The Role of Social Cohesion, Neighborhood Disorder and Neighborhood Decline on Internalizing Symptom Development in Children Aged 6 to 18

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Authors' contributions

This work was carried out in collaboration between all authors. Author CG performed the statistical analysis and wrote the first draft of the manuscript. Authors SPN and JW oversaw the statistical analyses and provided feedback on the draft manuscript. All authors read and approved the final manuscript.

Article Information

Original Research Article

ABSTRACT

Aims: Neighborhood characteristics have been implicated as potential risk and protective characteristics in the development of internalizing disorders. However, few studies have used longitudinal designs or included pre-adolescent children. This study evaluates the association between three neighborhood-level characteristics (social cohesion, neighborhood disorder, and neighborhood decline) and the development of internalizing

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symptoms in children.

Study Design: This is a secondary data analysis of data from an accelerated cohort study.

Place and Duration of Study: Data are from the Project on Human Development in Chicago Neighborhoods conducted between 1994 and 2001.

Methodology: Generalized linear mixed modeling was used to examine 5 age cohorts (age 3, 6, 9, 12, and 15), each measured at three - three year intervals (except the age 3 and 15 cohort, where there were only two follow-ups included), permitting an evaluation of the role of neighborhood and individual characteristics on the growth of internalizing symptoms between ages 6 and 18.

Results: Quadratic growth of internalizing symptoms was demonstrated from ages 6 through 18 (P = .006). Higher levels of social cohesion slowed the progression of the developmental increase of internalizing symptoms from childhood to middle adolescence. For each point increase in neighborhood social cohesion score, the growth in internalizing score was truncated by -.72 points (P = .02). Greater neighborhood disorder was associated with lower mean levels of internalizing symptoms at age 6 (P = .02), but this association was not significant after adjusting for social cohesion (P = .61). Perception of neighborhood decline was not associated with internalizing symptom baseline levels (P = 0.88) or change over time (slope: P = .39, quadratic: P = .48).

Conclusion: Neighborhood social cohesion demonstrated a protective effect against the development of internalizing symptoms, particularly evident at a young age. Although neighborhood disorder initially appeared to act as a risk factor for increased internalizing symptoms, the effect was attenuated after controlling for social cohesion. However, significant correlations between neighborhood characteristics indicate the need for further research and care in over generalizing results.

1. INTRODUCTION

Almost 30% of adults in the United States will meet criteria for depression or anxiety disorder in their lifetime, with over half of these cases beginning prior to age 12 [1]. Despite this morbidity, our understanding of their etiology is limited. Research suggests that depression and anxiety disorders first manifest as a prodrome of internalizing symptoms (i.e. sub-threshold symptoms of anxiety and depression such as withdrawal, and fearfulness that precede the development of the disorder) that eventually reach clinical levels if sufficient promoting factors are encountered [2]. Given the early age of onset, primary prevention efforts would need to focus on childhood risk factors among vulnerable populations. However, targets for these interventions are limited due to the lack of understanding of etiological factors.

Research over the past 20 years has suggested that neighborhood characteristics have the potential to act as promoting or inhibitory factors on the development of mental illness in children [3]. However, multi-level studies incorporating neighborhood characteristics have been limited by the difficulty of collecting longitudinal data that includes individual, familial, and neighborhood level data. Moreover, most studies that have examined neighborhood characteristics have focused on their role in the development of externalizing problems (e.g. conduct disorder). Less research has examined the effects of neighborhood characteristics on the development of internalizing problems, such as depression and anxiety [3]. This study

evaluates three neighborhood characteristics, two of which have some evidence of association with internalizing symptoms (social cohesion and neighborhood disorder) and one related but novel characteristic (neighborhood decline).

1.1 Social Cohesion

Social cohesion (also called cognitive social capital [4]), although loosely defined [5,6] refers to "a collective community-level characteristic measured by the levels of trust, norms of reciprocity, and the formation of strong social bonds within the local social structure [4]." Researchers have hypothesized several mechanisms in which social cohesion may affect the development of mental illness. Social cohesion may indirectly protect against mental illness by acting as a buffer against the stress of material deprivation [4]. Alternatively, the lack of social cohesion may promotes stress [7] and psychological distress [8]. It is likely that, if social cohesion is protective against the development of mental illnesses, it operates along multiple pathways [4].

Many studies have evaluated the association between social cohesion and closely related constructs (e.g. social capital, collective efficacy) and mental health or mental illness [4,9-11], including internalizing disorders [12-14]. However, the majority of these studies focused on adults, adolescents, and/or only examine a single cross-sectional association rather than examining longitudinal patterns [11,14]. This is problematic because internalizing problems often begin as prodromal internalizing symptoms in childhood [2] and the influence of neighborhood characteristics, such as social cohesion may have different influences across the lifespan [15]. Moreover, not all studies have identified a significant inverse relationship between social cohesion and internalizing symptoms (or disorders) [13,16].

