IMPACT OF THE BUILT ENVIRONMENT ON URBAN ADOLESCENT DEPRESSIVE SYMPTOMS

Ahmed Whitt

A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the School of Social Work.

Chapel Hill
2013

Approved by,

Dr. Trenette Clark

Dr. Gary Cuddeback

Dr. Larry M. Gant

Dr. Matthew O. Howard

Dr. Susan Snyder

ABSTRACT

AHMED WHITT: Impact of the Built Environment on Urban Adolescent Depressive Symptoms
(Under the guidance of Matthew O. Howard, Ph.D.)

Urban youth are particularly likely to experience depression; social and psychological risk factors alone fail to explain the disproportionately urban distribution of the disorder. Despite a growing body of evidence showing an independent impact of the neighborhood built environment on family processes, neighbor relations, and individual internalizing disorders, few researchers have attempted to isolate the effects of the built environment or the physical aspects of communities. This study examined the relationship between neighborhood built environment factors and adolescent depressive symptoms with three interconnected analyses. A systematic review of empirical studies of adolescents, which included a depressive symptoms dependent variable and at least one built environment independent variable found previous research to be consistent with an emerging conceptual model of depression in urban adolescents. Within the model, the neighborhood built environment is hypothesized to have direct and indirect influences on adolescent depressive symptoms and depressive symptom correlates, including individual mental processes, family social factors, and neighborhood social factors. Data from the Obesity and Neighborhood Environment (ONE) study, a substudy of the National Longitudinal Study of Adolescent Health (Add Health), were analyzed using factor analysis to generate an eight-item, two-factor built environment tool measuring resource availability and landscape diversity within

the urban context. In the final set of analyses, the two factors were found to assess different aspects of the physical makeup of community, were used in a multilevel logistic regression to predict adolescent depressive symptoms along with additional covariates measuring individual mental processes, family relationships, and neighborhood social factors covariates. Accessibility to neighborhood resources was found to have a minimal association with depressive symptoms; however, the significant association between adolescent neighborhood perceptions and depressive symptoms ($OR = .37$, $p < .001$) can provide insight on built environment measurement in future adolescent mental health studies by broadening the conceptualization of built environment to include both subjective and objective components. The findings also have implications for urban development policy; the role of social workers as client advocates for specific interventions is highlighted.

TABLE OF CONTENTS

LIST OF TABLES

Table

LIST OF FIGURES

Figure

CHAPTER 1

INTRODUCTION

Urban youth are particularly likely to experience depression; social and psychological risk factors alone fail to explain the disproportionately urban distribution of the disorder. National epidemiological surveys indicate that almost a quarter of all adolescents experience an episode of major depressive disorder by age 24 years (Kessler &Walters, 1998; Klerman, 1988; Klerman & Weissman, 1989; Lewinsohn, Rohde, & Seeley, 1998). Childhood and adolescent depression is associated with negative developmental outcomes, including low academic achievement, poor peer relationships, unsafe sexual activity, and increased fighting (Roeser, Eccles, & Strobel, 1998; Saluja et al., 2004); these outcomes disproportionately affect youth living in major metropolitan areas. Numerous researchers have attempted to explain these disparities using biopsychosocial models in which the interaction of family and neighborhood social factors with individual neurobiological predisposition to depression exacerbates incidence of depression (Hankin & Abramson, 2002; Hankin, 2006; McGowan & Kato, 2008). Despite a growing body of evidence showing an independent impact of the neighborhood built environment on family processes, neighbor relations, and individual internalizing disorders (Evans, 2003), few researchers have attempted to isolate the effects of the built environment or the physical aspects of communities (e.g., abandoned homes, accumulated litter) on these domains. The proposed model draws on pertinent theory and empirical evidence that suggest a direct effect of neighborhood built environment on youth

depressive symptoms exists in addition to potential moderating effects of the neighborhood built environment on the relationships of family and neighborhood social factors to youth depressive symptoms.

The strongest predictor of childhood depressive symptoms is the family social environment; specifically, parental depression and family instability (Jaffe et al., 2002; Hamrin & Pachler, 2005; Lewinsohn, Rohde, & Seeley, 1998). Moreover, relationships between family members are influenced by the structural characteristics of the neighborhoods in which they reside. Multiple pathways have been used to explain how parental disposition and behavior contribute to children's mental health outcomes. In addition to the moderate heritability of depressive symptoms (Goodman & Gotlib, 1999; Sullivan, Neale, & Kendler, 2000), increased psychological distress contributes to limiting adults' ability to engage in positive parenting practices by reducing the bonds between parent and child (Hill & Bush, 2001; Taylor, 1996). Disproportionate economic and social disadvantage plaguing inner-city communities might explain why individuals living in urban areas are at particular risk of developing depression (Peen et al., 2010).

In economically distressed inner-city communities, characteristics of the neighborhood social environment, particularly lack of cohesion between neighbors, are additional key predictors of disproportionally high rates of adolescent depression (Cantillon, 2006; Wang, 2004). The physical environment directly influences the relationship between neighborhood social factors and adolescent mental health by altering individual and family protective behaviors. The social characteristics indirectly elevate psychological distress in children and their parents by reducing their perceptions of safety and general well-being (McLoyd, 1990). Increased parental psychological distress is thought to influence child

mental health through the disruption of family processes, such as parent-child attachment and parental involvement (McLoyd, 1990; Rankin & Quane, 2002). Multilevel analyses of individual-, family-, and neighborhood-level factors have shown that a lack of social relationships between neighbors and the inability to trust each other to prevent neighborhood crime are negatively correlated with family cohesion and individual psychological distress (Deng et al., 2006). Given the reliance on social measures to estimate neighborhood effects, significant gaps in knowledge remain around the independent influence of the physical environment on adolescent depression.

This study seeks to contribute to a growing body of research in social work, public health, psychology, and other fields examining how many mental health stressors are exacerbated by built environment risk factors distinctively present in urban geographies. Chapter 2 describes a systematic review of existing theory and empirical research to propose a multilevel model of neighborhood built environment influences on depressive symptoms in urban adolescents. Chapter 3 reports on a factor analysis of 17 built environment variables from the National Longitudinal Study of Adolescent Health (Add Health) Obesity and Neighborhood Environment (ONE) database that generated an eight-item, two-factor built environment tool measuring resource availability and landscape diversity within the urban context. Chapter 4 reports on an analysis of the association between the likelihood of adolescents' experiencing elevated depressive symptoms and the two composite built environment factors along with measures of adolescent mental processes, family relationships, and neighborhood social factors with a nationally representative urban adolescent sample from Add Health.

REFERENCES

Cantillon, D. (2006). Community social organization, parents, and peers as mediators of perceived neighborhood block characteristics on delinquent and prosocial activities. *American Journal of Community Psychology, 37,* 111-127. doi:10.1007/s10464-005-9000-9

Deng, S., Lopez, V., Roosa, M. W., Ryu, E., Burrell, G. L., Tein, J. Y., & Crowder, S. (2006). Family processes mediating the relationship of neighborhood disadvantage to early adolescent internalizing problems. *Journal of Early Adolescence, 26,* 206-231. doi:10.1177/0272431605285720

Evans, G. W. (2003). The built environment and mental health. *Journal of Urban Health, 80,* 536-555. doi:10.1093/jurban/jtg063

Goodman, S. H., & Gotlib, I. H. (1999). Risk for psychopathology in the children of depressed mothers: A developmental model for understanding mechanisms of transmission. *Psychological Review, 106,* 458-490. doi:10.1037//0033-295X.106.3.458

Hamrin, V., & Pachler, M. C. (2005). Child and adolescent depression: Review of the latest evidence. *Journal of Psychosocial Nursing, 43,* 54-63.

Hankin, B. L. (2006). Adolescent depression: Description, causes, and interventions. *Epilepsy & Behavior, 8,* 102-114. doi:10.1016/j.yebeh.2005.10.012

Hankin, B., & Abramson, L. (2002). Measuring cognitive vulnerability to depression in adolescence: Reliability, validity, and gender differences. *Journal of Clinical Child and Adolescent Psychology, 31,* 491–504. doi:10.1207/S15374424JCCP3104_8

Hill, N. E., & Bush, K. R. (2001). Relationships between parenting environment and children's mental health among African American and European American mothers and children. *Journal of Marriage and the Family, 63,* 954−966. doi:10.1111/j.1741-3737.2001.00954.x

Jaffe, S.E., Moffitt, T. E., Caspi, A., Fombonne, E., Poulton, R., & Martin, P. (2002). Differences in early childhood risk factors for juvenile-onset and adult onset depression. *Archives of General Psychiatry, 9,* 215-222.

Kessler, R. C., & Walters, E. E. (1998). Epidemiology of *DSM-III-R* major depression and minor depression among adolescents and young adults in the National Comorbidity Survey. *Depression and Anxiety, 7,* 3-14. doi:10.1002/(SICI)1520-6394(1998)7:1<3::AID-DA2>3.0.CO;2-F

Klerman, G. L. (1988). The current age of youthful melancholia. Evidence for increase in depression among adolescents and young adults. *British Journal of Psychiatry, 152*, 4-14. doi:10.1192/bjp.152.1.4

Klerman, G. L., & Weissman, M. M. (1989). Increasing rates of depression. *Journal of the American Medical Association, 261*, 2229–2235. doi:10.1001/jama.1989.03420150079041

Lewinsohn, P. M., Rohde, P., & Seeley, J. R. (1998). Major depressive disorders in older adolescents: Prevalence, risk factors and clinical implications. *Clinical Psychology Review, 18*, 765-794. doi:10.1016/S0272-7358(98)00010-5

McGowan, P. O., & Kato, T. (2008). Epigenetics in mood disorders. *Environmental Health and Preventive Medicine, 13*, 16-24. doi:10.1007/s12199-007-0002-0

McLoyd, V. C. (1990). The impact of economic hardship on Black families and children: Psychological distress, parenting, and socioemotional development. *Child Development, 61*, 311-346. doi:10.2307/1131096

Peen, J., Schoevers, R. A., Beekman, J., & Dekker, J. (2010). The current status of urban-rural differences in psychiatric disorders. *Acta Psychiatrica Scandinavica, 121*, 84-93. doi:10.1111/j.1600-0447.2009.01438.x

Rankin, B. H., & Quane, J. M. (2002). Social contexts and urban adolescent outcomes: The interrelated effects of neighborhoods, families, and peers on African-American youth. *Social Problems, 49*, 79-100. doi:10.1525/sp.2002.49.1.79

Roeser, R., Eccles, J., & Strobel, K. (1998). Linking the study of schooling and mental health: Selected issues and empirical illustrations at the level of the individual. *Educational Psychologist, 33*, 153-176. doi:10.1207/s15326985ep3304_2

Saluja, G., Iachan, R., Scheidt, P. C., Overpeck, M. D., Sun, W., & Giedd, J. N. (2004). Prevalence of and risk factors for depressive symptoms among young adolescents. *Archives of Pediatrics and Adolescent Medicine, 158*, 760-765. doi:10.1001/archpedi.158.8.760

Sullivan, P. F., Neale, M. C., & Kendler, K. S. (2000). Genetic epidemiology of major depression: Review and meta-analysis. *American Journal of Psychiatry, 157*, 1552-1562. doi:10.1176/appi.ajp.157.10.1552

Taylor, R. D. (1996). Adolescents' perceptions of kinship support and family management practices: Association with adolescent adjustment in African American families. *Developmental Psychology, 32*, 487−495. doi:10.1037//0012-1649.32.4.687

Wang, J. (2004). Rural–urban differences in the prevalence of major depression and associated impairment. *Social Psychiatry and Psychiatric Epidemiology, 39*, 19-25.

CHAPTER 2

THE INFLUENCE OF NEIGHBORHOOD BUILT ENVIRONMENT ON ADOLESCENT DEPRESSIVE SYMPTOMS: A SYSTEMATIC REVIEW

Relative to youth from rural and suburban areas, urban youth are particularly likely to experience depression. Social and psychological risk factors alone fail to explain the urban youth's disproportionately high risk for depressive disorder. Findings from the National Survey on Drug Use and Health indicated that approximately 8.1% of youth ages 12 to 17 years old experience major depressive disorder annually (Department of Health and Human Services, 2010). Depression in youth is associated with negative outcomes, including low academic achievement, troubled peer relationships, unsafe sexual activity, and increased fighting (Roeser, Eccles, & Strobel, 1998; Saluja et al., 2004). Similar to depression, these adverse outcomes disproportionately affect youth living in urban areas. Numerous researchers have attempted to explain these disparities using biopsychosocial and diathesis-stress models in which individual neurobiological predisposition to depression is thought hypothesized to be exacerbated by deleterious family and neighborhood social influences (Hankin & Abramson, 2002; McGowan & Kato, 2008). Despite a growing body of evidence showing independent effects of the urban built environment on family processes, neighbor relations, and individual internalizing disorders such as depression (Evans, 2003; Miles, Coutts, & Mohamadi, 2011), an integrative model that explains how these elements interact to influence depression and depressive symptomology in urban youth is needed.

Findings on the relationship between geography of residence and the prevalence of depressive symptoms have been mixed, although recent research has suggested a positive correlation between urbanicity and mental health disorders generally (Kessler et al., 2011). In an analysis of data from the Behavioral Risk Factor Surveillance System, urban residents displayed greater psychological distress as compared with rural residents (Dhingra, Strine, Holt, Berry, & Mokdad, 2009). More research is needed to clarify the ways in which geography of residence interacts with other known risk factors of depression for youth populations.

This paper has a two-fold aim. First, the paper introduces an integration of existing theory and empirical research to propose a multilevel model of the influences of the neighborhood built environment on depressive symptoms in urban adolescents. Second, the paper presents a critical examination of available findings of adolescent populations with depressive symptom dependent measure and at least one built environment predictor. The ***built environment*** encompasses artificial, manufactured structures of the lived environment, such as homes, buildings, and roads. Elements of the built environment can be classified into ***internal elements***, which consist of individuals' homes and living quarters, and ***external elements***, which are comprised of public or community shared spaces. The conceptual model proposes two mechanisms that explain this influence: (a) the neighborhood built environment influences depression risk by increasing individuals' psychological distress; and (b) the direct influence of the neighborhood built environment on individuals' psychological distress is moderated by social characteristics of their families and their neighborhoods. The systematic review augments previous reviews on the health effects of the built environment by focusing

on depressive disorders in adolescent populations (Clark Myron, Stansfeld, & Candy, 2007;Mair, Diez-Roux, & Galea, 2008).

Theoretical Perspectives

Three theoretical perspectives help explain the multilevel relationships between individual traits, family processes, neighborhood risk factors, and the etiology of adolescent depression: the diathesis-stress model, social disorganization theory, and social cognitive theory. A brief review of these perspectives vis- à-vis the urban environment suggests their relevance and provides helpful background for the systematic review.

Diathesis-Stress Model

The diathesis-stress model attributes an individual's vulnerability to stress to heritable neurobiological processes creating a constitutional predisposition. This model is based on the supposition that the interplay of individual constitutional predispositions and external stressors cause psychological and behavioral changes (Benight & Bandura, 2004). Adolescents are hypothesized to have varying levels of diathesis, or vulnerability, to depressive symptoms; the likelihood of developing depression increases with the level of stress and decreases with the number of constitutional protective factors. Within this theoretical framework, stress is considered to have four aspects: temporal (e.g., acute or chronic), dimensional (e.g., ranging from major to minor from the perspective of the individual), qualitative (e.g., assessing an inconvenience vs. a potential dangerous situation), and varying combinations of these features (Elliot & Eisdorfer, 1982). Depending on the theoretician and/or outcome of interest, stress factors are hypothesized to combine cumulatively or via probabilistic mechanisms based on stressor type to influence individual vulnerability to depression (Monroe & Simons, 1991).

Recent empirical findings linking built environment factors to adolescent internalizing disorders, such as depression, support a diathesis-stress model of individual risk (Diez Roux, 2004). The built environment conditions of distressed urban neighborhoods are hypothesized to create an atmosphere of hopelessness. Researchers have identified negative expectations of life events and the perceived inability to prevent inevitable negative outcomes as proximal causes of hopelessness and melancholic depression (Abramson, Metalsky, & Alloy, 1989). A child's genetic, intrauterine, and other biological risk factors are considered distal causal factors of depression. The susceptibility of adolescents living in such dire environmental conditions to develop depressive symptoms is mediated by genetic and other biological risk factors (Abramson et al,, 1989).

Social Disorganization Theory

Social disorganization theory elucidates the interaction of neighborhood and family social factors with the built environment to influence adolescents' risk for depression. Social disorganization theory posits that positive bonds between neighbors serve as a collective neighborhood protective factor against negative outcomes (Shaw & McKay, 1942). In a seminal study, Sampson, Raudenbush, and Earls (1997) found low collective efficacy was the key neighborhood variable that was predictive of both poor educational outcomes and high rates of juvenile delinquency in the most-disadvantaged areas. Collective efficacy is defined by two components: (a) informal social control or neighborhood residents' ability to accomplish communal goals, and (b) trust between neighbors, that is, the expectation that a helpful or protective gesture extended to a neighbor will be returned (Sampson et al., 1997).

Social networks within neighborhoods are considered interdependent (Robbins, Chatterjee, & Canda, 2006) and the strength of these networks is influenced by individual

social and economic resources. Individuals with more social and economic resources tend to move to areas where their neighbors will have similar characteristics. Over time, families without such resources are isolated in distressed areas. With regard to adolescent depression, social disorganization theory posits that positive bonds between neighbors serve as a collective protective factor against depression by reducing risk and associated distress. Neighborhoods with high levels of social organization produce less stress and depression in residents.

The built environment can contribute to the deterioration of neighborhood social processes by allowing opportunities for crime. Influenced by the seminal work of Jacobs (1961), which emphasized the role of thoughtful urban design in improving quality of life, Newman (1972, 1996) identified design strategies for streets, buildings, and public spaces to prevent crime. Jeffery (1971), a criminologist, developed a similar theory labeled "crime prevention through environmental design" (CPTED). Similar to the concept of "defensible space," CPTED suggested that increasing surveillance and limiting access to nonresidents reduces crime by restricting opportunities for delinquents (Fleissner & Heinzelmann, 1996). CPTED emphasized the capacity of improvements made in the built environment to increase the individual quality of life and neighborhood collective social processes (Robinson, 1996). Increasing positive social factors (e.g., collective efficacy) and positive physical characteristics (e.g., enhanced street visibility) reduces individual distress by reducing perceived risks, and thereby, reduces the likelihood of depression in adolescents.

Social Cognitive Theory

Social cognitive theory emphasizes the proactive role adolescents can play in managing their stress; a individual's vulnerability to depression is considered a function of a

set of stress-management abilities acquired from familial and peer relationships as well as the amount of stress experienced. From the perspective of the social cognitive theory, mental health outcomes are influenced by stress-management behaviors that are learned behaviors (Bandura, 1977, 1997; Faris & Dunham, 1939; White, 1902). Development of depressive symptoms is critically dependent on an individual's self-perception of his or her self-efficacy in managing difficult situations. Self-efficacy, the individual's perception that he or she can organize and execute an action to produce desired effects, develops from observing and imitating others (i.e., peers, family members, neighbors; Bandura, 1986). The primary source of adolescents' perceived self-efficacy are the skills acquired from their parents, with secondary sources consisting of the external social environments, such as neighborhoods and schools. Contextual cues from these social environments interact with personal behavioral traits to influence outcomes. The social cognitive theory suggests that the social and physical conditions of distressed urban neighborhoods alter parenting behaviors, and by doing so, compromise the ability of youth to acquire from their parents the skills needed to appropriately manage stress and to prevent depression. As compared with suburban parents, parents in distressed urban neighborhoods generally apply more restrictions to their adolescents with less explanation. Natsuaki and colleagues (2007) found an empirical relationship between neighborhood disorder and potentially detrimental parenting techniques. Social cognitive theorists have argued that continual interaction with external environmental stressors triggers a cognitive schema that links authoritative parenting with safety. Over time, the incessant uncertainty is hypothesized to jeopardize parent-child bonds, leading to increased psychological distress and depressive symptoms in adolescents.

Recent studies have attempted to differentiate effects of the built and social environments of neighborhoods on parental distress and parenting practices. Mulvaney and Kendrick (2005) used a sample of mothers with preschool-aged children to investigate risk of depressive symptoms, and found the mothers who reported higher levels of neighborhood deprivation also reported experiencing significantly greater levels of stress and increased level of depressive symptoms. Their research suggested that adverse built environments reduced social supports available to mothers living in disadvantaged areas; however, the researchers cautioned that interventions aimed at improving the physical conditions of neighborhoods would be more difficult than other types of interventions (Mulvaney & Kendrick, 2005).

Integrated Theoretical Model

An integration of the three theoretical models—diathesis-stress, social disorganization, and social cognitive theories—helps to explain the role of the built environment with respect to urban adolescent depression. Figure 1 shows that the neighborhood built environment contributes directly to adolescent depressive symptoms as well as indirectly through effects of individual psychological processes, neighborhood social factors, and family social factors. Family social processes, neighborhood social factors, and individual psychological processes moderate the pathway between the built environment and the individual's expression of stress. Figure 1 also presents the relationship between neurobiological factors and depressive symptoms as moderated by both social and built environmental factors, which is consistent with the diathesis-stress model.

Neurobiological Factors Influencing Adolescent Depression Risk

Neurobiological correlates of depression vulnerability generally include sleep disturbance, hormonal dysregulation, and dysfunction of biological stress systems. These factors are influenced by neighborhood conditions. For example, sleep disturbance is particularly relevant to a discussion of the built environment effects given the prevalence of noise pollution in urban environments.

