



Exploring the impact of network characteristics on substance use outcomes among homeless former foster youth

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Abstract

Objectives This study examined network structure differences between homeless youth with and without a history of foster care and the impact of network position and location on substance use outcomes among former foster youth specifically.

Methods Sociometric and individual-level data were collected from a cross-sectional community-based sample ($n = 814$) of homeless youth from drop-in centers in Los Angeles across three points in time. To determine the structure and position of foster youth in the larger homeless network, structural variables and regressions examining the impact of network structure on substance use were calculated.

Results Results indicated that former foster youth were more likely to have low connectivity compared to homeless youth without a history of foster care. Furthermore, the impact of structure on substance use among former foster youth varied by panel; location in the core was significantly associated with recent and lifetime rates of substance use.

Conclusions Results highlight the need for a more in-depth understanding of the impact of network changes over time and their effect on substance use outcomes in this population.

Keywords Homeless youth · Former foster youth · Social network analysis · Substance use · Network structure

Introduction

Homeless former foster youth are a vulnerable population receiving relatively little attention in the scientific literature, compared to both homeless youth and youth with foster care experiences. However, 30 % of all homeless adults report a foster care history, compared to 4 % of the general public (Courtney and Piliavin 1998; Reilly 2003), and research has shown that between 11 and 36 % of the foster youth population experiences homelessness (Dworsky et al. 2012). Recent research has begun to demonstrate high rates of substance use and problem behaviors (Courtney et al. 2011; Hudson and Nandy 2012; Nyamathi et al. 2012). Because social networks have been shown to affect some behavioral health outcomes for both homeless youth and former foster youth (Bao et al. 2000; Halkitis et al. 2013; Joseph et al. 2014; Kidd 2003; Rice et al. 2007; Rice and Rhoades 2013; Rice et al. 2008) and studies have begun to discover the role that foster care plays in network disruption, a need exists to better understand the network characteristics of homeless young adults with a history of foster care and associations between these characteristics and behavioral health outcomes in this population.

Substance use rates among older foster youth are high, often higher than in the general public (Braciszewski and Stout 2012; DiClemente et al. 2008; Vaughn et al. 2007; White et al. 2008), as are rates for youth who have transitioned out of foster care (Braciszewski and Stout 2012; Courtney et al. 2011; Narendorf and McMillan 2010).

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Homelessness, likewise, is a risk factor for a variety of negative behavioral health outcomes among young people (Milburn et al. 2009). These young adults face rates of substance abuse and substance abuse disorders many times higher than their peers who are not homeless and engage in high rates of recent and regular use of illicit drugs (Bousman et al. 2005).

Theories of risk amplification offer a model for explaining how foster care experiences may impact peer influences and their effect on an individual's substance use and developmental trajectory. The risk amplification and abatement model views negative contact with socializing agents as amplifying risk, whereas positive contact with socializing agents abates risk (Milburn et al. 2009). In general this theory asserts that youth exit dysfunctional family environments filled with parental substance abuse, violence, and neglect that prime them for risk taking. When youth run away or are thrown out of home, they enter street networks in which they form linkages to other youth from similar dysfunctional backgrounds who reinforce norms of risk taking. The risk amplification and abatement model suggests that there are four major socialization domains that affect this trajectory: family, peers, social services, and larger institutions such as schools. Foster care is one of these critical institutions. Long-term foster care and the process of discharge have been shown to hinder the development of an ideal support structure, increasing network disruption that results in sparse social networks, disengagement from formal services, and increased behavioral problems (Blakeslee 2012). We explored how this history of system involvement and its likely impact on former foster youth may differentiate the experiences of network engagement for homeless youth with and without such history. Thus, we suggest that engagement in deviant social networks and negative life experiences may predict unique network characteristics among these former foster youth, including engagement in risky drug use behaviors.

Peer behavior has been shown to be strongly correlated with individual behavior (Weis and Hawkins 1981). Network characteristics may inform us about the types of behaviors in which an individual is likely to engage (Rice et al. 2012). Structural network theory has been used to describe the impact of network structure and node position on aspects of behavioral health, such as substance use (Borgatti and Halgin 2011), positing that it is not random (Christakis and Fowler 2009). Rice et al. (2012) found that position in the overall network and individual connectivity to other homeless youth were significantly associated with engagement in certain risk behaviors. Similarly, it is likely that former foster youth occupy a unique location in the larger homeless network, and affiliation with one another may uniquely affect their engagement in certain risks behaviors. Thus, we hypothesize that homeless former

foster youth occupy a unique position in the larger homeless network and that engagement of homeless former foster youth in drug risk behaviors is uniquely affected by this position and location.

