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Neighborhood characteristics and psychiatric disorders in the aftermath of mass trauma: A representative study of New York City public school 4th-12th graders after 9/11

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ABSTRACT

Studies of the relationship between neighborhood characteristics and childhood/adolescent psychopathology in large samples examined one outcome only, and/or general (e.g., 'psychological distress') or aggregate (e.g., 'any anxiety disorder') measures of psychopathology. Thus, in the only representative sample of New York City public school 4th-12th graders (N = 8202) surveyed after the attacks of 9/11/2001, this study examined whether (1) indices of neighborhood Socioeconomic Status, Quality, and Safety and (2) neighborhood disadvantage (defined as multidimensional combinations of SES, Quality and Safety indicators) are associated with eight psychiatric disorders: posttraumatic stress disorder, separation anxiety disorder (SAD), agoraphobia, generalized anxiety disorder (GAD), panic disorder, major depression, conduct disorder, and alcohol use disorder (AUD). (1) The odds ratios (OR) of psychiatric disorders were between 0.55 (AUD) and 1.55 (agoraphobia), in low and intermediate-low SES neighborhoods, respectively, between 0.50 (AUD) and 2.54 (agoraphobia) in low Quality neighborhoods, and between 0.52 (agoraphobia) and 0.65 (SAD) in low Safety neighborhoods. (2) In neighborhoods characterized by high disadvantage, the OR were between 0.42 (AUD) and 1.36 (SAD). This study suggests that neighborhood factors are important social determinants of childhood/adolescent psychopathology, even in the aftermath of mass trauma. At the community level, interventions on modifiable neighborhood characteristics and targeted resources allocation to high-risk contexts could have a cost-effective broad impact on children's mental health. At the individual-level, increased knowledge of the living environment during psychiatric assessment and treatment could improve mental health outcomes; for example, specific questions about neighborhood factors could be incorporated in DSM-5's Cultural Formulation Interview.

1. Introduction

"New York is the most beautiful manifestation of man's power, courage, enterprise and force, but it is utterly lacking in order and harmony and the comforts of the spirit. The skyscrapers […] should be great obelisks, far apart, so that the city would have space and light and order. Those are the things that men need just as much as they need bread or a place to sleep" Le Corbusier (The New York Times, 1985).

Le Corbusier, one of the fathers of modern architecture, strongly believed that living in a well-ordered environment, with an abundance of green space and sunlight, would not only improve the well-being of its residents, but also contribute to creating a better society. Unfortunately,

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structural inequality, classism and systemic racism still dominate New York City (NYC) and, in fact, most cities in the United States (US) (Nijman and Wei, 2020). Le Corbusier's view is consistent with growing worldwide evidence indicating that neighborhood factors are associated with childhood, adolescent (see Supplementary material, available online) and adult (Alegria et al., 2014; Lund et al., 2018) mental health.

Improving access to mental health care will not be sufficient to promote overall health, reduce the burden of psychiatric disorders, or eliminate health disparities. Detrimental living conditions, especially during childhood, will need to be targeted as well (Kolak et al., 2020; Lund et al., 2018; World Health Organization, 2008). Neighborhood-level factors constitute one of the key domains of the social determinants of psychiatric disorders linked with the Sustainable Development Goals for 2030, endorsed by all United Nations members (Lund et al., 2018).

Because higher per-person expenditure for healthcare in the US has not led to better health outcomes, compared to other developed countries (Kolak et al., 2020), uncovering the social determinants of mental health should be a public health priority. This could improve mental health outcomes while reducing costs, through more effective early prevention, more focused individual treatments, and more targeted allocation of resources. At the community-level, a better understanding of the relationship between neighborhood risk factors and mental health is especially important when sources of information at the individual level (e.g., symptoms, specific exposures, etc.) are not immediately available or would be difficult to acquire (e.g., in the aftermath of a mass traumatic event). Furthermore, population level interventions focused on preventing psychopathology by addressing their upstream social determinants will be more effective if they are applied during childhood and adolescence, since the onset of most mental disorders occurs during this vulnerable development period (Lund et al., 2018).

