Journal of Urban Health: Bulletin of the New York Academy of Medicine, No. 87, Vol. 1
doi:10.1007/s11524-009-9397-9

The Challenge of Understanding Mortality Changes among Street Youth

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ABSTRACT *According to a cohort study conducted in Montréal, Québec from 1995 to 2000, the mortality rate among street youth was 921/100,000 person-years. Several new community initiatives aiming to increase access to housing and to social and health services for the homeless were implemented in the city between 2000 and 2003. This study aims to update the mortality rate estimate for the period 2001–2006 and to examine factors that could explain a difference between rates, if any. A second cohort study was conducted between 2001 and 2006. The Cohort 2 mortality rate was computed and compared with the Cohort 1 rate. Several analyses were then carried out: (1) mortality rates in the general population were compared with street youth rates using standardized mortality ratios (SMR); (2) Cohorts 1 and 2 distributions of risk factors for mortality were examined, and their effects were assessed using multivariate proportional hazards regression analyses carried out on a combined Cohorts 1 and 2 dataset. Mortality rate among street youth decreased by 79% while it declined by only 19% in the general population; the SMR for Cohort 1 was higher than for Cohort 2 (11.6 versus 3.0). Multivariate proportional hazards regression analyses yielded estimates that were close to the model's estimates based on Cohort 1 data only, and participation in Cohort 1 was an independent predictor of mortality, with an adjusted hazard ratio of 9.0. The mortality decline cannot be completely explained by a similar decrease among the general population or by a difference in distribution of risk factors for mortality between the two cohorts. Field workers suggested that the decrease in heroin consumption they had observed in the streets might have contributed to the mortality decline. We then performed additional analyses which showed that even though the proportion of street youth currently using heroin decreased significantly between 1995 and 2005, the association between heroin use and mortality was not significant (adjusted hazard ratio of 0.9; 95% CI, 0.4 to 2.3). It seems that various factors could have contributed to the decline in mortality rates among street youth, one plausible factor being the implementation of new services for the homeless. This study underscores the importance of monitoring risky behaviors among vulnerable populations to ensure that morbidity and mortality data among these populations is correctly interpreted. Setting up a system to monitor the drug market could improve the quality of information collected.*

KEYWORDS *Mortality, Incidence, Predictors, Street youth, Cohort study*

INTRODUCTION

Street youth reality has different faces depending on the social environments where it takes place. In Canada and the USA, street-involved youth are generally aged

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25 years old or below, and approximately one third of them are girls. Despite some heterogeneity, mostly based on local subcultural differences, these youth share many characteristics that jeopardize their development and health: they are highly entrenched in the streets and live in unstable residential conditions with frequent episodes of homelessness; many of them engage in high-risk behaviors such as prostitution and substance abuse, which seriously compromise their health.[1] The ultimate consequence of these precarious living conditions (death of street youth) is poorly documented. Several studies addressed mortality among homeless individuals, but only a few presented data for youth less than 25 years.[2–5] Although the mortality ratio varied greatly from one study site to another, ranging between 2.7 and 28.5, all these studies clearly showed that homeless youth experienced mortality rates much higher than their counterparts in the general population.

Preliminary findings on mortality risk factors among street youth in Montréal, Canada, were first reported in 1998,[6] and final results were published in 2004.[7] Briefly, a prospective cohort study on risk factors for HIV and hepatitis C virus (HCV) infections was conducted from 1995 to 2000 among street youth aged 14 to 25 years at recruitment. Secondary analyses showed that 26 of the 1,013 participants died during follow-up for a mortality rate of 921 per 100,000 person-years (95% confidence interval (CI), 602–1350). This represented a standardized mortality ratio of 11. Causes of death were suicide (13), overdose (8), accident (2), fulminant hepatitis A (1), heart disease (1), and 1 unknown. A multivariate proportional hazards regression analysis showed that independent risk factors for mortality were as follows: HIV infection (adjusted hazard ratio (AHR = 8.1)), daily alcohol use in the last month (AHR = 3.7), homelessness and drug injection in the last 6 months (AHR = 3.9 and 3.7, respectively), and male sex (AHR = 2.6).