Methods

The YouthNet dataset (Rice 2012) was generated using an event-based approach (EBA), a sampling approach proposed by Freeman and Webster (1994) to capture the interactions of individuals over time when entry and exit from the network are common and the grouping of individuals retains a level of fluidity. Thus, for a network of homeless youth engaging in risk behaviors, EBA allows researchers to impose constraints on the edges of this population by setting the boundaries on a shared set of activities or events, such as homelessness and engagement in similar risk behaviors (Freeman and Webster 1994).

Sampling

In Panel 1, homeless youth (aged 14–28 years) were recruited between January 17 and February 10, 2012. At this site, 80.2 % of youth approached agreed to participate; six respondents were later determined to have provided incomplete or invalid responses to the self-interview questionnaire and were excluded. In Panel 2 (July 10 to August 6, 2012), 83.44 % of approached youth participated, of whom 152 were new respondents [149 baseline self-interviews (SIs) and 143 baseline social network interviews (SNIs)] and 108 were follow-up youth (103 SIs and 103 SNIs). In Panel 3 (January 23 to February 22, 2013), 75.68 % of the youth approached agreed to participate in the survey ($n = 308$), with 211 new youth completing baseline interviews (207 SIs and 182 SNIs) and 97 follow-up respondents (96 SIs and 86 SNIs). Table 1 provides detailed information on the sample characteristics of each panel.

Procedures

Any client receiving services at the respective agency during data collection periods was eligible to participate. Youth new to the agency first completed the agency's intake process before beginning the study to ensure they met the eligibility requirements for the agency (and thus the study). Signed voluntary informed consent was obtained from each youth, with the caveat that child abuse and suicidal and homicidal intentions would be reported. Informed consent was obtained from youth 18 years of age or older and informed assent was obtained from youth 14–17 years old. The institutional review board at the

Table 1 Sample demographics ($N = 814$), Los Angeles, CA, United States, 2010–2012

	Panel 1 $n = 239$ % or M (SD)	Panel 2 $n = 263$ % or M (SD)	Panel 3 $n = 312$ % or M (SD)
Age	21.12 (2.01)	21.08 (1.88)	21.35 (2.07)
Race and ethnicity			
American Indian or Alaska Native	3.57	1.21	3.64
Asian	0.45	0.44	0.66
Black or African American	41.52	36.44	34.44
Native Hawaiian or Pacific Islander	0.89	0.81	0.33
White	16.52	16.60	22.19
Latino or Hispanic	20.54	22.27	16.23
Mixed	16.52	22.27	22.52
Gender			
Male	64.73	88.35	66.99
Female	33.93	11.65	30.07
MTF	0.89	1.59	1.96
FTM	0.45	0.80	0.98
Sexual orientation			
Homosexual	10.50	9.72	12.33
Queer	0.91	0.40	0.33
Bisexual	13.70	13.77	16.67
Heterosexual	72.15	74.49	67.67
Questioning	2.74	1.62	3.00
Time spent homeless (years)	3.53 (2.54)	3.11 (2.64)	4.14 (7.40)
Foster care experience			
Yes	37.66	32.70	35.58
No	62.34	67.30	64.42

FTM female-to-male transgender, *MTF* male-to-female transgender

University of Southern California waived parental consent, because homeless youth younger than 18 years old are unaccompanied minors who may not have a parent or adult guardian from whom to obtain consent.

The study consisted of two parts: a computerized self-administered survey and a social network interview. All participants received \$20 in cash or gift cards as compensation for their time. The face-to-face social network-mapping interview was conducted by trained research staff members (Rice 2012). Participants were asked to name every person they interacted with, either face-to-face, on the phone, or in written forms of communication including text messages, emails, or through a social networking website. Interviewers asked for each alter's name, age, race, gender, length known, and if the alter was a relative. Questions included the individual's perception of the alters' behaviors, including drug and sex behaviors. Examination of the network was completed using a sociomatrix, a tabular representation of interpersonal relationships. Ties were created when participants nominated other participants. A third common tie was used to assign adjacency when two individuals matched on all information (name, alias, ethnicity, gender, age, and agency attendance). Both self-interview and sociometric variables

were used in this analysis. Details on the data collection and sociomatrix creation procedures have been published elsewhere (Petering et al. 2015).