Yet, to date, studies of the relationship between neighborhood characteristics and childhood and adolescent psychopathology in large samples (Table S1, available online) have had serious limitations in that they focused on one outcome only (Lowe et al., 2014; Sariaslan et al., 2013; Solmi et al., 2017, 2019; Winstanley et al., 2008), used general scales to assess psychological/psychiatric problems (e.g., 'psychological distress'), instead of examining specific psychiatric disorders (Osypuk et al., 2012; Reijneveld et al., 2005; Schneiders et al., 2003; Xue et al., 2005), and/or only examined aggregate measures of psychopathology (e.g., 'any anxiety disorder') (Boyle et al., 2019; Butler et al., 2012; Dahal et al., 2018; Ford et al., 2004; Rudolph et al., 2014; Sundquist et al., 2015).

Therefore, using data from the NYC Department of Education (NYC-DOE) study, the only city-wide representative sample of NYC public school students in the aftermath of the World Trade Center (WTC) attacks of 9/11/2001 (Hoven et al., 2005), the researchers examined whether neighborhood-level variables are associated with odds of eight psychiatric disorders. Neighborhoods were studied in two ways, using (1) three indices reflecting distinct neighborhood characteristics, namely Socioeconomic status (SES), Quality, and Safety, and (2) levels of neighborhood disadvantage, defined as multidimensional combinations of SES, Quality and Safety indicators.

2. Material and methods

2.1. Sample

The NYC-DOE Study sample is representative of 715,966 NYC public school students (grades 4th-12th) at the time of assessment (see Appendix 1, available online), conducted six months after 9/11 (Hoven et al., 2005). In the current analysis, thirty-four participants were excluded because they did not report their zip code (N = 8202; 52.4% females; mean age: 13.6 ± 2.6). Parental consent was required for 4th-5th graders; parental notification was required for 6th-12th graders. The NYC-DOE Study complied with the institutional review boards of Columbia University-New York State Psychiatric Institute, the NYC-DOE, and the New York State Office of Mental Health Committee for WTC-Related Research. The sampling strategy and consent process have been described elsewhere (Hoven et al., 2005); the sampling strategy is reported also in Appendix 1.

2.2. Measures

2.2.1. Psychiatric disorders

The DISC Predictive Scales (DPS), a self-report screening measure derived from the National Institute of Mental Health Diagnostic Interview Schedule for Children Version IV (Hoven et al., 2005; Lucas et al., 2001), was used to assess past-month prevalence (except conduct disorder and alcohol use disorder, assessed "*since 9/11*") of 9/11-related posttraumatic stress disorder (PTSD; prevalence: 9.3%), separation anxiety disorder (SAD; 10.6%), agoraphobia (12.7%), generalized anxiety disorder (GAD; 9.5%), panic disorder (PD; 8.0%), major depressive disorder (MDD; 8.2%), conduct disorder (CD; 9.5%), and alcohol use disorder (AUD; 3.0%). Additional information on the DPS is provided in Appendix 2.

2.2.2. Neighborhood-level variables

Neighborhood was defined as residential zip code, the only type of residential information collected. Two sets of variables were created.

2.2.2.1. Neighborhood indices. Three indices – Quality, Safety, and Socioeconomic status (SES) – were created for each zip code. The Quality index (NYC Department of City Planning, 2001) included eleven measures of neighborhood deterioration: number of complaints regarding disorderly youth, derelict vehicles, rodents, noise, and air quality; tons of refuse collected per day for disposal; percent of streets, sidewalks, and small parks/playgrounds that are not acceptably clean; percent of small parks/playgrounds that are not in acceptable condition; lack of open space (in percent, relative to the total zip code area). The Safety index (NYC Department of City Planning, 2001) included twelve variables representing crime and fire statistics: total number (for the year 2001) of robberies, felonious assaults, forcible rapes, major felonies, murders and non-negligent manslaughters, burglaries, grand larcenies, structural fires, non-structure fires, civilian fire fatalities, drug abuse deaths, and grand thefts auto. The SES index (United States Census, 2000) comprised seven variables: percent of non-white persons, households with public assistance, single-parent households, residents living below poverty, unemployed residents, residents with annual income below $30,000, and residents without at least a high school diploma. The indices were calculated by standardizing and summing the variables comprising each index, and multiplying by −1, so that higher scores indicate higher neighborhood Quality, Safety and SES (for details, see Appendix 3, available online). Each index was divided into four levels, based on z-scores: ≥ 1 standard deviation (SD) above the mean (*high* scores), between 0 and 1 SD above the mean (*intermediate-high* scores), between 0 and 1 SD below the mean (*intermediate-low* scores), and ≤1 SD below the mean (*low* scores).