Overall, studies of the association of sleep and depression in adolescents have yielded mixed findings (Armitage, Hoffman, & Rush, 1999; Emslie, Rush, Weinberg, Rinteloran, & Roffwarg, 1994). Because many depressed children report difficulty sleeping, researchers have tested multiple causal mechanisms linking brain activity, particularly in the prefrontal cortex, to major depressive disorder (Garber, 2006). The most consistent findings of an association between sleep disorder and depression have been found in samples of older adolescents and adolescents with the most severe forms of depression (Birmaher & Heydl, 2001). One study suggested that sleep disturbance might be an especially potent predictor of depression in adolescent females (Armitage et al., 2000). Similar observations have been identified in other studies (Birmaher & Heydl, 2001).

A growing body of research has identified changes in gene-environmental interactions that attempt to explain the relationship between the urban environment and adolescent depression. Pharmacological studies have identified dysfunction in the production of growth hormone and the limbic-hypothalamic-pituitary-adrenal (LHPA) system as key neurobiological correlates of adolescent depression (Birmaher & Heydl, 2001; Garber, 2006). The LHPA system, which produces cortisol, mediates the effects of stressful life events and how the body reacts (e.g., fight-or-flight response) to such events (De Kloet, 2004). Over time, increasing numbers of stressful life events and cumulative exposure to environmental

stressors exacerbate the excessive secretion of cortisol (Goodyear, Herbert, & Altham, 1998). A recent analysis of data from the Detroit Neighborhood Health Study (DNHS) confirmed differential methylation in genetic samples obtained from urban adolescents with lifetime depression (Galea, Uddin, & Koenen, 2011). As research advances the understanding of depression-relevant gene clusters and the dysfunction in the LHPA system, special consideration should be given to the specific contribution of the effects of the built environment on neurobiological processes.

Familial Biological and Social Predictors of Depression

Family functioning affects depression via two primary pathways: the heritability of biological processes predisposing an offspring to depression, and the family relationships that influence an individual's level of stress and ability to manage stress. It is important to understand these pathways in the neighborhood context.

Controversy exists over which subtypes of depression (e.g., early-onset, recurrent) are most heritable (Sullivan, Neale, & Kendler, 2000). Nevertheless, having a parent with a history of major depressive disorder remains one of the stronger predictors of adolescent depression (Beardslee, Versage, & Gladstone, 1998). Reviews of biological studies have estimated that between 30% and 80% of adolescent depression stem from genetic factors (Hankin, 2006). In addition to genetic factors, children from households with a parent or primary caregiver with depression are likely to have learned ineffective techniques of stress management, which is thought to place these children at greater risk for depression. Explanations of this pathway have been attempted by studies that included examination of environmental risk factors. For example, Pachter, Auinger, Palmer, and Weitzman (2006) found variations in the moderating effect that parenting practices had on the relationship

between maternal depression and adolescent depression depending on the race/ethnicity of the family and neighborhood environment factors. Another recent study found that family coping processes moderated the relationship between exposure to violence and poor mental health outcomes (Boynton-Jarrett, Ryan, Berkman, & Wright, 2008). In distressed urban environments, family support appears to buffer adolescents from the effect of deleterious social conditions.

Given the evidence suggesting family support is a protective factor, it is not surprising that other research has shown the deterioration of family processes, such as those related to attachment and trust, is predictive of poor adolescent mental health (Evans & English, 2002; Sheeber, Hops, & Davis, 2001). Further, this deterioration is often exacerbated by the physical and social conditions in distressed urban environments. Just as the trauma of environmental stress can disproportionately affect adolescent's functioning, similar processes can affect adults' abilities to be nurturing, involved parents. Several studies have found a relationship between a family's level of environmental stress and deterioration in positive family processes (Erel & Burman, 1995; Evans & English, 2002; Levendosky & Graham-Bermann, 1998). Many studies have narrowed the focus on environmental stressors to examine economic uncertainty and safety concerns as the primary causes of parental distress and subsequent family dysfunction (Ceballo & McLoyd, 2002; Conger et al., 2003; Kiser & Black, 2005).

Neighborhood Social Factors Influencing Adolescent Depression Risk

Despite recent methodological advances, neighborhood-level correlates of crime remain a starting point for understanding neighborhood effects on individual mental health. Inspired by the work of Shaw and McKay (1925), Sampson and Groves (1989) developed a

conceptualization of community social processes that has been an influential model in the field of neighborhood effects research. The researchers developed three survey scales that measured the aspects of community social organization that the research team perceived as the most important: friendships (i.e., number of friends within a 15-minute walk), group affiliation (i.e., weekly attendance of community group activities), and informal control (i.e., how common it was for teenagers to hang out in public spaces).

Various derivative conceptualizations of community social organization have been used in other research to determine which neighborhood social factors were predictive of individual mental health symptoms (Browning & Cagney, 2005; Matlin, Molock, & Tebes, 2011; Sampson et al., 1997; Vega, Ang, Rodriguez, & Finch, 2011). Stemming from this work, a growing interest has emerged in accounting for the role of the built environment in such analyses. In a recent population-based cohort study, Galea and colleagues (2007) collected data on 1,120 adult residents from 59 community districts in New York City to examine the effects of neighborhood-of-residence traits (e.g., abandoned housing) on mental health outcomes; their analyses controlled for lifetime history of mental disorders and available social supports. Residents of neighborhoods with lower mean socioeconomic status were 2 times more likely to develop depression during the 18-month follow-up as compared with participants from higher median-income neighborhoods. The researchers suggested more extensive evaluations of the physical characteristics of urban neighborhoods could help clarify the link between socioeconomic status and depression (Galea et al., 2007).

The Built Environment Connects Social and Neurobiological Risks for Adolescent Depression

The built environment may increase the level of stress a person experiences by exacerbating existing individual and social risks, including the person's perceptions of general well-being, fears of crime, and attributions of self-worth (Evans, 2003). Recent studies have attributed 3% to 8% of the variance in individual mental health uniquely to features of the neighborhood built environment (Diez-Roux, 2007; Leventhal & Brooks-Gunn, 2003); however, the direct explanatory pathways remain unclear. Recent research has attempted to clarify the pathways by controlling for potential confounders, and has confirmed causal links between "urbanicity" (i.e., the extent to which an area is urban) and severe mental illness (Galea, Bresnahan, & Susser, 2006). Common avenues for these effects include urban characteristics related to environmental pollution (Yang, 2002), ambient noise (Lercher, Evans, Meis, & Kofler, 2002), and inadequate green space (Srinivasan, O'Fallon, & Dearry, 2003), all of which can increase psychological distress and lead to depression. Other researchers have differentiated the roles of the internal (e.g., an individual's living quarters) and external built environments (e.g., street litter) on symptoms of depression and other mood disorders (Dalgard & Tambs, 1997; Weich et al., 2002; Yang & Matthews, 2010). Most researchers have extended the assumption of individual vulnerability to include the interactive role of family and neighborhood (Diez-Roux, 2007).

The physical environment also affects the social processes within the family and the neighborhood. Family relationships have been shown to be directly affected by the internal built environment (i.e., home conditions). For example, two studies have found an inverse relationship between the size of a family's living quarters and individual levels of psychological distress and the deterioration of parent-child relationships (Baum & Paulus, 1987; Evans, 2001). Moreover, various studies have shown the built environment,

specifically physical structures that limit visibility (e.g., multistoried buildings, skyscrapers) and public spaces with few seats, increase individuals' levels of fear about crime and decrease the extent of their feelings of neighborhood cohesion (Evans, 2003; Nasar & Fisher, 1993). These findings are noteworthy because neighborhood cohesion, generally conceptualized as the shared expectations neighbors have for their community (Markowitz, Bellair, Liska, & Liu, 2001; Rountree & Land, 1996), has been associated with protecting urban areas from crime (Sampson et al., 1997).

For families, the parents' perceived lack of neighborhood safety and limited expectations of neighbors looking out for each other's children prompts changes in parenting styles. Parenting that encourages positive youth development requires a combination of protective (e.g., close supervision) and promotive (e.g., increased involvement) strategies (Furstenberg, Cook, Eccles, Elder, & Sameroff, 1999). Protective strategies aim to decrease the probability of suffering negative outcomes in the presence of risk whereas promotive strategies aim to enhance individual well-being independent of risk exposure. In high crime areas, parents often turn to stricter, authoritarian styles of parenting to counteract neighborhood disorder (McLoyd, 1990). Some evidence has suggested that these strategies have varying influence on youth outcomes (e.g., aggression, delinquency), but the evidence has been inconsistent, thus clearly warranting more research analyzing parenting style along with parent-child relationships (Dodge, Coie, & Lynam, 2006).

This vulnerability of mental health to be affected by the built environment has been confirmed by results from the Moving to Opportunity demonstration (MTO), which is the only randomized controlled trial of the effects of the built environment on mental health. Participating low-income families in Baltimore, Boston, Chicago, Los Angeles, and New

York City were randomly assigned to 1 of 3 conditions: (a) an experimental group that received conditional housing assistance to move into low poverty communities; (b) a comparison group that received standard Section 8 housing assistance, but without the low poverty neighborhood requirement; and (c) a control group that remained in their current public housing unit. The experimental and comparison groups were predominantly Black and Latino and were predominantly welfare recipients (Goering et al., 1999). To supplement the overall study design assessing economic-related outcome differences between the study subgroups, Leventhal and Brooks-Gunn (2003) conducted a follow-up analysis of the New York City site examining parent and child mental health outcomes. The research team conducted in-depth interviews with 550 families between 1998 and 2000, which was an average of 3 year post study participation. The social and physical characteristics of neighborhoods of the experimental group were rated significantly superior to those of the control group by respondents and by interviewer observations. Controlling for baseline individual and familial characteristics, parents in the experimental group reported fewer depressive symptoms than control group parents. As compared with boys who remained in their original public housing units, boys who moved into new neighborhoods reported significantly fewer symptoms of anxiety or depression. Qualitative research conducted with MTO program participants suggested that experimental group participants were often less active in the social organization of their new neighborhoods than they were in their original neighborhoods (De Souza Briggs, Popkin, & Goering, 2010). These findings may give more credence to an independent physical environment impact hypothesis.

Systematic Review

Much of the empirical work to support the influence of the neighborhood built environment on mental health has two properties that hinder evaluation of the interrelationships of variables: (a) most studies have been conducted with adult populations, and (b) many assessments of the built environment used composite measures of both social (e.g., crime, poverty) and built environmental factors. This systematic review extends the findings of previous reviews by limiting the focus to studies that used nonadult samples and by highlighting the measurement and statistical inference related to independent variables of the built environment. The review addresses three primary research questions: (a) Does an empirically verified association exist between adolescent depressive symptoms and the neighborhood built environment? (b) How are built environmental risk factors measured within statistical analyses? (c) Which analytical approaches are used to include individual, family, and neighborhood social covariates analyzed within assessment of the relationship between the neighborhood built environment risk factors and depressive symptoms?

Method

Consistent with the methods of previous neighborhood built environment effects research reviews (Casagrande, Whitt-Glover, Lancaster, Odoms-Young, & Gary, 2009; Clark Myron, Stansfeld, & Candy, 2007; Feng, Glass, Curriero, Stewart, & Schwartz, 2010), multiple search strategies were used to identify relevant articles. The following electronic databases were searched for articles published between January 1995 and January 2013: PubMed, PsycINFO, and Web of Science. The search terms were selected to capture the primary independent variable of interest, the built environment (search terms: *physical environment, built environment, neighborhood, community*), the dependent variable of

interest (search terms: *depression, depressive symptoms, internalizing behaviors*), and the population of interest (search terms: *adolescents, youth*).

Inclusion criteria for this review consisted of all published studies (including research reports, dissertations, and theses) reporting studies that used experimental, quasi-experimental, and observational designs with the following characteristics: (a) a sample of children who were between 8 and 18 years old; (b) at least one analysis that tested a dependent measure of depressive symptoms, internalizing behaviors, or depression diagnoses, which included testing composite psychological/mental health measures with a depressive symptoms subscale; and (c) at least one measure of participant neighborhood built environment included within the analysis of depressive symptoms. The *neighborhood built environment* was defined as human-made features of the external lived environment of participants, such as presence of graffiti, litter, abandoned or dilapidated housing, commercial buildings, as well as characteristics such as lighting, street connectivity, and availability of community resources (e.g., recreation centers, churches). Included studies featured participant-, interviewer-, and/or objective measures of the built environment or perceptions of such features.

Excluded literature included studies using samples of nonhuman, nonguardian adult, infants or toddlers, as well as studies without the requisite depression-based dependent measure and built environment independent variable. Additional exclusion criteria were studies featuring dependent measures of mental health without a depression or depressive symptoms subscale, and studies with independent measures of neighborhood social organization (e.g., collective efficacy, relationships with neighbors) without a built environment component.

Studies were coded based on built environment measurement type, depressive symptom measurement type, design type, analytical method, and included covariate measures. To establish reliability, two raters worked independently using a three-point checklist based on inclusion criteria. Disagreements were resolved by discussion. In addition to the electronic database search, each rater performed a backward search of the reference sections of the included sources to identify additional studies meeting the review inclusion criteria.

Through abstract reviews, both reviewers identified articles within the electronic database search that featured at least 2 of 3 points of inclusion. Of the 6,517 articles identified with the keyword searches of three electronic databases (PsychINFO, 1,726; PubMed, 2,952; Web of Science, 1,839), the researchers identified 29 articles that met partial inclusion criteria (See Appendix A). The methodological features of the study were published for public review with the International Prospective Register of Systematic Reviews (PROSPERO). After a full article review of the 29 studies identified, seven studies met all inclusion criteria (interrater reliability K =.71). Five additional studies were identified from the reviewer's reverse searches of the reference lists of these articles. In all, 12 articles met the full inclusion criteria.

Results

Table 1 displays the study population, study design and location, assessment of built environment, measurement of depression, control variables, and types of reported associations included in the reviewed studies. No obvious conflicts of interests with regard to research funding sources were identified among the studies included in the review (See Appendix B). All 12 studies reported on in the reviewed articles used samples that included

adolescents (i.e., ages 6 to18 years); one study included responses from young adults (i.e., ages 12 to 20 years) as well as adolescents (Uddin, de los Santos, Bakshis, Cheng, & Aiello, 2011) and one study included responses from both adolescents and their guardians (Gutman & Sameroff, 2004). Among the included studies, seven studies used depressive symptoms as the primary dependent variable. Within this group of seven studies, two studies used the National Institute of Mental Health Diagnostic Interview Schedule (NIMH DISC-IV; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000), four used a participant-rated tool (e.g., Children's Depression Inventory [CDI; Kovacs, 1992], Center for Epidemiologic Studies Depression Scale [CES-D; Radloff, 1977]), and one study used caregiver ratings of depressed mood in children. The remaining five studies used a composite mental health measure that included a depression or depressive symptoms component.

The built environment was measured with a different tool in 10 of 12 studies. Two studies used the Neighborhood Inventory of Environmental Typology (Furr-Holden et al., 2011; Milam et al., 2012), which is an environmental hazards and protections instrument designed to be completed by the interviewer. In total, six measures used interviewer ratings, four measures used participant ratings, one measure used an objective assessment of area noise, and one measure used caregiver ratings of neighborhood risk factors. The six interviewer-rated measures and the caregiver-rated measure assessed the presence of various risk factors, including drug paraphernalia, poorly lit buildings or structures, and plant life; these measures also assessed the respondents' perception of the severity of each factor (Furr-Holden et al., 2011; Gutman & Sameroff, 2004; Milam et al., 2012; Natsuaki et al., 2007; Uddin et al., 2011; Wells & Evans, 2003). Of the participant-rated scales, three of the built environment measures were composite measures of neighborhood environment that

featured both social environment and built environment components (Aneshensel, & Sucoff, 1996; Hadley-Ives, Stiffman, Johnson, & Dore, 2000; Singh & Ghandour, 2012). These composite measures highlighted sources of neighborhood dilapidation (e.g., abandoned buildings, graffiti, and litter; Aneshensel, & Sucoff, 1996; Hadley-Ives et al., 2000).

With regard to study outcomes, 9 of 12 studies found statistically significant relationships between neighborhood built environment measures and depressive symptoms in adolescents. The findings of the studies were not pooled given this heterogeneity in the primary independent variable of interest. Linear regression studies using participant-rated composite dependent measures of the neighborhood environment that included built environment components yielded small, but significant positive associations between increased risk factors and increased depressive symptoms and overall psychological health, when controlling for both individual demographic characteristics (e.g., race/ethnicity) and neighborhood and family social characteristics (e.g., cohesion; Aneshensel & Sucoff, 1996; Hadley-Ives et al., 2000). Similarly, significant associations between the presence of built environment risks and internalizing problems were found in both logistic regression studies included in the review (Ford & Rechel, 2012; Milam et al., 2012).

Of the studies reviewed, 2 of 12 studies used multilevel modeling techniques, which allowed individual-level and neighborhood-level covariates to be simultaneously evaluated while accounting for clustering within geographic boundaries. The analyses conducted by Natsuaki and colleagues (2007), the researchers controlled for individual-level covariates (e.g., gender, age, race/ethnicity, relationships with parents) and neighborhood-level (e.g., interviewer-rated built environment assessment) covariates. Their results showed a significant negative relationship between the interaction of neighborhood disorder and

primary caregivers' use of inductive reasoning. The proportional reduction in mean squared prediction error with the addition of the interaction term was 2% at the individual level and 3% at the neighborhood level (Natsuaki et al., 2007). The protective effects of parenting on depressive symptoms were significantly stronger in more disordered neighborhoods.
The analyses conducted by Uddin and colleagues (2011) controlled for individual-, family-, and building-level covariates, and found a positive relationship between poorer building conditions and depressive symptoms in males, but not females.

The included studies were evaluated on analytical comprehensiveness relative to classes of depressive symptoms correlates highlighted in the proposed conceptual model (Figure 1). As shown in Table 2, each study was scored on a 5-point scale based on the inclusion of at least one measure in each of five categories:

- demographic information (e.g., age, race, gender);
- neurological or genetic predisposition factors (e.g., family history of depression, previous mental health/substance abuse diagnoses);
- individual mental processes (e.g., stress management techniques, self-efficacy);
- family social environment (e.g., perceived parent relationship, household roster, parent communication style); and
- neighborhood social environment (e.g., relationships with neighbors, fear of crime/victimization).

Studies with scores of 0 to 2 were evaluated as having low comprehensiveness (n = 5), scores of 3 represented studies of moderate comprehensiveness (n = 2), and studies with scores of 4 or 5 were considered as having high comprehensiveness (n = 5). All 12 studies included participant demographics and measures of the neighborhood built environment. Among the

high- and moderate-comprehensive studies, the most frequently omitted covariate class neurological or genetic predisposition factors for depressive symptoms. Studies of low comprehensiveness were likely to include only neighborhood social factors and participant demographics information, but few other covariates known to be associated with adolescent depressive symptoms.

Conclusion

Despite the increasing number of empirical studies in neighborhood effects research, empirical studies examining the relationship of neighborhood built environment and adolescent depressive symptoms are relatively scarce. Therefore, it remains difficult to disentangle the effects of social and physical neighborhood factors. Guided by the Assessment of Multiple Systematic Reviews (AMSTAR; Shea et al., 2007; See Appendix C), this paper reviewed the theoretical and empirical literatures on adolescent depression, and proposed a conceptual model to explain the notable prevalence of adolescent depression in distressed urban areas.

This model was consistent with findings from the articles examined within the systematic review. Of the articles identified using the database search criteria, nine articles met the full criteria of adolescent population, depression or depressive symptom dependent variable and a built environment independent variable. Nine articles found significant, though small, associations between poor neighborhood built environment conditions and increased depressive symptoms; however, only seven articles included variables from multiple classes of the proposed conceptual model. Although the present analysis was limited by the dearth of relevant articles, opportunities exist to expand current knowledge of built environmental effects and to develop interventions that can address the needs of populations

vulnerable to depression and other adverse health and mental health outcomes. Two themes identified in the systematic review highlight specific opportunities to add clarity to the field: (a) a lack of consistent measures of the built environment; and (b) underuse of multilevel modeling to account for clustering.

Built Environment Measurement

Developing consistently reliable and valid measures of the physical aspects of neighborhoods is an essential component of furthering the growing literature on community-based disease prevention interventions (Sallis, Owen, & Fotheringham, 2000). Although a few tools have been adapted to various areas of study (e.g., crime and obesity research), measures specific to the effects of built environment stressors on mental health are lacking. Three primary approaches are used to measure the physical properties of neighborhood: self-report questionnaires, independent observer rating inventories, and secondary data analyses within a geographic information systems (GIS) framework.

Questionnaires administered to participants generally ask about their perceptions of particular structures in relation to safety, physical activity, and overall perception of their neighborhood. The approach of asking those directly affected by the environment to measure the impact offers the advantage of ease of application and reduction of bias. However, inventories completed by independent observers are thought to be superior to self-administered scales because such inventories are more objective and less obtrusive (Troped et al., 2001). When using independent observation, researchers are trained to qualitatively assess neighborhood features (e.g., presence of trash, lighting) using a combination of Likert-style measurement items and field notes. Although participant bias is eliminated, the method is still subject to inconsistencies between raters. GIS technology might improve upon

frameworks for independent observer ratings of the built environment by enabling researchers to assess large areas with reduced time and equipment costs. In addition, when defining neighborhood boundaries, GIS technology can be used to enhance congruence between administratively-defined neighborhood boundaries (i.e., census tracts) and resident perceptions of the geographic extent of their neighborhood (Coulton, Korbin, Chan, & Su, 2001; Spilsbury, Korbin, & Colton, 2009). Researchers and policy makers must give careful consideration to environment-related outcomes being measured and/or the targets of interventions. The integration of GIS technology with participant-centered research methods might provide superior data within regard to construct validity.