Measures

Demographics

All demographic information was collected from self-report data. All variables used in these analyses were collected during these panels of data collection. Age at first foster care placement was operationalized as an open-ended question. Number of foster care placements was operationalized as an ordinal variable: 1 or 2 placements, 3 or 4 placements, 5–9 placements, or more than 10 placements. This variable was dichotomized with more than 10 placements as the reference group.

Drug risk variables

Drug risk was measured as recent and lifetime engagement in drug use. Each drug use variable was treated as a unique drug risk behavior using self-report data from the study questionnaire. All drug use variables were measured using

6-point Likert scales, ranging from 0 times to 40 or more times. Questions addressed issues such as the number of times an individual had used cocaine, heroin, methamphetamines, or ecstasy or misused prescription drugs during the previous 30 days (e.g., “During the past 30 days, how many times have you used prescription drugs without a doctor’s prescription?”). Additional questions addressed the number of times participants reported using cocaine, heroin, methamphetamines, or ecstasy or misusing prescription drugs during the course of their lifetime (e.g., “During your life, how many times have you used cocaine?”).

Degree centrality

Degree centrality is a measure of the number of ties to a node, or the number of edges adjacent to a node (Freeman 1978; Otte and Rousseau 2002). Calculating the degree centrality of each node in the network and transforming these values into variables enables the examination of minimum, maximum, and average degree centrality in the network. For the purpose of this analysis, only undirected ties were considered, allowing for an examination of the impact of those network ties within the bounds of the homeless network. Calculation of degree centrality allowed for determination of foster youth position in the network, or how popular these youth were in the larger homeless network.

K-core

A measure of *k*-cores describes a subgroup of actors in a larger network, all of whom are connected to some minimum number (*k*) of other members in that subnetwork (Hanneman and Riddle 2005; Rice et al. 2012). *k*-core identifies spaces of highly interconnected persons in a larger network. For the purpose of this analysis, *k*-core was operationalized as low (0), high (more than 3), and specific values of 0, 1, 2, 3, and 4. Given the interconnectedness of this network and homogeneity of characteristics and experiences of these youth, and in consideration of pros and cons regarding the potential operationalization of *k*-core values discussed by Everett and Borgatti (2000), we considered *k*-core to be the most appropriate way to measure core–periphery structure for this unique network (Rombach et al. 2013). These *k*-core values were transformed into variables and correlated with drug risk behaviors.

Bonacich centrality

Bonacich centrality is a modified measure of degree centrality. Degree centrality equates the number of connections to an individual’s level of power in a network, whereas Bonacich centrality weighs connections by considering the centrality of those individuals. This measure

accounts the centrality of the people to whom an individual is connected (Hanneman and Riddle 2005), essentially providing an estimate of embeddedness in the network.

Analysis

To address the proposed research questions, a two-step analysis plan was developed to thoroughly examine network-based questions related to structure and substance use outcomes, stratified by panel. To determine the structure and position of foster youth in the larger homeless network, measures of degree centrality, *k*-core, and Bonacich centrality were calculated in UCINET 6 (Borgatti et al. 2002). These variables were generated to provide a sense of popularity, embeddedness, and interconnection of foster youth in the larger homeless youth network. Subsequently, an analysis of only former foster youth was conducted assessing how network structure was associated with various drug use variables as the outcomes, controlling for key demographic variables. These models were used to determine how network structure, i.e., degree centrality, *k*-core, and Bonacich centrality, were associated with an individual’s engagement in drug use; only models that yielded significant associations are reported in the text. Control variables were added to the final models. SAS 9.3 was used for all steps in the regression analysis.

Results

Demographics

Basic demographics were calculated across site and over time. Table 1 features these results. Across all panels, the average youth was approximately 21 years old and the average time spent homeless ranged from 3 to 4 years. Participants were predominately African American (ranging from 36.44 to 41.52 %), with large Latino or Hispanic (16.23 to 22.27 %) and mixed-race (16.52 to 22.52 %) populations. Overall, 9.72 to 12.33 % of participants identified as homosexual, with the majority of the population identifying as heterosexual. Finally, 32.70 to 37.66 % of youth reported a history of foster care involvement. Although many characteristics appeared consistent in the network, some demographics varied over time.