The analyses presented in this paper were based on data collected between 2001 and 2006 in a second prospective cohort study, the aim of which was to determine psychosocial determinants of initiation into injection drug use among street youth in addition to updating HIV and HCV infection incidence estimates. The objectives of the analyses presented here are to update the mortality rate estimate and to examine factors that could explain a difference between rates, if any.

METHODS

Criteria for entry into the study cohorts as well as recruitment strategies (fully detailed in previous papers[8,9]) were the same for both cohorts, except for age (14 to 25 years in Cohort 1 and 14 to 23 years in Cohort 2). Briefly, youth were eligible if they were street-active, English or French speaking, able to provide informed consent, and able to complete an interviewer-administered questionnaire. In the second cohort, a slightly younger sample was targeted because of the psychosocial component related to initiation into injection, the youngest among street youth being at greatest risk of initiation.[8] Study interviewers enrolled participants through regular visits to all major street youth agencies in Montréal. Semiannual follow-up interviews included completion of a questionnaire on sociodemographics, drug and alcohol use, and sexual behaviors. Mortality data were obtained from the Coroner's Office and the Institut de la statistique du Québec. Ethical approval was provided by the Institutional Review Board of the Faculty of Medicine, McGill University.

As in the first cohort analyses, mortality rate in the second cohort was estimated using the person-time method, and the 95% CI was calculated using the Poisson distribution.[10] Follow-up started at recruitment and ended either at death or

6 months after completion of the last questionnaire, which was mid-2006 for the second cohort. Mortality rates in Cohorts 1 and 2 were compared using a test developed by Oleinick and Mantel.[11]

To examine factors that could explain a possible difference between Cohorts 1 and 2 mortality rates, the following analyses were carried out. First, we examined mortality rates in Québec's general population for the same time periods. We then compared rates in the general population to Cohorts 1 and 2 mortality rates by computing standardized mortality ratios (SMRs). The indirect method of standardization by sex and age group was applied. The two SMRs were compared using confidence intervals calculated via Byar's approximation.[10, 12] Secondly, we tried to determine if a different distribution of risk factors for mortality (identified in Cohort1) in the cohorts could explain changes in mortality rates. Proportions of youth presenting risk factors at baseline were calculated for each cohort. Then, a multivariate proportional hazards regression analysis with time-varying covariates was carried out on a dataset combining data from both cohorts. We examined the independent effect of participation in Cohort 1 on mortality, controlling for the predictors of mortality. Analyses were carried out with SPSS 13.0.[13]

RESULTS

A total of 1,687 subjects participated in the two cohorts: 829 in Cohort 1 only, 674 in Cohort 2 only, and 184 in both cohorts. Sex distribution and mean age at recruitment into Cohort 2 (68.9% boys; 20.4 years) were similar to those reported for Cohort 1 (67.4% boys; 19.9 years).

Five of the 858 participants in Cohort 2 died during follow-up, for a mortality rate of 191/100,000 person-years (95% CI, 62–447). Causes of death were overdose (2), suicide (1), unintentional injury (1), and 1 unknown. This mortality rate represents a decrease of 79% (from 921/100,000 person-years to 191/100,000 person-years), and the difference between the rates was statistically different ($p<0.001$). The corresponding decline in the general population was only 19% and the SMRs in Cohorts 1 and 2 were 11.6 (95% CI, 7.6–17.0) and 3.0 (95% CI, 1.0–6.9), respectively. This statistically significant difference between SMRs shows that the decline in mortality was greater among street youth than in the general population.

Baseline proportions of street youth with risk factors for mortality were similar in the two cohorts (Table 1). As shown in Table 2, multivariate proportional hazards regression analyses of the combined dataset (model A) yielded estimates that were close to the previous model's estimates based on Cohort 1 data only (first column). The effect of the "Cohort" variable was statistically significant in the model where independent predictors of mortality were controlled for, and its addition in the model did not modify other estimates by more than 10% (model B). This shows that Cohort 1 participants were more likely to die during follow-up compared to Cohort 2 participants and that cohort difference in distribution of mortality predictors identified previously did not explain the decrease in mortality.