1.2 Neighborhood Disorder

Hill and colleagues hypothesized that neighborhood disorder (e.g. problems of litter, graffiti, public drinking, or vacant and vandalized houses) could act as a chronic stressor giving rise to psychological distress and an increased risk for mental health problems [17]. Several studies have linked different aspects of neighborhood disorder (physical, social, etc.) with mental health problems in children [18-20], including internalizing problems (e.g. depression or anxiety) [21-23]. However, like studies of social cohesion, there are a number of limitations to the current body of literature. Studies of neighborhood disorder have traditionally focused on externalizing problems, often overlooking internalizing problems [3]. Moreover, these studies have rarely included pre-adolescent children [24,25], are frequently underpowered to reliably measure neighborhood-level characteristics [3], and are rarely longitudinal in design [26]. No studies were identified that evaluated the relationship between neighborhood disorder and the development of internalizing symptoms in children.

1.3 Neighborhood Decline

Finally, there is the question of whether negative changes in neighborhood status (e.g. changes in perceived levels of safety, neighborhood appearance, types of people, or levels of policing) are related to the development of internalizing symptoms [27]. Although many studies examine absolute levels of disadvantage [12,28], no studies were identified that examined the impact of decreases in neighborhood quality on the internalizing symptoms of children living in declining neighborhoods.

2. OBJECTIVES

This objective of this study is to address the current limitations of the literature identified above by evaluating the role of three neighborhood characteristics (social cohesion, neighborhood disorder, and neighborhood decline) on the development of internalizing symptoms in children from age 6 through 18, while controlling for individual characteristics. We hypothesized that Social cohesion will attenuate the increase in internalizing symptoms from age 6 to 18, while neighborhood disorder and neighborhood decline will be related to an increase in internalizing symptoms over time.

3. METHODS

3.1 Data Source

These analyses were conducted using data from the Project on Human Development in Chicago Neighborhoods (PHDCN) community survey and longitudinal study. The community survey involved a multidimensional assessment of 343 Chicago, Illinois neighborhoods. These "neighborhood clusters" were identified using a cluster analysis of US census tracts to combine contiguous census tracts with similar demographic mixtures, knowledge of major geographic boundaries, and local perceptions of neighborhood boundaries.

The PHDCN longitudinal study involved a stratified probability sampling of children and caregivers in 80 of the neighborhood clusters assessed in the community survey. Sampling was conducted to represent the racial/ethnic and socioeconomic characteristics of Chicago. The longitudinal study was structured as an accelerated cohort (sequential cohort) design [29]. Seven birth cohorts (birth (0), 3, 6, 9, 12, 15, and 18 years) were assessed at three time points, with three years in between assessments. More information on the PHDCN study design can be found in Sampson, Raudenbush, and Earls, 1997 [30] and Sampson and Raudenbush, 1999 [31].

These analyses use interview data from the second and third waves of cohort 3 (age 6 and 9; n=876); all three waves for cohorts 6 (n= 979), 9 (n=828), and 12 (n=821); and the first two waves of cohort 15 (age 15 and 18; n=696). Covariate data is from the baseline wave for each cohort. The sample was restricted to participants with complete data on all second and third level covariates this left 3,506 participants (cohort 3: 402; cohort 6: 914; cohort 9: 768; cohort 12: 770; cohort 15: 652). The majority of missing data occurred in cohort 3, due to parental mental health history information not being collected (58%).

3.2 Measures

3.2.1 Outcome

Child internalizing symptoms (depression, anxiety, somatic complaints, and withdrawal) were measured using caregiver responses on the internalizing subscale of the Child Behavior Checklist/4-18 (CBCL). The CBCL is a widely used, extremely well validated and reliable measure of child mental health problems with test-retest reliability and Cronbach's alphas for the internalizing subscale of ≥ .9 [32]. Responses to the 33 questions on the internalizing subscale are scored on a Likert-scale (0=not true to 2=very true or often true) and are summed to produce a total score ranging from 0 to 66.

3.2.2 Neighborhood characteristics

Neighborhood characteristics were measures using the community survey that was conducted independently of the longitudinal component of the PHDCN. The development of community survey measures of neighborhood characteristics has been discussed extensively elsewhere [33]. In brief, the community survey assessed multidimensional structural conditions and the organization of the neighborhood clusters. Data collection included a household interview of adult residents (aged 18 or older) to assess a range of neighborhood characteristics including: perceived crime and violence, social order (e.g. gang activity or graffiti), beliefs about violence, crime victimization, and social organization.