Overview of basic network measures: foster care involvement and networks

The first hypothesis predicted that homeless former foster youth would occupy a specific location and position in the larger homeless network. A series of Chi-square tests was conducted to assess differences in degree and *k*-core

frequencies, whereas *t* tests were used to assess Bonacich centrality. Table 2 indicates that no significant differences existed for the frequencies of degree centrality values between youth with and without a history of foster care. However, several *k*-core values significantly differed for all three panels of data. Panel 1 had significant results for a *k*-core of 1 ($\chi^2 = 3.93$, $df = 1$, $p = 0.047$) and a *k*-core of 3 ($\chi^2 = 5.01$, $df = 1$, $p = 0.025$). Panel 2 had significant results for a *k*-core of 1 ($\chi^2 = 34.54$, $df = 1$, $p = 0.033$), as did Panel 3 ($\chi^2 = 4.86$, $df = 1$, $p = 0.028$). The results of the *t* tests revealed similar results with regard to Bonacich centrality values. For Panel 1, significant differences existed for mean Bonacich centrality measures ($t = 6.07$, $df = 89$, $p < 0.001$), with higher values for former foster youth ($M = 268.2$, $SD = 630.8$) compared to nonformer foster youth ($M = 90.46$, $SD = 256.0$). Similar results were found for Panel 3 ($t = 1.30$, $df = 200$, $p = 0.019$), but with higher values for nonformer foster youth ($M = 234.9$, $SD = 554.4$) compared to former foster youth ($M = 210.1$, $SD = 452.6$). Table 2 exhibits all the network variable frequencies.

Impact of network structure and position on drug risk behaviors

The second hypothesis proposed that the location and position of homeless former foster youth in the network would affect their engagement in drug risk behaviors.

Results indicated that across all panels, varying levels of *k*-core values were significantly associated with drug use, whereas degree and Bonacich centralities were not. Table 3 demonstrates that for homeless former foster youth, the impact of the core–periphery structure varied over time; only substance use variables that were significant are included in the table. For Panel 1, *k*-core values were significantly associated with lifetime methamphetamine use and recent ecstasy use. For lifetime methamphetamine use, a *k*-core value of 3 was significantly associated with an increase in lifetime use ($b = 1.20$, $t = 2.22$, $p = 0.030$). For recent ecstasy use, the overall *k*-core value ($b = 0.201$, $t = 2.53$, $p = 0.013$), a *k*-core value of 2 ($b = 0.494$, $t = 2.58$, $p = 0.012$), and a *k*-core value of 3 ($b = 0.615$, $t = 2.74$, $p = 0.008$) were associated with an increase in recent use, whereas an overall low *k*-core value ($b = -0.494$, $t = -2.58$, $p = 0.012$) was associated with a decrease in recent use. For Panel 2, *k*-core values were significantly associated with recent and lifetime heroin use. For recent heroin use, a *k*-core value of 3 ($b = 0.486$, $t = 2.12$, $p = 0.038$) and a high *k*-core value ($b = 2.91$, $t = 0.694$, $p = 0.001$) were associated with an increase in recent use. For lifetime heroin use, a *k*-core value of 3 ($b = 1.01$, $t = 2.36$, $p = 0.021$) and a high *k*-core value ($b = 3.30$, $t = 2.37$, $p = 0.021$) were associated with an increase in lifetime use. For Panel 3, *k*-core values were associated with recent cocaine use. The overall *k*-core value ($b = -0.223$, $t = -2.13$, $p = 0.035$), a *k*-core value

Table 2 Basic network descriptive statistics by foster care involvement across site and time, Los Angeles, CA, United States, 2010–2012