Applying Multilevel Modeling to Neighborhood Effects Research

Multilevel modeling (i.e., hierarchical linear modeling, random-effects models, covariance models) is a method for identifying the independent impact of neighborhood effects because it allows individual-level and neighborhood-level covariates to be simultaneously evaluated while accounting for the interdependence of observations clustered within geographic boundaries (Duncan, Jones, & Moon, 1998; Kutner, Nachtsheim, & Neter, 2004). Among the studies included in the systematic review, only 2 of 12 studies incorporated multilevel modeling (Natsuaki et al., 2007; Uddin et al., 2011).

It is not possible to draw valid casual inferences from multilevel modeling unless such models incorporate longitudinal data or corrective methodological approaches. In the context of research on the impact of the neighborhood built environment on depressive symptoms, using multilevel modeling with observational data alone does not account for the limitless number of confounders that contribute to how and why a participant might be affixed to a particular neighborhood (e.g., socioeconomic limitations, available housing, taste

preferences; Oakes, 2004). In this respect, multilevel models have few advantages over ordinary least squares regression. Other researchers have argued that the issue of variable endogeneity can be addressed by using longitudinal data, which might allow for the differentiation of confounders with potential mediators (Diez Roux, 2004). Although applying corrective methods might be appropriate in determining causation, identifying the independent influence of neighborhood built environment is a crucial first step in designing effective and comprehensive neighborhood effects research.

REFERENCES

** denotes article included in systematic review*

Abramson, L. Y., Metalsky, G. I., & Alloy, L. B. (1989). The hopelessness theory of depression: Does the research test the theory? In L.Y. Abramson (Ed.), *Social cognition and clinical psychology: A synthesis* (pp. 33–65). New York, NY: Guilford Press.

*Aneshensel, C. S., & Sucoff, C. A. (1996). The neighborhood context of adolescent mental health. *Journal of Health and Social Behavior, 37,* 293-310. doi:10.2307/2137258

Armitage, R., Emslie, G. J., Hoffman, R. F., Weinberg, W. A., Kowatch, R. A., Rintelman, J., & Rush, A. J. (2000). Ultradian rhythms and temporal coherence in sleep EGG in depressed children and adolescents. *Biological Psychiatry, 47*, 338-350. doi:10.1016/S0006-3223(99)00129-8

Armitage, R., Hoffman, R. F., & Rush, A. J. (1999). Biological rhythm disturbance in depression: Temporal coherence of ultradian sleep EGG rhythms. *Psychological Medicine, 29*, 1435-1448. doi:10.1017/S0033291799001300

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, CA: Prentice Hall.

Bandura A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*, 191-215. doi:10.1037//0033-295X.84.2.191

Baum, A., & Paulus, P. B. (1987). Crowding. In D. Stokols & I. Altman (Eds.), *Handbook of environmental psychology* (pp. 533-570). New York, NY: Wiley.

Beardslee, W. R., Versage, E. M., & Gladstone, T. R. G. (1998). Children of affectively ill parents: A review of the past 10 years. *Journal of the American Academy of Child and Adolescent Psychiatry, 37*, 1134-1141. doi:10.1097/00004583-199811000-00012

Benight, C., & Bandura, A. (2004). Social cognitive theory of posttraumatic recovery: The role of perceived self-efficacy. *Behaviour Research and Therapy*, 42, 1129-1148. doi:10.1016/j.brat.2003.08.008

Birmaher, B., & Heydl, P. (2001). Biological studies in depressed children and adolescents. *International Journal of Neuropsychopharmacology, 4*, 149-157. doi:10.1017/S1461145701002358

Boynton-Jarrett, R., Ryan, L. M., Berkman, L. F., & Wright, R. J. (2008). Cumulative violence exposure and self-rated health: Longitudinal study of adolescents in the United States. *Pediatrics, 122*, 961-970. doi:10.1542/peds.2007-3063

Browning, C. R., & Cagney, K. A. (2005). Neighborhood structural disadvantage, collective efficacy, and self-rated physical health in an urban setting. *Journal of Health and Social Behavior*, 43, 383-399. doi:10.2307/3090233

Casagrande, S. S., Whitt-Glover, M. C., Lancaster, K. J., Odoms-Young, A. M., & Gary, T. L. (2009). Built environment and health behaviors among African Americans: A systematic review. *American Journal of Preventive Medicine, 36,* 174-181. doi:10.1016/j.amepre.2008.09.037

Ceballo, R., & McLoyd, V. C. (2002). Social support and parenting in poor, dangerous neighborhoods. *Child Development, 73*, 1310–1321. doi:10.1111/1467-8624.00473

Clark, C., Myron, R., Stansfeld, S., & Candy, B. (2007). A systematic review of the evidence on the effect of the built and physical environment on mental health. *Journal of Public Mental Health, 6*, 14-27.doi:10.1108/17465729200700011

Conger, R. D., Wallace, L. E., Sun, Y., Simons, R. L., McLoyd, V. C., & Brody, G. H. (2002). Economic pressure in African American families: A replication and extension of the family stress model. *Developmental Psychology, 38*, 179-193. doi:10.1037//0012-1649.38.2.179

Coulton, C. J., Korbin, J., Chan, T., & Su, M. (2001). Mapping residents' perceptions of neighborhood boundaries: A methodological note. *American Journal of Community Psychology, 29*, 371-383. doi:10.1023/A:1010303419034

Dalgard, O. S., & Tambs, K. (1997). Urban environment and mental health—A longitudinal study. *British Journal of Psychiatry, 171*, 530-536. doi:10.1192/bjp.171.6.530

De Kloet, E. R. (2004). Hormones and the stressed brain. *Annals of the New York Academy of Sciences, 1018*, 1-15. doi:10.1196/annals.1296.001

De Souza Briggs, X. N., Popkin, S. J., & Goering, J. (2010). *Moving to opportunity: The story of an American experiment to fight ghetto poverty*. New York, NY: Oxford.

Dhingra, S. S., Strine, T. W., Holt, J. B., Berry, J. T., & Mokdad, A. H. (2009). Rural-urban variations in psychological distress: Findings from the Behavioral Risk Factor Surveillance System, 2007. *International Journal of Public Health, 54*, 16-22. doi:10.1007/s00038-009-0002-5

Diez-Roux, A. V. (2004). Estimating neighborhood health effects: The challenges of causal inference in a complex world. *Social Science & Medicine, 58*, 1953-1960. doi:10.1016/S0277-9536(03)00414-3

Diez-Roux, A. V. (2007). Neighborhoods and health: Where are we and where do we go from here? *Revue d'Epidemiologie et de Sante Publique, 55*, 13-21. doi:10.1016/j.respe.2006.12.003

Dodge, K. A., Coie, J. D., & Lynam, D. (2006). Aggression and antisocial behavior in youth. Handbook of child psychology. In W. Damon & R. M. Lerner (eds.), *Child and adolescent development: An advanced course* (pp. 437-461).Hoboken, NJ: Wiley.

Duncan, C., Jones, K, & Moon, G. (1998). Context, composition, and heterogeneity: Using multilevel models in health research. *Social Science and Medicine, 48*, 497-505. doi:10.1016/S0277-9536(97)00148-2

Elliot, G. R., & Eisdorfer, C. (1982). *Stress and human health: Analysis and implications of research*. New York, NY: Springer.

Emslie, G. J., Rush, A. J., Weinberg, W. A., Rinteloran, J. W., & Roffwarg, H. P. (1994). Sleep EEG features of adolescents with major depression. *Biological Psychiatry, 36*, 573-581. doi:10.1016/0006-3223(94)90067-1

Erel, O., & Burman, B. (1995). Interrelatedness of marital relations and parent–child relations: A meta-analytic review. *Psychological Bulletin, 118*, 108-132. doi:10.1037//0033-2909.118.1.108

Evans, G. W. (2001). Environmental stress and health. In A. Baum, T. Revenson, & J. E. Singer (Eds.), *Handbook of health psychology* (pp. 571-610). Mahwah, NJ: Erlbaum.

Evans, G. W. (2003). The built environment and mental health. *Journal of Urban Health, 80*, 536-555. doi:10.1093/jurban/jtg063

Evans, G. W., & English, K. (2002). The environment of poverty: Multiple stressor exposure, psychophysiological stress, and socioemotional adjustment. *Child Development, 73*, 1238-1248. doi:10.1111/1467-8624.00469

Faris, R. E., & Dunham, H. W. (1939). *Mental disorders in urban areas: An ecological study of schizophrenia and other psychoses*. Chicago, IL: University of Chicago.

Feng, J., Glass, T. A., Curriero, F. C., Stewart, W. F., & Schwartz, B. S. (2010). The built environment and obesity: A systematic review of the epidemiologic evidence. *Health & Place, 16*, 175-190. doi:10.1016/j.healthplace.2009.09.008

Fleissner, D., & Heinzelmann, F. (1996). *Crime prevention through environmental design and community policing*. Washington, DC: Department of Justice, Office of Justice Programs, National Institute of Justice.

*Ford, J. L., & Rechel, M. (2012). Parental perceptions of the neighborhood context and adolescent depression. *Public Health Nursing, 29,* 390-402. doi:10.1111/j.1525-1446.2012.01015.x

* Furr-Holden, C. D. M., Milam, A. J., Young, K. C., MacPherson, L., & Lejuez, C. W. (2011). Exposure to hazardous neighborhood environments in late childhood and anxiety. *Journal of Community Psychology, 39,* 876-883. doi:10.1002/jcop.20461

Furstenberg Jr., F. F., Cook, T. D., Eccles, J., Elder Jr., G. H., & Sameroff, A. (1999). *Managing to make it: Urban families and adolescent success*. Chicago, IL: University of Chicago Press.

Galea, S., Ahern, J., Nanadi, A., Tracy, M., Beard, J., & Vlahov, D. (2007). Urban neighborhood poverty and the incidence of depression in a population-based cohort study. *Annals of Epidemiology, 27,* 171-179. doi:10.1016/j.annepidem.2006.07.008

Galea, S., Bresnahan M., & Susser, E. (2006). Mental health in the city. In N. Freudenberg, S. Galea, & D. Vlahov (Eds.), *Cities and the health of the public*. Nashville, TN: Vanderbilt University Press.

Galea, S., Uddin, M., & Koenen, K. (2011). The urban environment and mental disorders. *Epigenetics, 6,* 400-404. doi:10.4161/epi.6.4.14944

Garber, J. (2006). Depression in children and adolescents: Linking risk research and prevention. *American Journal of Preventive Medicine, 31,* S104-S125. doi:10.1016/j.amepre.2006.07.007

Goering, J., Kraft, J., Feins, J., McInnis, D., Holin, M. J., & Elhassan, J. (1999). *Moving to Opportunity for Fair Housing Demonstration Program: Current status and initial findings*. Washington, DC: U.S. Department of Housing and Urban Development.

Goodyear, I. M., Herbert, J., & Altham, P. M. E. (1998). Adrenal steroid secretion and major depression in 8- to 16-year-olds: Influence of cortisol/DHEA ratio at presentation and subsequent rates of disappointing life events and persistent major depression. *Psychological Medicine, 28,* 265-273. doi:10.1017/S0033291797006314

*Gutman, L. M. & Sameroff, A. J. (2004). Continuities in depression from adolescence to young adulthood: Contrasting ecological influences. *Development and Psychopathology, 16,* 967-984. doi:10.1017/S095457940404009X

*Hadley-Ives, E., Stiffman, A. R., Elze, D., Johnson, S. D., & Dore, P. (2000). Measuring neighborhood and school environments perceptual and aggregate approaches. *Journal of Human Behavior in the Social Environment, 3,* 1-28. doi:10.1300/J137v03n01_01

Hankin, B. L. (2006). Adolescent depression: Description, causes, and interventions. E*pilepsy & Behavior, 8,* 102-114. doi:10.1016/j.yebeh.2005.10.012

Hankin, B., & Abramson, L. (2002). Measuring cognitive vulnerability to depression in adolescence: Reliability, validity, and gender differences. *Journal of Clinical Child and Adolescent Psychology, 31,* 491-504. doi:10.1207/S15374424JCCP3104_8

Jacobs, J. (1961). *The death and life of the great American cities*. New York, NY: Random House.

Jeffery, C. R. (1971). *Crime prevention through environmental design*. Beverly Hills, CA: Sage.

Kessler, R. C., Avenevoli, S., Costello, E. J., Georgiades, K., Green, J. G., Gruber, M. J, … Merikangas, K. R. (2011). Prevalence, persistence, and sociodemographic correlates of *DSM-IV* disorders in the National Comorbidity Survey Replication Adolescent Supplement. *Archives of General Psychiatry, 69,* 372-380. doi:10.1001/archgenpsychiatry.2011.160

Kiser, L. J., & Black, M. M. (2005). Family processes in the midst of urban poverty: What does the trauma literature tell us? *Aggression and Violent Behavior, 10,* 715-750. doi:10.1016/j.avb.2005.02.003

Kovacs, M. (1992). *The Children's Depression Inventory*. North Tonawanda, NY: Mental Health Systems.

Kutner, M. H., Nachtsheim, C. J., & Neter J. (2004). *Applied linear regression methods* (4th ed.). Chicago, IL: McGraw-Hill/Irwin.

*Lercher, P., Evans, G. W., Meis, M., & Kofler, W. (2002). Ambient neighborhood noise and children's mental health. *Occupational and Environmental Medicine, 59,* 380-386. doi:10.1136/oem.59.6.380

Levendosky, A. A., & Graham-Bermann, S. A. (1998). The moderating effects of parenting stress on children's adjustment in woman-abusing families. *Journal of Interpersonal Violence, 13,* 383-397. doi:10.1177/088626098013003005

Leventhal, T., & Brooks-Gunn, J. (2003). Moving to opportunity: An experimental study of neighborhood effects on mental health. *American Journal of Public Health, 93,* 1576-1582. doi:10.2105/AJPH.93.9.1576

Mair, C., Diez-Roux, A., & Galea, S. (2008). Are neighbourhood characteristics associated with depressive symptoms? A review of evidence. *Journal of Epidemiology and Community Health, 62,* 940-946.

Markowitz, F. E., Bellair, P. E., Liska, A. E., & Liu, J. (2001). Extending social disorganization theory: Modeling the relationships between cohesion, disorder, and fear. *Criminology, 39,* 293-319. doi:10.1111/j.1745-9125.2001.tb00924.x

Matlin, S. L., Molock, S. D., & Tebes, J. K. (2011). Suicidality and depression among African American adolescents: The role of family and peer support and community connectedness. *American Journal of Orthopsychiatry, 81*, 108-117. doi:10.1111/j.1939-0025.2010.01078.x

McGowan, P. O., & Kato, T. (2008). Epigenetics in mood disorders. *Environmental Health and Preventive Medicine, 13*, 16-24. doi:10.1007/s12199-007-0002-0

McLoyd, V. C. (1990). The impact of economic hardship on Black families and children: Psychological distress, parenting, and socioemotional development. *Child Development, 61*, 311-346. doi:10.2307/1131096

*Milam, A. J., Furr-Holden, C. D., Whitaker, D., Smart, M., Leaf, P., & Cooley-Strickland, M. (2012). Neighborhood environment and internalizing problems in African American children. *Community Mental Health Journal, 48*, 39-44. doi:10.1007/s10597-011-9379-8

Miles, R., Coutts, C., & Mohamadi, A. (2011). Neighborhood urban form, social environment, and depression. *Journal of Urban Health, 89*, 1-18. doi:10.1007/s11524-011-9621-2

Monroe, S. M., & Simons, A. D. (1991). Diathesis–stress theories in the context of life stress research: Implications for the depressive disorders. *Psychological Bulletin, 110*, 406-425. doi:10.1037//0033-2909.110.3.406

Mulvaney, C., & Kendrick, D. (2005). Depressive symptoms in mothers of pre-school children— Effects of deprivation, social support, stress and neighbourhood social capital. *Social Psychiatry and Psychiatric Epidemiology, 40*, 202-208. doi:10.1007/s00127-005-0859-4

Nasar, J. L., & Fisher, B. (1993). Hot spots of fear and crime: A multi-method investigation. *Journal of Environmental Psychology, 13*, 187-206. doi:10.1016/S0272-4944(05)80173-2

*Natsuaki, M. N., Ge, X., Brody, G. H., Simons, R. L., Gibbons, F. X., & Cutrona, C. E. (2007). African American children's depressive symptoms: The prospective effects of neighborhood disorder, stressful life events, and parenting. *American Journal of Community Psychology, 39*, 163-176. doi:10.1007/s10464-007-9092-5

Newman, O. (1972). *Defensible space*. New York, NY: Macmillan.

Newman, O. (1996). *Creating defensible space.* Washington, DC: U.S. Department of Housing and Urban Development.

Oakes, J. M. (2004).The (mis)estimation of neighborhood effects: Causal inference for a practicable social epidemiology. *Social Science & Medicine, 58,* 1929-1952. doi:10.1016/j.socscimed.2003.08.004

Pachter, L. M., Auinger, P., Palmer, R., & Weitzman. (2006). Do parenting and the home environment, maternal depression, neighborhood, and chronic poverty affect child behavioral problems differently in different racial-ethnic groups? *Pediatrics, 117,* 1329-1338. doi:10.1542/peds.2005-1784

Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*, 385-401. doi:10.1177/014662167700100306

Robbins, S. P., Chatterjee, P., & Canda, E. R. (2006). *Contemporary human behavior theory: A critical perspective for social work* (2nd ed.). Boston, MA: Pearson.

Robinson, M. B. (1996) The theoretical development of "CPTED": Twenty-five years of responses to C. Ray Jeffery. In W. Laufer & F. Adler (Eds.), *Advances in Criminological theory* (pp. 427-462). New York, NY: Transaction.

Roeser, R., Eccles, J., & Strobel, K. (1998). Linking the study of schooling and mental health: Selected issues and empirical illustrations at the level of the individual. *Educational Psychologist, 33*, 153-176. doi:10.1207/s15326985ep3304_2

Rountree, P. W., & Land, K. C. (1996). Perceived risk versus fear of crime: Empirical evidence of conceptually distinct reactions in survey data. *Social Forces, 74*, 1353-1376. doi:10.2307/2580354

Sallis, J. F., Owen, N., & Fotheringham, M. J. (2000). Behavioral epidemiology: A systematic framework to classify phases of research on health promotion and disease prevention. *Annals of Behavioral Medicine, 22*, 294-298. doi:10.1007/BF02895665

Saluja G., Iachan, R., Scheidt, P. C., Overpeck, M. D., Sun, W., & Giedd, J. N. (2004). Prevalence of and risk factors for depressive symptoms among young adolescents. *Archives of Pediatrics and Adolescent Medicine, 158,* 760-765. doi:10.1001/archpedi.158.8.760

Sampson, R., & Groves, W. (1989). Community structure and crime: Testing social disorganization theory. *American Journal of Sociology, 94*, 775-802. doi:10.1086/229068

Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997). Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science, 277,* 918-924. doi:10.1126/science.277.5328.918

*Schaefer-McDaniel, N. (2009). Neighborhood stressors, perceived neighborhood quality, and child mental health in New York City. *Health & Place, 1*5, 148-155. doi:10.1016/j.healthplace.2008.03.007

Shaffer, D., Fisher, P., Lucas, C. P., Dulcan, M. K., & Schwab-Stone, M. E. (2000). NIMH Diagnostic Interview Schedule for Children Version IV (NIMH DISC-IV): Description, differences from previous versions, and reliability of some common diagnoses. *Journal of the American Academy of Child & Adolescent Psychiatry, 39*, 28-38. doi:10.1097/00004583-200001000-00014

Shaw, C. R., & McKay, H. D. (1942). *Juvenile delinquency and urban areas*. Chicago, IL: University of Chicago Press.

