of acceptance of sexual minorities and/or heterosexist cultures and policies [34]; the fact that some facilities do not adhere to sex-positive principles [162]; and outright discrimination and oppression, including homophobia, sexism, and classism among mainstream medical personnel [163].

Although structural interventions to prevent adolescent health risk behaviours such as smoking, drinking and driving, and substance use have been

implemented in some settings, there is a paucity of knowledge regarding the potential effectiveness of such programs on the mitigation of youth sexual risk behaviour [71]. Structural interventions that address the housing and health care needs of homeless adolescents are urgently required, especially since street youth who report having unmet needs are more likely to be chronically homeless, have sex with IDU and HIV positive persons, and are less likely to have been tested for HIV [38, 107]. Several studies have suggested that rent subsidy programs and housing assistance may be associated with reductions in HIV risk behaviours, and among those living with HIV, improved clinical and medical care outcomes [149, 164-166]. Since persons who have tested positive for HIV have been shown to reduce their frequency of unprotected intercourse [167], improved access to testing facilities has the potential to decrease transmission of STIs and HIV within this population. Several multisite studies of homeless youth have observed significant variation in testing rates across communities, suggesting that local service availability and municipalities' health care policies do influence HIV testing behaviour [19, 168]. Some evidence also suggests that street-based CT and GC testing can be successfully incorporated into existing outreach programs, providing an innovative way to remove the many structural barriers associated with testing within traditional medical environments [169, 170].

Although relatively few studies have examined the impact of structural interventions on reducing sexual risk behaviours among street-involved youth, there is ample evidence to indicate that homeless adolescents are subjected to an array of structural barriers which hinder their ability to reduce risk activities [171-173]. For example, over the past decade in Canada, many provinces have reduced benefit levels for social assistance and have enacted legislation that makes it explicitly more difficult for individuals under 18 years of age to qualify for welfare [152]. Given that economically motivated sexual behaviours are closely linked with an individual's ability to reduce the harms associated with illegal work (e.g., economically disadvantaged sex workers being offered more money to engage in intercourse without a condom) [174, 175], structural interventions such as income support and social assistance may in fact be necessary precursors to sustained individual level behavior change. One study among female sex workers observed a significant decrease in HIV risk behaviours following a structural-level economic enhancement intervention [175]. Low threshold employment opportunities to reduce a reliance on illicit income generating activities and the risks associated with them have also been proposed for IDU populations [176]. Similar structural-level interventions that address the economic and financial marginalization of street-involved adolescents may also be successful at reducing the burden of HIV and STIs among this population in the future. Recently, Ziff et al. [177] have developed a

conceptual framework that directly links structural factors with the determinants of HIV transmission and thus HIV incidence among urban youth. The authors describe a multi-site community mobilization intervention that aims to reduce the elevated incidence of HIV among marginalized youth through the empowerment of and collaboration among HIV-related organizations and communities to encourage structural changes with regard to programs, policies and programs that are believed to influence HIV risk among youth. Such frameworks may be useful for researchers, youth workers, and policy makers to explicate with greater clarity the link between macro-level factors and the transmission dynamics of HIV and STIs that determine the prevalence and incidence of these diseases among street-involved youth.

2.4 SUMMARY

Historically, research among homeless youth has concentrated on understanding the individual level attributes, behaviours, and characteristics that predispose certain persons to acquiring HIV or STIs [103, 178]. It is increasingly recognized that individual risk factors are poor predictors of HIV and STI transmission; furthermore, macro-level factors contribute substantially to the persistently elevated rates of disease among marginalized people [179, 180]. Structural and environmental interventions, including the provision of youth-focused drug consumption rooms and supervised injecting facilities, reducing

institutional barriers to HIV testing and other forms of health care, the creation of low threshold employment and income support programs, and the development of sustained funding and infrastructure to support stable housing and shelter services, have all been hypothesized as being highly effective in terms of improving the health of homeless youth [58, 59, 71]. Future research that links social, structural and environmental inequities with the dynamics of HIV and STI transmission at a population level are required to inform, examine, and evaluate the effectiveness of these programs, policies, and interventions.

In this review, we have used an ecological approach to describe the multifactorial determinants of sexual risk behaviour among street-involved youth. We have concentrated on behaviours that directly or indirectly influence the reproductive rate (and subsequently the population spread) of HIV and STIs. In doing so, we have attempted to demonstrate that ecological and other social structural models that have been used to explain drug-related risk behaviour [65, 181] can be reframed and used to explore the dynamics and determinants of STI transmission at a population level. Although we have categorized factors into individual, drug-related, social, environmental, and structural components, such classifications are rather arbitrary in the sense that important determinants of sexual risk behaviour exist at the intersections of individual and macro-level factors [182]. Research that seeks to examine the multidimensional nature of street youth sexual

activity may benefit by situating these behaviours within the physical, social, economic, and political context of youth homelessness. These models have the capacity to inform effective population level sexual health interventions, particularly if the determinants of sexual behaviour are framed in terms of their direct or indirect impact on the dynamics of infectious disease transmission. In order to reduce the burden of HIV and STIs among street-involved youth in the future, the union of contextual, population-specific frameworks with rigorous epidemiological practice and theory that accounts for transmission dynamics at a population level is necessary.

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CHAPTER 3[2]

HOMELESSNESS AND UNSTABLE HOUSING ASSOCIATED WITH AN INCREASED RISK OF HIV AND STI TRANSMISSION AMONG STREET-INVOLVED YOUTH

3.1 INTRODUCTION

Homeless and street-involved youth are increasingly common in many North American settings [1]. In Canada, it has been estimated that there are upwards of 150,000 street-involved youth (i.e., individuals between the ages of 12 and 26 who are absolutely, temporarily, or periodically without shelter) [2]. Although street youth are known to be at increased risk for a host of negative health outcomes, some of the most commonly reported concerns among this population are sexual and reproductive health issues [3, 4]. Many studies of street-involved youth have documented drastically elevated rates of HIV, sexually transmitted infections (STIs), and other blood borne diseases, including hepatitis B (HBV) and hepatitis C (HCV) [5-9]. The prevalence of HIV among street-involved youth in Montreal [10] and Toronto [2] has been estimated to be approximately 2%, while some studies in the United States have documented rates over 8% [11, 12]. A recent report by the

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Public Health Agency of Canada indicated that the prevalence of *Chlamydia trachomatis* (CT) among Canadian street youth is at least ten times that of the general adolescent populations [13], while cross-sectional studies have documented CT rates between 6.6% and 8.6% [14, 15].

To explain the elevated rates of HIV and STIs among this population, epidemiological studies have described a range of sexual risk behaviours. The vast majority of street-involved youth are sexually active, among whom inconsistent condom use (i.e., not always using condoms with all sexual partners) is reported by 50 to 80% [16-19]. Street-involved youth are also likely to report multiple recent sexual partnerships. Several studies have observed that the median number of sex partners in the past six months varies between 1 and 6 [20-23]. Furthermore, studies in Canada and the US suggest that approximately one quarter of street-involved youth have ever exchanged sex for money, drugs, shelter, or gifts [24, 25].

Along with sociodemographic factors such as age, gender, and ethnicity, commonly reported correlates of sexual risk behaviour among street-involved youth include: childhood sexual abuse [26, 27], depression [28], relationship status [29, 30], and a range of drug-related factors, including injection drug use [31, 32]. While the majority of studies have focused primarily on the individual, social and drug-related factors associated with engagement in sexual risk behaviour, less is known about the environmental influences that impact the risk factors for HIV and STI transmission.

In a multi-site study of high risk adolescents conducted in the US, homelessness was found to be associated with HIV positivity, but only among males [33]. Although a large body of evidence indicates that homelessness negatively impacts the general and sexual health of adolescents [15, 18, 34, 35], there exists a paucity of knowledge regarding how specific physical conditions associated with these periods of homelessness may influence sexual risk behaviour. Given that street-involved youth reside in a wide variety of settings (e.g., shelters, hostels, vehicles, parks, and other public spaces) [36, 37], elucidating how specific environments may promote behaviours which drive the transmission of HIV and STIs is important to furthering our understanding of the multi-level factors that determine populational disease burden. Therefore, we conducted this study to determine if environmental factors, independent of individual level characteristics, are associated with engagement in sexual risk behaviour among a sample of street-involved youth in Vancouver.

3.2 METHODS

The At Risk Youth Study (ARYS) is an ongoing prospective cohort of homeless and street-involved youth recruited through snowball sampling and extensive street-based outreach in Vancouver, Canada. The study has been described in detail previously [38]. Briefly, persons were eligible for the study if they were 14 to 26 years of age, had used illicit drugs other than or in addition to

marijuana in the past 30 days, and provided informed consent. At baseline and semi-annually, participants complete an interviewer-administered questionnaire and provide blood samples for HIV and hepatitis C (HCV) serology. All participants receive a monetary stipend of $20 CDN after each visit. The study has been approved by the University of British Columbia/Providence Health Care Research Ethics Board.

All participants who were recruited and completed a baseline survey between September 1, 2005 and October 31, 2006 were included in this analysis. The primary outcomes of interest in this study were number of sexual partners in the past 6 months and condom use during vaginal and anal intercourse during the past 6 months. Participants were asked to report how many male and female partners they had engaged in sexual activities with, excluding those with whom they had engaged in sex for money, drugs, shelter, or gifts. For both same and opposite sex partnerships, participants were also asked to report how often a condom was used during vaginal and anal intercourse with voluntary partners. Possible responses included: always, regularly, occasionally, and never. To be consistent with previous studies of condom use among street-involved youth [17, 39], this variable was dichotomized into "consistent" (i.e., always) and "inconsistent" (i.e., regularly, occasionally, or never) condom use. Participants who reported more than one type

of sexual activity in the past six months and who reported discordant condom use patterns were coded as inconsistent condom users.

The primary explanatory variable of interest in this study was current place of residence. For analytical purposes, we created a categorical variable with the following three levels: 1) stable housing – living in an apartment, house or single room occupancy hotel (SRO); 2) unstable housing – living in a shelter or hostel; and 3) homeless – living on the street or living with no fixed address (NFA). Other independent variables included a range of sociodemographic, individual, drug-related, and social factors, and were chosen based on their known or *a priori* hypothesized relationship with both housing status and one or both of the sexual risk behaviours outcomes. Sociodemographic variables that were examined included: age, sex (female vs. male), Aboriginal ethnicity (yes vs. no) and sexual orientation (lesbian, gay, bisexual, transgendered, or transsexual [LGBTT] vs. heterosexual). Other individual level factors that were examined included engaging in anal intercourse in the past six months (yes vs. no), childhood sexual abuse (yes vs. no), depression, and self-efficacy for limiting HIV risk behaviours (LHRB). The latter two variables were defined using validated scales. The Center for Epidemiologic Studies Depression Scale (CES-D) is designed to measure current levels of depressive symptoms and has been shown to have high levels of internal consistency and reliability among groups of adolescents [40-42]. The presence of

depressive symptoms was evaluated using a well-defined cut-off (CES-D ≥ 16 [yes] versus CES-D < 16 [no]). The self-efficacy for LHRB scale is a validated instrument found to have high levels of consistency among at-risk youth [43, 44]. Responses were dichotomized into "high" versus "low" self-efficacy for LHRB based on their value with respect to the sample median. Social and drug-related factors that were examined included: relationship status (single or casually dating vs. regular partner or married), drug dealing (yes vs. no), alcohol dependence (yes vs. no), crack use (yes vs. no), cocaine use (yes vs. no), heroin use (yes vs. no), crystal methamphetamine use (yes vs. no), injection drug use (yes vs. no), and syringe sharing (yes vs. no). Alcohol dependence was measured using the Perceived-Benefit-of-Drinking Scale (PBDS), a validated instrument that assesses drinking behaviours among adolescents [45, 46]. All other drug use variables refer to behaviours occurring in the past six months; cocaine, heroin, and crystal methamphetamine use refer to both injection and inhalation routes of consumption. To be consistent with our previous work, syringe sharing was defined as lending or borrowing a used syringe in the past six months [47]. Since sexual risk behaviours are known to be interdependent [48], each dependent variable was included as a potential explanatory variable when not used as the primary dependent variable of interest.