Social cohesion was evaluated using five items evaluating social connectedness within the neighborhood. Respondents were asked to rate agreement with the following statements: this is a close-knit neighborhood, people around here are willing to help their neighbors, people in the neighborhood generally don't get along with each other, people in the neighborhood don't share same values, and people in the neighborhood can be trusted. Inter-rater agreement (ICC) of the social cohesion scale has been measured at 0.24 and the neighborhood-level reliability was 0.8 [33].

Neighborhood Disorder was comprised of five items that included residents perceptions of problems regarding litter, broken glass or trash on sidewalks and streets; problems with graffiti; problems with vacant or deserted buildings; problems with public intoxication, problems with people selling or using drugs; and problems with groups of teenagers or adults hanging out and causing trouble. Inter-rater agreement (ICC) of the neighborhood disorder scale has been measured at 0.36 and the neighborhood-level reliability was 0.89 [33].

Neighborhood Decline was assessed based on community residents' reports of four conditions: changes in personal safety in the neighborhood, change in the way the neighborhood looked, change in the people living in the neighborhood, and change in the level of police protection in the neighborhood. Respondents could indicate if conditions were better, the same, or worse. Higher scores on neighborhood decline indicate worsening conditions across more domains. Inter-rater agreement (ICC) of the neighborhood decline scale has been measured at 0.18 and the neighborhood-level reliability was 0.75 [33].

3.2.3 Covariates

Covariates were selected based upon those identified as important in previous research; however as this was a secondary data analysis, we were restricted to those available in the PHDCN study. These covariates included child sex, child race (white, black, or Hispanic), if the primary caregiver at baseline was a biological parent (yes/no), if the primary caregiver was married at baseline (yes/no), if a biological parent had a history of depression or anxiety (yes/no), the number of years the primary caregiver had lived at the residence at baseline, and a principle component score of baseline socioeconomic status (income, education, and job type).

3.3 Analyses

Analyses were conducted using generalized linear mixed models, with 2 levels of nesting—time nested within individuals and individuals within neighborhood clusters (a 3-level model in hierarchical linear modeling parlance), which was estimated using HLM version 7 [34].

The three waves of participant data were combined to generalize to a developmental span ranging from ages 6 to 18. This accelerated cohort design, with two points of overlap across each age group, enables modeling a single linear trajectory representing the pattern of change in internalizing symptoms across the entire age range [29]. Modeling diagnostics were conducted to evaluate outliers and a sensitivity analyses was conducted to evaluate the impact of removing 15 "outlier" neighborhoods. Models excluding these neighborhoods did not differ substantively from the model that included these neighborhoods and therefore they were retained.

4. RESULTS AND DISCUSSION

4.1 Sample Characteristics

In each cohort, between 45% and 52% of the children were female, approximately 14% to 16% were white, 34% to 43% were black, and 43% to 50% were Hispanic (Table 1).

Table 1. Sample characteristics of cohorts at baseline: percentage or mean (standard deviation)

Characteristic	Cohort 3 (Age 6) (n=402)	Cohort 6 (Age 6) (n=914)	Cohort 9 (Age 9) (n=768)	Cohort 12 (Age 12) (n=770)	Cohort 15 (Age 15) (n=652)
Child sex: Female	45.77	48.25	52.34	49.87	49.08
Child race/ethnicity					
White	14.43	15.21	14.71	14.16	15.80
Black	42.79	34.25	35.29	38.83	37.12
Hispanic	42.79	50.55	50.0	47.01	47.09
Primary caregiver					
Biological parent	95.27	93.22	93.23	91.17	92.48
Mother	89.55	86.54	85.68	81.43	83.90
Father	5.72	6.67	7.55	9.74	8.59
Not a biological parent	4.73	6.78	6.77	8.83	7.52
Married primary caregiver	49.25	54.49	59.51	55.32	51.99
Parental history of depression or anxiety	28.11	16.52	15.10	17.01	18.71
Mean socioeconomic status score (s.d.)	42.32 (17.08)	41.15 (16.72)	42.24 (17.48)	40.97 (16.71)	42.33 (17.37)
Mean years lived at residence (s.d.)	5.23 (6.74)	5.13 (6.02)	5.85 (6.3)	6.23 (7.03)	7.17 (7.67)

Approximately 85% of primary caregivers were mothers and between 49% and 60% were married at baseline. The prevalence of a family history of depression or anxiety ranged from 15% in cohort 9 to 28% in cohort 3. Mean socioeconomic status score ranged from 41.15 to 42.33 across the cohorts (total sample range 0 to 97). The mean number of years living at the residence ranged from 5.13 to 7.17 across the five cohorts. Examination of mean internalizing scores for each cohort at each age (Table 2) suggests a general increase in internalizing symptoms over time for each cohort.