Shea, B. J., Grimshaw, J. M., Wells, G. A., Boers, M., Andersson, N., Hamel, C., & Bouter, L. M. (2007). Development of AMSTAR: A measurement tool to assess the methodological quality of systematic reviews. *BMC Medical Research Methodology, 7*, 1-5. doi:10.1186/1471-2288-7-10

Sheeber, L., Hops. H., & Davis, B. (2001). Family processes in adolescent depression. *Clinical Child and Family Psychology Review, 4*, 19-35. doi:10.1023/A:1009524626436

*Singh, G. K., & Ghandour, R. M. (2012). Impact of neighborhood social conditions and household socioeconomic status on behavioral problems among US children. *Maternal and Child Health Journal, 16,* 158-169. doi: 10.1007/s10995-012-1005-z

Spilsbury, J. C., Korbin, J. E., & Coulton, C. J. (2009). Mapping children's neighbourhood perceptions: Implications for child indicators. *Child Indicators Research, 2*, 111-131. doi:10.1007/s12187-009-9032-z

Srinivasan, S., O'Fallon, L. R., & Dearry A. (2003). Creating healthy communities, healthy homes, and healthy people: Initiating a research agenda on the built environment and public health. *American Journal of Public Health, 93*, 1446-1450. doi:10.2105/AJPH.93.9.1446

Sullivan, P. F., Neale, M. C., & Kendler, K. S. (2000). Genetic epidemiology of major depression: Review and meta-analysis. *American Journal of Psychiatry, 157*, 1552-1562. doi:10.1176/appi.ajp.157.10.1552

Troped, P. J., Saunders, R. P., Pate, R. R., Reininger, B., Ureda, J. R., & Thompson, S. J. (2001). Associations between self-reported and objective physical environmental factors and use of a community rail-trail. *Preventative Medicine, 32*, 191-200. doi:10.1006/pmed.2000.0788

*Uddin, M., de los Santos, R., Bakshis, E., Cheng, C., & Aiello, A. E. (2011). Building conditions, 5-HTTLPR genotype, and depressive symptoms in adolescent males and

females. *Journal of Adolescent Health, 49*, 379-385. doi:10.1016/j.jadohealth.2011.01.013

United States Department of Health and Human Services. Substance Abuse and Mental Health Services Administration. Center for Behavioral Health Statistics and Quality. National Survey on Drug Use and Health, 2010. ICPSR32722-v1. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2011-12-05. doi:10.3886/ICPSR32722.v1

Vega, W. A., Ang, A., Rodriguez, M. A., & Finch, B.K. (2011). Neighborhood protective effects of depression in Latinos. *American Journal of Community Psychology, 47*, 114-126. doi:10.1007/s10464-010-9370-5

Weich, S., Blanchard, M., Prince, M., Burton, E., Erens, B., & Sproston, K. (2002). Mental health and the built environment: Cross-sectional survey of individual and contextual risk factors for depression. *British Journal of Psychiatry, 180*, 428-433. doi:10.1192/bjp.180.5.428

*Wells, N. M., & Evans, G. W. (2003). Nearby nature a buffer of life stress among rural children. *Environment and Behavior, 35*, 311-330. doi:10.1177/0013916503035003001

White W. (1902). The geographical distribution of insanity in the United States. *Journal of Nervous and Mental Disease, 30*, 257-281.doi:10.1097/00005053-190305000-00001

Yang, M. J. (2002). Neighborhood experience and mental health. *Chang Gung Medical Journal, 23*, 747-754

Yang, T., & Matthews, S. A. (2010). The role of social and built environments in predicting self-rated stress: A multilevel analysis in Philadelphia. *Health and Place, 16*, 803-810. doi:10.1016/j.healthplace.2010.04.005

Figure 2.1 A model of direct and indirect effects of neighborhood built environment on adolescent depression.

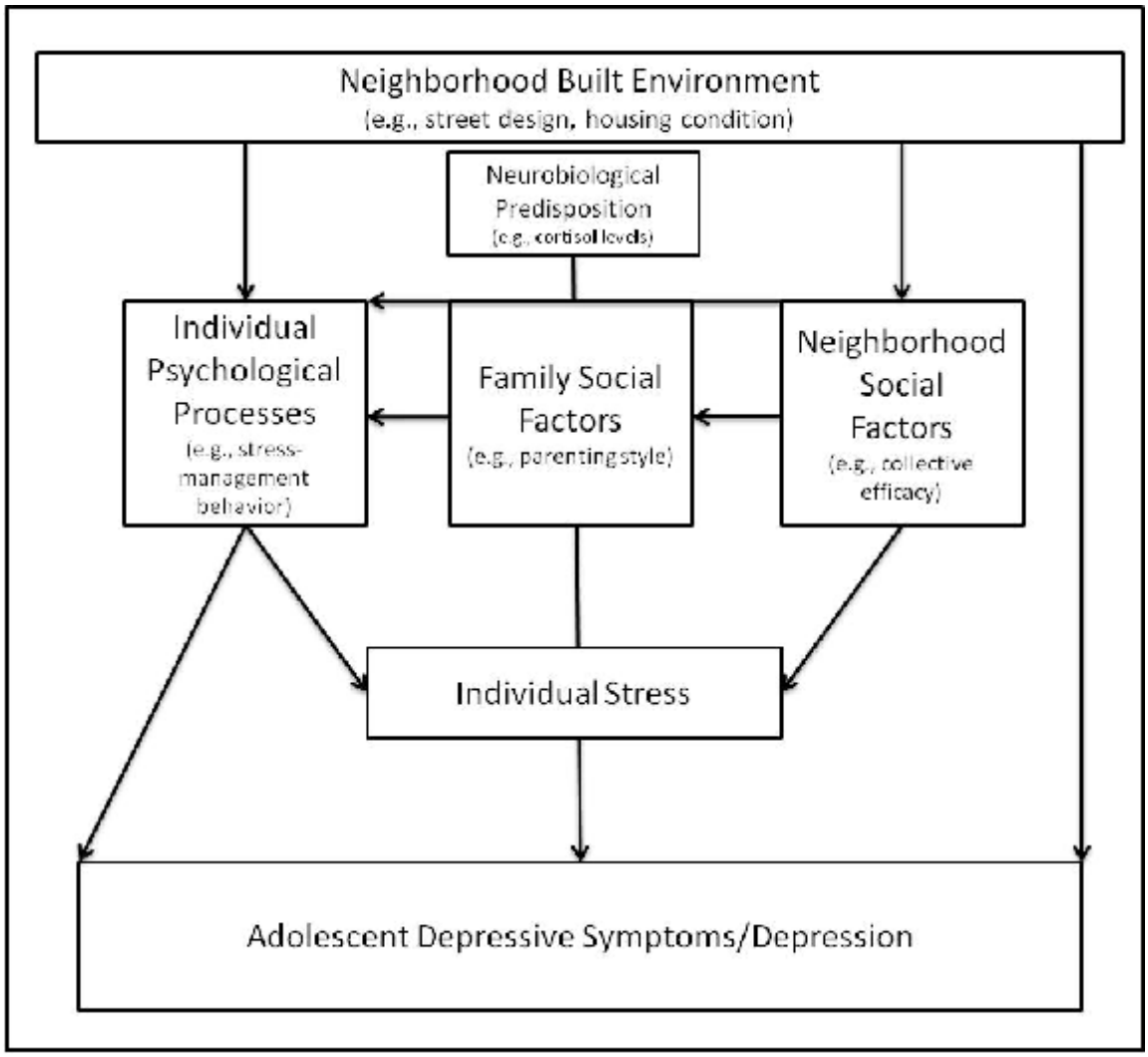


Table 2.1 Association Between Built Environment and Adolescent Depression and Mental Health Outcomes (N = 12).

Citation	**Built Environment Independent Variables**	**Design; Analytical Procedure**	**Sample; Location**	**Outcome Measure**	**Additional Independent Variables**	**Effects**
Aneshensel & Sucoff (1996)	Ambient hazard scale (participant ratings). B.E. measures include: graffiti, housing and neighborhood cleanliness.	Cross-sectional; Linear regression	469 males, 408 females (12-17 yrs); Los Angeles, CA	Children's Depression Inventory (CDI)	Neighborhood social cohesion, neighborhood socioeconomic status, anxiety, race/ethnicity, family structure	Increased ambient hazards were positively associated with increased depressive symptoms (b = .02, p <.01).
Ford & Rechel (2012)	Physical disorder scale (participant ratings) - the presence of litter, dilapidated housing, and vandalism	Cross-sectional; Logistic regression	Parental responses of 16,704 males, 15,795 females (12-17 yrs.); National dataset	3-item guardian-rated scale - perceived adolescent feeling of worthless, depressed mood	Neighborhood social isolation, neighborhood safety, household poverty, child race	Adjusting the control variables, parents who perceived higher levels of neighborhood physical disorder were more likely to report adolescent depression diagnosis, (*AOR* = 1.86, p < .01)

Citation	Built Environment Independent Variables	Design; Analytical Procedure	Sample; Location	Outcome Measure	Additional Independent Variables	Effects
Furr-Holden et al. (2011)	Neighborhood Inventory of Environmental Typology (NIfETy) score (interviewer ratings). B.E. measures include: physical neighborhood layout, presence of drugs and drug paraphernalia (AOD score); along with perceived safety	Longitudinal, Linear regression	104 Males, 68 Females (8-13 years old), Washington, DC metro area	Revised Child Anxiety and Depression Scale (RCADS)	Participant age, race, gender, annual family income	Neighborhood score was not significantly associated with depressive symptoms when analyzed with control variables.
Gutman& Sameroff (2004)	Neighborhood problems scale (caregiver ratings). B.E. measures included: vandalism; along with measures of potential crime/dangers	Longitudinal, Linear regression	372 parents with youth - 167 Males & 205 Females; Philadelphia, PA	Nine-item scale (participant ratings) assessing hopelessness, loneliness, and unhappiness in the past two months	Previous depression, socioeconomic status, parent-youth relationship, parental discipline, peer relationships, neighborhood cohesiveness	Neighborhood problems were not significantly associated with depressive symptoms when analyzed with control variables.

Citation	Built Environment Independent Variables	Design; Analytical Procedure	Sample; Location	Outcome Measure	Additional Independent Variables	Effects
Hadley-Ives et al. (2000)	NegNeb (participant ratings). B.E. measures include: abandoned buildings.	Cross-sectional, Linear regression	341 Males & 451 Females (13 - 18 years old); St. Louis, MO	Diagnostic Interview Schedule for Children-Revised (DISC-R)	Demographic characteristics (gender, age), school social environment, family social processes, peer behavior, perceptions of violence	Perceived neighborhood quality was positively associated with overall mental health (b =.04, p = .02, f^2 = .02)
Lercher et al. (2002)	Residential noise exposure - instrument collected average noise exposure over specified time period	Cross-sectional, Linear regression	653 Males & 627 Females (8 -11 years old); Innsbruck, Austria	KINDL quality of life and sleep disturbance scale	Education, house type, household density, gender	Greater noise exposure was significantly associated with lower psychological health.

Citation	Built Environment Independent Variables	Design; Analytical Procedure	Sample; Location	Outcome Measure	Additional Independent Variables	Effects
Milam et al. (2012)	Neighborhood Inventory of Environmental Typology (NIfETy) score (interviewer ratings). . B.E. measures include: physical neighborhood layout, presence of drug paraphernalia (AOD score).	Cross-sectional, Logistic regression	247 Males & 188 Females (8 - 11 years old); Baltimore, MD	Youth Self-Report (YSR) of the Achenbach System of Empirically Based Assessment (AESBA)	Grade-level, race, perceived safety	Girls living on blocks with an AOD indicator were 17% more likely to have internalizing problems than girls without an AOD indicator present (*OR* = 1.17, *p* = .04). The relationship between AOD score and internalizing problems was not significant among boys. Physical layout results not displayed.

Citation	Built Environment Independent Variables	Design; Analytical Procedure	Sample; Location	Outcome Measure	Additional Independent Variables	Effects
Natsuaki et al. (2007)	Interviewer neighborhood observations. B.E. measures include: Abandoned buildings, graffiti.	Longitudinal, Multilevel regression	417 Males & 480 Females (African-Americans, 9 - 12 years old): Iowa & Georgia	Diagnostic Interview Schedule for Children, Version IV (DISC-IV)	Age, household income, gender, stressful life events, parenting inductive reasoning scale	Multilevel regression (neighborhood- and individual-level) showed a significant negative relationship between an interaction between neighborhood disorder and primary caregivers' use of inductive reasoning (b = -.14, $p < .05$), indicating that the protective effects of parenting on depressive symptoms was significantly stronger in more disordered neighborhoods.
Schaefer-McDaniel (2009)	Physical disorder scale (interviewer ratings) - nine items: including graffiti, dilapidated buildings, deteriorated streets/sidewalk, litter	Cross-sectional, Linear regression	50 Males, 76 Females (9 - 13 years old), New York City, NY	Children's Depression Inventory (CDI)	Participant demographics (gender, age, ethnicity), perceived neighborhood quality (youth and guardian)	Interviewer indentified built environment stressors were not significantly associated with depressive symptoms when analyzed with control variables.

Citation	Built Environment Independent Variables	Design; Analytical Procedure	Sample; Location	Outcome Measure	Additional Independent Variables	Effects
Singh & Ghandour (2012)	Neighborhood conditions (participant ratings) - litter, dilapidated housing, vandalism	Cross-sectional, Linear regression	32,124 Males, 30,680 Females (6 - 17 years old), National dataset	Behavioral Problems Index (BPI)	Participant demographics (age, gender, race/ ethnicity), family characteristics (household composition, immigrant status, cohesion, mobility), protective factors (social participation sleep duration, television viewing, physical activity)	Children who reported neighborhood concerns of litter (δ = .08), dilapidated housing (δ = .08), and vandalism (δ =.06) displayed significantly higher BPI scores than those who did not, controlling for observed individual and family covariates.
Uddin et al. (2011)	Interviewer ratings of overall neighborhood building conditions	Cross-sectional, Multilevel regression	510 Males & 547 Females (12-20 years old); National dataset	Center for Epidemiol-ogical Studies Depression (CES-D)	5-HTTLPR genotype, family-level socioeconomic status, family structure	Multilevel analysis (individual-, family-, building-level) showed association between poorer building condition and depressive symptoms in males (b = .29, p<.01), but not females.

Citation	Built Environment Independent Variables	Design; Analytical Procedure	Sample; Location	Outcome Measure	Additional Independent Variables	Effects
Wells& Evans (2003)	Naturalness scale (interviewer ratings) - the amount of plant life around participant residence	Cross-sectional, Hierarchical linear regression	172 Males & 165 Females (8 - 11 years old); rural New York	Rutter Child Behavior Questionnaire	Lewis Stressful Life Events Scale, familial socioeconomic status	The interaction of nearby nature and stressful life events was significantly related to psychological distress (b = -.31, *p* =.03, f^2 = .07) suggesting that nature buffers the effects of stressful life events on children's psychological distress.

Table 2.2 Scores of variable measurement comprehensiveness among studies included in systematic review (N =12).

Citation	Demographic Information For Participants	Neurological Genetic Factors	Individual Mental Processes	Family Social Environment	Neighborhood Social Environment	Score
Aneshensel & Sucoff (1996)	X	O	X	X	X	4
Ford & Rechel (2012)	X	O	O	X	X	3
Furr-Holden et al. (2011)	X	O	O	O	X	2
Gutman & Sameroff (2004)	X	X	X	X	X	5
Hadley-Ives et al. (2000)	X	X	X	X	X	5
Lercher et al.(2002)	X	O	O	X	O	2
Milam et al. (2012)	X	O	O	O	X	2
Natsuaki et al.(2007)	X	O	X	X	O	3
Schaefer-McDaniel (2009)	X	O	O	O	X	2
Singh & Ghandour (2012)	X	O	X	X	X	4
Uddin et al. (2011)	X	X	X	X	O	4
Wells& Evans (2003)	X	O	X	O	O	2

CHAPTER 3

DEVELOPING A BUILT ENVIRONMENT MEASURE FOR USE IN URBAN ADOLESCENT MENTAL HEALTH RESEARCH: FACTOR ANALYTIC FINDINGS

The development of reliable and valid measures of the physical aspects of neighborhoods, known as the "built environment" is essential to furthering the growing literature evaluating community-based disease prevention interventions (Sallis, Owen, & Fotheringham, 2000). The built environment encompasses man-made structures of the lived environment, such as homes, buildings, and roads. Elements of the built environment can be classified into *internal* elements, which consist of individuals' homes and living quarters, and *external* elements, which are comprised of public or community-shared spaces. The built environment may have the potential to increase mental distress by exacerbating existing individual and social risks, including fears of crime, and attributions of low personal worth (Evans, 2003). The built environment may also influence the relationship between neighborhood social factors and adolescent mental health by altering individual and family protective behaviors (Mulvaney & Kendrick, 2005; Natsuaki et al., 2007).

Measuring the Built Environment

Of the three primary approaches used to measure the physical properties of neighborhoods, self-report questionnaires, independent observer rating inventories, and secondary geographic information systems data analyses, self-report approaches are predominant. Likert-type and open-ended questionnaires administered to participants generally ask about perceptions of particular structures in relation to safety, physical activity,

and overall neighborhood perceptions (e.g., Dalgard & Tambs, 1997; Palmerb & Lewisa, 2006). Despite the reduction of bias by directly assessing community members, participants may have difficulty reporting physical neighborhood characteristics that do not directly impede everyday life. Bias may be introduced when respondents are prompted to discuss characteristics of the lived environment previously considered by them to be inconsequential.

Inventories completed by independent observers are hypothesized to be superior to self-administered scales because they are more objective (Troped et al., 2001; Weich et al., 2001). With such methods, researchers are trained to assess neighborhood features, such as trash accumulation and lighting structures, using a combination of Likert-style measurement items and field notes. Although participant bias is removed, inconsistencies between raters can be a problem. Another potential source of error is a geographic mismatch between participant and researcher definitions of neighborhood boundaries. Without careful consideration of participants' perceived neighborhood boundaries, any assessment of built environmental factors will inadequately relate to the lived experiences of participants (Coulton et al., 2001).

Incorporating GIS technology into built environment measurement can enhance independent observer frameworks by reducing data collection costs and improving congruence between actual physical characteristics of neighborhoods and resident perceptions of their lived environment within the same geographic area. More comprehensive assessments use multiple data collection procedures. Two of the better tested scales to measure the built environment that incorporate multiple data collection methods are the Irvine-Minnesota Inventory (Boarnet et al., 2006; Day et al., 2006) and the Built Environment Site Survey Checklist (BESSC, Weich et al., 2001).

The Irvine-Minnesota Inventory consists of 162 items in four domains: accessibility, pleasurability, perceived safety from traffic, and perceived safety from crime. Day and colleagues (2006) improved upon previous observer rating tools that showed strong reliability on items measuring structural characteristics of neighborhood (e.g., land use), but yielded inconsistent inter-rater reliability in measuring physical disorder (e.g., litter, graffiti) and social factors (e.g., presence of drug dealers) (Brownson et al., 2004). The BESSC has been tested on a diverse set of geographies, primarily urban residential, commercial, and public areas of no more than one square mile in Southern California and the Minneapolis–St. Paul metropolitan area. Although comprehensive, a major limitation of the tool is that assessing a neighborhood of average size (.25 square mile total area) would require 4 hours to complete. Utilizing the Irvine-Minnesota Inventory within a GIS framework reduces the resources needed to assess larger neighborhoods (Clifton, Smith, & Rodriguez, 2007; Krizek & Johnson, 2006). The four domains of the inventory, accessibility (62 items), pleasurability (56 items), perceived safety from traffic (31 items), and perceived safety from crime (15 items), are large and somewhat broad. Using broad composite factors within studies of mental health symptoms may hinder interpretability of findings.

The BESSC is a 27-item scale assessing the following features of residents' housing and immediately surrounding areas: housing history (e.g., age, height), public space (e.g., gardens, parks), facilities (e.g., transportation areas), safety, and neighboring businesses. Of the 27 items, 25 questions require Likert-style responses to assess the number of particular traits within a fixed area. Two additional items ask respondents to rank the proportion of time spent in specific public spaces. To test the reliability of the instrument, researchers rated 86 different neighborhoods in two electoral wards. During pilot testing the majority of items (N

= 17) evidenced at least moderate inter-rater reliability (Kappas > .40) (Cohen, 1960; Fleiss, 1981). Subsequent research on the BESSC has affirmed its reliability when used in different neighborhood contexts (Burton et al., 2005). The specific dimensions of the urban environment shown to be associated with depressive symptoms (i.e., CES-D scores) included shared public spaces (e.g., parks, recreation centers) and the presence of green space within residential areas (Weich et al., 2001). After adjusting for neighborhood clustering among participants, researchers found statistically significant associations between depressive symptoms and the following built environment characteristics: access to green space, housing age, and presence of vandalism (Weich et al., 2001). Participants with high levels of depressive symptoms were more likely live in areas of older housing stock ($OR = 1.88$, $p < .01$), less green space ($OR = 1.75$, $p < .05$), and high levels of graffiti ($OR = 2.12$, $p < .01$).

Previous Research Using Add Health ONE Database

This study attempts to derive a composite measure of the built environment from the National Longitudinal Study of Adolescent Health (Add Health) Obesity and Neighborhood Environment (ONE) database. The ONE database includes an extensive collection of social and built environment variables that link community-level attributes to the residential location of each Add Health respondent. Within the database, residential street addresses were geographically-referenced and an 8.05-km (5-mile) buffer was drawn around each the home address of each respondent. Respondent locations at Waves I & III were joined to multiple sets of contextual data pertaining to the surrounding area using a spatial join within a GIS framework. This process produced a set of built environment measures within a 5-miles radius of each participant's home address, including physical activity and recreation resources, food resources, shopping establishments, street connectivity/organization, road

types, parks, air pollution, variety of land classes, and traffic congestion. Although primarily utilized in studies of physical health (Boone-Heinonen & Gordon-Larsen, 2012; Richardson et al., 2011), the relevance of the included variables to mental health outcomes (e.g., green space, street design, housing density) suggest that the dataset could be utilized for such studies if relevant composite measures of such attributes were available.

The present study is an extension of the research of Boone-Heinonen and colleagues (2010) that indentified three latent constructs of the built environment within the ONE database. Using exploratory factor analysis in a study of the interrelationships between social and built environment measures within the data (see Table 1), the researchers found three factors: 1) homogenous landscape (i.e., the ratio of green space to developed land); 2) concentration of pay facilities (e.g., count of entertainment resources combined with measures of population and intersection density); and, 3) concentration of public facilities (e.g., recreation centers combined with measures of population and intersection density).