Initially, we examined bivariate associations between the individual, social, drug-related and environmental variables and each sexual risk behaviour outcome. To analyse the sexual partnership data, a Poisson-type regression was used to estimate the unadjusted incidence rate ratio (IRR) and 95% confidence intervals (95% CI) associated with each independent variable. The distribution of recent sex partners was highly skewed; therefore, in order to account for overdispersion, we used a log-linear quasi-Poisson regression. This approach relaxes the assumption that the variance of the underlying distribution is equal to the mean by allowing the variance to be modeled as a linear function of the mean [49]. To analyse the bivariate associations with consistent condom use, dichotomous and categorical variables were examined using the Pearson χ^2 test.

Since the objective of this study was to determine whether environmental conditions, independent of established sociodemographic and individual level factors, are associated with sexual risk behaviour, we fit a series of confounding models based on an approach described by Rothman and Greenland [50, 51]. For a variable to be considered a confounder in the relationship between place of residence and sexual risk behaviour, it must be associated with both the behaviour and with housing status. Therefore, we conducted bivariate screenings based on a conservative *p*-value of 0.20 to determine which explanatory variables were associated with the outcome and thus may be potential confounders. We then used

these variables to create two "full" multivariate models. These models were then subjected to a manual stepwise approach to select significant confounders. Starting with the "full" models, variables that did not alter the relative change in the coefficient of the primary variable of interest by more than 10% were removed in a sequential fashion. Since the primary variable of interest was categorical with two coefficients, variables were considered significant confounders if their removal altered one or both of the coefficients by more than 10%. This technique has been described and used successfully by several authors [51, 52]. To account for the well-established confounding effects of age, sex, ethnicity, and sexual orientation, these variables were forced into the "full" models and were not included in the stepwise approach. All statistical modelling was conducted using S-PLUS software version 8.0. All reported *p*-values are two-sided.

3.3 RESULTS

A total of 529 participants completed a baseline interview between September 2005 and October 2006. In total, 159 (30.1%) were female, 127 (24.0%) were of Aboriginal ethnicity, and 69 (13.0%) self-identified as LGBTT. Sexual activity in the past six months was reported by 415 (78.4%), of whom 253 (61.0%) reported multiple sex partners and 288 (69.6%) reported inconsistent condom use. The median

number of sex partners in the past six months was 1 (interquartile range: 1 – 3; range: 0 – 55).

The results of the bivariate quasi-Poisson analyses are shown in Table 1. As a group, housing status was significantly associated with a greater number of recent sex partners (type 3 p-value < 0.001, 2 df). Additional pairwise comparisons revealed that living in a shelter or hostel (incidence rate ratio [IRR] = 1.65, 95% confidence interval [95% CI]: 1.12 – 2.43) was positively associated with sex partner incidence, and living NFA or on the street was marginally significant (IRR = 1.40, 95% CI: 0.98 – 2.01). Other variables that were positively associated with a greater number of sex partners included: LGBTT orientation (IRR = 1.90, 95% CI: 1.37 – 2.63); being single or casually dating (IRR = 1.79, 95% CI: 1.19 – 2.69); low self-efficacy for LHRB (IRR = 1.55, 95% CI: 1.14 – 2.13); sometimes/occasionally using condoms (IRR = 1.52, 95% CI: 1.10 – 2.10); anal intercourse (IRR = 2.52, 95% CI: 1.83 – 3.48); sexual abuse (IRR = 1.67, 95% CI: 1.25 – 2.24); crack use (IRR = 1.45, 95% CI: 1.07 – 1.98); and cocaine use (IRR = 1.62, 95% CI: 1.20 – 2.19). Never using condom (IRR = 0.56, 95% CI: 0.35 – 0.90) was inversely associated with sex partner incidence.

The factors associated with consistent condom use in bivariate analyses are shown in Table 2. Overall, housing status was marginally significant (type 3 p-value = 0.077, 2 df). Additional pairwise comparisons revealed that living NFA or on the street (odds ratio [OR] = 0.56, 95% CI: 0.35 – 0.92) was significantly and inversely

associated with consistent condom use. Other variables that were significantly associated with consistent condom use included: being single or casually dating ([OR] = 2.50, 95% CI: 1.46 – 4.30); LGBTT orientation (OR = 0.42, 95% CI: 0.20 – 0.90); and engaging in anal intercourse (OR = 0.41, 95% CI: 0.21 – 0.79).

The results of the multivariate analyses for sex partner incidence and consistent condom use are shown in Tables 1 and 3, respectively. Housing status as a group was independently associated with both sexual risk behaviour outcomes (type *p*-value < 0.001, df = 2). Additional pairwise comparisons revealed that living in a shelter or hostel was independently associated with a greater number of sex partners (adjusted incidence rate ratio [aIRR] = 1.44, 95% CI; 1.09 – 1.90), while living NFA or on the street was independently associated with inconsistent condom use (adjusted odds ratio [aOR] = 0.47, 95% CI: 0.27 – 0.82). Other factors that were significantly associated with number of sex partners in the final confounding model included: female gender (aIRR = 0.65, 95% CI: 0.49 – 0.87); Aboriginal ethnicity (aIRR = 0.75, 95% CI: 0.56 – 0.99); LGBTT orientation (aIRR = 1.75, 95% CI: 1.29 – 2.36); never using condoms (aIRR = 0.46, 95% CI: 0.31 – 0.68); engaging in anal intercourse (aIRR = 1.47, 95% CI: 1.13 – 1.91); childhood sexual abuse (aIRR = 1.40, 95% CI: 1.13 – 1.91); crack use (aIRR = 1.46, 95% CI: 1.14 – 1.87); and cocaine use (aIRR = 1.39, 95% CI: 1.10 – 1.74). In addition to housing status, only LGBTT orientation (aOR = 0.43,

95% CI: 0.19 – 0.98) was significantly associated with consistent condom use in the final model.

We also conducted a series of sensitivity analyses to determine if our model selection procedure impacted the significance of the observed associations between housing status and sexual risk behaviours. Implementing an alternate model selection protocol whereby all variables significant in bivariate analyses ($p < 0.10$) were included did not significantly alter our results (data not shown). We also examined whether the observed associations between LGBTT orientation and sexual risk behaviours were confounded by sex. An analysis of variance (ANOVA) revealed no significant difference between LGBTT men and LGBTT women with respect to the mean number of recent sex partners ($p = 0.068$), while Fisher's exact test revealed no significant difference in consistent condom use by sex when the sample was restricted to LGBTT participants ($p = 0.720$).

3.4 DISCUSSION

In the present study, we observed a high prevalence of multiple sexual partnerships and inconsistent condom use among a community-recruited cohort of street-involved adolescents. In multivariate analyses, we observed that housing status was strongly associated with both greater numbers of sex partners and inconsistent condom use, even after adjustment for sociodemographic, drug-related,

and other individual level confounders. In particular, living in a shelter or hostel was positively associated with an elevated number of recent sex partners, while living NFA or on the street was inversely associated with consistent condom use. Since both the transmissibility of infection (determined in part by condom use) and the rate of sex partner change are key parameters that determine population level HIV and STI incidence [53, 54], these findings indicate that precarious housing environments may act synergistically to increase sexual HIV and STI transmission among young street-involved populations.

We observed that specific housing and shelter environments appear to have distinct yet important impacts on sexual risk behaviours. Our finding that shelter and hostel-style housing conditions were associated with an increased number of sex partners is consistent with studies of other marginalized youth populations, including young MSM [55], young IDU [30], and HIV positive adolescents [56]. These results suggest that conditions associated with the unique environment of shelter and hostel-based residences may play an important role in influencing behaviours that drive HIV and STI transmission. For example, shelters and hostels in which a high turnover of clients is common may facilitate elevated rates of partner change among residents, particularly if cramped conditions necessitate the sharing of beds or sleeping quarters. Such environments may also facilitate discordant sexual mixing patterns that promote the transmission of HIV and other

STIs [57]; for example, young or recently homeless adolescents may be more likely to come in contact with older, higher HIV or STI prevalence populations within shelter or hostel-based environments. Given that numerous epidemiological studies have shown how discordant mixing patterns can fuel the spread of HIV and STIs, particularly among low prevalence populations [58-60], future research should be conducted to examine the social-sexual networks of sheltered and unstably housed youth.

We also observed that over two thirds of sexually active youth reported inconsistent condom use with their recent sex partners, a prevalence similar to that observed in other North American and international settings [17, 19, 61, 62]. Furthermore, those who were currently living NFA or on the street were twice as likely to report inconsistent condom use with their recent sexual partner(s). This effect remained significant even after accounting for potentially confounding factors, including relationship status, drug and injection-related risk behaviours, and a range of sociodemographic characteristics. Therefore, it is plausible that exposure to street environments may impact condom use patterns. While less is known regarding the influence of public and street-based environments on condom use, there exists an extensive literature describing how micro- and macro-environmental factors impact injection-related risk behaviour [63]. For example, public injection has been linked to an array of HIV and health-related harms [64-66]. Analogously,

studies of MSM who have sex in public environments have observed low rates of condom use, which may be due to rushed encounters stemming from the fear of being harassed by police and homophobic individuals or groups [67, 68]. Although youth who report living NFA or on the street likely have sex in a number of (semi)-public and private environments, these results indicate that similar environmental mechanisms may play a role in structuring the context in which sexual risk behaviour and HIV/STI transmission among street-involved youth occurs.