Table 2. Mean raw internalizing symptoms by cohort and age

Cohort	Age 6	Age 9	Age 12	Age 15	Age 18
Cohort 3	6.6 (6.21)	6.99 (6.46)	N/A	N/A	N/A
Cohort 6	6.63 (6.25)	8.16 (7.33)	8.42 (6.47)	N/A	N/A
Cohort 9	N/A	7.56 (6.57)	8.35 (7.63)	8.43 (7.46)	N/A
Cohort 12	N/A	N/A	7.99 (7.03)	9.25 (7.84)	10.61 (8.8)
Cohort 15	N/A	N/A	N/A	9.4 (8.12)	10.29 (9.07)

N/A =Data not collected at that age for that cohort, Notes: Because HLM requires complete data at the second or third modeling levels, this table presents descriptive characteristics only for participants who had complete covariate data

4.2 Evaluating Cohort Effects

The accelerated cohort design assumes that the cohorts share comparable first and second order moment structures (e.g., mean and variance) before combining them into a single statistical model comprised of separate overlapping and non-overlapping time points. Violation of this assumption leads to model-misspecification resulting from the underlying heterogeneity between the cohorts. Thus, we followed established procedures for identification of cohort effects in cross-lagged panel designs by testing if the intercept and slope of internalizing symptoms were equivalent in each cohort at each overlapping age [35]. For the analyses of mean equivalence, differences were observed between Cohorts 6, 9, and 12 (age 6 to 9: *P*= .01, age 6 to 12: *P*<.001, age 9 to 12: *P* =.02). Effect sizes for these differences were small (Cohen's d=0.17 – 0.24) [36]. Evaluating cohort effects in slope indicated that Cohort 9 was not equivalent with Cohorts 6 and 12. The differences between Cohorts 9 and 6 were small but significant (*P*<.001, Cohen's d= 0.55 – 0.69). The largest effect size was observed between Cohorts 9 and 12 at age 12 (*P*<.001, Cohen's d=1.05). To control for these differences, cohort membership was added as a fixed effect on the intercept and slope.

4.3 Modeling Trajectory Shape

The unconditional model of change over time indicated that the intercept and linear growth terms were significant (*P*<.001; Model 1, Table 3), but the quadratic growth term was not (*P* = .20). However, after controlling for the non-equivalence of cohorts, the quadratic function became significant (*P* = .003; Model 2, Table 3). Model results indicated that, overall, internalizing symptoms increase from age 6 through age 18 (slope: 0.99, *P <0.001*), but this increase decelerates over time (quadratic: -0.06, *P* = .003).

4.4 Modeling Neighborhood Effects

A pearson product-moment correlation coefficient was calculated for the neighborhood characteristics. Social cohesion was significantly inversely correlated with neighborhood disorder (Pearson's r=-0.78, *P*<.001) and neighborhood decline (Pearson's r=-0.23, *P*<.001). Neighborhood disorder and neighborhood decline were also not significantly correlated with each other (Pearson's r=0.02, *P* = .162).

Table 3. Development of internalizing symptoms in children age 6 to 18; associations with Social Cohesion, neighborhood disorder, and neighborhood decline

Model term	Model 1 coefficient (SE)	Model 2[1] coefficient (SE)	Model 3[1] coefficient (SE)	Model 4[1] coefficient (SE)	Model 5[1] coefficient (SE)	Model 6[1] coefficient (SE)
Intercept	6.77 (0.227)**	4.58 (0.948)**	10.28 (2.95)**	1.44 (1.7)	5.04 (2.74)†	3.84 (6.3)
Social cohesion	--	--	-1.74 (0.898)*	--	--	-0.52 (1.39)
Neighborhood disorder	--	--	--	1.59 (0.68)*	--	1.25 (1.08)
Neighborhood decline	--	--	--	--	-0.2 (1.613)	--
Slope	0.24 (0.061)**	0.99 (0.225)**	2.6 (0.757)**	0.66 (0.44)†	0.37 (0.751)	3.77 (1.74)*
Social cohesion	--	--	-0.48 (0.207)*	--	--	-0.7 (0.38)*
Neighborhood disorder	--	--	--	0.19 (0.2)	--	-0.23 (0.30)
Neighborhood decline	--	--	--	--	0.31 (0.433)	--
Quadratic growth	0.01 (0.006)	-0.06 (0.017)**	-0.18 (0.075)*	-0.03 (0.04)	-0.01 (0.069)	-0.21 (0.16)
Social cohesion	--	--	0.04 (0.02) †	--	--	0.04 (0.04)
Neighborhood disorder	--	--	--	-0.02 (0.02)	--	0.01 (0.03)
Neighborhood decline	--	--	--	--	-0.02 (0.037)	--

*SE=Standard error, -- = Not applicable. [1]Model controls for cohort membership on intercept, slope, and quadratic terms, †P<.1, *p<.05, **p<.01*

To conduct hypothesis testing, separate models were estimated regressing conditioned internalizing symptom development (intercepts and slopes) on each neighborhood characteristic, while controlling for cohort membership. Social cohesion (Model 3, Table 3) and neighborhood disorder (Model 4, Table 3) were associated with baseline internalizing symptoms (-1.74, *P* =.03; and 1.59, *P* =.01, respectively). Social cohesion was also associated with symptom change over time (-0.48, *P*<.03). Neighborhood decline was not associated with internalizing symptom trajectory and was excluded from further analyses (Model 5, Table 3; intercept -0.2, *P =.9; slope 0.31, P* = .48; quadratic: -0.02, *P* = .51).