2.2.2.2. Neighborhood disadvantage. To examine how neighborhood factors might collectively be associated with psychopathology, cluster analysis, performed in R (R Core Team, 2013) with the package mclust (Scrucca et al., 2016), was applied to each of the SES, Quality, and Safety indicators comprising the indices. The analysis generated nine clusters of subjects. For simplicity and to improve interpretability, the clusters were categorized as belonging to one of three typologies of neighborhood disadvantage, based on the average z-scores of the thirty neighborhood variables (Table S2, available online). Higher neighborhood variables scores indicate worse neighborhood disadvantage (e.g., higher number of complaints regarding disorderly youth). Thus, typologies of neighborhood disadvantage were created as follows (Fig. 1): *Low*

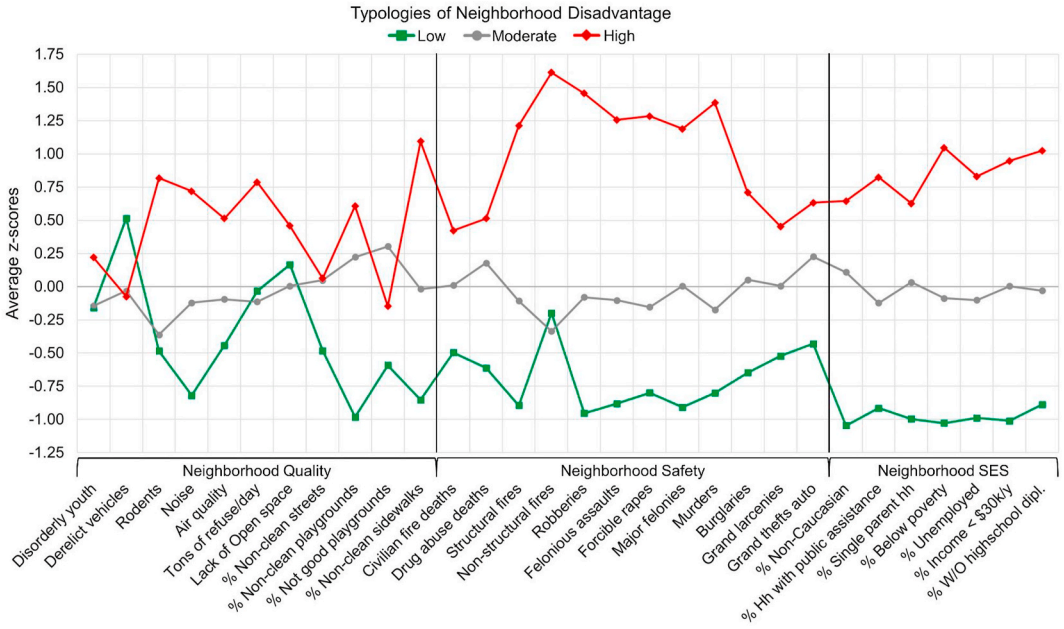

Fig. 1. Average Z-scores of neighborhood variables across neighborhood typologies characterized by low, moderate, and high disadvantage. Abbreviations: Hh = households; W/O = without.

neighborhood disadvantage, for clusters with average z-scores ≤ 0.25 SD below the sample mean of 0 (for standard scores); *moderate neighborhood disadvantage*, for clusters with average z-scores < 0.25 SD above and below the mean; *high neighborhood disadvantage*, for clusters with average z-scores ≥ 0.25 SD above the mean.

2.3. Statistical analyses

The association of neighborhood indices and neighborhood disadvantage with each disorder was examined using design-based, survey-weighted multilevel logistic regressions implemented with the GLIMMIX procedure in SAS, Version 9.4 (SAS Institute Inc, 2009), to account for clustering of youth into zip codes. Age was categorized in two groups: 8–12 (37.0% of participants) and ≥13 (reference group). Youth's race/ethnicity was self-identified as White (18.1%; reference group), African American (22.5%), Hispanic (35.7%), Asian (18.8%), or Other/Mixed/Unknown (4.9%). Three types of exposure to the WTC attacks were assessed: direct, family and media exposure (see Appendix 4, available online). Each psychiatric disorder was regressed (1) on the three neighborhood indices (entered together in the model) and, in

Table 1
Percent (%) of participants across levels of neighborhood indices and adjusted[a] odds of psychiatric disorders by levels of neighborhood indices scores.