Our results have a number of important implications for policy makers, health care workers, and youth organizations seeking to implements policies, laws, and programs that aim to reduce HIV and STI transmission among young street-involved populations. While historically youth sexual health interventions have privileged individual level determinism as the primary mechanism for enacting behaviour change, such programs often fail to result in sustained, population-level health outcomes [58, 69]. Furthermore, it has been argued that such programs are unable to account for the social, environmental, and structural context in which HIV and STI risk is produced [70]. Our results support these arguments and provide quantitative evidence that sexual risk behaviour is influenced by environmental factors, including housing conditions. As such, we recommend that future policies and programs implement structural-environmental interventions within preexisting health-based infrastructures. Multiple studies, including several intervention trials,

have demonstrated that rent subsidy programs are highly effective at reducing the risk of future homelessness and mitigating HIV risk behaviour among persons living with HIV/AIDS [71-73] and among low-income families [74]. Similar programs are likely to be equally effective for marginalized and at-risk youth. Given that rental prices in Vancouver for low-income and SRO housing increased by almost 8% from 2005 to 2007 [75], policies and structural-environmental interventions that prioritize the provision of safe and stable housing for homeless and street-involved youth are urgently required in our setting.

The present study should be interpreted within the context of several important limitations. It is important to note that the data is cross-sectional, and therefore the relationships between explanatory variables and sexual risk behaviour outcomes do not imply causality. Secondly, although extensive snowball and outreach-based sampling methods were conducted in an attempt to derive a representative sample of street-involved youth, we are unable to generalize our results to the entire street youth population in Vancouver. However, it is important to note that the demographic profile of our sample is very similar to other studies of street-involved adolescents that have been conducted in our setting previously [76, 77]. Thirdly, self-reported sexual behaviours are known to be highly susceptible to reporting and recall bias. Since the accuracy of such reports increases with shorter recall periods [78], we attempted to maximize the accuracy of the data by restricting

our analysis to recent (past six month) behaviours and outcomes. Finally, it is important to note that our analyses were restricted to sexual activity that did not occur in the context of sex in exchange for money, drugs, gifts, or shelter. Since sex work is known to be associated with a profile of sexual risk behaviour distinct from that in the context of voluntary sex among both male and female street youth [79, 80], we chose to omit this activity from our analyses. Future research should be conducted to examine the specific environmental factors associated with sexual risk behaviour and HIV/STI transmission among young street-involved sex workers.

In summary, the results of our study suggest that housing status may influence sexual risk behaviour and therefore may play an important role in driving HIV and STI transmission among street-involved youth. Along with LGBTT orientation, housing status was independently associated with both number of recent sex partners and inconsistent condom use. These results support the adoption and evaluation of structural-environmental frameworks that explicitly include environmental determinants of HIV and STI transmission, and suggest that policies, law, and programs be restructured to prioritize housing conditions and other environmental factors as primary prevention strategies. Our results add to a growing literature that indicates HIV and STI prevention efforts must target the environmental-structural contexts in which these diseases are transmitted and risk is produced.

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Table 3.1: Environmental factors associated with number of sex partners among a cohort of street-involved youth (n = 529).

	Unadjusted Incidence Rate Ratio (IRR)			Adjusted Incidence Rate Ratio (aIRR)		
Characteristic	**IRR**	**(95% CI)**	***p* - value**	**aIRR**	**(95% CI)**	***p* - value**
Age (per year older)	0.98	(0.93 – 1.04)	0.566	0.99	(0.95 – 1.04)	0.693
Sex (female vs. male)	0.80	(0.57 – 1.13)	0.198	0.65	(0.49 – 0.87)	0.004
Aboriginal ethnicity (yes vs. no)	0.84	(0.58 – 1.22)	0.366	0.75	(0.56 – 0.99)	0.043
Sexual orientation (LGBTT[a] vs. heterosexual)	1.90	(1.37 – 2.63)	< 0.001	1.75	(1.29 – 2.36)	< 0.001
Housing (ref: apt./house/ SRO[b])						
shelter/hostel	1.65	(1.12 – 2.43)	0.012	1.44	(1.09 – 1.90)	0.010
NFA[c]/street	1.40	(0.98 – 2.01)	0.065	1.21	(0.93 – 1.57)	0.149
Relationship (single vs. partner)	1.79	(1.19 – 2.69)	0.005	1.13	(0.83 – 1.53)	0.440
Depression (yes* vs. no)	1.14	(0.84 – 1.56)	0.402			
Self-Efficacy LHRB[d] (low vs. high)	1.55	(1.14 – 2.13)	0.006	1.19	(0.96 – 1.49)	0.119
Condom Use† (ref: always)						
regularly/occasionally	1.52	(1.10 – 2.10)	0.010	1.28	(0.98 – 1.67)	0.065
never	0.56	(0.35 – 0.90)	0.015	0.46	(0.31 – 0.68)	< 0.001
Anal Intercourse† (yes vs. no)	2.52	(1.83 – 3.48)	< 0.001	1.47	(1.13 – 1.91)	0.004
Sexual Abuse‡ (yes vs. no)	1.67	(1.25 – 2.24)	< 0.001	1.40	(1.09 – 1.79)	0.008
Drug Dealing† (yes vs. no)	1.30	(0.95 – 1.77)	0.104			
Alcohol Dependence (yes vs. no)	1.32	(0.97 – 1.79)	0.073	1.07	(0.86 – 1.34)	0.549
Crack Use† (yes vs. no)	1.45	(1.07 – 1.98)	0.018	1.46	(1.14 – 1.87)	0.003
Cocaine Use† (yes vs. no)	1.62	(1.20 – 2.19)	0.002	1.39	(1.10 – 1.74)	0.005
Heroin Use† (yes vs. no)	0.99	(0.72 – 1.37)	0.952			
Crystal Meth Use† (yes vs. no)	1.07	(0.79 – 1.44)	0.671			
Injection Drug Use† (yes vs. no)	1.01	(0.73 – 1.40)	0.944			
Sharing Syringes† (yes vs. no)	1.17	(0.72 – 1.91)	0.521			

Note: a – LGBTT denotes lesbian, gay, bisexual or transgendered/transsexual; b – SRO denotes single room occupancy hotel; c – NFA denotes no fixed address; d – denotes self-efficacy for limiting HIV risk behaviours scale; * – CES-D standard cut-off score of 16 or greater; † - refers to activities in the past 6 months; ‡ - refers to lifetime history.

Table 3.2: Environmental factors associated with consistent condom use among a cohort of sexually active street-involved youth (n = 415).

Characteristic	Consistent n (%) n = 127	Inconsistent n (%) n = 288	Odds Ratio (95% CI)	*p* - value
Age[¶]				
< 22	61 (27.4)	162 (72.6)		
≥ 22	66 (34.4)	126 (65.6)	0.72 (0.47 – 1.09)	0.150
Sex				
Female	36 (27.5)	95 (72.5)		
Male	90 (31.6)	192 (68.1)	0.81 (0.51 – 1.28)	0.426
Aboriginal Ethnicity				
Yes	37 (35.6)	67 (64.4)		
No	90 (28.9)	221 (71.1)	1.36 (0.85 – 2.17)	0.251
Sexual Orientation				
LGBTT[a]	9 (17.0)	44 (83.0)		
Heterosexual	117 (32.5)	243 (67.5)	0.42 (0.20 – 0.90)	0.033
Housing				
Apt./House/SRO[b]	57 (36.5)	99 (63.5)		
Shelter/Hostel	32 (34.8)	60 (65.2)	0.93 (0.54 – 1.59)	0.777*
NFA[c]/Street	38 (24.5)	117 (75.5)	0.56 (0.35 – 0.92)	0.021*
Relationship Status				
Single/Dating	105 (35.2)	193 (64.8)		
Regular Partner	20 (17.9)	92 (82.1)	2.50 (1.46 – 4.30)	0.001
Depression[◊]				
Yes	63 (29.2)	153 (70.8)		
No	60 (32.6)	124 (67.4)	0.98 (0.64 – 1.49)	0.526
Self Efficacy LHRB[d]				
Low	46 (26.3)	129 (73.7)		
High	79 (34.6)	149 (65.4)	0.67 (0.44 – 1.04)	0.091
Number of Sex Partners[†]				
> 1	79 (32.4)	165 (67.6)		
≤ 1	48 (28.1)	123 (71.9)	1.23 (0.80 – 1.88)	0.407
Anal Intercourse[†]				
Yes	12 (16.9)	59 (83.1)		
No	111 (33.2)	223 (66.8)	0.41 (0.21 – 0.79)	0.010

Characteristic	Consistent n (%) n = 127	Inconsistent n (%) n = 288	Odds Ratio (95% CI)	*p* - value
Sexual Abuse‡				
Yes	33 (29.5)	79 (70.5)		
No	91 (30.6)	206 (69.4)	0.95 (0.59 – 1.52)	0.912
Drug Dealing†				
Yes	71 (28.9)	175 (71.1)		
No	56 (33.1)	113 (66.9)	0.82 (0.54 – 1.25)	0.412
Alcohol Dependence				
Yes	56 (26.7)	154 (73.3)		
No	63 (34.1)	122 (65.9)	0.70 (0.46 – 1.09)	0.137
Crack Use†				
Yes	67 (27.8)	174 (72.2)		
No	60 (34.5)	114 (65.5)	0.73 (0.48 – 1.12)	0.177
Cocaine Use†				
Yes	58 (29.7)	137 (70.3)		
No	69 (31.4)	151 (68.6)	0.93 (0.61 – 1.41)	0.802
Heroin Use†				
Yes	43 (31.6)	93 (68.4)		
No	84 (30.1)	195 (69.9)	1.07 (0.69 – 1.67)	0.842
Crystal Meth Use†				
Yes	52 (26.3)	146 (73.7)		
No	75 (34.6)	142 (65.4)	0.67 (0.44 – 1.03)	0.084
Injection Drug Use†				
Yes	35 (29.4)	84 (70.6)		
No	92 (31.1)	204 (68.9)	0.92 (0.58 – 1.47)	0.829
Syringe Sharing†				
Yes	7 (17.9)	32 (82.1)		
No	120 (31.9)	256 (68.1)	0.47 (0.20 – 1.09)	0.105

Note: a – LGBTT denotes lesbian, gay, bisexual or transgendered/transsexual; b – SRO denotes single room occupancy hotel; c – NFA denotes no fixed address; d – denotes Self-Efficacy for Limiting HIV Risk Behaviours Scale; ¶ - dichotomization based on sample median; ◊ – CES-D standard cut-off score of 16 or greater; † - refers to activities in the past 6 months; ‡ - refers to lifetime history; * overall *p*-value is 0.077.

Table 3.3: Multivariate logistic regression analysis of factors associated with consistent condom use among a cohort of sexually active street-involved youth (n = 415).

Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval (95% CI)	*p* - value
Age¶			
(< 22 vs. ≥ 22)	0.81	(0.50 – 1.33)	0.410
Sex			
(female vs. male)	1.07	(0.62 – 1.86)	0.802
Aboriginal Ethnicity			
(yes vs. no)	1.32	(0.77 – 2.27)	0.308
Sexual Orientation			
(LGBTT[a] vs. heterosexual)	0.43	(0.19 – 0.98)	0.043
Relationship Status			
(single/dating vs. regular)	3.50	(1.89 – 6.50)	< 0.001
Housing Status (ref: apt./house/SRO[b])			
shelter/hostel	0.68	(0.37 – 1.27)	0.229
NFA[c]/Street	0.47	(0.27 – 0.82)	0.008
Self-Efficacy LHRB[d]			
(low vs. high)	0.66	(0.40 – 1.08)	0.094
Alcohol Dependence			
(yes. vs. no)	0.67	(0.42 – 1.08)	0.100

Note: a – LGBTT denotes lesbian, gay, bisexual or transgendered/transsexual; b – SRO denotes single room occupancy hotel; c – NFA denotes no fixed address; d – denotes Self-Efficacy for Limiting HIV Risk Behaviours Scale; ¶ - dichotomization based on sample median.