Fig. 1 demonstrates the relationship between social cohesion and internalizing symptom trajectory, controlling for cohort membership (Model 3). Children living in a neighborhood with the lowest level of social cohesion had higher baseline level and steeper increases in internalizing symptoms over time, whereas those with the highest level of social cohesion had the lowest baseline level and least increase in symptoms from ages 6 to 18.
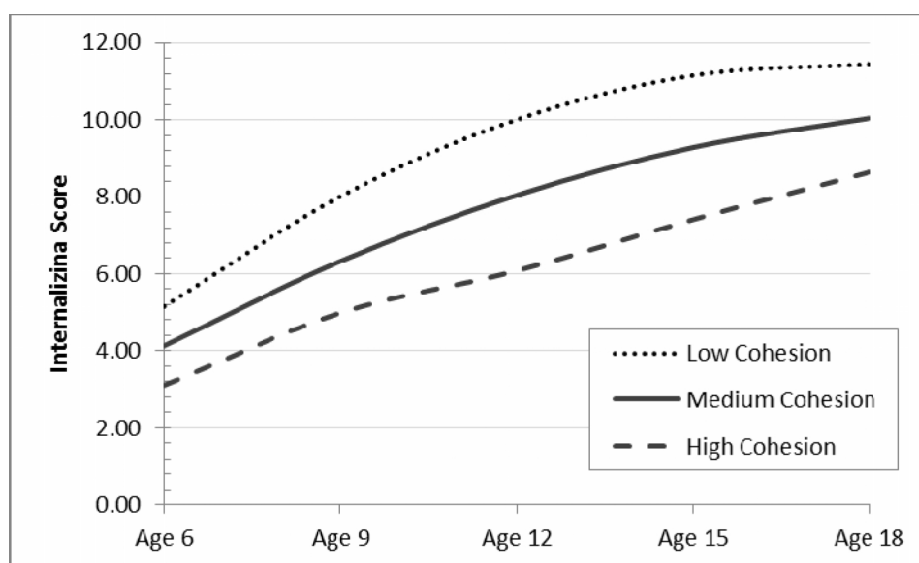
Fig. 1. Estimated growth trajectory of internalizing score in children age 6 to 18, by level of neighborhood social cohesion

In the growth model that regressed internalizing trajectory on social cohesion and neighborhood disorder, and controlled for cohort, neighborhood disorder was no longer significantly associated with internalizing symptom development (intercept 1.25, *P=.23;* slope -0.23, *P* = .37; quadratic 0.01, *P* = .82)*, however social cohesion remained associated with symptom change (slope: -0.7, *P* = .03, Model 6, Table 3).

4.5 Final Model Evaluation

The final model included the two neighborhood level characteristics and controlled for individual level covariates. Results indicated that, after controlling for neighborhood disorder and the individual level covariates, social cohesion was significantly associated with a reduction in internalizing symptom growth (slope -0.72, *P* = .02), but not baseline level of symptoms (0.08, *P* = 0.95). For each point increase in neighborhood social cohesion score, the growth in internalizing score was truncated by -.72 points (Table 4). Moreover, being

female (slope *P* = .02; quadratic *P*<.001), having a biological parent as the primary caregiver (slope *P* =.049; quadratic *P* =.03), and having a married primary caregiver (slope *P* =.03; quadratic *P* =.01) were associated with the slope and quadratic form of internalizing symptom trajectory. Hispanic children had a significantly higher level of internalizing symptoms at age 6 compared to black children (*P* = .03) and increasing socioeconomic status was associated with lower baseline levels of internalizing symptoms (*P* = .003).

Table 4. Influence of social cohesion and neighborhood disorder on development of internalizing symptoms in children aged 6 to 18