Previous mental health research suggests that landscape homogeneity (Evans, 2003; Galea, Bresnahan, & Susser, 2006; Kuo & Sullivan, 2001; Wells & Evans, 2003) and the presence of neighborhood facilities (e.g., recreation centers) (Ellaway, 2001; MacIntyre, 2003; Yang, 2002) have mental health implications; however, sampling limitations of the Boone-Heinonen et al. (2010) study compromised the external validity of the derived scales for future studies. The authors noted that the use of a national sample failed to account for the heterogeneity between urban, rural, and suburban environmental contexts. The present study accounts for this issue by using a completely urban sample to analyze the relevant community-level constructs using factor analytic procedures.

Method

Study Sample

The sample for this study includes data from Wave 1 of the National Longitudinal Study of Adolescent Health (Add Health). Funded by the National Institute of Child Health and Human Development (NICHD) and administered under University of North Carolina at Chapel Hill Institutional Review Board protocols, Add Health is a longitudinal, nationally representative, school-based study of US adolescents between grades 7 and 12 that examines the influence of individual, family, school, and community factors on health behaviors. Wave 1 data were collected between 1994 and 1996. The primary sampling frame consisted of 80 high schools and 52 associated "feeder" middle schools selected via systematic sampling methods and implicit stratification to ensure a representative sample with respect to region of country, level of urbanization, school size, school type, and ethnicity (Udry & Bearman, 1998).

The study included all Add Health participants who completed the Wave 1 In-Home questionnaire and who resided in urban areas as defined by the US Census (N = 16,417). Approximately 51% of respondents were female (N = 8,297) and their ages ranged from 10 to 19 years (M = 15.0, S.D. = 1.68). Male participants ranged in age from 10 to 19 (M = 15.2, S.D. = 1.71). Of the 16,417 respondents, 10,189 (62.1%) were Caucasian, 3,315 (20.2%) were African-American, 1,349 (8.2%) were Asian-American, 571 (3.5%) were American Indian, and the remaining 5.0% did not report their race. With regard to ethnicity, 3367 (20.5%) respondents were of Hispanic origin.

Measures

Table 1 displays sample characteristics across the seventeen neighborhood-level built environment measures examined. Built environment measures from the Add Health Wave 1

ONE database were generated within a 5km network distance around participants' home addresses represent the geographic extent of lived experience within an urban environment. The five street connectivity indices were constructed using ESRI Street Map data to reflect ratios of intersections, road links, and travel route options. The four community resource indices were constructed using a combination of business and park address data to assemble community-level counts of publically-accessible recreation facilities (Boone et al., 2008). The five land cover variables compiled from U.S. Geological Service data measure the shape, size, and land types of participant's neighborhood areas. One built environment-related contextual variable included in the factor analysis, percentage of neighborhood properties that are vacant, was aggregated from the census tract level, a U.S. Census defined territorial unit of varying sized encompassing an average of 4,000 inhabitants.

Analysis Plan

Exploratory factor analysis (EFA) was used to determine the underlying structure of built environment items within the dataset. EFA is statistical technique used to estimate how many latent variables are necessary to determine the relationships between a set of items (Pett, Lackey, & Sullivan, 2004). Variables were extracted using both principal components analysis and principal axis factoring with direct oblimin rotation. The number of factors was determined using a combination of procedures: 1) analysis of the face validity of individual variables and groupings of variables; 2) consideration of the eigenvalue rule (Kaiser, 1960) which recommends including elements with values > 1.0; and 3) evaluation of the scree plot (Cattell, 1966). In the comparison of the two EFA methods, items with high loadings across factors and factors consisting of fewer than three items were removed, consistent with established methodological practices (Costello & Osborne, 2005). Cronbach's alpha was

used to assess internal consistency reliability for sets of items associated with each derived factor.

Results

Exploratory Factor Analysis

Results of the EFA are displayed in Table 2. Two factors were extracted from nine items in both the principal components analysis (PCA) and principal axis factoring (PAF) procedures. Six items overlapped between the extracted factors from each procedure. Matching factor names were developed for each analysis type based on the included response items. Factor 1, labeled Resource Availability, consisted of street connectivity variables (i.e., cyclomatic index) and community resource variables. Factor 2, labeled Land Diversity, consisted of street connectivity variables (i.e., cul de sac density) and landscape variability variables.

The preliminary analysis was performed using a visual inspection of factor loadings. Items with large loadings across multiple factors (i.e., values > .40) were excluded. The cutoff for minimum loading was .32, based on widely accepted standards (Tabachnick & Fidell, 1996). According to these standards, six items were removed from the PCA analysis and nine items were removed from the PAF analysis (see Table 2). Both analyses yielded identical Land Diversity factors. In the PCA analysis, eight of the eleven items included in the proposed two-factor structure had loadings that were considered excellent (i.e., .71 and higher) and the remaining items had loadings considered good to very good (i.e., .60 to .71). Both subscales showed internal consistency reliabilities exceeding the acceptable minimum value of .70 (Nunnaly, 1978). In the PAF analysis, five of eight items included in the proposed two-factor structure had loadings considered excellent (i.e., .71 and higher) and the

remaining items had loadings considered good to very good (i.e., .60 to .71). Both subscales' internal consistency reliabilities exceeded the acceptable minimum value of .70 (α=.87; α=.78). The PAF-estimated two-factor structure of resource availability (youth organizations, public resources, inactivity resources, and cyclomatic index) and land diversity (patch density, perimeter-fractal dimension, Simpson diversity index, and cul de sac density) was determined to be the most acceptable built environment factor structure for the analyzed neighborhoods in the present sample.

Table 3 displays correlations of both built environment factors with Wave 1 Add Health measures of neighborhood resources, including area crime rate, neighbor perceptions of litter, poverty, and vacant homes. Both built environment factors had small significant correlations with the poverty and litter variables in the hypothesized direction. The Land Diversity factor was negatively correlated to the percentage of vacant homes in participants' neighborhoods (r=-.22). The Resource Availability factor displayed a moderate positive correlation with past year's crime rate (r=.53).

Table 4 displays a comparison of means of both factors relative to metropolitan and large town classifications. In the present study, the Resource Availability and Land Diversity factors were compared with US Census 1990 Rural-Urban commuting area (RUCA) codes which defined the neighborhoods based on geographic positioning relative to central cities and population density. Communities located completely within metropolitan areas displayed significantly higher levels of Resource Availability (M = 347.15, $S.D.$ = 222.29, N = 13,622) and Land Diversity (M = 14.10, $S.D.$ = 4.66, N = 13,622) than communities classified as large towns (M = 37.12, $S.D$ = 19.28, N = 2,321; M = 6.60, $S.D.$ = 2.42, N = 2,321).

Discussion

This research presents two composite measures that assess features of the built environment within urban environments. Although the previous investigation of the factor structure of the ONE database built environment measures found measures to cluster into homogenous groups (i.e., land cover, activity resources), the present study of participants living in urban settings found two factors of heterogeneous measures combining aspects of street connectivity with land cover and public facilities variables. The Resource Availability factor combines three objective measures of the number of communal resources in an administratively defined neighborhood with an index of intersection connectivity. Consistent with previous urban structure analyses (Cervero & Kockelman, 1997; Sallis et al., 2006), this composite measure is hypothesized to capture the concentration of available resources and the potential for community members to encounter these features. The Land Diversity factor demonstrated the relatedness between three measures of the complexity of land cover (i.e., green space vs. grey space) and one measure of street isolation. As a composite measure, this factor is conceptualized as an indicator of the level of separation of landscape complexity away from the main thoroughfare(s) within a community. Including street connectivity dimensionality within the measurement of urban land cover is consistent with accepted evaluative procedures of healthy communities (Miles & Song, 2009).

An ideal test of the extent to which both measures assess the hypothesized aspects of urban communities (i.e., construct validity) would require a cross-validation with an expansive set of street connectivity, neighborhood resources, and land cover variables (DeVellis, 2003). Insights from previous health and community studies may counteract the limitations of the available data. For example, Resource Availability may a protective factor for individual health and social outcomes (i.e., higher scores indicate greater access to

neighborhood resources) (Ellaway, 2001; MacIntyre, 2003). Within the current study, higher scores on the Land Diversity factor would indicate greater isolation of land mix within neighborhoods and may indicate a risk factor for individual outcomes (Wells & Evans, 2003). Both built environment factors had small significant correlations with the poverty and litter variables in the hypothesized direction (i.e., positive correlation with Resource Availability, negative association with Land Diversity). Despite possibly being a protective factor for individual health and social outcomes, Resource Availability (i.e., increased access to public and private facilities) may also indicate an increased opportunity for crime in particular neighborhoods.

Criterion-related validity is the extent to which a scale item reflects objective measures of real-world constructs (DeVellis, 2003). Consistent with expectations that urbanicity would be positively correlated with the developed built environment measures, communities located completely within metropolitan areas displayed significantly higher levels of Resource Availability and Land Diversity than communities classified as large towns.

Recent studies have attributed 3% to 8% of the variance in individual mental health symptoms uniquely to features of the neighborhood built environment (Diez-Roux, 2007; Leventhal & Brooks-Gunn, 2003). The direct explanatory pathways remain unclear, although the physical environment is hypothesized to impact family and neighborhood social processes. The internal built environment (i.e., home condition) has been shown to directly affect family relationships. Experimental research has shown that individual psychological distress and the deterioration of parent-child relationships are inversely related to the size of living quarters (Baum & Paulus, 1987; Evans, 2001). Various studies show that physical

structures that prohibit or limit interpersonal interaction (e.g., tall residential buildings, public spaces with few seats) increase the amount of fear individuals have for crime and decrease the cohesion neighbors feel with one another (Evans, 2003; Nasar & Fisher, 1993). Neighborhood cohesion, generally conceptualized as the shared expectations neighbors have for their community (Markowitz et al., 2001; Rountree & Land, 1996), has been shown to be highly influential in protecting urban areas from crime (Sampson, Raudenbush, & Earls, 1997). For families, lack of safety within the neighborhood and limited perceived collective cohesion among neighbors may change the style of parenting provided. Developing more consistent measures of the specific characteristics of the neighborhood built environment is an important building block for testing these relationships.

REFERENCES

Baum, A., & Paulus, P. B. (1987). Crowding. In D. Stokols and I. Altman (Eds.), *Handbook of environmental psychology* (pp. 533-570). New York, NY: Wiley.

Boarnet, M., Day, K., Alfonzo, M., Forsyth, A., & Oakes, M. (2006). The Irvine-Minnesota Inventory to measure built environments: Reliability tests. *American Journal of Preventive Medicine, 30,* 153-159. doi:10.1016/j.amepre.2005.09.018

Boone-Heinonen, J., & Gordon-Larsen, P. (2012). Obesogenic environments in youth: Concepts and methods from a longitudinal national sample. *American Journal of Preventive Medicine, 42*, e37-e46. doi:10.1016/j.amepre.2012.02.005

Boone, J. E., Gordon-Larsen, P., Stewart, J. D., & Popkin, B. M. (2008). Validation of a GIS facilities database: Quantification and implications of error. *Annals of Epidemiology, 18*, 371-377. doi:10.1016/j.annepidem.2007.11.008

Brownson, R. C., Hoehner, C. M., Brennan, L. K., Cook, R. A., Elliot, M. B., & McMullen, K. M. (2004). Reliability of 2 instruments for auditing the environment for physical activity. *Journal of Physical Activity and Health, 1*, 191–208. doi:10.2105/AJPH.94.3.473

Burton, E., Weich, S., Blanchard, M., & Prince, M. (2005). Measuring physical characteristics of housing: The Built Environment Site Survey Checklist (BESSC). *Environment and Planning B: Planning and Design, 32*, 265-280. doi:10.1068/b3038

Cattell, R. B. (1966). The Scree test for the number of factors. *Multivariate Behavioral Research, 1*, 245-276.

Cervero, R., & Kockelman, K. (1997). Travel demand and the 3Ds: Density, diversity, and design. *Transportation Research Part D: Transport and Environment, 2*, 199-219. doi: 10.1016/S1361-9209(97)00009-6

Clifton, K. J., Livi Smith, A. D., & Rodriguez, D. (2007). The development and testing of an audit for the pedestrian environment. *Landscape and Urban Planning, 80*, 95–110. doi:10.1016/j.landurbplan.2006.06.008

Costello, A. B., & Osborne, J. W. (2005) Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation, 10*, 1-9.

Coulton, C. J., Korbin, J., Chan, T., & Su, M. (2001). Mapping residents' perceptions of neighborhood boundaries: A methodological note. *American Journal of Community Psychology, 29*, 371–383. doi:10.1023/A:1010303419034

Dalgard, O. S., & Tambs, K. (1997). Urban environment and mental health—a longitudinal study. *British Journal of Psychiatry, 171,* 530–536. doi:10.1192/bjp.171.6.530

Day, K., Boarnet, M., Alfonzo, M. & Forsyth, A. (2006). The Irvine-Minnesota Inventory to measure built environments: Development. *American Journal of Preventive Medicine, 30,* 144-152. doi:10.1016/j.amepre.2005.09.017

DeVellis, R. F. (2003). *Scale development: Theory and applications. Second edition (Applied Social Research Methods).* New York, NY: Sage.

Diez-Roux, A. V. (2007). Neighborhoods and health: Where are we and where do we go from here? *Revue d'Epidemiologie et de Sante Publique, 55,* 13-21.

Ellaway, A., Macintyre, S., & Kearns, A. (2001). Perceptions of place and health in socially contrasting neighbourhoods. *Urban Studies, 38,* 2299-2316. doi:10.1080/00420980120087171

Evans, G. W. (2001). Environmental stress and health. In A. Baum, T. Revenson, & J. E. Singer (eds.), *Handbook of health psychology* (pp. 571-610). Mahwah, NJ: Erlbaum.

Evans, G. W. (2003). The built environment and mental health. *Journal of Urban Health, 80,* 536-555. doi:10.1093/jurban/jtg063

Galea, S., Bresnahan M., & Susser, E. (2006). Mental health in the city. In N. Freudenberg, S. Galea, & D. Vlahov (Eds.), *Cities and the health of the public.* Nashville, TN: Vanderbilt University Press.

Kaiser, H. F. (1960) The application of electronic computers to factor analysis. *Educational and Psychological Measurement, 20,* 141-151.

Krizek, K. J., & Johnson, P.J. (2006). Proximity to trails and retail: Effects on urban cycling and walking. *Journal of the American Planning Association, 72,* 33–42. doi:10.1080/01944360608976722

Kuo, F. E., & Sullivan, W. C. (2001). Environment and crime in the inner city: Does vegetation reduce crime? *Environment and Behavior, 33,* 343-367. doi: 10.1177/0013916501333002

Leventhal, T., & Brooks-Gunn, J. (2003). Moving to Opportunity: An experimental study of neighborhood effects on mental health. *American Journal of Public Health, 93,* 1576–1582. doi:10.2105/AJPH.93.9.1576

Macintyre, S., Ellaway, A., Hiscock, R., Kearns, A., Der, G., & McKay, L. (2003). What features of the home and the area might help to explain observed relationships between housing tenure and health? Evidence from the west of Scotland. *Health & Place, 9,* 207- 218. doi:10.1016/S1353-8292(02)00040-0

Markowitz, F. E., Bellair, P. E., Liska, A. E., & Liu, J. (2001). Extending social disorganization theory: Modeling the relationships between cohesion, disorder, and fear. *Criminology, 39,* 293-319. doi:10.1111/j.1745-9125.2001.tb00924.x

Miles, R., & Song, Y. (2009). "Good" neighborhoods in Portland, Oregon: Focus on both social and physical environments. *Journal of Urban Affairs, 31,* 491-509. doi:10.1111/j.1467-9906.2009.00457.x

Mulvaney, C., & Kendrick, D. (2005). Depressive symptoms in mothers of pre-school children-effects of deprivation, social support, stress and neighbourhood social capital. *Social Psychiatry and Psychiatric Epidemiology, 40,* 202–208. doi:10.1007/s00127-005-0859-4

Nasar, J. L., & Fisher, B. (1993). Hot spots of fear and crime: A multi-method investigation. *Journal of Environmental Psychology, 13,* 187–206. doi:10.1016/S0272-4944(05)80173-2

Natsuaki, M. N., Ge, X., Brody, G. H., Simons, R. L., Gibbons, F. X., & Cutrona, C. E. (2007). African American children's depressive symptoms: The prospective effects of neighborhood disorder, stressful life events, and parenting. *American Journal of Community Psychology, 39,* 163-176. doi:10.1007/s10464-007-9092-5

Nunnaly, J. (1978). *Psychometric theory*. New York, NY: McGraw-Hill.

Palmerb, S., & Lewisa, G. (2006). Perceptions of social capital and the built environment and mental health. *Social Science & Medicine, 62,* 3072-3083. doi: 10.1016/j.socscimed.2005.11.037

Pett, M. A., Lackey, N. R., & Sullivan, J. J. (2003) *Making sense of factor analysis: The use of factor analysis for instrument development in health care research*. Thousand Oaks, CA: Sage.

Richardson, A. S., Boone-Heinonen, J., Popkin, B. M., & Gordon-Larsen, P. (2011). Neighborhood fast food restaurants and fast food consumption: A national study. *BMC Public Health, 11,* 543. doi:10.1186/1471-2458-11-543

Rountree, P. W., & Land, K. C. (1996). Perceived risk versus fear of crime: Empirical evidence of conceptually distinct reactions in survey data. *Social Forces, 74,* 1353-76. doi:10.2307/2580354

Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annual Review of Public Health, 27,* 297-322. doi:10.1146/annurev.publhealth.27.021405.102100

Sallis, J. F., Owen, N., & Fotheringham, M. J. (2000). Behavioral epidemiology: A systematic framework to classify phases of research on health promotion and disease prevention. *Annals of Behavioral Medicine, 22*, 294–298. doi:10.1007/BF02895665

Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997). Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science, 277*, 918–924. doi:10.1126/science.277.5328.918

Tabachnick, B. G., & Fidell, L. S. (1996) *Using multivariate statistics.* (3rd ed.) New York, NY: HarperCollins.

Troped, P. J., Saunders, R. P., Pate, R. R., Reininger, B., Ureda, J. R., & Thompson, S. J. (2001). Associations between self-reported and objective physical environmental factors and use of a community rail-trail. *Preventative Medicine, 32*, 191-200. doi:10.1006/pmed.2000.0788

Udry, J. R., & Bearman, P. S. (1998). New methods for new research on adolescent sexual behavior. In: R. Jessor (Ed.), *New perspectives on adolescent risk behavior* (pp. 241–269). New York, NY: Cambridge University Press.

Weich, S., Burton, E., Blanchard, M., Prince, M., Sproston, K., & Erens, M. (2001). Measuring the built environment: Validity of a site survey instrument for use in urban settings. *Health & Place, 7*, 283-292. doi:10.1016/S1353-8292(01)00019-3

Wells, N. M., & Evans, G. W. (2003). Nearby Nature: A buffer of life stress among rural children. *Environment and Behavior, 35*, 311-330. doi:10.1177/0013916503035003001

Yang, M. J. (2002). Neighborhood experience and mental health. *Chang Gung Medical Journal, 23*, 747-754

Table 3.1 Sample characteristics across neighborhood environment variables included in exploratory factor analysis (N=16,417).

Measure (Geographic Radius)	Short Description	Mean (S.D.)	Min.	Max.
Street Connectivity (5km)				
Beta Index	Ratio of the number of connections between intersections and number of intersections	1.45(.14)	1.10	2.03
Cul de sac Density	Ratio of single-link intersections divided by neighborhood area	4.76(3.07)	0.00	20.96
Cyclomatic Index	Count of route options between intersection	1175.27(923.96)	4.00	5315.00
Gamma Index	Ratio of connections between intersections and total amounts of connection per area	0.48(.05)	0.38	0.72
Intersection Density	Count of 3- or more-way intersections per km^2	24.18(15.78)	0.09	77.31
Landscape Variability (5km)				
Land Patch Density	Patches per hectare within radius	44.34(18.62)	0.41	90.53
Patch Richness	Number of different types of land patches	5.94(.27)	2.00	6.00
Perimeter-fractal Dimension	Measure of land patch size and shape variability	1.52(.04)	1.14	1.62
Simpson Diversity Index	Probability that two random land patches would be of different types (e.g., residential vs. agricultural)	0.62(.13)	0.00	0.82
Community Resources (5km, network distance)				
Inactivity Resources	Including arcades, movie theaters	1.78(2.62)	0.00	76.00
Outdoor Resources	Including youth camps	2.51(2.82)	0.00	29.00
Park Resources	Including public parks, green space	0.21(.27)	0.00	11.00
Public Resources	Including recreation centers	2.29(3.20)	0.00	38.00
Youth Organizations	Including youth centers	3.39(4.67)	0.00	65.00
Condition (Census Tract)				
% Properties Vacant	Count of vacant homes divided by count of total homes	.08(.04)	0.03	0.38

Table 3.2 Exploratory factor analysis factor loadings using principal component analysis and principal axis factoring with direct oblimin rotation.