CHAPTER 4[3]

STRUCTURAL FACTORS ASSOCIATED WITH AN INCREASED RISK OF HIV AND STI TRANSMISSION AMONG STREET-INVOLVED YOUTH

4.1 INTRODUCTION

Structural factors, defined as the economic, social, policy, and organizational determinants that "structure" the context in which risk production occurs [1], are increasingly recognized as important determinants in the acquisition, transmission, and prevalence of HIV disease [2, 3]. In recent years, extensive research has examined the structural factors that produce and re-produce HIV risk among high prevalence populations of men who have sex with men (MSM), injection drug users (IDU) and sex workers [4-6]. More recently, homeless and street-involved adolescents have also been recognized as a marginalized population with unique exposures to risk environments and structural factors that increase the likelihood of sustained and elevated incidence of HIV and other sexually transmitted infections (STIs) [7-9]; however, these factors remain poorly understood.

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In Canada and the United States, it is estimated that between 4 and 7% of youth between the ages of 14 and 26 are absolutely, periodically, or temporarily without safe and stable shelter [10, 11]. Homeless and street-involved youth are known to be at a significantly increased risk for a wide range of adverse health outcomes, including a heightened risk of mortality [12]. Of considerable public health concern is the elevated prevalence and incidence of HIV and STIs observed among these populations. In urban centres in Canada, the prevalence of HIV among street-involved youth is approximately 2% [13, 14], while the prevalence of Chlamydia has been estimated to be between 7 and 11% [15-17]. Similar rates have been observed in the United States [18-20]. Not surprisingly, street-involved youth engage in a greater number of sexual risk behaviours than their non-homeless peers [21, 22]. The vast majority are sexually active, of whom inconsistent condom use is commonly reported [23-25]. Street-involved youth are also likely to have multiple recent sex partners; the median number of recent partnerships has been observed to vary between 1 and 6 [26-28]. Of further concern is that approximately one quarter of street youth have engaged in survival sex (i.e., sex in exchange for money, gifts, shelter, or drugs) [29-31]. Among youth who are coerced or manipulated into survival sex, sexual victimization and abuse are extremely common [32, 33].

Research that has attempted to elucidate the underlying reasons for increased engagement in sexual risk behaviour among street-involved youth has continued to

rely predominantly on individual level risk factor analyses [34]. However, a growing body of literature has demonstrated that a focus on individual level characteristics (e.g., childhood abuse, self-efficacy to engage in risk reduction strategies, knowledge) and drug use patterns (e.g., stimulant use, injection drug use) fails to acknowledge the social structural factors that shape and determine the context in which sexual risk behaviour takes place [2, 4, 35]. Furthermore, it is increasingly recognized that structural factors, including economic inequities, laws, policies, societal vulnerabilities, and systemic discrimination, are better predictors of population level HIV and STI prevalence than individual level parameters that have been used to predict an individual's risk of infection [3]. Population level STI transmission dynamics are determined primarily by the reproductive rate of infection (R_0), which itself depends on three key parameters: 1) the transmissibility of the disease between infected and susceptible individuals (β); the average rate of partner change (c); and the average duration of infection (D) [36, 37]. The primary objective of structural HIV/STI prevention efforts should be to reduce the empirical value of R_0 by identifying and removing structural factors that promote behaviours which increase the value(s) of β, c, or D [38]. In order to do so, epidemiological research must seek to elucidate how structural factors shape the context in which sexual risk behaviours (and high empirical values of R_0) are produced.

Given these methodological challenges and concerns, we sought to determine whether structural factors are associated with increased engagement in sexual risk behaviour among a community-recruited cohort of street-involved youth in Vancouver, Canada. We focused our analysis on two important behaviours that are intrinsically linked to the population-level burden of HIV and STIs: 1) number of recent sexual partners (*c)*; and 2) consistent condom use (closely related to β, the transmissibility of infection between discordant partners). Research among populations of IDU and street-based sex workers has demonstrated that policies and laws promoting the displacement, criminalization, and enforcement-based regulation of marginalized persons are commonly associated with sexual and injection-related HIV risk production [4, 5, 39, 40]; therefore, we chose to focus our analysis on similar structural variables that may potentially shape the production of sexual risk-taking among street-involved youth.

4.2 METHODS

The At Risk Youth Study (ARYS) is a prospective cohort of homeless and street-involved youth in Vancouver, Canada that has been described in detail previously [41]. Briefly, participants were recruited through snowball sampling and extensive street-based outreach. Persons were eligible for the study if they were 14 to 26 years of age, had used illicit drugs other than or in addition to marijuana in the past 30 days, and provided

informed consent. At baseline and semi-annually, participants complete an interviewer-administered questionnaire and provide blood samples for HIV and hepatitis C (HCV) serology. The questionnaire elicits demographic data and information regarding injection and non-injection illicit drug use, HIV risk behaviors, addiction treatment experience, encounters with police and security guards, health service utilization, and sexual activity. All participants receive a monetary stipend of $20 CDN after each visit. The study has received ethical approval from the University of British Columbia/Providence Health Care Research Ethics Board.

All participants who completed a baseline survey between September 2005 and October 2006 were included in this analysis. We examined as our primary outcomes two sexual risk behaviours: 1) number of sexual partners in the past six months, and 2) condom use during vaginal and anal intercourse. Participants were asked to report how many male and female partners they had engaged in sexual activities with, excluding those with whom they had engaged in sex for money, drugs, shelter, or gifts (i.e., sex trade work). Sex trade work was excluded since sexual behaviour in the context of this activity is known to be distinct from that during voluntary intercourse [29, 30]. For both same and opposite sex partnerships, participants were also asked to report how often a condom was used during vaginal and anal intercourse with voluntary partners. Possible responses included: always (100%), regularly (50% to 99%), occasionally (1% to 49%), and never (0%). To be

consistent with previous studies of condom use among street-involved youth [42, 43], this variable was dichotomized into "consistent" (i.e., always) and "inconsistent" (i.e., regularly, occasionally, or never) condom use. Participants who reported more than one type of sexual activity (e.g., vaginal and anal intercourse or same and opposite sex partnerships) and who reported discordant condom use patterns (e.g., always using condoms during vaginal intercourse and sometimes using condom during anal intercourse) were coded as inconsistent condom users.

The primary variables of interest in this study were a set of structural factors that shape the context in which street youth behaviour is situated. We defined: "homeless" as any participant who reported homelessness at any time in the past six months; "barriers to health services" as being in need of but unable to obtain health or harm reduction services (including a hospital, doctor, nurse, clinic, dentist, optometrist, or needle exchange); "jacked up" as being stopped, searched or detained by the police; "warrants" as currently having a warrant or area restriction that affects access to needle exchange programs (NEP) or other services; "unable to access treatment" as trying to access an alcohol or drug treatment program but being unable to; and "assault from police/security guards" as experiencing assault (e.g., bruises, scratches, broken bones) from police or security guards. All variables except for "warrants" refer to behaviours and events occurring in the past six months since the date of the interview. Other independent variables included a broad range of

sociodemographic, individual, drug-related, and social factors, chosen based on their known or *a priori* status as risk factors for one or both sexual behaviour outcomes. Sociodemographic variables that were examined included: age, sex (female vs. male), Aboriginal ethnicity (yes vs. no) and sexual orientation (lesbian, gay bisexual, transgendered/transsexual [LGBTT] vs. heterosexual). Other individual level factors that were examined included: engaging in anal intercourse in the past six months (yes vs. no), childhood sexual abuse (yes vs. no), depression (defined using the Centre for Epidemiologic Studies Depression [CES-D] scale), and the self-efficacy for limiting HIV risk behaviours (LHRB) scale. The CES-D has been shown to have high levels of internal consistency and reliability among groups of adolescents [44-46]. The presence of depressive symptoms was evaluated using a well-defined cut-off (CES-D ≥ 16 [yes] versus CES-D < 16 [no]). The self-efficacy for LHRB scale is a validated instrument found to have high levels of consistency among at-risk youth [47, 48]. Responses were dichotomized into "high" versus "low" self-efficacy for LHRB based on the sample median. Social and drug-related factors that were examined included: relationship status (single or casually dating vs. regular partner or married), drug dealing (yes vs. no), alcohol dependence (yes vs. no), crack use (yes vs. no), cocaine use (yes vs. no), heroin use (yes vs. no), crystal methamphetamine use (yes vs. no), injection drug use (yes vs. no), sharing syringes (yes vs. no), and binge drug use (yes vs. no). Alcohol dependence was measured

using the Perceived-Benefit-of-Drinking Scale (PBDS), a validated true/false instrument that assesses drinking behaviours among adolescents [49, 50]. All other drug use variables refer to behaviours occurring in the past six months. Cocaine, heroin, and crystal methamphetamine use refer to all modes of consumption, including inhalation (i.e., smoking), nasal insufflation (i.e., snorting), and injection (i.e., fixing). To be consistent with our previous work, "syringe sharing" was defined as lending or borrowing a syringe that had been used by someone else, and "binge drug use" was defined as the consumption of drugs (injection or non-injection) more often than usual [51, 52].

Initially, we examined bivariate associations between each independent variable and each sexual risk behaviour outcome. Given that the precise number of recent sexual partners was obtained for each participant, we used a Poisson-type regression to estimate the unadjusted incidence rate ratio (IRR) and 95% confidence interval (95% CI) associated with each explanatory variable. The distribution of recent sex partners was highly skewed; therefore, we used a log-linear quasi-Poisson regression to account for overdispersion in the data. Quasi-Poisson analysis relaxes the assumption that the variance of the distribution is equal to the mean by modelling the variance as a function of the mean and an estimated dispersion parameter, θ [53]. To examine the bivariate associations between each independent variable and consistent condom use, we used the Pearson χ^2 test. Fisher's exact test

was used when one or more of the cells contained values less than or equal to five. Since sexual risk behaviour profiles among street-involved youth are often observed to be moderated by gender [54, 55], we also assessed each structural variable for possible interaction with gender. If a statistically significant interaction effect was observed, the coefficients corresponding to the main and interaction terms were combined to construct IRR estimates reflective of each gender separately. The overall significance of the main and interaction effect was assessed using the likelihood ratio rest.

One of the primary objectives of this study was to develop a series of explanatory models to describe the structural factors associated with an increased risk for HIV and STI transmission among our sample of street-involved youth. Since there is a paucity of knowledge regarding the potential impact of structural factors on sexual risk behaviours among this population, we used an *a priori* defined liberal bivariate cut-off of $p \leq 0.10$ as the major criterion for inclusion of structural variables into multivariate analyses. This approach minimizes the potential impact of predictor selection on inference, reduces the likelihood of type-2 error, and is particularly appropriate for analysis of novel or under-studied associations [56]. In order to account for potential confounding, we also included any sociodemographic, individual-level, social or drug-related variables that were significant at $p \leq 0.10$ in bivariate analyses. Since sexual risk behaviours are interdependent [57], each

independent variable was included as a potential explanatory factor when not used as the primary outcome of interest. All statistical analyses were conducted using S-PLUS software version 8.0. All reported *p*-values are two-sided.