DISCUSSION

This study shows a striking decline in mortality rate among Montréal street youth between the periods 1995–2001 and 2001–2006. This decrease cannot be explained by a similar drop among the general population; the decline was significantly greater

TABLE 1 Presence of risk factors for mortality at study entry in both street youth cohorts in Montréal

Characteristic	Cohort 1 (n=1,013)	Cohort 2 (n=858)
HIV infection	1.4%[a]	0.9%[b]
Daily alcohol use in last month	10.2%	12.5%[c]
Homelessness in last 6 months	78.9%	83.0%[c]
Drug injection in last 6 months	30.5%	31.1%
Male sex	67.4%	68.9%

[a]Two missing values
[b]Six missing values
[c]One missing value

for street youth than for the general population during the same time period. Also, differences in distribution of mortality risk factors between the two samples did not appear to be involved. According to the final multivariate model, Cohort 1 participants were nine times more likely to die during follow-up than Cohort 2 participants when controlling for other independent predictors.

In April 2008, while presenting these results to community groups and institutions working with street youth in Montréal, we suggested that the significant drop in mortality among street youth could be at least partially explained by the implementation of new services for homeless people during the period 2000 to 2003. In fact, soon after publication of our preliminary results in 1998, the Montréal Public Health Department set up a working group in response to this mortality epidemic. The working group was asked to make recommendations to the regional and provincial health authorities to take actions to decrease mortality among street youth.[14] Within several months of receiving the working group's report, around the end of 2000, Québec's Minister of Health and Social Services allocated new funds to community organizations working with street youth to improve services, both medical and social. At the same time, a federal-provincial agreement on homelessness provided new funding for special projects to increase access to housing and to social and health services for the homeless in Montréal. With these funds, several community initiatives were implemented between 2000 and 2003. These included

TABLE 2 Multivariate proportional hazards regression analyses of mortality among street youth

	Adjusted hazard ratio (95% CI)		
		Cohorts 1 and 2[b]	
Characteristic	Cohort 1[a]	Model A	Model B
HIV infection	5.6 (1.9–16.8)	6.0 (2.0–17.5)	5.4 (1.8–15.9)
Daily alcohol use in last month	3.2 (1.3–7.7)	3.1 (1.4–6.9)	3.1 (1.4–6.9)
Homelessness in last 6 months	3.0 (1.1–7.6)	2.8 (1.2–6.6)	2.9 (1.3–6.9)
Drug injection in last 6 months	2.7 (1.2–6.2)	2.5 (1.2–5.1)	2.4 (1.1–4.9)
Male sex	2.6 (0.9–7.7)	2.9 (1.1–7.5)	2.8 (1.1–7.3)
Cohort (1 vs. 2)			9.0 (2.3–35.5)

[a]n=1,012 (26 deaths)
[b]n=1,682 (31 deaths)

increased hours for outreach community interventions, training of outreach and community workers regarding mental health issues and suicide prevention, opening of a new hassle-free primary care clinic for street youth, and improved access to social housing with community support. Consequently, our hypothesis that newly implemented services helped reduce mortality seemed plausible, especially since these services specifically targeted suicide prevention. However, while the organizations participating in the meeting did not reject this hypothesis, some workers proposed that the decrease in mortality could also be partly due to a change in the youth's drug consumption habits. Workers said they had observed a decline in heroin consumption in the streets; this could mean a decrease in the number of heroin users and injection drug users and, thus, a reduced risk of deadly overdoses due to heroin consumption or injection.

To further examine this question, we looked at the temporal variation in the proportion of heroin users during the period covered by the two cohort studies. We had previously shown that the annual prevalence of current injection among street youth was stable between 1995 and 2005.[15] The new analysis demonstrated that the odds of being a current heroin user (last month), controlling for sex and age, had declined significantly since 1995, with an odds ratio of 0.94/year (95% CI, 0.92–0.97; $p<0.0001$). Given this result, we carried out additional proportional hazards regression analyses, assessing the effect of current heroin use on mortality. The univariate analysis showed a marginal association between heroin use and mortality (hazard ratio of 2.0; 95% CI, 0.9–4.3; $p=0.07$). Once included in the multivariate model (shown in model B, last column of Table 2), the association between heroin use and mortality was not significant (adjusted hazard ratio of 0.9; 95% CI, 0.4–2.3; $p=0.90$). There was no confounding effect of heroin use on other parameter estimates (changes in estimates were less than 4%). Thus, heroin use did not seem to be an independent predictor of mortality among street youth. It is, therefore, unlikely that the reduction in heroin use among the youth explains the decrease in mortality.