	%	PTSD	Separation Anxiety Disorder	Agoraphobia	Generalized Anxiety Disorder	Panic Disorder	Major Depressive Disorder	Conduct Disorder	Alcohol Use Disorder
		AOR (95% CI)							
SES score									
High (Ref)	18.9	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Intermediate-high	30.9	1.42 (1.01, 1.99)	1.39 (1.04, 1.85)	1.49 (1.12, 1.98)	1.43 (1.07, 1.91)	1.33 (0.98, 1.82)	1.42 (1.04, 1.95)	0.88 (0.70, 1.12)	0.80 (0.58, 1.10)
Intermediate-low	28.5	1.55 (1.08, 2.25)	1.36 (0.99, 1.87)	1.46 (1.06, 2.00)	1.48 (1.07, 2.06)	1.37 (0.97, 1.95)	1.05 (0.73, 1.51)	0.94 (0.71, 1.23)	0.88 (0.59, 1.32)
Low	21.7	1.39 (0.94, 2.07)	1.27 (0.90, 1.78)	1.24 (0.89, 1.75)	1.27 (0.89, 1.81)	1.01 (0.69, 1.48)	0.97 (0.66, 1.43)	0.77 (0.56, 1.04)	0.55 (0.35, 0.87)
Quality score									
High (Ref)	16.5	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Intermediate-high	30.1	1.96 (1.34, 2.87)	1.19 (0.88, 1.62)	1.26 (0.92, 1.73)	1.12 (0.81, 1.54)	1.13 (0.80, 1.60)	1.22 (0.85, 1.74)	0.94 (0.71, 1.23)	1.01 (0.60, 1.72)
Intermediate-low	33.8	1.65 (1.01, 2.70)	1.41 (0.94, 2.12)	1.95 (1.30, 2.92)	0.85 (0.56, 1.31)	1.01 (0.64, 1.59)	1.32 (0.83, 2.09)	0.87 (0.60, 1.26)	0.94 (0.63, 1.40)
Low	19.7	2.00 (1.18, 3.39)	1.63 (1.05, 2.53)	2.54 (1.64, 3.94)	1.15 (0.72, 1.82)	1.31 (0.80, 2.15)	1.56 (0.94, 2.60)	1.18 (0.78, 1.78)	0.50 (0.26, 0.96)
Safety score									
High (Ref)	19.6	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Intermediate-high	31.1	0.56 (0.42, 0.76)	0.63 (0.48, 0.82)	0.81 (0.62, 1.07)	0.76 (0.57, 1.01)	0.89 (0.66, 1.21)	1.00 (0.72, 1.38)	1.05 (0.81, 1.36)	0.82 (0.55, 1.21)
Intermediate-low	28.9	0.73 (0.50, 1.06)	0.59 (0.42, 0.83)	0.59 (0.42, 0.83)	0.99 (0.69, 1.41)	0.89 (0.61, 1.31)	0.93 (0.62, 1.39)	0.86 (0.62, 1.19)	0.84 (0.51, 1.36)
Low	20.4	0.68 (0.44, 1.04)	0.65 (0.45, 0.96)	0.52 (0.35, 0.77)	1.11 (0.74, 1.68)	0.91 (0.59, 1.41)	1.00 (0.63, 1.60)	0.80 (0.55, 1.17)	0.84 (0.47, 1.53)

Abbreviations: PTSD = posttraumatic stress disorder; AOR = adjusted odds ratios; CI = confidence interval.

[a] Adjusted for gender, age group, race/ethnicity and three types of exposure to the World Trade Center (WTC) attacks. Full models including results for demographic and exposure variables are shown in Table S3, available online; unadjusted models are also shown in Table S3.

separate models, (2) on neighborhood disadvantage. Regressions were adjusted for the three categorical (presence vs. absence) exposure variables and for gender, age group, and race/ethnicity. Unadjusted models for neighborhood indices and neighborhood disadvantage are reported in Table C and D, respectively, available online.