Items	Factor 1	Factor 2	Items	Factor 1	Factor 2
Principal Component Analysis			Principal Axis Factoring		
Factor 1: Resource Availability			**Factor 1: Resource Availability**		
Youth Organizations	**0.88**	-0.04	Youth Organizations	**0.98**	-0.07
Cyclomatic Index	**0.85**	0.15	Public Resources	**0.92**	-0.06
Public Resources	**0.85**	-0.06	Cyclomatic Index	**0.71**	0.11
Intersection Density	**0.79**	0.34	Inactivity Resources	**0.71**	0.03
Inactivity Resources	**0.79**	0.03			
Outdoor Resources	**0.68**	0.06			
Park Resources	**0.65**	0.06			
Factor 2: Land Diversity			**Factor 2: Land Diversity**		
Patch Density	0.05	**0.90**	Patch Density	0.05	**0.97**
Cul De Sac Density	0.15	**0.78**	Cul De Sac Density	0.12	**0.66**
Perimeter-Fractal Dimension	0.03	**0.77**	Perimeter-Fractal Dimension	0.05	**0.68**
Simpson Diversity Index	-0.13	**0.67**	Simpson Diversity Index	-0.13	**0.55**
Cronbach's Alpha (Standardized Items)	0.80	0.78	Cronbach's Alpha (Standardized Items)	0.87	0.78
KMO 0.65			KMO 0.74		
Percentage Variance Explained 65.1%			Percentage Variance Explained 70.6%		

Table 3.3 Built environment factor correlations with neighborhood contextual variables.

Factor	Resource Availability	Vacant Homes[a]	Poverty[b]	Litter[c]	Crime[d]
Resource Availability		0.02	0.22***	0.13***	0.53***
Land Diversity	0.23***	-0.22***	-0.22***	-0.05***	0.09***

***p<.001

[a]Vacant Homes-Percentage of vacant homes in neighborhood
[b]Poverty-Percentage of households earning less than $25000 annually (US Census)
[c]Trash-Participant guardians indicating problem with litter in neighborhood
[d]Crime-FBI Uniform Crime Reports of previous year violent and nonviolent crime

Table 3.4 Mean built environment scores by land classification.

Neighborhood Classification	Resource Availability Mean(S.D.)	Land Diversity Mean(S.D.)	Mean Difference Significance
Metropolitan	278.12(178.15)	18.58(6.20)	***
Large Town	29.87(19.28)	8.62(3.20)	***

***p<.001

CHAPTER 4

EFFECTS OF NEIGHBORHOOD BUILT ENVIRONMENT ON URBAN ADOLESCENT DEPRESSIVE SYMPTOMS: A MULTILEVEL ANALYSIS

An abundance of theory and empirical research supports the impact of cognitive, family, and neighborhood factors on adolescent depressive symptoms. However, few researchers have examined the independent influence of neighborhood built environment along with these factors. The built environment encompasses man-made structures of the lived environment, such as homes, buildings, and roads. Elements of the built environment may increase stress by exacerbating existing individual and social risks, including perceptions of general well-being, fears of crime, and attributions of personal worth (Evans, 2003). Specific built environment characteristics shown to impact individual depressive symptoms and psychological distress include environmental pollution and litter (Yang, 2000; Yang & Matthews, 2010), noise (Lercher et al., 2002), the presence of public resource facilities (Weich et al., 2002), lack of green space (Srinivasan, O'Fallon, & Dearry, 2003) and the condition of an individual's living quarters (Dalgard & Tambs, 1997). Studies using composite measures of the built environment have yielded similar results (Evans, 2003; Hadley-Ives et al, 2000). Generally the results of research to date are mixed regarding which factors have the greatest effects on adolescent depressive symptoms.

Trends in the limited research on built environment and depressive symptoms suggest that many factors may uniquely affect adolescents growing up in urban environments. In an analysis of the National Comorbidity Survey, the relationship between geography of

residence and the prevalence of depressive symptoms was inconsistent, but recent research suggests a positive correlation between level of "urbanicity" and mental health disorders (N=10,148) (Kessler et al., 2011). An analysis of Behavioral Risk Factor Surveillance System data showed greater psychological distress experienced by urban residents compared with rural residents (Dhingra et al., 2009). More research is needed to clarify how geography of residence interacts with other known risk factors for depressive symptoms within youth populations. This study focuses on the experiences of urban adolescents.

This study examines the impact of the built environment on depressive symptoms controlling for individual demographic and social bonding factors, perceptions of neighborhood, and communal socioeconomic factors. Specifically, this study is designed to answer the following questions: controlling for individual, family, and school catchment area structural risk factors, do adolescents living in urban areas with reduced accessibility to public resources and limited landscape diversity (i.e., green space and developed land) have an increased likelihood to experience depressive symptoms? Based on previous research, the following hypotheses are tested: (a) controlling for individual demographics, reported closeness to guardians, and neighborhood social factors (coded at the school-level), adolescents with greater geographic accessibility to community resources (e.g., recreation centers, churches) will have a reduced likelihood of experiencing depressive symptoms; (b) controlling for the aforementioned factors, adolescents with reduced access to landscape diversity are hypothesized to have an increased likelihood of experiencing depressive symptoms; and (c) based on positive correlation between socioeconomic disadvantage and built environment disorder, the impact of geographic accessibility to community resources on

depressive symptoms is hypothesized to vary by the level of school-level communal poverty controlling for the aforementioned factors.

Background

Neighborhood Social Factors

Although the built environment is the focus of this study, the most researched neighborhood factor shown to impact individual health outcomes is community social organization. Seminal studies by Sampson and colleagues (1989, 1997) demonstrated collective efficacy as a key element of community social organization. Collective efficacy is the interplay of social cohesion and trust among neighbors along with the degree to which neighbors exert an informal level of control over other residents and outsiders. Various studies have used derivative conceptualizations of community social organization to find neighborhood social factors predictive of individual depressive symptoms and other mental health symptoms (Browning & Cagney, 2005; Matlin, Molock, & Tebes, 2011; Sampson et al., 1997; Vega, Ang, Rodriguez, & Finch, 2011) and there is growing interest in accounting for the role of the built environment in such analyses. Recent studies have found significant associations between depressive symptoms and neighborhood condition scales that measure participant perceptions of features of both the social and built environments (Ford & Rechel, 2012; Hadley-Ives et al., 2000; Singh & Ghandour, 2012).

Family Factors

Previous analyses suggest there may be an interactive effect between caregiver perceptions of neighborhood built and social environments and how they relate to their children. Experimental research has shown that individual psychological distress and deterioration of parent-child relationships are related to elements of the built environment

(Baum & Paulus, 1987; Evans, 2001). In high crime and disadvantaged areas, parents often adopt stricter, authoritarian parenting styles to counteract neighborhood disorder (McLoyd, 1990). Various studies show that physical structures that limit visibility, such as tall residential buildings and public spaces with few seating areas, increase the level of fear individuals have regarding crime and decrease the amount of cohesion neighbors feel with one another (Evans, 2003; Nasar & Fisher, 1993). For families in distressed areas, the lack of safety within the neighborhood and limited expectations of neighbors may deleteriously affect parenting. Although a combination of protective (e.g., close supervision) and promotive (e.g., increased involvement) strategies have been shown to yield positive developmental outcomes in youth (Furstenberg et al., 1999), living in dangerous environments may create an overreliance on protective strategies. Overly authoritative parenting (i.e., limited communication in decision-making or punishment) may be restrictive of child development (Rankin & Quane, 2002).

Individual Factors

Similarly, individual risk factors for depressive symptoms have been shown to interact with neighborhood factors. Recent empirical findings linking built environment factors to adolescent internalizing behaviors support a diathesis-stress model of individual risk (Diez Roux, 2004). The diathesis-stress model posits that the interplay of individual predispositions and external stressors cause psychological and behavioral change (Benight & Bandura, 2004). Adolescents are hypothesized to have some diathesis, or vulnerability, to depressive symptoms; the likelihood of developing depression increases with the level of stress and decreases with the number of constitutional protective factors. In additional to epidemiological findings suggesting an increased susceptibility to depression among female

and Latino populations (Centers for Disease Control and Prevention, 2012), studies have found the following individual factors to be predictive of depression: hormonal dysregulation (Birmaher & Heydl, 2001; Garber, 2006); history of familial depression (Beardslee, Versage, & Gladstone, 1998; Hankin, 2006); and, sleep irregularity (Armitage, Hoffman, & Rush, 1999; Emslie et al., 1994). The likelihood of developing depression increases with the level of experienced stress given one's individual diathesis. The social and built environment conditions of distressed urban neighborhoods likely increase adolescents' susceptibility to developing depressive symptoms, which is mediated by genetic and other biological risk factors (Abramson, Metalsky, & Alloy, 1989; Diez Roux, 2004).

Multilevel Modeling in Previous Analyses of Neighborhood Built Environment Factors

Despite the growing number of studies testing the influence of neighborhood built environment factors within a multilevel framework (i.e., individual factors and neighborhood factors), a smaller proportion of studies have adequately accounted for the violation of the regression assumption of independent and identically distributed error terms within the analysis (e.g., Gutman & Sameroff, 2004, Milam et al., 2012. Multilevel modeling, known interchangeably across disciplines as hierarchical linear modeling, random-effects models, or covariance models, is the superior method for identifying the independent impact of neighborhood effects because it allows individual-level and neighborhood-level covariates to be simultaneously evaluated while accounting for the interdependence of observations clustered within geographic boundaries (Duncan, Jones, & Moon, 1998; Kutner, Nachtsheim, & Neter, 2004). This study examined two levels of analysis to account for individual-level factors, including demographic and family relationship factors that may influence

vulnerability to depressive symptoms and the risk and protective factors of the neighborhood in which participants live and attend school.

Method

Sample

Data from Waves I-III of the National Longitudinal Study of Adolescent Health (Add Health) were utilized to test hypotheses 1 and 2. Funded by the National Institute of Child Health and Human Development (NICHD) and administered under University of North Carolina at Chapel Hill Institutional Review Board protocols, Add Health is a longitudinal, nationally representative, school-based study of US adolescents from grades 7 to 12 that examines the influence of individual, family, school, and community factors on health behaviors. Wave 1 data were collected between 1994 and 1996. Wave III data were collected between 2001 and 2002. The primary sampling frame consisted of 80 high schools and 52 associated "feeder" middle schools selected via systematic sampling methods and implicit stratification to ensure a representative sample with respect to region of country, level of urbanization, school size, school type, and ethnicity (Udry & Bearman, 1998). This study utilized two data sources: (a) in-home interviews of the respondent at Waves I and III, and (b) contextual neighborhood information within the Obesity and Neighborhood Environment (ONE) database.

Within the ONE database, the residential street addresses of all Add Health respondents were recorded at each interview. Residential street addresses were geocoded and an 8.05-km (5-mile) buffer was drawn around each respondent's residence to best estimate the geographic extent of their neighborhood. Respondent locations at Waves I & III were joined to Census 1990 and 2000 data using a spatial join within a GIS framework. This

process produced the neighborhood structural factors describing each participant's neighborhood (e.g., percent of vacant homes). Wave 1 reports of neighborhood variables were used in this study.

The sample for this study included Add Health participants who completed the Waves 1, 2, and 3 In-Home questionnaire, resided in the same urban neighborhood in Waves 1 and 3 (N = 4,080). Approximately 51.0% respondents were female (N = 2,061). Of the 4,080 respondents, 2,374 (58.2%) were Caucasian and 751(18.4%) were African-American. With regard to ethnicity, 742 (18.2%) respondents were of Hispanic origin.

Measures

Depressive Symptoms. At Wave 1, emotional distress was measured via Add Health's "Feeling Scale (FS)," which is a shortened version of the 20-item Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977). Participants were asked how frequently they experienced the following 19 symptoms in the previous week: "You were bothered by things that usually don't bother you;" "You didn't feel like eating/Your appetite was poor;" "You felt that you could not shake off the blues, even with help from your family or friends;" "You felt that you were just as good as other people;" "You had trouble keeping your mind on what you were doing;" "You felt depressed;" "You felt that you were too tired to do things;" "You felt hopeful about the future;" "You thought your life had been a failure;" "You felt fearful;" "You were happy;" "You talked less than usual;" "You felt lonely;" "People were unfriendly to you;" "You enjoyed life;" "You felt sad;" "You felt that people dislike you;" "It was hard to get started doing things;" and "You felt life was not worth living." Item responses could range from 0 "never or rarely" to 3 "most of the time or all of the time." Total score range from 0 to 57with three items reverse scored.

Within the sample, the internal consistency of the scale was .89. Depressive symptoms were transformed into a binary measure of low and elevated depressive symptoms based on the CES-D cutoff score of 16, which represents increased likelihood of experiencing clinical depression (Radloff, 1977). Comparisons of clinical interviews with CES-D scores with community samples of adolescents have shown a CES-D score of 16 to represent having multiple depressive symptoms with no functional impairment (Kandel & Davies, 1982; Lewnisohn et al., 1998). The distribution of depressive symptoms scores within the sample is displayed in Appendix D.

Built Environment Factors. Two composite measures of the built environment developed from the previous factor analysis study in Chapter 3 were included in the present analysis. The Resource Availability factor is comprised of the following variables: public resources (i.e., count of resources including recreation centers and athletic fields), youth organizations (i.e., count of resources such as scout clubhouses), inactivity resources (i.e., count of resources such as malls and arcades), and cyclomatic index (i.e., measure of route options between intersections). This composite measure is hypothesized to capture available neighborhood resources and the potential for community members to encounter these features. With regard to hypothesis 1, higher scores on this factor (increased access to resources) were predicted to be associated with a decreased likelihood of elevated depressive symptoms. The Land Diversity factor is comprised of the following variables: path density (i.e., measure of land patches per hectare within radius), perimeter-fractal dimension (i.e., measure of land patch size and shape variability), Simpson diversity index (i.e., probability that two random land patches would be of different types) and cul de sac density (i.e., ratio of single-link intersections divided by neighborhood area). This factor is conceptualized as the

level of landscape complexity isolated from the main thoroughfare(s) within a community. With regard to hypothesis 2, a higher score (decreased connectivity and land diversity) were predicted to be associated with an increased likelihood to experience elevated depressive symptoms.

Neighborhood Social Factors. At Wave 1, participants were asked a set of six items about their interaction with their neighbors and community resources. Add Health respondents were asked the following true or false questions, "You know most of the people in your neighborhood," "In the past month, you have stopped on the street to talk with someone who lives in your neighborhood?" "People in this neighborhood look out for each other," "Do you use a physical fitness or recreation center in your neighborhood," "Do you usually feel safe in your neighborhood?" Respondents were also asked to answer the following questions using a 5-point response format ranging from 1 "not at all" to 5 "very much," "On the whole, how happy are you with living in your neighborhood?" Within this sample, the internal consistency of the scale was .92.

Social Bonding. At Wave 1, participants were asked to answer the following eight questions using a 5-point response format ranging from 1 "not at all" to 5 "very much," "How much do you feel that adults care about you?" "How much do you feel that your teachers care about you?" "How much do you feel that your parents care about you?" "How much do you feel that your friends care about you?" "How much do you feel that people in your family understand you?" "How much do you feel that you want to leave home?" "How much do you feel that you and your family have fun together?" "How much do you feel that your family pays attention to you?" Within the sample, the internal consistency of the scale was .97.

Family Processes. Parenting was assessed using Wave 1adolescent self-reports of feelings of closeness to and perceptions of relationship quality with his or her mother. Adolescents were asked whether (a) most of the time, his/her mother was warm and loving toward him/her; and (b) overall, he/she was satisfied with his/her relationship with mom. These items were rated on a scale ranging from 1 (strongly disagree) to 5 (strongly agree) and summed. High scores indicated a stronger relationship. Within the sample, the internal consistency of the scale was .94.

Control Variables. At both levels of the analysis, individual and school, various indicators will serve as controls for the likelihood of experiencing depressive symptoms. At the individual level, risk will be assessed using demographic variables, such as race (dummy coded with White as reference variable) and gender (dummy coded with female as reference variable). At the level of school catchment area, risk will be assessed using US Census data on median neighborhood income (US Census), percentage of vacant homes (US Census) and crime rate per 100,000 persons (FBI Uniform Crime Reporting).

Analytic Approach

Multilevel logistic regression was used to examine the binary dependent variable, Feelings Scale score above vs. below the recommended CES-D cutoff score for elevated depressive symptoms. A multilevel approach was utilized to account for clustering based on the data collection and sampling procedures. The structural characteristics representative of participant's communities (i.e., crime rate, percent vacant homes, percent households with incomes below $25,000) are fixed at the school level. The primary sampling frame consisted of 132 schools selected via systematic sampling methods and implicit stratification to ensure a nationally representative sample. School catchment areas are used in the present study (as

opposed to census tract or other neighborhood clustering variables) to utilize the available multilevel sample weights. The Add Health systematic sampling procedures accounted for characteristics of the sample important to the external validity of the present study, including geographic region (e.g., West, Midwest), geographic division (e.g., Middle Atlantic, Mountain), and urbanicity at the cluster-level (Udry & Bearman, 1998). At the individual level, these factors included four race/ethnicity oversamples: Chinese, Puerto Rican, Cuban, and Blacks with high socioeconomic status.

All analyses were conducted using Stata 12 using the *gllamm* package (Rabe-Hesketh, Pickles, & Skrondal, 2001). The multilevel weights will be constructed using the individual and school level weights and the *pwigls* program in Stata (Chantala, Blancette, & Suchindran, 2006). The procedure constructs the school-level weight for the multilevel analysis by summing the within-school sampling weight for each participant per school and dividing by the number of participants. The individual level weight estimate was computing by dividing the participant sample weight provided in Add Health by the school-level adjustment. Missing data on exploratory variables was minimal (0 to 2.2%). List-wise deletion was performed on cases with missing variables. A series of posttest bivariate analyses was performed between sample analyzed- and sample unanalyzed- data on key demographic and independent variables.

Results

Table 1 displays the individual- and school-level characteristics of the participants in the present study. Approximately 25.5% of the sample had depressive scores above the cutoff for elevated symptoms (n=3,774). Participants without full information on the analyzed variables were removed from the final analysis (n=306). Participants reported a mean score

of 3.79 (S.D. = .47) out of a possible 5 protective traits. Participants reported high mean levels of (M = 4.72, S.D. = .53) maternal closeness on a 5-point scale. With respect to neighborhood connectedness (i.e., social cohesion), participants reported a mean of 3.42 (S.D. = 1.12) on a 5-point scale. The two built environment variables, Resource Availability and Land Diversity, were measured within a 5-km radius around participants' home locations. Participants averaged Resource Availability scores of 312.56 (S.D. = 227.43, Minimum = 3.00, Maximum = 1197.50) and Land Diversity scores of 13.18 (S.D. = 5.22, Minimum = 1.44, Maximum = 25.14). At the school-level, contextual variables were aggregated from participant census tract to be representative of neighborhood. Participant neighborhoods had reported mean crime rates of approximately 6 per 100,000 residents the year prior to Wave 1 data collection (Minimum = 2, Maximum = 14). Approximately 7% of houses in participants' school catchment area were vacant collection (Minimum = 3%, Maximum = 38%). Approximately 38% of households in participants' school catchment area earned less than $25,000 annually collection (Minimum = 21%, Maximum = 68%).

Table 2 displays the results of the multilevel logistic regression analyses of low and elevated depressive symptoms. In the multilevel logistic regression model of only the individual- and school-level covariates (Model 1), the odds of elevated depressive symptoms were .53 times lower for males than for females given the other variables being held constant. For Whites, the odds of elevated depressive symptom were .59 times lower than for non-Whites. For a one unit increase in social bonding score, the odds of elevated depressive symptoms were .37 times lower, given the other variables being held constant. For a one unit increase in reported maternal closeness, the odds of elevated depressive symptoms were .70 times lower. The Resource Availability score was significantly associated with the odds of

elevated depressive symptoms, but the magnitude was negligible (*OR* = 1.003). As for other neighborhood-related variables, living in an area of increased poverty (i.e., percentage of households earning < $25,000) increased the odds of elevated depressive symptoms by 5.6 times. The variance of level 2 or school level random effect is estimated at .13 with a standard error of .23. Model 2 is a multilevel logistic regression model that added an interaction variable of Resource Availability and the included measure of neighborhood socioeconomic disadvantage. The interaction term was not significantly associated with elevated depressive symptoms. In Model 2, the covariates remained of equivalent significance and comparable magnitude to the covariates in Model 1. Appendices E and F display the results of multilevel logistic and ordered logistic analyses using alternative depressive symptom score cutoffs for elevated symptoms.

Discussion

This study examined whether objective measures of the neighborhood built environment were associated with elevated depressive symptoms in a nationally representative sample of urban adolescents. Insights from prior research were used to formulate hypotheses based on measures of youth accessibility to neighborhood resources and the diversity of landscape. Although one factor, Resource Availability, showed a significant association with depressive symptoms in the hypothesized direction, neither measure displayed a meaningful relationship with the dependent variable. Using an adolescent sample of participants who had not moved between Waves 1 and 3 and using neighborhood variables at Wave 1 may have impacted the findings of the study by excluding the degree of variability of lived experience among urban adolescents. Additional limitations of both the study and the available data are important when considering these findings.

With regard to the outcome variable, depressive symptoms, measurement was limited due to the use of the CES-D, a participant-rated tool. Observer-rated instruments are generally hypothesized to offer superior psychometric properties (e.g., reliability, internal consistency) than participant-rated tools; however, self-report instruments require fewer resources to administer (Brooks & Kutcher, 2001; Rush et al., 1994). Despite the inability of self-report tools to be used to assign psychiatric diagnoses to participants (Brooks & Kutcher, 2001), the ability of these tools to assess depressive symptoms quickly and accurately have made them the most utilized data collection method.