	Panel 1			Panel 2			Panel 3		
	Foster <i>n</i> = 90 %	Nonfoster <i>n</i> = 149 %	χ^2	Foster <i>n</i> = 86 %	Nonfoster <i>n</i> = 177 %	χ^2	Foster <i>n</i> = 111 %	Nonfoster <i>n</i> = 201 %	χ^2
Degree centrality									
0	23.33	34.69		22.09	35.03		18.02	29.35	
1	23.33	23.81		31.40	19.21		30.63	24.38	
2	16.67	19.73		18.60	15.25		14.41	14.43	
3	10.00	6.80	18.00	11.63	9.04	15.81	17.12	9.45	22.21
<i>K</i> -core									
0	23.33	34.69	3.16	22.09	35.03	2.01	18.02	29.35	0.12
1	33.33	31.29	3.93*	39.53	27.12	4.54*	37.84	27.36	4.86*
2	21.11	22.45	2.29	22.09	18.08	0.00	20.72	19.40	0.02
3	15.56	10.88	5.01*	15.12	17.51	0.47	20.72	18.41	0.01
4	6.67	0.68	7.09	1.16	2.26	0.37	2.70	5.47	1.28
Low (0 or 1)	56.67	65.99	2.07	61.63	62.15	0.01	55.85	56.72	0.22
High (3 or 4)	6.67	0.67	7.09	1.16	2.26	0.37	2.70	5.47	1.28
Bonacich centrality ^a	268.17 (630.78)	90.00 (256.03)	6.07**	243.31 (501.87)	205.67 (440.11)	1.30	210.09 (452.62)	234.92 (554.42)	1.50*

* $p < 0.05$, ** $p < 0.001$

^a Figures represent *M* (*SD*)

Table 3 Multiple ordinary least squares regression of the effect of k -core on recent and lifetime drug use of former foster youth, Los Angeles, CA, United States, 2010–2012

	Panel 1				Panel 2				Panel 3	
	Lifetime Meth $n = 82$		Recent Ecstasy $n = 83$		Recent Heroin $n = 74$		Lifetime Heroin $n = 73$		Recent Cocaine $n = 95$	
	b (SE)	R^2	b (SE)	R^2	b (SE)	R^2	b (SE)	R^2	b (SE)	R^2
K -core	0.342 (0.192)	0.07	0.201 (0.079)*	0.02	0.239 (0.038)	0.00	0.298 (0.155)	0.05	-0.222 (0.104)*	0.01
0	-0.769 (0.574)	0.05	-0.285 (0.243)	0.00	-0.071 (0.208)	0.00	-0.361 (0.394)	0.01	0.719 (0.317)*	0.02
1	0.769 (0.575)	0.05	0.285 (0.242)	0.00	0.071 (0.208)	0.00	0.361 (0.394)	0.01	-0.719 (0.317)*	0.02
2	0.677 (0.468)	0.06	0.494 (0.192)*	0.02	0.154 (0.185)	0.00	0.326 (0.342)	0.01	-0.208 (0.225)	0.00
3	1.20 (0.54)*	0.09	0.615 (0.224)**	0.03	0.486 (0.229)*	0.09	1.01 (0.43)*	0.07	-0.540 (0.258)*	0.01
Low	-0.677 (0.468)	0.06	-0.494 (0.192)*	0.02	-0.154 (0.185)	0.00	-0.326 (0.342)	0.01	0.208 (0.225)	0.00
High	-0.180 (0.903)	0.03	0.175 (0.380)	0.00	2.91 (0.69)***	0.15	3.30 (1.39)*	0.07	-0.544 (0.769)	0.00

All models included control variables of age, race and ethnicity, gender, sexual orientation, age at first foster care placement, and number of foster care placements

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

of 1 ($b = -0.719$, $t = -2.27$, $p = 0.026$), and a k -core value of 3 ($b = -0.540$, $t = -2.09$, $p = 0.039$) were associated with a decrease in recent use, whereas a k -core value of 0 ($b = 0.719$, $t = 2.27$, $p = 0.026$) was associated with an increase in recent use.

Discussion

Among homeless youth both with and without a history of foster care, the largest percentage of youth occupied the periphery of the network. However, to assess whether former foster youth occupied a unique space in this network, it was important to determine if structural variables significantly differed between youth with and without a history of care. All three panels had significantly higher frequencies of k -core values of 1, indicating that a larger percentage of former foster youth occupied the periphery compared to other homeless youth, who either occupied isolated positions in the network or positions in the more interconnected core. These results suggest that several network characteristics were unique to foster-care-involved youth. Statistically significant differences existed between youth with and without a history of foster care with regard to a k -core of 1 (and a k -core of 3 for Panel 1), with former foster youth having significantly higher frequencies. This indicates that former foster youth occupied a unique location in the structure of the network when compared to youth without a history of foster care, especially concerning their connectivity; former foster youth were more likely to have low connectivity (k -core = 1) when compared to those without a foster care history. This indicates that foster youth occupy a specific space in the network; they tend to occupy the periphery and yet are largely not

isolates. Thus, they were more likely to be found in peripheral dyadic relationships that have little connection with the rest of the network.