3. Results

3.1. Neighborhood indices

Across all models, intermediate-high, intermediate-low, and low indices scores were compared to high scores. The percent of participants across levels of neighborhood indices and the adjusted results are reported in Table 1.

The odds of PTSD were 1.96, 1.65, and 2.00 times as likely in intermediate-high, intermediate-low, and low Quality neighborhoods, respectively, and 1.42 and 1.55 times as likely in intermediate-high and intermediate-low SES neighborhoods, respectively. The odds of PTSD were 0.56 times as likely in intermediate-high Safety neighborhoods. The odds of SAD were 1.63 as likely in low Quality neighborhoods and 1.39 times as likely in intermediate-high SES neighborhoods. The odds of SAD were 0.63, 0.69, and 0.65 times as likely in intermediate-high, intermediate-low, and low Safety neighborhoods, respectively. The odds of agoraphobia were 1.95 and 2.54 times as likely in intermediate-high and low Quality neighborhoods, respectively, and 1.49 and 1.46 times as likely in intermediate-high and intermediate-low SES neighborhoods, respectively. The odds of agoraphobia were 0.59 and 0.52 times as likely in intermediate-low and low Safety neighborhoods, respectively. The odds of GAD were 1.43 and 1.48 as likely in intermediate-high and intermediate-low SES neighborhoods, respectively. The odds of MDD were 1.42 times as likely in intermediate-high SES neighborhoods. The odds of alcohol used disorder were 0.50 and 0.55 times as likely in low Quality and low SES neighborhoods, respectively.

The following associations, albeit marginally significant, could still be indicative of higher/lower odds of psychiatric disorders across levels of neighborhood indices: PTSD and low Safety, SAD and intermediate-low SES and Quality, GAD and intermediate-high Safety, PD and intermediate-high and intermediate-low SES, MDD and low Quality, and CD and low SES (Table 1).

3.2. Neighborhood disadvantage

Across all models, high and moderate disadvantage were compared to low disadvantage. The percent of participants across typologies of neighborhood disadvantage and the adjusted results are reported in Table 2.

The odds of SAD, agoraphobia, and GAD were 1.36, 1.32, and 1.32 times as likely in neighborhoods characterized by high disadvantage. The odds of AUD were 0.69 and 0.42 times as likely in neighborhoods characterized by moderate disadvantage and in neighborhoods characterized by high disadvantage, respectively.

The following associations were marginally significant: PTSD and high neighborhood disadvantage, agoraphobia and moderate neighborhood disadvantage, and CD and moderate neighborhood disadvantage (Table 2).

4. Discussion

The findings of this study extend the literature on neighborhood factors and childhood and adolescent psychopathology to a broad array of psychiatric disorders assessed in the aftermath of a major mass traumatic event (the WTC attack of 9/11/2001) in a representative sample of children and adolescents: (1) indices of neighborhood SES, Quality and Safety and (2) empirically-derived typologies of neighborhood disadvantage are associated with specific psychiatric disorders, even after adjusting for three types of exposure to 9/11 and for demographic variables. Several other novel findings are noteworthy.

First, compared to high Quality scores, lower neighborhood Quality was associated with higher odds of 9/11-related PTSD, SAD, and agoraphobia, disorders involving fear and avoidance. However, surprisingly, compared to high Safety scores, lower Safety scores were associated with lower odds of PTSD, SAD, and GAD. This difference between the Quality and Safety indices may be due to the fact that the Quality indicators included in this study are more likely to be experienced directly by children (e.g., disorderly youth, derelict vehicles, lack of parks and playgrounds in acceptable condition), while Safety indicators (e.g., felonious assaults and drug abuse deaths) may be less manifest in their everyday life. Thus, children living in lower-Quality neighborhoods might be more inclined to consider the living environment as a dangerous and unsafe place, compared to children living in lower-Safety neighborhoods; this negative neighborhood perception might be related to SAD symptoms, such as nightmares and wanting to stay home and not going to school/other places without the parents. Similarly, neighborhood factors comprising the Quality index, such as higher levels of noise, and lower availability of streets, sidewalks, parks and playgrounds in acceptable condition, might influence the development and/or maintenance of PTSD symptoms assessed in this study, such as problems falling/staying asleep and avoidance of places and activities, respectively. Finally, in regard to agoraphobia, youth living in lower-quality neighborhoods might experience increased fear/anxiety when outside of the home alone; they may also be more prone to believe that escape from such feared situations might be difficult, and develop the associated avoidance behaviors. Furthermore, compared to their children, parents living in lower-safety neighborhoods may instead have better knowledge of safety-related statistics that comprise the Safety index, and – to compensate – may tend to adopt positive parenting practices/behaviors (e.g., enhanced parental support and positive reinforcement of child behavior) and reduce negative parenting strategies (e.g., harsh, inconsistent practices), which may buffer against PTSD, SAD, and GAD (Lindstrom Johnson et al., 2018). The adaptive calibration model (Del Giudice et al., 2011) offers an additional explanation of