The measurement of built environment variables is a limitation in the present study and the field of neighborhood effect research as a whole. The two composite built environment measures used in the present study were developed using data from the Add Health ONE database, which was developed from a variety of secondary data source within a geographic information systems (GIS) framework (e.g., U.S. Geological Service, ESRI Street Map). Of the three dominant built environment measurement approaches, self-report questionnaires, independent observer rating inventories, and secondary data analyses within a GIS framework, the lack of information about the condition of neighborhood features is a key disadvantage in the GIS-focused type. Combining multiple measurement types would be a preferred method because of the ability to combine objective measures with participant- and/or interviewer-rated information. Within the present study, the neighborhood social scale consisted of two items reflective of participants' perception of the built environment (i.e., "Do you use a physical fitness or recreation center in your neighborhood," "Do you usually feel safe in your neighborhood?"), provides some insight into how this concern presents itself within the sample.

The definition of neighborhood boundaries and clustering variables is another measurement limitation. The decision to use school catchment area to define neighborhood was based on the sampling procedures of the dataset and the proximity of the cluster-level variables to participant census tract, another problematic though often used proxy for neighborhood. In multiple studies, Coulton and colleagues have found incongruence between administratively-defined neighborhood parameters, adult-defined neighborhood parameters, and child-defined neighborhood parameters (Coulton et al., 2001; Spilsbury, Korbin, & Colton, 2009). Researchers and policymakers must give careful consideration to environment-related outcomes being measured and/or intervened upon. The integration of GIS technology with participant-centered research methods may provide superior data within regard to construct validity.

One of the biggest challenges to measuring geo-spatial effects is the financial and ethical difficulty involved in conducting a randomized experiment that would assign participants to control and treatment units that vary across social or built environment characteristics. Without randomization of persons into, say, neighborhoods, observational study of neighborhood effects on mental health outcomes is subject to multiple threats to internal validity, including ambiguous temporal precedence, history, maturation, and selection (Shadish et al., 2002). Simply put, there are many attributes of participants other than residing in a particular neighborhood that may increase the likelihood of experiencing elevated depressive symptoms. This analysis attempted to limit alternative explanations for the relationship between the built environments and depressive symptoms while accounting for endogeneity within a regression framework; however, hidden bias remains. Without addressing the ignorable treatment assignment assumption, causal inferences cannot be

drawn between neighborhood built environment characteristics and adolescent depressive symptoms.

The assessment of depression was also limited in that it was only a measure of past week as opposed to past year or lifetime depression. Further, structured psychiatric interviews are typically regarded as the gold standard of depression assessment, whereas this study relied on a questionnaire assessment of depression. Despite this limitation, the significant relationships between depressive symptoms and social relationships with parents, peers, and neighbors are meaningful. This study extends previous analyses of depressive symptoms and family relations using Add Health by also controlling for neighborhood factors (Herrenkohl et al., 2009; Moon & Rao, 2010). In addition to adolescents' maternal closeness, participants' relationships with neighbors (i.e., Neighborhood Inclusion) and peers (i.e., Social Bonding) were significant predictors of depressive symptoms.

The role of the built environment in the expression of depressive symptoms requires more analysis, particularly in relation to social bonds between parents, peers, and neighbors. More information is needed on adolescent perceptions of the built environment. The present study was focused on objective measures of neighborhood physical properties, but no information was available on how resource availability and landscape diversity impacted the everyday lives of participants. The inclusion of self-report assessments of the physical structures within neighborhoods, similar to adolescents' assessments of interpersonal relationships, may provide clarity in the relationship between neighborhood and depression in future studies.

REFERENCES

Abramson, L. Y., Metalsky, G. I., & Alloy, L. B. (1989). The hopelessness theory of depression: Does the research test the theory? In L.Y. Abramson (Ed.), *Social cognition and clinical psychology: A synthesis* (pp. 33–65). New York, NY: Guilford Press.

Armitage, R., Hoffman, R. F., & Rush, A. J. (1999). Biological rhythm disturbance in depression: Temporal coherence of ultradian sleep EGG rhythms. *Psychological Medicine, 29*, 1435-1448. doi:10.1017/S0033291799001300

Baum, A., & Paulus, P. B. (1987). Crowding. In D. Stokols and I. Altman (Eds.), *Handbook of environmental psychology* (pp. 533-570). New York, NY: Wiley.

Beardslee, W. R., Versage, E. M., & Gladstone, T. R. G. (1998). Children of affectively ill parents: A review of the past 10 years. *Journal of the American Academy of Child and Adolescent Psychiatry, 37*, 1134–41.

Benight, C., & Bandura, A. (2004). Social cognitive theory of posttraumatic recovery: The role of perceived self-efficacy. *Behaviour Research and Therapy*, 42, 1129–1148. doi:10.1016/j.brat.2003.08.008

Birmaher, B., & Heydl, P. (2001). Biological studies in depressed children and adolescents. *International Journal of Neuropsychopharmacology, 4*, 149-157. doi:10.1017/S1461145701002358

Brooks, S. J., & Kutcher, S. (2001). Diagnosis and measurement of adolescent depression: A review of commonly utilized instruments. *Journal of Child and Adolescent Psychopharmacology, 11*, 341-376.

Browning, C. R., & Cagney, K. A. (2005). Neighborhood structural disadvantage, collective efficacy, and self-rated physical health in an urban setting. *Journal of Health and Social Behavior*, 43, 383–399

Centers for Disease Control and Prevention. (2012). Youth Risk Behavior Surveillance – United States, 2011. Morbidity and Mortality Weekly Report, 61, 1-138. Retrieved from www.cdc.gov/mmwr

Chantala, K., Blanchette, D., & Suchindran, C. M. (2006). Software to compute sampling weights for multilevel analysis. Research Tools & Resources [research tools online]. Chapel Hill, NC: Carolina Population Center. Available from www.cpc.unc.edu (accessed 26 February 2013).

Coulton, C. J., Korbin, J., Chan, T., & Su, M. (2001). Mapping residents' perceptions of neighborhood boundaries: A methodological note. *American Journal of Community Psychology, 29*, 371–383. doi:10.1023/A:1010303419034

Dalgard, O. S., & Tambs, K. (1997). Urban environment and mental health—a longitudinal study. *British Journal of Psychiatry, 171*, 530–536. doi:10.1192/bjp.171.6.530

Dhingra, S. S., Strine, T. W., Holt, J. B., Berry, J. T., & Mokdad, A. H. (2009). Rural-urban variations in psychological distress: Findings from the behavioral risk factor surveillance system, 2007. *International Journal of Public Health, 54*, 16-22. doi:10.1007/s00038- 009-0002-5

Diez Roux, A. V. (2004). Estimating neighborhood health effects: The challenges of causal inference in a complex world. *Social Science & Medicine, 58*, 1953-1960. doi:10.1016/S0277-9536(03)00414-3

Duncan, C., Jones, K., & Moon, G. (1998). Context, composition, and heterogeneity: Using multilevel models in health research. *Social Science and Medicine, 48*, 497-505. doi:10.1016/S0277-9536(97)00148-2

Emslie, G. J., Rush, A. J., Weinberg, W. A., Rinteloran, J. W., & Roffwarg, H. P. (1994). Sleep EEG features of adolescents with major depression. *Biological Psychiatry, 36*, 573-581. doi:10.1016/0006-3223(94)90067-1

Evans, G. W. (2001). Environmental stress and health. In A. Baum, T. Revenson, & J. E. Singer (eds.), *Handbook of health psychology* (pp. 571-610). Mahwah, NJ: Erlbaum.

Evans, G. W. (2003). The built environment and mental health. *Journal of Urban Health, 80*, 536-555. doi:10.1093/jurban/jtg063

Ford, J. L., & Rechel, M. (2012). Parental perceptions of the neighborhood context and adolescent depression. *Public Health Nursing, 29*, 390-402. doi.:10.1111/j.1525-1446.2012.01015.x

Furstenberg, Jr., F. F., Cook, T. D., Eccles, J., Elder, Jr., G. H., & Sameroff, A. (1999). *Managing to make it: Urban families and adolescent success*. Chicago, IL: The University of Chicago Press.

Garber, J. (2006). Depression in children and adolescents: Linking risk research and prevention. *American Journal of Preventive Medicine, 31*, S104–S125. doi:10.1016/j.amepre.2006.07.007

Gutman, L. M., McLoyd, V. C., & Tokoyawa, T. (2005). Financial strain, neighborhood stress, parenting behaviors, and adolescent adjustment in urban African American families. *Journal of Research on Adolescence, 15*, 425−449.

Hadley-Ives, E., Stiffman, A. R., Elze, D., Johnson, S. D., & Dore, P. (2000). Measuring neighborhood and school environments: Perceptual and aggregate approaches. *Journal of Human Behavior in the Social Environment, 3,* 1-28. doi:10.1300/J137v03n01_01

Hankin, B. L. (2006). Adolescent depression: Description, causes, and interventions. *Epilepsy & Behavior, 8,* 102-114. doi:10.1016/j.yebeh.2005.10.012

Herrenkohl, T. I., Kosterman, R., Hawkins, J. D., & Mason, W. A. (2009). Effects of growth in family conflict in adolescence on adult depressive symptoms mediating and moderating effects of stress and school bonding. *Journal of Adolescent Health, 44,* 146–152. doi:10.1016/j.jadohealth.2008.07.005

Kessler, R. C., Avenevoli, S., Costello, E. J., Georgiades, K., Green, J. G., Gruber, M. J, He J-P., Koretz, D., McLaughlin, K. A., Petukhova, M., Sampson, N. A., Zaslavsky, A. M., & Merikangas, K. R. (2011). Prevalence, persistence, and sociodemographic correlates of DSM-IV disorders in the National Comorbidity Survey Replication Adolescent Supplement. *Archives of General Psychiatry, 69,* 372-380. doi:10.1001/archgenpsychiatry.2011.160

Kutner, M. H., Nachtsheim, C. J., & Neter J. (2004). *Applied linear regression methods* (4th ed.). Chicago, IL: McGraw-Hill/Irwin.

Lercher, P., Evans, G. W., Meis, M., & Kofler, W. (2002). Ambient neighborhood noise and children's mental health. *Occupational and Environmental Medicine, 59,* 380–386. doi:10.1136/oem.59.6.380

Matlin, S. L., Molock, S. D., & Tebes, J. K. (2011). Suicidality and depression among African American adolescents: The role of family and peer support and community connectedness.*American Journal of Orthopsychiatry, 81,* 108-117. doi:10.1111/j.1939-0025.2010.01078.x

McLoyd, V. C. (1990). The impact of economic hardship on Black families and children: Psychological distress, parenting, and socioemotional development. *Child Development, 61,* 311-346. doi:10.2307/1131096

Milam, A. J., Furr-Holden, C. D., Whitaker, D., Smart, M., Leaf, P., & Cooley-Strickland, M. (2012). Neighborhood environment and internalizing problems in African American children. *Community Mental Health Journal, 48,* 39-44.

Moon, S. S., & Rao, U. (2010). Youth-family, youth-school relationship, and depression. *Child and Adolescent Social Work Journal, 27,* 115–131. doi:10.1007/s10560-010-0194-9

Nasar, J. L., & Fisher, B. (1993). Hot spots of fear and crime: A multi-method investigation. *Journal of Environmental Psychology, 13,* 187–206.

doi:10.1016/S0272-4944(05)80173-2

Rabe-Hesketh, S., Pickles, A. & Skrondal, A. (2001) *gllamm Manual*. Department of Biostatistics and Computing, Institute of Psychiatry, Kings College, University of London, London.

Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*, 385-401. doi:10.1177/014662167700100306

Rankin, B. H., & Quane, J. M. (2002). Social contexts and urban adolescent outcomes: The interrelated effects of neighborhoods, families, and peers on African-American youth. *Social Problems, 49*, 79-100. doi:10.1525/sp.2002.49.1.79

Rush, A. J., Gullion, C. M., Raskin, A., Kellner, R., & Bartko, J. J. (1994). Assessment and measurement of clinical change. In R. F. Prien & D. S. Robinson (eds.), *Clinical Evaluation of psychotropic drugs* (pp 85–122). New York, NY: Raven Press.

Sampson, R., & Groves, W. (1989). Community structure and crime: Testing social disorganization theory. *American Journal of Sociology, 94*, 775–802. doi:10.1086/229068

Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997). Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science, 277*, 918–924. doi:10.1126/science.277.5328.918

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference.* Boston: Houghton-Mifflin.

Singh, G. K., & Ghandour, R. M. (2012). Impact of neighborhood social conditions and household socioeconomic status on behavioral problems among US children. *Maternal and Child Health Journal, 16*, 158-169. doi:10.1007/s10995-012-1005-z

Spilsbury, J.C., Korbin, J.E., & Coulton, C.J. (2009). Mapping children's neighbourhood perceptions: Implications for child indicators. *Child Indicators Research, 2*, 111-131. doi:10.1007/s12187-009-9032-z

Srinivasan, S., O'Fallon, L. R., & Dearry A. (2003). Creating healthy communities, healthy homes, and healthy people: Initiating a research agenda on the built environment and public health. *American Journal of Public Health, 93*, 1446-1450. doi:10.2105/AJPH.93.9.1446

Udry, J. R., & Bearman, P. S. (1998). New methods for new research on adolescent sexual behavior. In: R. Jessor (Ed.), *New perspectives on adolescent risk behavior* (pp. 241–269). New York, NY: Cambridge University Press.

Vega, W. A., Ang, A., Rodriguez, M. A., & Finch, B.K. (2011). Neighborhood protective effects on depression in Latinos. *American Journal of Community Psychology, 47*, 114-126.doi:10.1007/s10464-010-9370-5

Weich, S., Blanchard, M., Prince, M., Burton, E., Erens, B., & Sproston, K. (2002). Mental health and the built environment: Cross-sectional survey of individual and contextual risk factors for depression. *British Journal of Psychiatry, 180*, 428–433. doi:10.1192/bjp.180.5.428

Weich, S., Burton, E., Blanchard, M., Prince, M., Sproston, K., & Erens, M. (2001). Measuring the built environment: Validity of a site survey instrument for use in urban settings. *Health & Place, 7*, 283-292. doi:10.1016/S1353-8292(01)00019-3

Wells, N. M., & Evans, G. W. (2003). Nearby Nature: A buffer of life stress among rural children. *Environment and Behavior, 35*, 311-330. doi:10.1177/0013916503035003001

Yang, T., & Matthews, S. A. (2010). The role of social and built environments in predicting self-rated stress: A multilevel analysis in Philadelphia. *Health and Place, 16*, 803-810. doi:10.1016/j.healthplace.2010.04.005

Yang, M. J. (2002). Neighborhood experience and mental health. *Chang Gung Medical Journal, 23*, 747-754

Table 4.1 Sample characteristics across individual and neighborhood variables included in urban adolescent sample (N=3,774).

Item	Mean	S.D.	Min	Max
Individual Level				
Gender (Female is the reference)	0.51	0.50	0.00	1.00
Race (Non-white is the reference)[a]	0.57	0.50	0.00	1.00
Social Bonding	3.79	0.47	1.00	5.00
Maternal Closeness	4.72	0.53	1.00	5.00
Neighborhood Inclusion	3.42	1.12	0.00	5.00
Resource Availability	312.56	227.43	3.00	1197.50
Landscape Diversity	13.18	5.22	1.44	25.14
School (Neighborhood) Level				
Neighborhood Serious Crime (per 100,000)	0.06	0.03	0.02	0.14
Percentage Vacant Homes	0.07	0.04	0.03	0.38
Percentage Household Income < $25,000	0.38	0.09	0.21	0.68

[a] = Within the sample, 24% non-White Hispanic, 16% African American, 11% Asian

Table 4.2 Odds ratios from multilevel logistic regression models predicting depressive symptoms (Feelings Scale scores < 16 as reference category) (N=3,434).

	Model 1				Model 2			
Item	*b*	O.R.	S.E.	*p*	*b*	O.R.	S.E.	*p*
Individual Level								
Gender (Female is the reference)	-0.644	0.525	0.137	***	-0.651	0.522	0.137	***
Race (Non-white is the reference)	-0.533	0.587	0.107	***	-0.520	0.595	0.107	***
Social Bonding	-1.000	0.368	0.131	***	-1.000	0.368	0.131	***
Maternal Closeness	-0.359	0.698	0.110	**	-0.354	0.702	0.110	**
Neighborhood Inclusion	-0.174	0.840	0.034	***	-0.175	0.839	0.034	***
Resource Availability	-0.001	0.999	0.003	*	-0.003	0.997	0.003	*
Landscape Diversity	0.003	1.003	0.012		0.002	1.002	0.012	
School Level								
Neighborhood Serious Crime	-5.720	0.003	3.436		-4.731	0.009	3.768	
Percentage Vacant Homes	-1.695	0.184	1.322		-2.233	0.107	1.466	
Percentage Household < $25,000	1.719	5.579	1.352	*	3.050	21.115	1.280	*
Cross-Level Interaction								
Resource Availability * HH<$25K					-0.005	0.995	0.003	
Intercept	4.946	140.611	0.691	***	4.364	78.571	0.930	***
Random Effect (Standard Error)	.127(.231)				.098(.042)			
Number of Adolescents	3434							
Number of Schools	109							

*p<.05, **p<.01, ***p<.001

CHAPTER 5

SUMMARY AND CONCLUSIONS

Adolescent depression is a significant national problem that may have attributes unique to urban populations. The National Survey on Drug Use and Health (NSDUH) estimates that approximately 8.1% youth ages 12 to 17 experience major depressive disorder annually (Department of Health and Human Services, 2010). Recent research has shown greater psychological distress and suicidal ideation experienced by urban residents as compared with rural residents (Centers for Disease Control and Prevention, 2012; Dhingra, et al., 2009; Kessler, et al., 2011). Characteristics of the neighborhood social environment, particularly lack of cohesion between neighbors, are key predictors of disproportionally high rates of adolescent depression in urban areas, particularly economically distressed inner-city communities (Cantillon, 2003; Wang, 2004). The physical environment directly influences the relationship between neighborhood social factors and adolescent mental health by altering individual and family protective behaviors. The social characteristics indirectly elevate the level of psychological distress in children by reducing perceptions of safety and general well-being in children and their guardians (McLoyd, 1990). Increased parental psychological distress is hypothesized to influence child mental health through the disruption of family processes, such as parent-child attachment and parental involvement (McLoyd, 1990; Rankin & Quane, 2002).

The review of theoretical and empirical literature on adolescent depressive symptoms and the neighborhood built environment informed a conceptual model of the interactive role of physical elements of communities with the more extensively researched individual and collective social correlates of mental health disorders. The analysis of established built environment variables yielded two objectively measured features of urban neighborhoods that may be relevant to future health studies, resource availability and landscape diversity. In the present study, the resource availability factor showed limited association with elevated depressive symptoms when analyzed along with well-established depressive symptom correlates although limitations of the study warrant caution in drawing conclusions. Despite the limitations, the results provide insights for social work practice, policy, and research to target elements of the built environment to improve individual adolescent outcomes.

Study Limitations

Many of the challenges inherent in this study are related to available data and measurement. A key limitation of the systematic review is the lack of previous empirical studies on the association between the built environment and adolescent mental health. The complexities of measurement were identified as a limitation; the second component of this study sought to specifically address this limitation by analyzing a collection of objective measures of urban neighborhoods. Along with self-report questionnaires and independent observer rating inventories, the objective measures, generally developed within a GIS framework, are key aspects of reliably measuring the physical properties of neighborhoods. Despite strong evidence of the structure of the factors, more analysis of construct validity is necessary. The limited association found between the constructed built environment factors and elevated depressive symptoms is more evidence for the need for further analysis of built

environment measurement. The strong association found between the participant neighborhood perceptions and depressive symptoms suggests that a combination of objective measurement and subjective observations may be most appropriate.

Implications for Social Work

Changing the material elements of clients' neighborhoods to improve their well-being is within the scope of social work's guiding principles. Historically, the "person-in-environment" perspective has served as a guide to approaching social work practice (Green & McDermott, 2010). By stressing the ecological nature of the factors that influence vulnerable populations, the "person-in-environment" perspective accentuates the importance of working with, not despite, environments to create sustainable social change (Fook, 2002). Clinical practitioners acquire direct knowledge of how the physical conditions of clients' homes, schools, work and neighborhood environments exacerbate psychosocial risk factors. An example of this type of influence is the work of Project H.O.M.E, a Philadelphia-based social work organization, which has contributed insights from clinical services with homeless and working-poor populations to the site assessment process for government-subsidized residential development. The organization is currently lobbying for amendments to the Pennsylvania Housing Authorities Act of 1937 that will provide more local control for large scale, state-funded development activities.

Community practice social workers have an excellent opportunity to promote client well-being within the context of their built environment. Practitioners working in community organizing, policy advocacy, and related areas are able to influence the laws that govern those responsible for the physical environments in which our clients live. Despite the mandate of the National Environmental Policy Act (NEPA) (United States Congress, 1969)

to consider a wide range of community health impacts, planning for economic development activity frequently neglects to consider the mental health consequences to those populations living in areas where new roads, buildings, and other structures are being altered. With respect to the specific concerns of this paper, social workers can play an active role in expanding the protocols of environmental impact assessment, which is a requirement for any policy, program, or project that alters the built environment, to include mental health outcomes. Political advocacy should be grounded in both in-depth knowledge of our clients and empirically-based research.