Covariate	Intercept			Slope			Quadratic growth		
	Coefficient	**SE**	**p-value**	**Coefficient**	**SE**	**p-value**	**Coefficient**	**SE**	**p-value**
Model term	3.33	5.96	0.578	**3.61**	**1.51**	**0.020**	-0.21	0.14	0.139
Neighborhood characteristic									
Social cohesion	0.08	1.25	0.949	**-0.72**	**0.31**	**0.023**	0.04	0.03	0.132
Neighborhood disorder	0.66	1.06	0.534	-0.15	0.30	0.608	0.00	0.03	0.915
Individual characteristic									
Female	0.06	0.32	0.859	**-0.28**	**0.12**	**0.016**	**0.04**	**0.012**	**0.001**
White (Ref. = Black)	0.64	0.64	0.413	0.13	0.26	0.626	-0.02	0.02	0.710
Hispanic (Ref. = Black)	**1.59**	**1.59**	**0.030**	0.03	0.21	0.892	-0.01	0.02	0.710
Years lived in residence	-0.02	0.32	0.499	-0.01	0.01	0.421	0.00	0.00	0.699
SES	**-0.42**	**0.14**	**0.003**	0.03	0.06	0.588	-0.00	0.01	0.922
Primary caregiver is a biological parent	-0.57	0.78	0.466	**0.60**	**0.31**	**0.049**	**-0.07**	**0.03**	**0.024**
Primary caregiver is married	-0.10	0.37	0.776	**-0.42**	**0.14**	**0.002**	**0.03**	**0.01**	**0.013**
Family history of depression or anxiety	**2.8**	**0.46**	**<0.001**	0.08	0.19	0.674	0.00	0.02	0.865
Cohort 3 (Ref. = Cohort 9)	1.44	0.92	0.119	**-0.90**	**0.41**	**0.027**	0.11	0.06	0.056
Cohort 6 (Ref. = Cohort 9)	1.53	0.94	0.103	-0.13	0.40	0.749	-0.03	0.05	0.505
Cohort 12 (Ref. = Cohort 9)	-4.05	2.41	0.094	0.35	0.69	0.616	0.03	0.05	0.493
Cohort 15 (Ref. = Cohort 9)	0.37	3.81	0.924	-0.52	0.84	0.533	0.07	0.05	0.168

SE=Standard Error, SES=Socioeconomic status, Ref.= Omitted reference group, Model Statistics: Intercept variance component=13.54, P<0.001, slope variance component=0.14, P <0.001, quadratic slope variance was fixed due to high correlation with linear slope

4.6 Discussion

Our findings suggest that social cohesion may have a protective effect on internalizing symptom development in children. These results are comparable with two cross-sectional studies that have found lower rates of depression [37] and symptoms among children residing in neighborhoods with high cohesion [38] and several studies examining similar outcomes in adults [39,40]. The findings that cohesion was not related to mean level of symptoms at age 6, but related to symptom change may be a result of timing (age 6 may be

too young to detect the influence of cohesion on internalizing symptoms) and/or duration (older children lived in the neighborhood longer).

Neighborhood disorder was not significantly associated with internalizing symptoms after social cohesion was controlled for, which may be due to the high correlation with social cohesion. These findings are in some contrast to a related study by Aneshensel and colleagues who examined social cohesion and perceptions of neighborhood hazard on depression and anxiety symptoms in adolescents [12]. Similar to our findings, Aneshensel and colleagues' bivariate analyses indicated that social cohesion and neighborhood hazard were associated with depression and anxiety symptoms. However, when the two neighborhood characteristics were evaluated simultaneously, perceptions of neighborhood hazard remained significantly associated with symptoms and social cohesion became non-significant. The PHDCN also collected data on perceptions of neighborhood violence, which are correlated with neighborhood disorder (r=0.88), and the inclusion of perceptions of violence rather than neighborhood disorder had little impact on our findings (results not shown). The contrast in these findings may be due to differences in construct measurement, which is problematic across much of the neighborhood influence and mental health research. The differences in findings may also be due to the timing of the evaluations, Aneshensel and colleagues only examined a single time point in adolescents.

Neighborhood decline was not statistically associated with internalizing symptom trajectory in children, even at the bivariate level. One possible reason for the lack of association is that changes in neighborhood quality may be less important than absolute levels of disorder and disadvantage. To the best of our knowledge there is no other published research to compare to these findings.

Several limitations must be considered when interpreting these findings. First, we cannot rule out omitted variable biases [3] where a closely correlated neighborhood level factor may be the true driver of the observed association between social cohesion and growth in internalizing symptoms. Similarly, because all neighborhood effects eventually act upon individual-level characteristics, it is not entirely possible to disentangle neighborhood and individual level variables [19]. It is possible that unmeasured individual characteristics (particularly parental characteristics) are associated with neighborhood residence and may contribute to the observed association between social cohesion and internalizing symptoms. We have attempted to control for these effects by including factors that may impact where a parent chose to live (e.g. socioeconomic status, race/ethnicity, and parental mental health problems), but cannot guarantee the absence of these influences. Third, interpretation of these results may be made more difficult due to the accelerated cohort design. Although the growth curve is estimated starting at age 6, for the later cohorts, the assessment of the baseline characteristics is older (e.g. Cohort 9's baseline characteristics are measured at age 9). Thus, for the older cohorts, it is assumed that the baseline characteristics have remained constant since the time they were age 6. For most of the included characteristics this can be safely assumed, however, years living in the residence, family socioeconomic status, and caregiver marital status may have some variability. Finally, these analyses only look at baseline covariates and do not include time-varying covariates (e.g. changes in neighborhood of residence). If participants who changed residents relocated to neighborhoods with similar characteristics, there would be no effect on the estimates. If, however, participants moved into neighborhoods of more social cohesion, it suggests that later exposure to better neighborhoods does not completely ameliorate the exposure to disadvantaged neighborhoods early on.