We come to the conclusion that various factors could have contributed to the decline in mortality rates among street youth. A certain decrease having been observed among the general population, it is possible that the steep drop among street youth can be explained in part by this population trend. Another plausible factor is the implementation of new services for the homeless. However, we cannot state this conclusively, given that our study is a post hoc analysis. An evaluative study design, for instance a quasi-experimental design, would undoubtedly have been better to assess the effects and impact of services implemented to counter the issue of mortality.

Some limitations of our study could have been detrimental to our capacity to identify all factors that could have contributed to the drop in mortality. One is the limited power of the study due to the relatively small number of observed deaths. It is possible that this prevented us from detecting other significant predictors, including a significant effect of the decline of heroin consumption among youth. Finally, another area of concern may be the generalizability of the results. However, cohort participants should be representative of the larger Montréal street youth population, given that recruitment was conducted in all major street youth organizations and that refusals were infrequent.[8] Moreover, according to a survey carried out in the late 1990s, most of the homeless population in Montréal (over 90%) attend community organizations offering services to homeless people.[16]

This study highlights the challenge of understanding mortality trends in marginalized populations, such as street-involved people and drug users. Immediate

causes of death reported in official databases are, of course, very useful, but they are only part of the explanation. Factors that are precursors to these causes, such as substance use or suicidal behaviors and psychological distress, are rarely well documented among these individuals, who are generally overlooked in population surveys. Behavioral epidemiological surveillance of vulnerable populations is an effective way to monitor risky behaviors that can shed light on morbidity and mortality data among these populations. In our study, one possible explanation for the decrease in mortality was the decline in heroin use among youth. Our longitudinal research data enabled us to study the effect of these changes and, thus, to conclude that a reduction in heroin use was not a major cause of mortality decline. However, data collected from both users and informers in the field have their limitations. Additional information, particularly concerning the drug market, including price, purity, and availability of a drug, is also necessary to better understand users' behaviors. Indeed, studies have shown that the drug market influences the types of drugs consumed and methods used among drug-using populations.[17–19] In this regard, we would like to underline the importance of collecting systematic data through highly performing integrated surveillance systems to understand morbidity and mortality trends among marginalized populations and, thus, to better inform health policies addressing their needs. It is crucial that these systems rely on a variety of sources. In this regard, examples from Europe and Australia that include multiple data collection strategies such as behavioral surveys, consultations with key informants, and analyses of drug seizures are inspiring.[17,20]

Finally, despite a striking decrease in mortality rates among street youth between 1995–2001 and 2001–2006, it is noteworthy that mortality in this group is still higher than in the general population. It is, thus, essential to maintain public funding to strengthen the preventive work that has been started in Montréal and to continue developing innovative services that will improve the lives of street youth as well as decrease morbidity and mortality among them. On a broader level, faced with the high rates of mortality among homeless people documented elsewhere in the world, the Montréal example suggests that it is essential to develop services adapted to their needs to reduce the disparity between affluent and poor individuals with regard to health and mortality.

ACKNOWLEDGEMENTS

Project funding: This study was financially supported through unconditional grants received from the following sources: Medical Research Council of Canada, Health Canada, Ministère de la Santé et des Services sociaux du Québec, Human Resources Development Canada: Supporting Communities Partnership Initiative, Direction de santé publique de Montréal-centre, and Fonds de recherche en santé du Québec.

We wish to thank the youth who participated in this study as well as all collaborating street youth community organizations. This study was made possible through the dedicated contribution of all members of the research team: the coordinator, interviewers, secretaries, and data entry clerk.

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