4.3 RESULTS

A total of 529 participants completed an interview between September 1, 2005 and October 31, 2006, of whom 159 (30.1%) were female, 127 (24.0%) were of Aboriginal ethnicity, and 69 (13.0%) self-identified as LGBTT. The majority, 415 (78.4%), reported engaging in voluntary sexual activity in the past six months. Of these participants, 288 (69.6%) reported inconsistent condom use, and 253 (61.0%) reported multiple sex partners. Among the entire sample, the median number of sex partners in the past six months was 1 (interquartile range [IQR]: 1 – 3; range: 0 – 55).

The results of the bivariate quasi-Poisson analyses are shown in Table 1. Structural variables that were positively associated with number of recent sex partners included homelessness (incidence rate ratio [IRR] = 1.87, 95% confidence interval [95%CI]: 1.24 - 2.82) and having a warrant or area restriction that affects access to services (IRR = 2.51, 95%CI: 1.21 - 5.18). Statistically significant interaction effects were observed for both "jacked up" and "barriers to health service" variables. The former was positively associated with number of recent sex partners for males (IRR = 1.53, 95%CI: 1.07 - 2.18), while the latter was marginally significant for

females (IRR = 1.92, 95%CI: 0.97 - 3.79). Other variables that attained a $p < 0.05$ level of significance and were positively associated with number of recent sex partners included: LGBTT orientation (IRR = 1.90, 95% CI: 1.37 – 2.63); being single or casually dating (IRR = 1.79, 95% CI: 1.19 – 2.69); low self-efficacy for LHRB (IRR = 1.55, 95% CI: 1.14 – 2.13); anal intercourse (IRR = 2.52, 95% CI: 1.83 – 3.48); sexual abuse (IRR = 1.67, 95% CI: 1.25 – 2.24); crack use (IRR = 1.45, 95% CI: 1.07 – 1.98); cocaine use (IRR = 1.62, 95% CI: 1.20 – 2.19); and binge drug use (IRR = 1.35, 95%CI: 1.00 – 1.83).

The bivariate results for factors associated with consistent condom use are shown in Table 2. Barriers to health services (odds ratio [OR] = 0.53, 95% CI: 0.28 – 1.00) was inversely associated with consistent condom use. Other variables that were significant at $p < 0.05$ included: LGBTT orientation (OR = 0.42, 95% CI: 0.20 – 0.90); being single or casually dating (OR = 2.50, 95% CI: 1.46 – 4.30); and anal intercourse (OR = 0.41, 95% CI; 0.21 – 0.79).

The results of the multivariate analyses modelling number of recent sex partners and consistent condom use are shown in Tables 1 and 3, respectively. Homelessness (adjusted incidence rate ratio [aIRR] = 1.54, 95% CI: 1.11 – 2.14) and having a warrant or area restriction that affects access to services (aIRR = 2.32, 95% CI: 1.28 – 4.18) were positively and independently associated with number of recent sex partners. Furthermore, the overall contributions (main and interaction effect) of

both "jacked up" and "barriers to health services" to the final model were highly significant ($p < 0.001$ for both variables). For males, being jacked up by the police was positively associated with number of recent sex partners (aIRR = 1.36, 95% CI: 1.02 – 1.81), while barriers to health services was marginally significant for females (aIRR = 1.76, 95% CI: 0.98 – 3.15). Other factors that were positively and independently associated with number of recent sex partners included: LGBTT orientation (aIRR = 1.58, 95% CI: 1.16 – 2.16); being single or casually dating (aIRR = 1.44, 95% CI: 1.04 – 2.00); low self-efficacy for LHRB (aIRR = 1.41, 95% CI: 1.10 – 1.81); anal intercourse (aIRR = 2.01, 95% CI: 1.51 – 2.69); sexual abuse (aIRR = 1.41, 95% CI: 1.08 – 1.83); and cocaine use (aIRR = 1.63, 95% CI: 1.28 – 2.08). In multivariate logistic regression analysis, factors associated with consistent condom included LGBTT orientation (adjusted odds ratio [aOR] = 0.38, 95% CI: 0.15 – 0.97) and being single or casually dating (aOR = 2.82, 95% CI: 1.59 – 5.01). Barriers to health services was marginally and inversely associated with consistent condom use (aOR = 0.52, 95% CI: 0.25 – 1.07); no significant interaction with gender was observed (data not shown).

4.4 DISCUSSION

These findings reveal high rates of inconsistent condom use and multiple sexual partnerships among a cohort of street-involved youth in Vancouver. Given

that these behaviours describe two important parameters which partially determine the population level transmission dynamics of HIV and STIs, we conclude that the continued propagation of these diseases among this population is likely. Our results also suggest that structural factors, including homelessness, warrants or area restrictions, specific police activities, and barriers to health and harm reduction services, may play an important and direct role in driving risk behaviours that increase the likelihood of HIV and STI transmission. Further, the impact of structural factors on the sexual risk behaviours of street-involved youth appear to be moderated by gender, leading us to conclude that the intersection of structural determinants with gender and sexual inequities promotes the production of HIV risk within this marginalized population.

In multivariate analysis, having a warrant or area restriction that affects access to NEPs or other services was the strongest predictor of number of recent sex partners, even after adjustment for potential confounders such as homelessness and hard drug use (i.e., crack and cocaine). Furthermore, being "jacked up" by the police was independently associated with number of recent sex partners among males in our sample. These findings suggest that enforcement-based policies and practices which result in the criminalization of street youth activity may be a contributing factor to the spread of HIV and STIs among these populations. While few studies have characterized the potential impact of policing and enforcement policies on HIV

and STI transmission among street youth, several authors have argued that street-level law enforcement promotes HIV risk behaviour among older populations, in particular among injection drug users who consume drugs in public spaces. For example, ethnographic research among IDU has shown that having outstanding warrants exacerbates the health and safety concerns associated with public injection due to fears of being arrested by police, particularly following overdose [58]. Furthermore, prohibitionist policies that criminalize drug consumption, drug dealing, and other street-based income generating activities such as outdoor sex work have been shown to deter drug users and sex workers from harm reduction programs such as NEPs and other primary medical care settings [5, 39, 59]. Other studies of homeless and street-based youth indicate that negative interactions with police, particularly those involving assault, discourage help-seeking behaviours and may pose barriers to obtaining emergency assistance in future situations [60, 61]. The displacement of marginalized populations acts as a structural barrier to health and harm reduction services, but may also impact the spread of HIV and STIs through more direct mechanisms. For example, the separation of sex partners due to the removal or displacement of individuals from normative structural environments has been theorized to increase the likelihood of new discordant sexual partnerships and riskier sexual behaviours [3, 61]. Our results provide quantitative evidence to support these hypotheses and also corroborate previous qualitative findings that

indicate police and other authority figures push street-involved youth from public spaces into private and secluded environments that augment the production of HIV risk [61, 62].

Our finding that individuals who reported experiencing one or more barriers to health and harm reduction services were half as likely to use condoms consistently is also worrisome. It is likely that youth who encounter barriers when trying to access services such as clinics and NEPs encounter similar obstacles when attempting to obtain condoms. Judgmental policies and procedures, a failure to adhere to sex-positive principles, and a lack of systems that discourage heterosexist cultures and other forms of discrimination have all been recognized as structural barriers that prevent street-involved youth from accessing services that sell or distribute condoms [63-65]. Other authors have argued that the societal constructions of adolescent sexuality, which characterize teenage sex as dangerous and reinforce heteronormative and sexist stereotypes of youth sexual behaviour, further marginalize sexually active adolescents, in particular LGBTT youth [35]. It has also been suggested that these social and structural factors result in policies and procedures that limit creative efforts to establish youth-friendly health service environments [66]. Financial barriers also play a role in determining access to sexual and reproductive health services, particularly in the United States [66, 67]; however, further research is needed to investigate whether similar factors exist within

Canada's universal health care system. It is also important to note that our findings regarding barriers to health services must be interpreted cautiously, as the associations between health service barriers and both sexual risk behaviour outcomes achieved only marginal statistical significance. However, these results do suggest a possible mechanism for the well-established correlation between barriers to health care and increased HIV and STI rates within street youth communities [16, 68, 69].

This study has a number of important implications that support the establishment and evaluation of innovative environmental-structural policies, programmes, and interventions designed to reduce population level burden of HIV and STI among young street-involved communities. We have shown that the displacement of street youth and the regulation of their behaviour through law enforcement strategies and other legal practices (i.e., warrants and area restrictions) independently predicts behaviours that increase the likelihood of sustained HIV and STI transmission. Therefore, socio-legal reforms that de-emphasize enforcement-based policies and incorporate health or harm reduction frameworks may be more effective at reducing HIV and STI incidence in the future. For example, policy and legal reforms that promote the health and safety of street-based sex workers have been shown to be effective at reducing HIV vulnerability among these populations [5, 70]. Our results suggest that similar policies may be equally effective at reducing

the spread of HIV and STIs among street-involved adolescents. Recently, Ziff and colleagues [7] have created a framework that explicitly links HIV and STI transmission dynamics among street youth populations with structural determinants such as organizational structures, laws, and policies. The authors describe a community mobilization project in which a number of community partners, including representatives from the legal justice system, attempt to create or alter structural elements that have been associated with elevated HIV prevalence and incidence among urban youth. Our findings provide further evidence that structural interventions such as those described by Ziff and colleagues may be effective at removing or mitigating the factors that result in high rates of HIV/STI incidence. Consistent with other studies [9, 71, 72], our results also indicate that homelessness is a driver of HIV and STI transmission. Youth who are homeless and are not in contact with the shelter system report the highest rates of sexual risk behaviour and the greatest need for health and social services [9, 20, 73]. Therefore, interventions and public health programmes should seek to target youth who are homeless and deeply entrenched within the street culture and economy, and may benefit from the incorporation of youth-friendly, sex-positive policies and practices that reduce social-structural barriers to traditional health care environments. For example, street-based STI testing that is incorporated within pre-existing outreach

services has been shown in a number of settings to be highly effective at reducing the structural barriers associated with traditional hospital or clinic settings [68, 74].

The results of this study must be interpreted within the context of several sampling and methodological limitations. Although extensive snowball and street-based outreach was used to maximize the representativeness of our sample, we are unable to generalize our findings to other settings with different social, political, economic, and physical environments. Secondly, the low sample size across several covariates resulted in wide confidence intervals that may have reduced our ability to observe small but significant effects. We attempted to reduce the probability of type-2 error by using a liberal bivariate cut-off of $p \leq 0.10$, and have encouraged the cautious interpretation of marginally significant results. It is also possible that socially desirable reporting resulted in an under-estimate of stigmatized behaviours such as anal intercourse, injection drug use, syringe sharing, and inconsistent condom use, particularly with casual or anonymous sex partners. However, we have no reason to suspect that differential reporting of these behaviours occurred between those who reported structural barriers and those that did not. Therefore, if socially desirable reporting were present, our results would likely be biased towards the null. We have also attempted to mitigate social desirability bias by building rapport with the participants and ensuring confidentiality at several stages of the

interview. Lastly, it is important to recognize that these results are cross-sectional, and therefore no conclusions can be made with respect to causation.