5. CONCLUSION

Despite these limitations, this study offers several contributions to the existing literature. Few studies have examined the development of internalizing symptoms across such a large age range (6 to 18) in a community-based sample. We find continuing support for the hypothesis that neighborhood characteristics can impact children's mental health, independent of factors that frequently impact neighborhood of residence. Additionally, this study evaluated a novel neighborhood characteristic, neighborhood decline, with the null results likely narrowing the list of characteristics, which may impact internalizing symptoms.

ETHICAL APPROVAL

These secondary analyses of de-identified data were determined to be exempt by the RTI International Institutional Review Board (IRB).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1.   Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the national comorbidity survey replication. Arch Gen Psychiatry. 2005;62(6):593. DOI: 10.1001/archpsyc.62.6.593

2.   Rueter M, Scaramella L, Wallace L, Conger R. First onset of depressive or anxiety disorders predicted by the longitudinal course of internalizing symptoms and parent-adolescent disagreements. Arch Gen Psychiatry. 1999;56(8):726-732. DOI: 10.1001/archpsyc.56.8.726

3.   Leventhal T, Brooks-Gunn J. The neighborhoods they live in. The effects of neighborhood residence on child and adolescent outcomes. Psychol Bull. 2000;126(2):309. DOI: 10.1037/0033-2909.126.2.309

4.   Fone D, Dunstan F, Lloyd K, Williams G, Watkins J, Palmer S. Does social cohesion modify the association between area income deprivation and mental health? A multilevel analysis. Int J Epidemiol. 2007;36(2):338-345. DOI: 10.1093/ije/dym004

5.   Friedkin NE. Social cohesion. Annu Rev Sociol. 2004:409-425. DOI: 10.1146/annurev.soc.30.012703.110625

6.   Moody J, White DR. Structural cohesion and embeddedness: A hierarchical concept of social groups. Am Sociol Rev. 2003;68:103-127. DOI: 10.2307/3088904

7.   Rainford L, Mason V, Hickman M, Morgan A. Health in England 1998: Investigating the links between social inequalities and health. London, The Stationary Office; 2000.

8.   Berry H, Rickwood D. Measuring social capital at the individual level: Personal social capital, values and psychological distress. J Public Ment Health. 2000;2(3):35-44. DOI: 10.1108/17465729200000020

9.   Kawachi I, Berkman LF. Social ties and mental health. J Urban Health. 2001;78(3):458-467. DOI: 10.1093/jurban/78.3.458

10.   Mulvaney-Day NE, Alegria M, Sribney W. Social cohesion, social support, and health among Latinos in the United States. SocSci Med. 2007;64(2):477-495. DOI: 10.1016/j.socscimed.2006.08.030