Table 2
Percent (%) of participants across levels of neighborhood disadvantage and adjusted[a] odds of psychiatric disorders by levels of neighborhood disadvantage.

	%	PTSD	Separation Anxiety Disorder	Agoraphobia	Generalized Anxiety Disorder	Panic Disorder	Major Depressive Disorder	Conduct Disorder	Alcohol Use Disorder
	AOR (95% CI)								
Disadvantage									
Low (Ref)	24.2	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Moderate	50.2	1.20 (0.91, 1.58)	1.16 (0.92, 1.47)	1.25 (0.99–1.57)	1.21 (0.96, 1.52)	0.93 (0.73, 1.19)	1.16 (0.90, 1.49)	0.84 (0.69, 1.02)	0.69 (0.53, 0.90)
High	25.6	1.35 (0.99, 1.85)	1.36 (1.04, 1.77)	1.32 (1.02–1.72)	1.32 (1.01, 1.73)	0.91 (0.69, 1.21)	1.16 (0.86, 1.57)	0.85 (0.67, 1.07)	0.42 (0.29, 0.61)

Abbreviations: PTSD = posttraumatic stress disorder; AOR = adjusted odds ratios; CI = confidence interval.

[a] Adjusted for gender, age group, race/ethnicity and three types of exposure to the World Trade Center (WTC) attacks. Full models including results for demographic and exposure variables are shown in Table S4, available online; unadjusted models are also shown in Table S4.

why lower Safety scores were associated with lower odds of PTSD, SAD, and GAD. According to this model, individuals who rarely experience strong, sustained activation of the stress response systems, such as those in safe, low-stress environments (high Safety score), develop a sensitive stress responsivity pattern; moderate levels of environmental stress, and repeated activation of the stress response systems in childhood, will instead tend to adaptively down-regulate the stress responsivity, leading to *buffered* phenotypes and increased resistance to stress. A recent study in urban youth also suggests that blunted stress responsivity, associated with greater exposure to neighborhood violence and adversity, may represent an adaptive physiological buffer against the stressors occurring in their ecological context (Theall et al., 2017).

Second, compared to high SES scores, intermediate-high and intermediate-low SES scores were associated with higher odds of disorders belonging to the "distress" subfactor (PTSD, GAD, and MDD) and the "fear" subfactor (SAD and agoraphobia) of the internalizing spectrum of psychopatholgy (Waszczuk et al., 2020). Surprisingly, living in the lowest SES range was not associated with higher odds of psychiatric disorders. Findings from a national survey of US adolescents may help explaining this result, in that, among youth, the subjective perception of social status was reported to be a stronger determinant of psychopatholgy than other aspects of SES (McLaughlin et al., 2012). However, status perceptions are less strongly associated with mental health among adolescents with low objective SES (McLaughlin et al., 2012), who are supposedly concentrated in neighborhoods in the lowest SES range. Thus, living in a low SES neighborhood, with a more uniformly low socioeconomic composition throughout, might not worsen youths' perception of low social status. Compared to low SES neighborhoods, the socioeconomic composition of neighborhoods characterized by a SES score in the middle range (intermediate-high and intermediate-low SES neighborhoods) may instead be more heterogenous, heightening the perception of socioeconomic inequality and differences among youths in low-SES families.