Second, differences existed over time. Specifically regarding location in the core and Bonacich centrality, Panel 1 differed, with more former foster youth affiliating with one another, higher centrality measures, and more youth in the core and along the periphery compared to other homeless youth. This may indicate that this network is structurally different in some way, or it could merely indicate that the network changed over time, affecting the structure of the networks. Very few studies have examined any aspects of network composition or structure of networks of foster youth (Blakeslee 2012; Perry 2006), and no studies to date have examined the unique location of former foster youth in any network or the impact of this structure or location on behavioral health risk factors.

Results of regressions with behavioral health outcomes for the subsample of former foster youth indicated that position in the larger network of youth was associated with substance use and varied by panel. For Panel 1, location in less embedded regions was associated with a decrease in recent ecstasy use. Panel 3 differed greatly from the other two panels in that both low and high k -core values were associated with a decrease in recent cocaine use; however, location as an isolate predicted increased recent cocaine use. This reinforces prior work that demonstrated the increased risk-taking behaviors occurring in highly interconnected regions of homeless youth networks (Rice et al. 2012). Because former foster youth were more likely than other youth to reside in less interconnected but not isolated spaces, and location in the highly interconnected regions was more highly associated with substance use, foster youth who are less connected to the larger network may

generally be protected against higher rates of use because of their location. This suggests that deterring former foster youth from becoming too deeply enmeshed in street networks may protect them from the negative behavioral influences often found among youth in more highly interconnected regions of those networks.

These results suggest that for both substance use and impact of network structure on substance use, heterogeneity existed in this network over time. Because these youth were affected differently across time, it cannot be said that youth in a specific position are at higher risk of substance use, but rather that there is a unique impact, sometimes increasing risk and sometimes decreasing risk. Complexity theory (Anderson 1999), which takes into consideration the dynamic nature of networks in organizations, i.e., adapting and changing over time, may help make sense of these findings. In a network of homeless youth, members are constantly entering and exiting and affiliating with other members on a regular basis. These changes over time affect the larger network, prompting the structure to evolve. Complexity theory rarely suggests that all networks reach a steady equilibrium that will be maintained over time, but rather the constant flux created by human engagement over time leads to a set of equilibriums that can vary over time, as in the current study.

Clinical implications from these results include applications for interventions; knowledge of the impact of network structure on substance use can focus clinical interventions on the low connectivity of homeless former foster youth, the impact of connections on substance use, and the impact of networks on substance-specific use, particularly among homeless former foster youth.

Limitations

Limitations of this analysis include sampling from drop-in centers, which limits the generalizability of our findings to service-seeking homeless youth. It is important to note, however, that this sample of youth included individuals in emergency shelters and independent living programs and those sleeping on the streets, and as such is generalizable to a wide spectrum of homeless youth. Additionally, with self-reported data, there is the possibility of social desirability bias. Furthermore, although the data were collected over time in panels, strictly speaking, we cannot classify this dataset as longitudinal because the sample did not represent a single cohort. As a result, we could not infer causality with regard to the effect of network structure on substance use. Future studies should seek to better understand why variability exists at specific points in time and what network variables drive these high rates of substance use among former foster youth.

The unique structural aspects of this network affected the engagement of homeless former foster youth in substance use, highlighting the need for a more in-depth understanding of the unique characteristics of this population, the driving force behind the structuring of the network, and the factors affecting the relationship between this structure and their engagement in substance use.

Likewise, substance use interventions have not focused on the intersection of homelessness and foster care experience, nor have they examined the impact of network structure on substance use behaviors for this unique population. A better understanding of the mechanism through which unique structural network factors affect behavioral health outcomes, and the role of foster care experience in this relationship, may be used to improve and tailor current interventions that have had some success in the homeless youth population.

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