11. De Silva MJ, McKenzie K, Harpham T, Huttly SR. Social capital and mental illness: A systematic review. J Epidemiol Community Health. 2005;59(8):619-627. DOI: 10.1136/jech.2004.029678
12. Aneshensel CS, Sucoff CA. The neighborhood context of adolescent mental health. J Health SocBehav. 1996:293-310.
13. Harpham T, Grant E, Rodriguez C. Mental health and social capital in Cali, Colombia. SocSci Med. 2004;58(11):2267-2277. DOI: 10.1016/j.socscimed.2003.08.013
14. McKenzie K, Whitley R, Weich S. Social capital and mental health.Br J Psychiatry. 2002;181(4):280-283. DOI: 10.1007/978-0-387-71311-3_9
15. Almedom AM. Social capital and mental health: An interdisciplinary review of primary evidence. SocSci Med. 2005;61(5):943-964. DOI: 10.1016/j.socscimed.2004.12.025
16. Caughy MOB, O'Campo PJ, Muntaner C. When being alone might be better: Neighborhood poverty, social capital, and child mental health. Soc Sci Med. 2003;57(2):227-237. DOI: 10.1016/S0277-9536(02)00342-8
17. Hill TD, Ross CE, Angel RJ: Neighborhood disorder, psychophysiological distress, and health.J Health SocBehav. 2005;46(2):170-186. DOI: 10.1177/002214650504600204
18. Moren-Cross JL. Perceived neighborhood characteristics and problem behavior among disadvantaged children. Child Psychiatry Hum Dev. 2006;36(3):273-294. DOI: 10.1007/s10578-005-0003-4
19. Haney TJ. "Broken windows" and self-esteem. Subjective understandings of neighborhood poverty and disorder. Soc Sci Res. 2007;36(3):968-994. DOI: 10.1016/j.ssresearch.2006.07.003
20. Copeland-Linder N, Lambert SF, Chen Y-F, Ialongo NS. Contextual stress and health risk behaviors among African American adolescents. J Youth Adolesc. 2011;40(2):158-173. DOI: 10.1007/s10964-010-9520-y
21. Lima J, Caughy M, Nettles SM, O'Campo PJ. Effects of cumulative risk on behavioral and psychological well-being in first grade: Moderation by neighborhood context. Soc Sci Med. 2010;71(8):1447-1454. DOI: 10.1016/j.socscimed.2010.06.022
22. Ford JL, Rechel M. Parental perceptions of the neighborhood context and adolescent depression. Public Health Nurs. 2012;29(5):390-402. DOI: 10.1111/j.1525-1446.2012.01015.x
23. Furr-Holden CDM, Milam AJ, Young KC, Mac Pherson L, Lejuez CW. Exposure to hazardous neighborhood environments in late childhood and anxiety. J Community Psychol. 2011;39(7):876-883. DOI: 10.1002/jcop.20461
24. Caughy MB, Nettles S, O'Campo P. The effect of residential neighborhood on child behavior problems in first grade. Am J Community Psychol. 2008;42(1-2):39-50. DOI: 10.1007/s10464-008-9185-9
25. Milam AJ, Furr-Holden CD, Whitaker D, Smart M, Leaf P, Cooley-Strickland M. Neighborhood environment and internalizing problems in African American children. Community Ment Health J. 2012;48(1):39-44. DOI: 10.1007/s10597-011-9379-8
26. Mair C, Roux AD, Galea S. Are neighborhood characteristics associated with depressive symptoms? A review of evidence. J Epidemiol Community Health. 2008;62:940-946. DOI:10.1136/jech.2007.066605
27. Cutrona CE, Wallace G, Wesner KA. Neighborhood characteristics and depression an examination of stress processes. Curr Dir Psychol Sci. 2006;15(4):188-192. DOI: 10.1111/j.1467-8721.2006.00433.x
28. Eamon MK. Influences and mediators of the effect of poverty on young adolescent depressive symptoms. J Youth Adolesc.2002;31(3):231-242.
29. Raudenbush SW, Chan W-S. Growth curve analysis in accelerated longitudinal designs. J Res Crime Delinq. 1992;29(4):387-411.
    DOI: 10.1177/0022427892029004001

30. Sampson RJ, Raudenbush SW, Earls F. Neighborhoods and violent crime: A multilevel study of collective efficacy. Science 1997;277(5328):918-924. DOI: 10.1126/science.277.5328.918

31. Sampson RJ, Raudenbush SW. Systematic social observation of public spaces: A new look at disorder in urban neighborhoods. Am J Sociol. 1999;105(3):603-651. DOI: 10.1086/210356

32. Achenbach TM, Rescorla LA. Manual for the ASEBA school-age forms & profiles: An integrated system of multi-informant assessment. Burlington, VT: University of Vermont; 2001.

33. Raudenbush SW. The quantitative assessment of neighborhood social environments. In: Wawachi I, Berkman LF, editors.Neighborhoods and Health. New York, NY: Oxford University Press; 2003.

34. Raudenbush SW, Bryk AS, Cheong YF, Congdon RT, duToit M. HLM 7: Hierarchical linear and nonlinear modeling. Chicago, IL: Scientific Software International; 2011.

35. Miyazaki Y, Raudenbush SW. Tests for linkage of multiple cohorts in an accelerated longitudinal design. Psychol Methods. 2000;5(1):44-63.

36. Ferguson CJ. An effect size primer: A guide for clinicians and researchers. Prof Psychol Res Pr. 2009;40(5):532.

37. Abada T, Hou F, Ram B. Racially mixed neighborhoods, perceived neighborhood social cohesion, and adolescent health in Canada. Soc Sci Med. 2007;65(10):2004-2017. DOI: 10.1016/j.socscimed.2007.06.030

38. Xue Y, Leventhal T, Brooks-Gunn J, Earls FJ. Neighborhood residence and mental health problems of 5-to 11-year-olds. Arch Gen Psychiatry. 2005;62(5):554.

39. Echeverría S, Diez-Roux AV, Shea S, Borrell LN, Jackson S. Associations of neighborhood problems and neighborhood social cohesion with mental health and health behaviors: The multi-ethnic study of atherosclerosis.Health Place. 2008;14(4):853-865. DOI: 10.1016/j.healthplace.2008.01.004

40. Diez Roux AV, Mair C. Neighborhoods and health. Ann N Y Acad Sci. 2010;1186(1):125-145. DOI: 10.1111/j.1749-6632.2009.05333.x