Third, the examination of typologies of neighborhood disadvantage indicated which combination of Quality, Safety and SES indicators, characterizing high neighborhood disadvantage, is associated with higher odds of SAD, agoraphobia, and GAD. While close comparisons with the literature are limited since no prior studies used this approach, The findings of this study are generally consistent with large studies worldwide reporting a relationship between broadly defined neighborhood deprivation/disadvantage and internalizing outcomes, echoing concern for the disproportionate burden that impoverished, and minority neighborhoods have on the well-being of families living there, especially the children (Butler et al., 2012; Lowe et al., 2014; Sundquist et al., 2015; Xue et al., 2005).

Fourth, high and moderate neighborhood disadvantage were associated with lower odds of AUD; similar results were observed for low neighborhood Quality and SES. In a review of the literature (Karriker-Jaffe et al., 2013), neighborhood effects on substance use were in the same direction reported here, in that neighborhood *advantage* was in general associated with *more* substance use (alcohol/drugs) among adolescents. Neighborhood affluence may influence behavior through exposure to social norms supportive of light, frequent alcohol use or act through available disposable income to enable alcohol use during adolescence (Karriker-Jaffe et al., 2013).

Finally, even though the discussion focused on associations between neighborhood variables and psychiatric disorders that met the p-value threshold of 0.05, other associations with p-values that were only slightly higher than 0.05 could still be indicative of higher/lower odds of psychiatric disorders across different levels of neighborhood variables (these are reported in the Results section). For example, even after controlling for different types of exposure to 9/11 and for demographic variables, the odds of 9/11-related PTSD were 1.35 times as likely (95% CI 0.99–1.85) in neighborhoods characterized by high disadvantage. This is a potentially important finding, not previously reported in the extensive literature on 9/11-related PTSD, that could have implication for the prevention of PTSD in youth exposed to mass trauma, and that would have been missed with sole reliance on the 0.05 significance threshold (Amrhein et al., 2019).

As the surveys were collected in 2002, all neighborhood indices were created with data available at the time. In 2002, the data were only available aggregated to a spatially coarse administrative area (Police Precinct, NYC Community Board, etc.), not spatially contiguous with zip codes, the only residence identifier in the survey. Thus, extensive work using Geographic Information System approaches (areal weighting, dasymetric mapping, etc.) was performed to estimate the data values at the Census Block level and then to re-aggregate the data at the zip code level (see Appendix 3, available online). Much of this work would not be needed if the study was done today. In the past few years, the NYC Mayor's Office of Data Analytics and the Department of Information Technology and Telecommunications has made NYC data available in a finer spatial resolution (https://opendata.cityofnewyork.us/), many to the point level (the actual location of the reported crime, complaint, etc.). For example, crime statistics similar to the ones that comprise the Safety index are available at the point level at https://data.cityofnewyork.us/Public-Safety/NYPD-Complaint-Data-Historic/qgea-i56i; neighborhood Quality indicators are available at the same portal (Census data comprising the SES index hasn't changed and it's downloadable at https://data.census.gov/cedsci/). For research at the zip code level, as in this study, researchers could simply collect the zip code as location of the participants' residence, and the data could easily be aggregated to the zip code level without the need of estimations. With the type of data now available, an interesting approach would also be the use of cluster analysis of points, to identify – for example – hot spots of crime (using Safety indicators) and neighborhood deterioration (using Quality indicators) (Hart and Zandbergen, 2014).

This study has several limitations. First, psychiatric disorders were assessed with a screening tool (Hoven et al., 2005). Second, due to IRB restrictions, zip codes were used as a proxy for residential neighborhoods instead of finer spatial resolutions, as mentioned above. Third, as this was a cross sectional study, some limitations are related to issues involving causal inference. These include distinguishing social causation vs. social selection or reverse causation (e.g., Do neighborhood variables cause psychiatric outcomes or does the presence of a psychiatric outcome cause change to the selection of a neighborhood?) (Karriker-Jaffe et al., 2013; Sundquist et al., 2015), and causation vs. confounding (e.g., Is higher family vulnerability to psychopathology a common cause of both living in a disadvantaged neighborhood and an adverse outcome?). Youth typically don't choose their place of residence; however, it is common knowledge that psychiatric disorders aggregate in families. Thus, based on the social selection hypothesis, the 'downward drift' of parents with psychiatric disorders into disadvantaged neighborhoods over time might explain why children with higher odds of psychiatric disorders could be more likely to live in disadvantaged neighborhoods. Also, there was no data to distinguish direct vs. indirect causation (e.g., Do neighborhood variables exert causal effects on psychiatric outcomes directly or through more proximal variables?). Examples of proximal variables are parental psychological functioning and caregiving practices (Curtis et al., 2013; Lorenc et al., 2012), exposure to racism and discrimination (Hughes et al., 2016; Pachter et al., 2018), and characteristics within the neighborhood (Jackson et al., 2014), such as social cohesion, inequalities in resource distribution (e.g., access to mental health services), and environment pollutants and toxicants (e.g., lead exposure) (Lorenc et al., 2012; Reuben et al., 2019; Sundquist et al., 2015; Xue et al., 2005).