We have shown that structural factors, in particular those that correspond to the displacement, regulation, and criminalization of street youth activity, are associated with behaviours which increase the risk for HIV and STI transmission. Furthermore, street-involved youth who report barriers to traditional health services are more likely to engage in sexual risk behaviours that put them at an increased risk for the acquisition and transmission of these diseases. We have also shown that structural factors appear to influence the drivers of HIV and STI transmission independently of individual, social, and drug-related characteristics; therefore, structural interventions that incorporate youth-friendly, accessible, health-based policies and practices may be most effective at promoting sustained and improved population level sexual health outcomes. These findings support the need for innovative interventions including legal reforms, non-coercive policing practices, and street-based outreach and sexual health services to reduce the prevalence of HIV and other sexually transmitted infections among marginalized youth populations in the future.

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Table 4.1: Structural factors associated with number of sex partners among a cohort of street-involved youth (n = 529).

	Unadjusted Incidence Rate Ratio (IRR)			Adjusted Incidence Rate Ratio (aIRR)		
Characteristic	**IRR**	**(95% CI)**	***p* - value**	**aIRR**	**(95% CI)**	***p* - value**
Age (per year older)	0.98	(0.93 – 1.04)	0.566			
Sex (female vs. male)	0.80	(0.57 – 1.13)	0.198			
Aboriginal Ethnicity (yes vs. no)	0.84	(0.58 – 1.22)	0.366			
Sexual Orientation (LGBTT[a] vs. heterosexual)	1.90	(1.37 – 2.63)	< 0.001	1.58	(1.16 – 2.16)	0.004
Relationship (single vs. partner)	1.79	(1.19 – 2.69)	0.005	1.44	(1.04 – 2.00)	0.028
Depression[b] (yes* vs. no)	1.14	(0.84 – 1.56)	0.402			
Self-Efficacy LHRB[c] (low vs. high)	1.55	(1.14 – 2.13)	0.006	1.41	(1.10 – 1.81)	0.007
Condom Use† (consistent vs. inconsistent)	0.86	(0.62 – 1.20)	0.380			
Anal Intercourse† (yes vs. no)	2.52	(1.83 – 3.48)	< 0.001	2.01	(1.51 – 2.69)	< 0.001
Sexual Abuse‡ (yes vs. no)	1.67	(1.25 – 2.24)	< 0.001	1.40	(1.08 – 1.83)	0.011
Drug Dealing† (yes vs. no)	1.30	(0.95 – 1.77)	0.104			
Alcohol Dependence (yes vs. no)	1.32	(0.97 – 1.79)	0.073	1.05	(0.82 – 1.35)	0.711
Crack Use† (yes vs. no)	1.45	(1.07 – 1.98)	0.018	1.20	(0.88 – 1.64)	0.249
Cocaine Use† (yes vs. no)	1.62	(1.20 – 2.19)	0.002	1.63	(1.28 – 2.08)	< 0.001
Heroin Use† (yes vs. no)	0.99	(0.72 – 1.37)	0.952			
Crystal Meth Use† (yes vs. no)	1.07	(0.79 – 1.44)	0.671			
Injection Drug Use (yes vs. no)	1.01	(0.73 – 1.40)	0.944			
Sharing Syringes† (yes vs. no)	1.17	(0.72 – 1.91)	0.521			
Binge Drug Use† (yes vs. no)	1.35	(1.00 – 1.83)	0.047	0.94	(0.71 – 1.26)	0.681
Homelessness† (yes vs. no)	1.87	(1.24 – 2.82)	0.003	1.54	(1.11 – 2.14)	0.011
Barriers To Health Services† (yes vs. no)			< 0.001*			< 0.001*
Male	0.97	(0.62 – 1.51)	0.889	0.82	(0.57 – 1.16)	0.259
Female	1.92	(0.97 – 3.79)	0.061	1.76	(0.98 – 3.15)	0.058

	Unadjusted Incidence Rate Ratio (IRR)			Adjusted Incidence Rate Ratio (aIRR)		
Characteristic	**IRR**	**(95% CI)**	***p* - value**	**aIRR**	**(95% CI)**	***p* - value**
Jacked Up† (yes vs. no)			< 0.001*			< 0.001*
Male	1.53	(1.07 – 2.18)	0.020	1.36	(1.02 – 1.81)	0.034
Female	1.15	(0.62 – 2.10)	0.661	0.85	(0.51 – 1.41)	0.526
Warrants (yes vs. no)	2.51	(1.21 – 5.18)	0.007	2.32	(1.28 – 4.18)	0.005
Unable To Access Treatment† (yes vs. no)	1.14	(0.74 – 1.78)	0.545			
Assault From Police/Guards† (yes vs. no)	1.12	(0.79 – 1.61)	0.500			

Note: a – LGBTT denotes lesbian, gay, bisexual, transgendered, or transsexual; b – CES-D standard cut-off score of 16 or greater;
c – denotes self-efficacy for limiting HIV risk behaviours scale; † - refers to activities in the past 6 months; ‡ - refers to lifetime history;
* - overall *p*-value for main and interaction effect.

Table 4.2: Structural factors associated with consistent condom use among a cohort of sexually active street-involved youth (n = 415).

Characteristic	Consistent n (%) n = 127	Inconsistent n (%) n = 288	Odds Ratio (95% CI)	*p* - value
Age[¶]				
< 22	61 (27.4)	162 (72.6)		
≥ 22	66 (34.4)	126 (65.6)	0.72 (0.47 – 1.09)	0.150
Sex				
Female	36 (27.5)	95 (72.5)		
Male	90 (31.6)	192 (68.1)	0.81 (0.51 – 1.28)	0.426
Aboriginal Ethnicity				
Yes	37 (35.6)	67 (64.4)		
No	90 (28.9)	221 (71.1)	1.36 (0.85 – 2.17)	0.251
Sexual Orientation				
LGBTT[a]	9 (17.0)	44 (83.0)		
Heterosexual	117 (32.5)	243 (67.5)	0.42 (0.20 – 0.90)	0.033
Relationship Status				
Single/Dating	105 (35.2)	193 (64.8)		
Regular Partner	20 (17.9)	92 (82.1)	2.50 (1.46 – 4.30)	0.001
Depression[b]				
Yes	63 (29.2)	153 (70.8)		
No	60 (32.6)	124 (67.4)	0.98 (0.64 – 1.49)	0.526
Self Efficacy LHRB[c]				
Low	46 (26.3)	129 (73.7)		
High	79 (34.6)	149 (65.4)	0.67 (0.44 – 1.04)	0.091
Number of Sex Partners[†]				
> 1	79 (32.4)	165 (67.6)		
≤ 1	48 (28.1)	123 (71.9)	1.23 (0.80 – 1.88)	0.407
Anal Intercourse[†]				
Yes	12 (16.9)	59 (83.1)		
No	111 (33.2)	223 (66.8)	0.41 (0.21 – 0.79)	0.010
Sexual Abuse[‡]				
Yes	33 (29.5)	79 (70.5)		
No	91 (30.6)	206 (69.4)	0.95 (0.59 – 1.52)	0.912
Drug Dealing[†]				
Yes	71 (28.9)	175 (71.1)		
No	56 (33.1)	113 (66.9)	0.82 (0.54 – 1.25)	0.412
Alcohol Dependence				
Yes	56 (26.7)	154 (73.3)		
No	63 (34.1)	122 (65.9)	0.70 (0.46 – 1.09)	0.137
Crack Use[†]				
Yes	67 (27.8)	174 (72.2)		
No	60 (34.5)	114 (65.5)	0.73 (0.48 – 1.12)	0.177

Characteristic	Consistent n (%) n = 127	Inconsistent n (%) n = 288	Odds Ratio (95% CI)	*p* - value
Cocaine Use†				
Yes	58 (29.7)	137 (70.3)		
No	69 (31.4)	151 (68.6)	0.93 (0.61 – 1.41)	0.802
Heroin Use†				
Yes	43 (31.6)	93 (68.4)		
No	84 (30.1)	195 (69.9)	1.07 (0.69 – 1.67)	0.842
Crystal Meth Use†				
Yes	52 (26.3)	146 (73.7)		
No	75 (34.6)	142 (65.4)	0.67 (0.44 – 1.03)	0.084
Injection Drug Use†				
Yes	35 (29.4)	84 (70.6)		
No	92 (31.1)	204 (68.9)	0.92 (0.58 – 1.47)	0.829
Syringe Sharing†				
Yes	7 (17.9)	32 (82.1)		
No	120 (31.9)	256 (68.1)	0.47 (0.20 – 1.09)	0.105
Binge Drug Use†				
Yes	49 (26.1)	139 (73.9)		
No	74 (34.3)	142 (65.7)	0.68 (0.44 – 1.04)	0.094
Homeless†				
Yes	91 (28.6)	227 (71.4)		
No	36 (37.1)	61 (62.9)	0.68 (0.42 – 1.10)	0.143
Barriers To Health Services†				
Yes	14 (20.6)	54 (79.4)		
No	113 (32.8)	241 (67.2)	0.53 (0.28 – 1.00)	0.065
Jacked Up†				
Yes	55 (28.9)	135 (71.1)		
No	69 (31.7)	149 (68.3)	0.88 (0.58 – 1.35)	0.628
Warrants				
Yes	4 (44.4)	5 (55.6)		
No	121 (30.6)	275 (69.4)	1.82 (0.48 – 6.92)	0.492
Unable To Access Treatment†				
Yes	13 (26.0)	37 (74.0)		
No	114 (31.3)	250 (68.7)	0.77 (0.39 – 1.51)	0.548
Assault From Police/Guards†				
Yes	27 (28.7)	67 (71.3)		
No	97 (31.0)	216 (69.0)	0.90 (0.54 – 1.49)	0.771

Note: a – LGBTT denotes lesbian, gay, bisexual, transgendered, or transsexual; b – CES-D standard cut-off score of 16 or greater; c – denotes Self-Efficacy for Limiting HIV Risk Behaviours Scale; ¶ - dichotomization based on sample median; † - refers to activities in the past 6 months; ‡ - refers to lifetime history.

Table 4.3: Multivariate logistic regression analysis of structural factors associated with consistent condom use among a cohort of street-involved youth (n = 415).

Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval (95% CI)	*p* - value
Sexual Orientation			
(LGBTT[a] vs. heterosexual)	0.38	(0.15 – 0.97)	0.044
Relationship Status			
(single/dating vs. regular)	2.82	(1.59 – 5.01)	< 0.001
Self-Efficacy LHRB[b]			
(low vs. high)	0.66	(0.41 – 1.07)	0.091
Anal Intercourse[†]			
(yes vs. no)	0.61	(0.30 – 1.24)	0.173
Crystal Meth Use[†]			
(yes vs. no)	0.74	(0.47 – 1.19)	0.217
Binge Drug Use[†]			
(yes vs. no)	0.67	(0.42 – 1.08)	0.098
Barriers To Health Services[†]			
(yes vs. no)	0.52	(0.25 – 1.07)	0.074

Note: a – LGBTT denotes lesbian, gay, bisexual, transgendered or transsexual; b – denotes Self-Efficacy for Limiting HIV Risk Behaviours Scale; † - refers to activities in the past 6 months.

CHAPTER 5

DISCUSSION, IMPLICATIONS, DIRECTIONS FOR FUTURE RESEARCH, AND CONCLUSIONS

5.1 DISCUSSION AND SUMMARY OF FINDINGS

This research sought to examine the contextual determinants of sexual risk-taking behaviour within a cohort of street-involved youth in Vancouver, Canada. Using as a conceptual framework a synthesis of ecological and STI transmission dynamic models, this project has described the prevalence and contextual correlates of two behaviours that act synergistically to increase the risk for the continued transmission and elevated spread of HIV and other sexually transmitted infections. As discussed in Sections 5.2 and 5.3 below, the results of this work provide a more complete understanding of the multi-level factors that drive sexual risk behaviour and subsequent HIV/STI transmission, and may be used to inform interventions and policies that seek to reduce the burden of these diseases among street-involved youth in the future.

The first phase of this project began with a review of street youth sexual behaviour and a critical analysis of studies investigating the individual, social, drug-related, environmental, and structural determinants of risk factors for HIV/STI transmission. Historically, research has focused on individual level factors (e.g.,

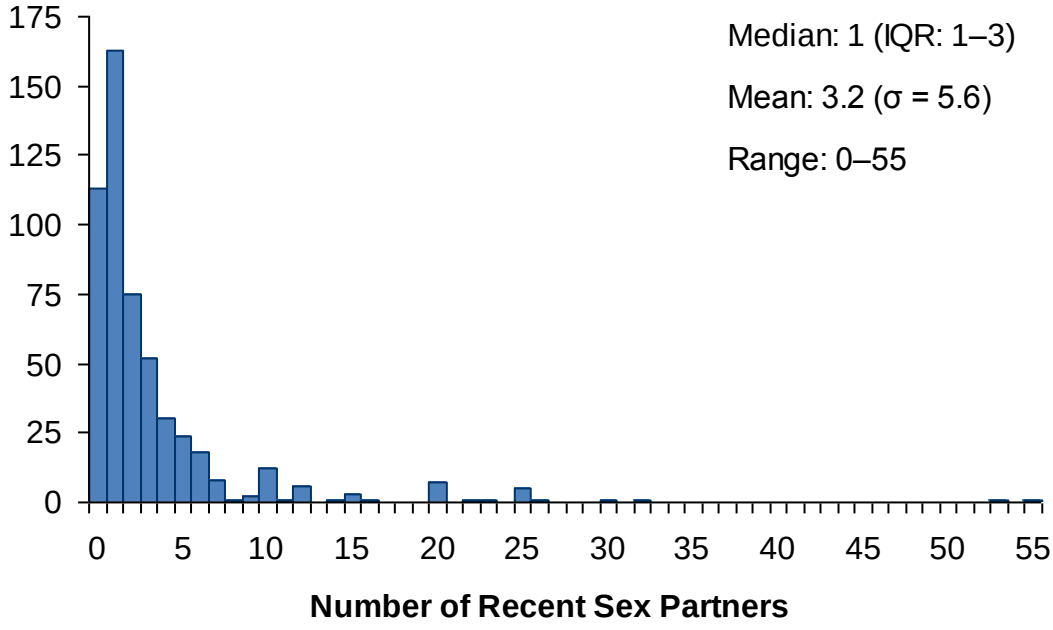
knowledge, self-esteem) to explain sexual risk-taking behaviour among street-involved and homeless adolescents. Several authors have argued that the result of this reliance on individual level models was the proliferation of behavioural interventions during the last two decades of the twentieth century [1-3]. More recent research has examined the social and peer-group factors that influence street youth sexual activity; however, more work is required to characterize how social and sexual network factors drive HIV and STI transmission among these populations. Although an extensive body of literature has identified that homelessness negatively impacts adolescent health [4-7], there is a gap in knowledge regarding the specific environmental and structural influences on street youth sexual health. In order to inform HIV and STI-related programming and policy, epidemiological research should account for contextual determinants within existing HIV/STI transmission dynamics frameworks.

The primary objectives of this research were to: 1) describe the prevalence and characteristics of sexual risk behaviour, 2) identify the environmental determinants associated with an increased number of recent sexual partners and inconsistent condom use, and 3) identify the structural factors associated with these outcomes among street-involved and drug-using adolescents.

5.1.1 The Prevalence and Characteristics of Street Youth Sexual Behaviour

The majority of sexually active participants in the ARYS cohort reported inconsistent condom use and multiple sexual partnerships in the past six months. As described in Chapters 3 and 4 and as shown in Figure 5.1, the distribution of number of sexual partners was positively skewed.

Figure 5.1: Histogram of number of recent† sex partners among street-involved youth in Vancouver.



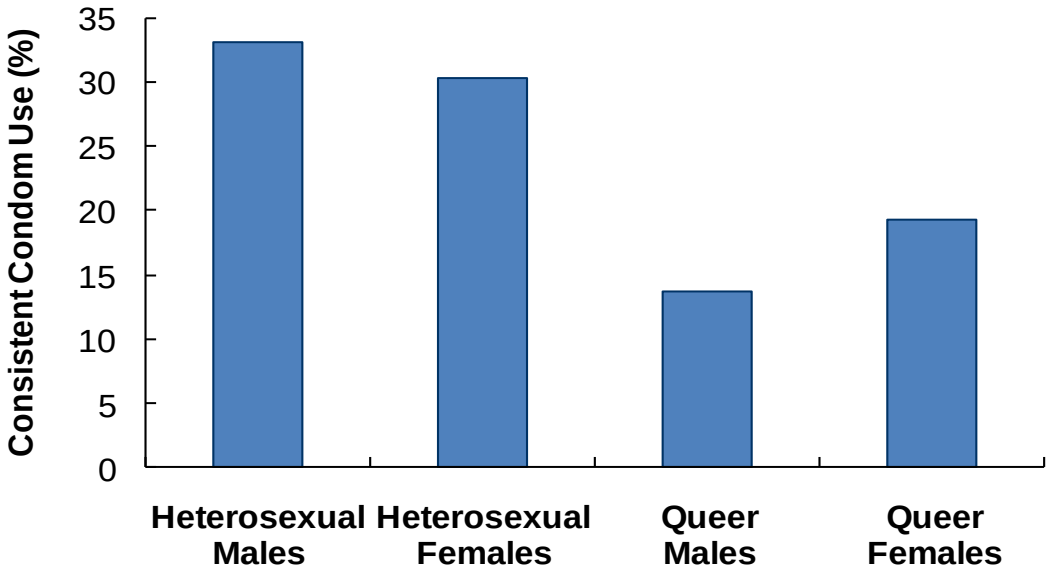
† Refers to total number of regular and casual partners in the past six months.

I hypothesized that the mean number of recent sex partners would differ by gender, and also that those who self-identified as LGBTT would report greater numbers of sexual partners than their heterosexual peers. As described in Chapters 3 and 4, there was no statistically significant difference between the number of sex partners

reported by males and females. However, LGBTT street youth had almost twice the number of recent sex partners as compared to the heterosexual population.

Overall, less than one third of sexually active participants reported consistent condom use with regular and casual partners (Figure 5.2). I hypothesized that the prevalence of consistent condom use would differ by gender and sexual orientation. As shown in Figure 5.2 and as described in Chapters 3 and 4, there was no significant gender difference between males and females reporting consistent condom use in the sample. However, youth who identified as LGBTT were significantly less likely to use condoms consistently with all regular and casual partners.

Figure 5.2: Proportion of street-involved youth reporting consistent condom use, stratified by gender and sexual orientation†.



† Queer refers to lesbian, gay, bisexual, transgendered or transsexual orientation.

These findings add to a growing literature that suggests homeless sexual minorities have unique and elevated health risks [8-10]. Furthermore, as discussed

more fully in Section 5.3, these results have significant implications for youth sexual health programming and policy in Vancouver. Street-involved youth who identify as LGBTT appear to be at increased risk for HIV and STI acquisition; furthermore, the continued transmission and spread of these diseases among this subpopulation of street youth is likely. Innovative interventions that adhere to non-heterosexist policies and incorporate programming that is inclusive of diverse gender and sexual identities may be necessary to reduce the incidence and prevalence of HIV and other STIs among marginalized LGBTT youth populations in Vancouver.

5.1.2 The Environmental Determinants of Street Youth Sexual Behaviour

In Chapter 3, I demonstrated that environmental factors, including the housing and shelter conditions in which street youth reside, may be important determinants influencing the acquisition, transmission, and spread of HIV and STIs among this population. Distinct environmental conditions were found to correlate with engagement in distinct sexual risk behaviours; for example, unstable housing was associated with an increased number of recent sex partners, while homelessness was associated with inconsistent condom use. These factors remained significant even after extensive adjustment for other individual- and drug-related factors.

Taken together, these findings suggest that housing conditions may play an important role in driving behaviours that increase the risk for HIV and STI

transmission among street-involved youth. Along with other HIV-related risk factors that have been associated with unstable housing and homelessness, including injection drug use, equipment sharing, public injecting, and survival sex work [11-13], these results point to the need for more research that elucidates how environmental conditions may directly influence HIV/STI transmission dynamics. For example, it has been hypothesized that unstable housing environments such as shelters and hostels result in heightened rates of HIV/STI transmission due to separation from sex partners and the lack of social, structural and environmental checks that discourage the formation of new sexual partnerships [14]. Our results provide quantitative evidence to support these theories and add further support to the growing body of empirical evidence that suggests the provision of safe and stable housing for marginalized adolescents is effective in reducing HIV-related risks [15, 16].

5.1.3 The Structural Determinants of Street Youth Sexual Behaviour

The analyses presented in Chapter 4 demonstrate that structural factors are associated with sexual risk behaviours and an increased risk for sustained and elevated HIV and STI transmission among street-involved youth. Consistent with other studies investigating HIV risk among populations of IDU and street-based sex workers [17-20], I observed that factors related to the displacement of street youth

through enforcement-based mechanisms correlate with increased engagement in sexual risk behaviour. For example, having a warrant or area restriction that affects access to health services was the strongest correlate of number of recent sex partners, even after adjustment for potential confounders such as homelessness. Barriers to health care were also associated with increased engagement in sexual risk behaviour; for example, youth who reported being in need of but unable to obtain a health or harm reduction service were half as likely to also report consistent condom use. Innovative strategies are clearly required to reduce barriers to access and provide services to street-involved youth at high risk of acquiring and transmitting HIV/STIs and who may not be in contact with traditional health care systems (see Section 5.3).