Answering causal inferential questions is of critical importance for the implications of the results of this study to public health and psychiatry. At the community level, findings based on publicly and readily available variables that are objective and regularly measured could inform community-based policy design and public health interventions. Cost-effective interventions on modifiable neighborhood characteristics (derived from publicly available and regularly updated data) and

targeted resources allocation to high-risk contexts could have a broad effect on the mental health of children and adolescents, even in the aftermath of a mass traumatic event (the WTC attacks) that was strong risk factor for psychopathology in exposed youth (Geronazzo-Alman et al., 2018, 2019; Hoven et al., 2005). For example, intervening on neighborhood Quality indicators (e.g., increasing the number of clean streets, sidewalks, parks and playgrounds) could reduce the odds of SAD, GAD and - in the event of another mass traumatic event - PTSD. Furthermore, community-based preventive efforts aimed at reducing anxiety disorders could allocate more resources to youth living in neighborhoods characterized by high disadvantage (only about 25% of participants in this study), a neighborhood typology which was found to be associated with higher odds of anxiety disorders. However, intervening on neighborhood factors will have no influence on these outcomes if living in a higher risk neighborhood is a consequence of these outcomes, or – a more likely scenario with youths – if the observed association is a result of a common cause, such as parental psychopatholgy. Future work on causal inference can greatly benefit from the application of novel causal discovery methods, which have recently been applied to psychiatric research (Anker et al., 2019; Saxe et al., 2020).

At the individual level, the relevance of contextual factors in psychiatry has recently been formalized in the Cultural Formulation Interview (CFI) (Lewis-Fernandez et al., 2016), introduced as an emerging measure in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013). The CFI is a semi-structured interview with clinical guidelines to assess a patient's social, cultural, and contextual background. In the CFI, psychiatric disorders and the patient's perspective and approach to clinical care are understood to be embedded in, and shaped by, the patient's specific cultural and socioeconomic contexts (La Roche and Bloom, 2018; Lewis-Fernandez et al., 2016). However, the current CFI was designed for adults and, thus, there is a paucity of research on youth that incorporates the CFI (La Roche and Bloom, 2018). Furthermore, the current CFI does not specifically inquire about neighborhoods. This may be a limitation, as suggested by the findings of this study and others' findings (see Supplementary Material), and by a recent clinical illustration of the effectiveness of the CFI with youths (La Roche and Bloom, 2018). Thus, the researchers suggest including additional questions to specifically assess the neighborhood context during a mental health assessment. For example, the CFI's incorporated the supplementary module 9, "School-Age Children and Adolescents" (SACA), which can be directly administered to the child (Rousseau and Guzder, 2016). The section of the SACA about "age-related stressors and supports" could easily be integrated with probes about the patient's neighborhood, such as "What do you like/don't you like [SACA questions 8 and 9, respectively] about being a child/youth at home? At school? With friends? *In your neighborhood?*". Similarly, instructions to directly probe for stressors in the neighborhood could be included in question 8 in the "stressors and supports" section of the CFI and CFI-Informant Version. More detailed questions can follow up on specific issues if necessary (La Roche and Bloom, 2018). Further research on how culture and neighborhoods influence the perception and experience of both life stressors and illness in youth is needed to improve diagnostic accuracy, treatment specificity, and the clinical and ecological relevance of public health policies. The synthesis of neighborhood and culture into a holistic perspective of the lived milieu may lead to the delineation, in future editions of the DSM, of an approach that systematically and efficiently includes these elements into our understanding of the development and clinical management of childhood and adolescent psychopathology.

Author statement

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Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2021.05.002.

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