The observed associations between structural factors and sexual risk behaviours also appear to be moderated by gender. In multivariate analyses, barriers to health services was a significant correlate of number of sex partners for females, while being stopped, searched, or detained by the police was significant for males. As discussed in greater detail below, these findings point to the need for contextual public health interventions that address and are sensitive to gender and sexual identities. Further research must be conducted to examine how gendered macro-level factors structure the context in which HIV and STI transmission among street-involved youth occurs.

5.2 UNIQUE CONTRIBUTIONS AND IMPACT

To my knowledge, this project is the first to examine quantitatively the influence of environmental-structural factors on sexual risk behaviour among street-involved youth. Furthermore, I have examined the multi-level determinants of sexual risk behaviour using a novel framework consisting of a synthesis of ecological and dynamical models. The development and success of this approach may be useful for future researchers who seek to explore the intersecting determinants of infectious disease-related health behaviours using quantitative methodologies.

The results of this project also contribute to a growing epidemiological literature that seeks to unpack the social, environmental, and structural conditions that result in sexual risk behaviours that produce elevated disease incidence among marginalized populations. Although the "contextual epidemiology" of HIV risk production has been explored in some detail among older populations of IDU and street-based sex workers [17, 21], only recently have similar methods been applied to research among street-involved adolescents. The analyses presented in this thesis may provide a foundation for future work that seeks to elucidate the unique multi-level factors that drive HIV and STI transmission among young marginalized populations.

5.3 IMPLICATIONS FOR POLICY AND PROGRAMMING

Since intervention efforts targeting individual-level behaviour change have been shown to have only modest, short-term effects among groups of school-based and street-involved adolescents [1], programs and policies that address the contextual factors that promote elevated rates of HIV and STI transmission are necessary. Furthermore, for contextual interventions to result in sustained reductions in the population incidence of HIV and STIs, a combination of individual, social, and structural strategies should be designed to modify the three primary determinants of STI transmission dynamics (i.e., probability of exposure, rate of partner change, and duration of infectiousness) [22]. Although the theoretical foundations of ecological HIV/STI prevention interventions have been relatively well-described, the vast majority of sexual health interventions for adolescents continue to rely on the modification of individual characteristics, attributes, and behaviours [2]. It is my hope that the quantitative evidence presented in this dissertation prompts the development and implementation of effective multi-level HIV/STI interventions for street-involved adolescents.

5.3.1 Interventions to Reduce the Probability of HIV/STI Exposure

A variety of physiological and behavioral factors, including male circumcision, use of contraceptives, and micro-sexual practices (i.e., positioning), have all been shown to impact the transmission probability of HIV and STIs [23]; however, the consistent and correct use of condoms has been shown to be one of the most effective interventions to reduce the likelihood of HIV and STI transmission between discordant partners [24, 25]. Although reductions in unprotected sex acts are often a primary target for sexual health interventions for adolescents (e.g., [26-28]), the vast majority rely on educational sessions based on cognitive-behavioural or health belief models. Results presented in Chapters 3 and 4 suggest that such interventions do not acknowledge important environmental-structural determinants that also influence engagement in this behaviour. For example, homelessness was independently associated with inconsistent condom use. These findings are consistent with recent studies demonstrating an association between homelessness and inconsistent condom use among at-risk youth [11, 29], and provide further evidence that access to safe and stable housing is an effective environmental-structural intervention for HIV/STI prevention [30, 31].

Results presented in Chapter 4 support previous studies that have documented an array of structural barriers to accessing sexual health care, including perceived lack of confidentiality, waiting times, inconvenience (e.g., location and

operating hours), and stigma and discrimination from adult authorities [32, 33]. Since peer street-based outreach has been shown to reduce barriers to care and result in increased rates of consistent condom use [34, 35], it is recommended that these programs be scaled up and targeted specifically at youth who are street-entrenched and absolutely homeless. It is important to note that such programs are most effective if they are accompanied with structural changes to the practices and policies that impact the organization and operation of street outreach programming. For example, a multi-site HIV/STI intervention for urban youth in the United States has incorporated both street outreach and a community mobilization component that focuses on altering community-level practices, laws and policies that impact street youth sexual health outcomes [36].

5.3.2 Interventions to Reduce Rate of Partner Change

Although many behavioural interventions for adolescents have included strategies that attempt to reduce rates of partner change [37, 38], to my knowledge no research has evaluated the potential impact of environmental-structural interventions on reducing the number of sex partners acquired by street-involved adolescents. However, the findings that unstable housing and structural factors related to criminalization and displacement are independently associated with an elevated number of recent sex partners suggests that macro-level strategies may be

necessary to produce significant and sustained reductions in population-level HIV/STI incidence. Housing interventions are likely to be effective at reducing rate of partner change among street-involved youth, particularly since mounting evidence indicates that improved housing status has direct and indirect benefits with regard to reductions in HIV risk behaviours [14, 16, 31].

Consistent with other studies of IDU and street-based sex workers [19, 39], results presented in Chapter 4 suggest that the displacement of street youth and the criminalization of their activities may perpetuate HIV and STI risk production. For example, enforcement measures such as "crackdowns" and the removal of street youth from public spaces have been shown increase the likelihood of both physical and sexual victimization [40]. It is recommended that governments at the federal, provincial, and/or municipal levels as well as agencies that operate under their rubrics (e.g., police organizations, health care providers, social workers) undergo reviews of policies and laws that privilege the displacement and criminalization of street youth over health and harm reduction priorities. Novel intersecting interventions that balance the priorities of public order with HIV and STI-related health issues are urgently required.

5.4 DIRECTIONS FOR FUTURE RESEARCH

A major contribution of this research to the scientific knowledge base of sexual risk behaviour and HIV/STI transmission among street-involved youth is the measurement and analysis of multiple outcomes (i.e., condom use and number of sex partners) that act synergistically to promote the spread of these diseases. However, it must be noted that a constellation of other factors not included in these analyses also influence transmission dynamics. For example, I was unable to address factors associated with behaviours that influence the mean duration of infectiousness (*D*). These determinants are often amenable to public health intervention and include: health seeking-behaviours (e.g., interval between recognition of symptoms and care-seeking); barriers to appropriate treatment and care; and availability and use of HIV/STI testing [23, 32, 41]. Future research should be conducted to examine the multi-level factors associated with behaviours that determine the duration of infectiousness, particularly since among adolescents, the length of time between dissolution and formation of new sex partners has been observed to be shorter than the duration of infectiousness for the majority of STIs [42, 43].

There is a paucity of knowledge regarding how the sexual networks of street-involved youth impact the population level characteristics of HIV and other STIs. However, research conducted in the United States has demonstrated significant

overlap between street youth's social, injecting, and sexual networks, particularly among young females [44]. Other studies have observed dense and overlapping sexual networks among high school youth [45, 46]. To my knowledge, no studies have investigated whether street-involved youth populations have distinct sexual network characteristics that may partially explain the elevated rate of HIV and STIs among this population. Future research should also examine whether "bridging" and sexual mixing with other high prevalence populations (older MSM, IDU) drives HIV/STI transmission among street-involved youth.

Finally, it is also recommended that future research explore the impact of sex trade work and coerced sexual activity on the dynamics of HIV/STI transmission among this population. Since sexual activities in the context of these situations are known to be distinct from those occurring during voluntary intercourse, they have been excluded from the analyses presented in Chapters 3 and 4. However, given that approximately one quarter of street-involved youth engage in sex in exchange for money, gifts, drugs, or shelter [47, 48], the contribution of these activities to the overall prevalence and incidence of HIV/STIs among street youth sexual networks is likely significant.

5.5 CONCLUSIONS

The primary objectives of this research were to determine the prevalence and environmental-structural correlates of sexual risk behaviours among a cohort of street-involved adolescents in Vancouver. The majority of street youth in this setting were found to engage in a number of behaviours that promote the transmission of HIV and STIs, including multiple recent sexual partnerships and inconsistent condom use. Furthermore, these behaviours appear to act synergistically to increase the likelihood of transmission HIV and other STIs; thus, the measurement, analysis and interpretation of these factors in context of each other have important implications for population level sexual health outcomes. The results presented in this dissertation suggest that innovative, intersecting interventions are urgently required to reduce the burden of these diseases and prevent generalized epidemics among street-involved youth in the future.

I have also demonstrated that macro-level factors, including environmental conditions and structural mechanisms, likely play an important and direct role in the dynamics of HIV/STI transmission among street youth populations. While historically sexual health interventions for at-risk youth have relied overwhelmingly on the modification of individual level determinants to prevent risk behaviour, these results offer empirical evidence for the implementation of multi-level interventions. Future research and interventions must recognize that the physical, social and

structural environments of marginalization and impoverishment structure the context in which HIV and STI acquisition occurs, and contribute to the perpetuation of disease transmission as well.

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APPENDIX 1: HUMAN ETHICS APPROVAL CERTIFICATE

UBC-Providence Health Care Research Institute
Office of Research Services
11th Floor Hornby Site - SPH
c/o 1081 Burrard St.
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ETHICS CERTIFICATE OF EXPEDITED APPROVAL

PRINCIPAL INVESTIGATOR:	**DEPARTMENT:**	**UBC-PHC REB NUMBER:**
Thomas Kerr	Infectious Diseases - Medicine	H07-01440

INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT:

Institution	Site
Providence Health Care	St. Paul's Hospital

Other locations where the research will be conducted:
ARYS study office (807 Drake Street)

COINVESTIGATOR(S):
Brandon D.L. Marshall

SPONSORING AGENCIES:
Canadian Institutes of Health Research (CIHR)
Michael Smith Foundation for Health Research

PROJECT TITLE:
Sexual behaviours among a cohort of street-involved youth in Vancouver

THE CURRENT UBC-PHC REB APPROVAL FOR THIS STUDY EXPIRES: June 22, 2008

The UBC-PHC Research Ethics Board Chair or Associate Chair, has reviewed the above described research project, including associated documentation noted below, and finds the research project aceeptable on ethical grounds for research involving human subjects and hereby grants approval.

DOCUMENTS INCLUDED IN THIS APPROVAL:	**APPROVAL DATE:** **June 22, 2007**	
Document Name	**Version**	**Date**
Protocol:		
Thesis proposal (Marshall): Sexual behaviours among a cohort of street-involved youth in Vancouver	N/A	May 23, 2007

CERTIFICATION:

1. The membership of the UBC-PHC REB complies with the membership requirements for research ethics boards defined in Part C Division 5 of the Food and Drug Regulations of Canada.
2. The UBC-PHC REB carries out its functions in a manner fully consistent with Good Clinical Practices.
3. The UBC-PHC REB has reviewed and approved the research project named on this Certificate of Approval including any associated consent form and taken the action noted above. This research

project is to be conducted by the principal investigator named above at the specified research site(s). This review of the UBC-PHC REB have been documented in writing.

Approval of the UBC-PHC Research Ethics Board or Associate Chair, verified by the above signature of one of the following:

Dr. I. Fedoroff,	Dr. J. Kernahan,
Chair	Associate Chair