A better understanding of the effects of the built environment on adolescent mental health is needed to inform social interventions. Despite research that supports direct and indirect influences of the built environment on adolescent depressive symptoms, little is known about which specific aspects of youths' physical environment (e.g., home vs. neighborhood elements) exert the greatest influence on mental health and which specific characteristics of youth make them more susceptible. A pressing need exists for intervention research that tests the effects of environmental change on individual outcomes. Ethical concerns and the availability of resources may preclude researchers from attempting randomized controlled trials using communities as a level of analysis; researchers who implement quasi-experimental designs will need to be cognizant of issues of selection bias when testing causal mechanisms.

Conclusion

Almost a century has passed since the seminal work of Shaw, McKay, and Park that established the unique effect of neighborhood characteristics on individual outcomes (Park, Burgess, & McKenzie, 1925; Shaw & McKay, 1942). Despite a recent increase of

observational research supporting the influence of neighborhood characteristics, no scalable community interventions to improve these collective processes as a means to reduce mental distress exist. This study found a significant relationship between depressive symptoms and social relationships with parents, peers, and neighbors; however, acquiring the resources needed to build and test programs to improve neighborhood social traits, such as collective efficacy and social capital, is difficult. By targeting the physical environment in addition to social factors related to depressive symptoms, interventionists have the opportunity to persuade a more diverse group of stakeholders to participate than would be likely for a typical social intervention. In addition to the potential positive effects on adolescent depressive symptoms discussed in this study, improvements to the built environment have other social (e.g., crime reduction) and economic (e.g., property value) benefits to distressed urban communities that may encourage external stakeholders to indirectly invest in the mental health of vulnerable populations.

Appendix A: Excluded articles, Systematic review

Citation	Inclusion Criteria Violation
Bohnert, A. M., Richards, M., Kohl, K., & Randall, E. (2009). Relationships between discretionary time activities, emotional experiences, delinquency and depressive symptoms among urban African American adolescents. *Journal of Youth and Adolescence, 38*, 587-601.	No clear neighborhood built environment measurement.
Bond, L., Toumbourou, J. W., Thomas, L., Catalano, R. F., & Patton, G. (2005). Individual, family, school, and community risk and protective factors for depressive symptoms in adolescents: a comparison of risk profiles for substance use and depressive symptoms. *Prevention Science, 6*, 73-88.	No clear neighborhood built environment measurement.
Curto, B. M., Paula, C. S., do Nascimento, R., Murray, J., & Bordin, I. A. (2011). Environmental factors associated with adolescent antisocial behavior in a poor urban community in Brazil. *Social Psychiatry and Psychiatric Epidemiology, 46,* 1221-1231.	No clear neighborhood built environment measurement.
Dupéré, V., Leventhal, T., & Lacourse, E. (2009). Neighborhood poverty and suicidal thoughts and attempts in late adolescence. *Psychological Medicine, 39,* 1295-1306.	No clear neighborhood built environment measurement.
Eamon, M. K. (2000). Structural model of the effects of poverty on externalizing and internalizing behaviors of four-to five-year-old children. *Social Work Research, 24*, 143-154.	Only internal built environment measurement.
Estrada-Martínez, L. M., Caldwell, C. H., Bauermeister, J. A., & Zimmerman, M. A. (2012). Stressors in multiple life-domains and the risk for externalizing and internalizing behaviors among African Americans during emerging adulthood. *Journal of Youth and Adolescence, 41*, 1600-1612.	No clear neighborhood built environment measurement.
Gapen, M., Cross, D., Ortigo, K., Graham, A., Johnson, E., Evces, M.,& Bradley, B. (2011). Perceived neighborhood disorder, community cohesion, and PTSD symptoms among low-income African Americans in an urban health setting. *American Journal of Orthopsychiatry, 81*, 31-37.	No clear depressive symptom measurement.
Gary, T. L., Stark, S. A., & LaVeist, T. A. (2007). Neighborhood characteristics and mental health among African Americans and whites living in a racially integrated urban community. *Health & Place, 13*, 569-575	Adult sample
Hazel, N. A., Hammen, C., Brennan, P. A., & Najman, J. (2008). Early childhood adversity and adolescent depression: The mediating role of continued stress. *Psychological Medicine, 38*, 581-590.	No clear neighborhood built environment measurement.
Jalaludin, B. B., & Garden, F. L. (2011). Does urban sprawl impact on self-rated health and psychological distress? A multilevel study from Sydney, Australia. *EcoHealth, 8*, 268-276.	Adult sample
Kling, J. R., Liebman, J. B., & Katz, L. F. (2007). Experimental analysis of neighborhood effects. *Econometrica, 75*, 83-119.	No clear neighborhood built environment measurement.

Kruger, D. J., Reischl, T. M., & Gee, G. C. (2007). Neighborhood social conditions mediate the association between physical deterioration and mental health. *American Journal of Community Psychology, 40*, 261-271.	Adult sample
Leventhal, T., & Brooks-Gunn, J. (2003). Moving to Opportunity: An experimental study of neighborhood effects on mental health. *American Journal of Public Health, 93*, 1576 - 1582.	No clear neighborhood built environment measurement.
Riina, E. M., Martin, A., Gardner, M., & Brooks-Gunn, J. (2013). Context matters: Links between neighborhood discrimination, neighborhood cohesion and African American adolescents' adjustment. *Journal of Youth and Adolescence, 42*, 136-146.	No clear neighborhood built environment measurement.
Thurber, C. A., & Malinowski, J. C. (1999). Environmental correlates of negative emotions in children. *Environment and Behavior, 31*, 487-513.	Built environment measurement not conducted in participant neighborhood.
Wickrama, K. A. S., & Bryant, C. M. (2003). Community context of social resources and adolescent mental health. *Journal of Marriage and Family, 65*, 850-866.	No clear neighborhood built environment measurement.
Xue, Y., Leventhal, T., Brooks-Gunn, J., & Earls, F. J. (2005). Neighborhood residence and mental health problems of 5-to 11-year-olds. *Archives of General Psychiatry, 62*, 554 -563.	No clear neighborhood built environment measurement.

Appendix B: Sources of funding and potential conflicts of interest, Systematic review

Citation	Sources of Funding
Aneshensel & Sucoff (1996)	National Institute of Mental Health (5R0 1 MH4083 1- 05)
Ford& Rechel (2012)	N/A; Lead Author Affiliation: College of Nursing, The Ohio State University.
Furr-Holden et al. (2011)	N/A; Lead Author Affiliation: Department of Mental Health, Bloomberg School of Public Health, Johns Hopkins University.
Gutman& Sameroff (2004)	John D. and Catherine T. MacArthur Foundation
Hadley-Ives et al. (2000)	National Institute of Mental Health (5R24MH50857)
Lercher et al. (2002)	Austrian Ministry of Science and Transportation; Austrian-US Fulbright Commission; National Institute of Child Health and Human Development (1F33 HD08473–01): College of Human Ecology, Cornell University.
Milam et al. (2012)	N/A; Lead Author Affiliation: Department of Mental Health, Bloomberg School of Public Health, Johns Hopkins University.
Natsuaki et al. (2007)	National Institute of Mental Health (MH48165)
Schaefer-McDaniel (2009)	The Graduate Center of the City University of New York; Ontario Ministry of Health and Long-Term Care.
Singh & Ghandour (2012)	N/A; Lead Author Affiliation: Maternal and Child Health Bureau, Health Resources and Services Administration, U.S. Department of Health and Human Services
Uddin et al. (2011)	National Institutes of Health (DA022720; DA022720-S1; RC1 MH088283-01)
Wells& Evans (2003)	John D. and Catherine T. McArthur Foundation; W. T. Grant Foundation; Cornell University; National Institute for Child Health and Human Development, New York State; National Institute of Mental Health (T32MH19958-05).

Appendix C: AMSTAR checklist, Systematic review

AMSTAR Checklist	**Response**
1. Was an 'a priori' design provided? The research question and inclusion criteria should be established before the conduct of the review. *Note: Need to refer to a protocol, ethics approval, or pre-determined/a priori published research objectives to score a "yes."*	Yes. Registered on PROSPERO.
2. Was there duplicate study selection and data extraction? There should be at least two independent data extractors and a consensus procedure for disagreements should be in place. *Note: 2 people do study selection, 2 people do data extraction, consensus process or one person checks the other's work.*	Yes. See page 21.
3. Was a comprehensive literature search performed? At least two electronic sources should be searched. The report must include years and databases used (e.g., Central, EMBASE, and MEDLINE). Key words and/or MESH terms must be stated and where feasible the search strategy should be provided. All searches should be supplemented by consulting current contents, reviews, textbooks, specialized registers, or experts in the particular field of study, and by reviewing the references in the studies found. *Note: If at least 2 sources + one supplementary strategy used, select "yes" (Cochrane register/Central counts as 2 sources; a grey literature search counts as supplementary).*	Yes. Three databases and alternative sources included in addition to backward search of included articles. See pages 19-21.
4. Was the status of publication (i.e. grey literature) used as an inclusion criterion? The authors should state that they searched for reports regardless of their publication type. The authors should state whether or not they excluded any reports (from the systematic review), based on their publication status, language etc. *Note: If review indicates that there was a search for "grey literature" or "unpublished literature," indicate "yes." SINGLE database, dissertations, conference proceedings, and trial registries are all considered grey for this purpose. If searching a source that contains both grey and non-grey, must specify that they were searching for grey/unpublished lit.*	Yes. See page 20.
5. Was a list of studies (included and excluded) provided? A list of included and excluded studies should be provided. *Note: Acceptable if the excluded studies are referenced. If there is an electronic link to the list but the link is dead, select "no."*	Yes. Included list: Table2.1; Excluded list: Appendix A.
6. Were the characteristics of the included studies provided? In an aggregated form such as a table, data from the original studies should be provided on the participants, interventions and outcomes. The ranges of characteristics in all the studies analyzed e.g., age, race, sex, relevant socioeconomic data, disease status, duration, severity, or other diseases should be reported. *Note: Acceptable if not in table format as long as they are described as above.*	Yes. Included in Table 2.1.

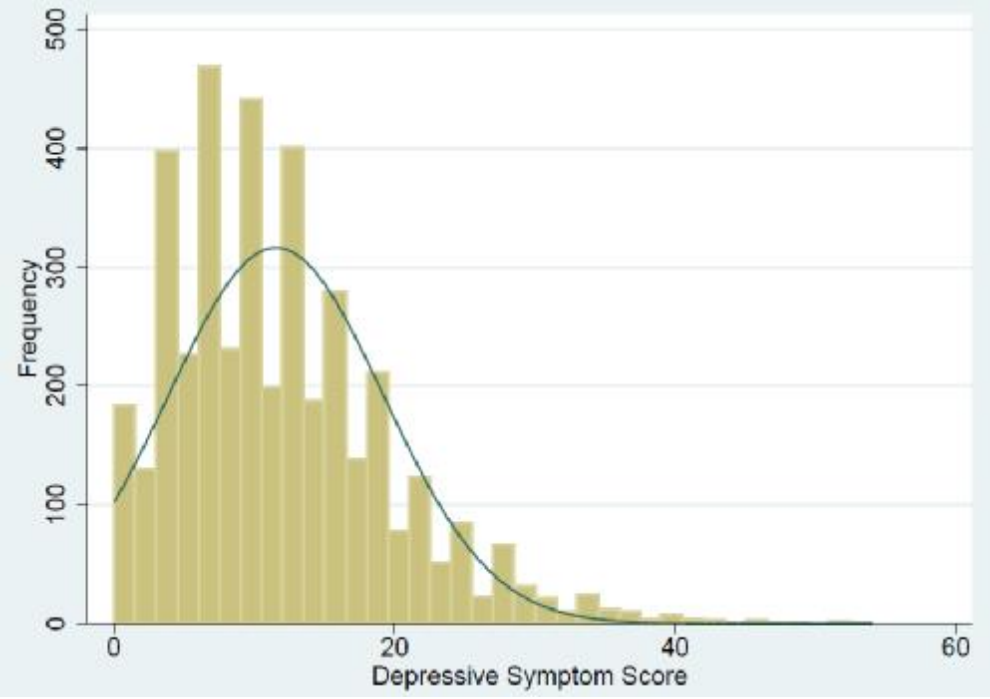
7. Was the scientific quality of the included studies assessed and documented? 'A priori' methods of assessment should be provided (e.g., for effectiveness studies if the author(s) chose to include only randomized, double-blind, placebo controlled studies, or allocation concealment as inclusion criteria); for other types of studies alternative items will be relevant. *Note: Can include use of a quality scoring tool or checklist, e.g., Jadad scale, risk of bias, sensitivity analysis, etc., or a description of quality items, with some kind of result for EACH study ("low" or "high" is fine, as long as it is clear which studies scored "low" and which scored "high"; a summary score/range for all studies is not acceptable).*	Comprehensiveness measure included, see Table 2.2.
8. Was the scientific quality of the included studies used appropriately in formulating conclusions? The results of the methodological rigor and scientific quality should be considered in the analysis and the conclusions of the review, and explicitly stated in formulating recommendations. *Note: Might say something such as "the results should be interpreted with caution due to poor quality of included studies." Cannot score "yes" for this question if scored "no" for question 7.*	Yes, see page 25.
9. Were the methods used to combine the findings of studies appropriate? For the pooled results, a test should be done to ensure the studies were combinable, to assess their homogeneity (i.e., Chi-squared test for homogeneity, I2). If heterogeneity exists a random effects model should be used and/or the clinical appropriateness of combining should be taken into consideration (i.e., is it sensible to combine?). *Note: Indicate "yes" if they mention or describe heterogeneity, i.e., if they explain that they cannot pool because of heterogeneity/variability between interventions.*	Heterogeneity of findings addressed, page 23.
10. Was the likelihood of publication bias assessed? An assessment of publication bias should include a combination of graphical aids (e.g., funnel plot, other available tests) and/or statistical tests (e.g., Egger regression test, Hedges-Olken). *Note: If no test values or funnel plot included, score "no". Score "yes" if mentions that publication bias could not be assessed because there were fewer than 10 included studies.*	Insufficient information available for an adequate number of studies.
11. Was the conflict of interest included? Potential sources of support should be clearly acknowledged in both the systematic review and the included studies. *Note: To get a "yes," must indicate source of funding or support for the systematic review AND for each of the included studies.*	Included (none identified), See Appendix B

Appendix D. Sample characteristics and histogram of dependent variable of depressive symptom scores (N=4055; Minimum=0, Maximum=54)

	Value	Percent
Mean	11.54	
Median	10.00	
Standard Deviation	7.67	
Skewness[a]	1.08	
Kurtosis[b]	4.71	
Depressive Symptom Score Clinical Cutoff ≥ 16		
Sample Above	3023	74.55%
Sample Below	1032	25.45%
Depressive Symptoms Score (Original Proposal)		
Reduced (Scores 0-11)	1290	31.81%
Moderate (Scores 12-20)	2001	49.36%
Elevated (20-57)	794	18.83%

[a]Degree and direction of asymmetry. A normal distribution has a skewness of 0.

[b]Heaviness of the tails of a distribution. A normal distribution has a kurtosis of 3.



Appendix E. Odds ratios from multilevel logistic regression models predicting depressive symptoms (Feelings Scale scores < 16 as reference category) (N=3,434)

	Model 1 Score Cutoff=20				Model 2 Score Cutoff=25				Model 3 Score Cutoff=30			
Item	*b*	O.R.	S.E.	*p*	*b*	O.R.	S.E.	*p*	*b*	O.R.	S.E.	*p*
Individual Level												
Gender (Female is the reference)	-0.703	0.495	0.130	***	-0.883	0.414	0.235	***	-0.962	0.382	0.474	*
Race (Non-white is the reference)	-0.428	0.652	0.112	***	-0.183	0.833	0.213		0.158	1.171	0.375	
Social Bonding	-0.853	0.426	0.144	***	-1.011	0.364	0.151	***	-0.999	0.368	0.201	***
Maternal Closeness	-0.356	0.700	0.113	***	-0.440	0.644	0.111	***	-0.653	0.520	0.131	***
Neighborhood Inclusion	-0.204	0.815	0.069	**	-0.131	0.877	0.049	**	-0.168	0.845	0.149	
Resource Availability	0.003	1.003	0.002		0.002	1.002	0.002		0.005	1.005	0.003	
Landscape Diversity	0.002	1.002	0.017		-0.009	0.991	0.03		-0.046	0.955	0.046	
School Level												
Neighborhood Serious Crime	-2.579	0.076	4.310		5.340	208.513	4.535		5.390	219.203	7.597	
Percentage Vacant Homes	-6.542	0.001	2.420	*	-14.519	0.000	5.54	*	-18.895	0.000	9.732	
Percentage Household < $25K	3.141	23.127	1.421	*	3.961	52.510	1.893	*	7.716	2243.966	2.609	*
Cross-Level Interaction												
Resource Availability * HH<$25K	-0.004	0.996	0.004		-0.003	0.997	0.005		-0.008	0.992	0.007	
Intercept	3.147	23.266	0.740	***	2.964	19.375	0.875	*	1.617	5.038	1.668	
Random Effect (Standard Error)	.134(.080)				.046(.082)				.422(.518)			
Number of Adolescents	3434				3434				3434			
Number of Schools	109				109				109			

Appendix F. Odds ratios from ordered multilevel logistic regression models predicting depressive symptoms (Feelings Scale scores 0-11 as reference category) (N=3,423)

	Model 1 Scores: 0-11, 12-20, 21-57				Model 2 Scores: 0-11, 12-25, 26-57				Model 3 Scores: 0-11, 12-30, 31-57			
Item	*b*	O.R.	S.E.	*p*	*b*	O.R.	S.E.	*p*	*b*	O.R.	S.E.	*p*
Individual Level												
Gender (Female is the reference)	-0.384	0.681	0.107	***	-0.618	0.539	0.111	***	-0.602	0.548	0.117	***
Race (Non-white is the reference)	-0.140	0.869	0.095		-0.482	0.618	0.124	***	-0.493	0.611	0.123	***
Social Bonding	-0.620	0.538	0.132	***	-1.136	0.321	0.109	***	-1.168	0.311	0.109	***
Maternal Closeness	-0.299	0.742	0.079	***	-0.374	0.688	0.093	***	-0.388	0.678	0.012	***
Neighborhood Inclusion	-0.048	0.953	0.039		-0.151	0.860	0.011	***	-0.154	0.857	0.044	***
Resource Availability	0.002	1.002	0.001		0.001	1.001	0.001		0.001	1.001	0.001	
Landscape Diversity	0.019	1.019	0.008	*	-0.015	0.985	0.011		-0.012	0.988	0.012	
School (Neighborhood) Level												
Neighborhood Serious Crime	1.307	3.695	3.997		-2.866	0.057	2.817		-1.881	0.152	3.137	
Percentage Vacant Homes	-1.332	0.264	2.593		0.140	1.150	1.736		0.105	1.111	1.762	
Percentage Household < $25000	0.982	2.670	1.095		1.389	4.011	0.838		1.124	3.077	0.871	
Cross-Level Interaction												
Resource Availability * HH<$25K	-0.004	0.996	0.003		-0.002	0.998	0.002		-0.001	0.999	0.002	
Intercept (Individual Level)	-4.159	0.016	0.730	***	-6.079	0.002	0.647	***	-6.389	0.002	0.676	***
Intercept (School Level)	-1.564	0.209	0.717	*	-3.335	0.036	0.635	***	-2.807	0.060	0.699	***
Random Effect (Standard Error)	.140(.056)				.119(.033)				.258(.078)			
Number of Adolescents	3423				3423				3423			
Number of Schools	108				108				108			
Percentage of Sample												
Minimal	61.26%				61.26%				61.26%			
Moderate	26.88%				33.24%				36.50%			
Elevated	11.86%				5.50%				2.24%			

*p<.05, **p<.01, ***p<.001

REFERENCES

Cantillon, D., Davidson, W. S., & Schweitzer, J. H. (2003). Measuring community social organization: Sense of community as a mediator in social disorganization theory. *Journal of Criminal Justice, 31*, 321-339. doi:10.1016/S0047-2352(03)00026-6

Centers for Disease Control and Prevention. (2012). Youth Risk Behavior Surveillance – United States, 2011. Morbidity and Mortality Weekly Report, 61, 1-138. Retrieved from www.cdc.gov/mmwr

Dhingra, S. S., Strine, T. W., Holt, J. B., Berry, J. T., & Mokdad, A. H. (2009). Rural-urban variations in psycho-logical distress: Findings from the behavioral risk factor surveillance system, 2007. *International Journal of Public Health, 54*, 16-22. doi:10.1007/s00038- 009-0002-5

Fook, J. (2002). *Social work: Critical theory and practice*. London and New York: Sage.

Green, D., & McDermott, F. (2010). Social work from inside and between complex systems: Perspectives on person-in-environment for today's social work. *British Journal of Social Work, 40*, 2414-2430. doi:10.1093/bjsw/bcq056

Kandel, D. B., & Davies, M. (1982). Epidemiology of depressive mood in adolescents: An empirical study. *Archives of General Psychiatry, 39*, 1205-1212.

Kessler, R. C., Avenevoli, S., Costello, E. J., Georgiades, K., Green, J. G., Gruber, M. J, He J-P., Koretz, D., McLaughlin, K. A., Petukhova, M., Sampson, N. A., Zaslavsky, A. M., & Merikangas, K. R. (2011). Prevalence, persistence, and sociodemographic correlates of DSM-IV disorders in the National Comorbidity Survey Replication Adolescent Supplement. *Archives of General Psychiatry, 69*, 372-380. doi:10.1001/archgenpsychiatry.2011.160

Lewinsohn, P. M., Rohde, P., & Seeley, J. R. (1998). Major depressive disorders in older adolescents: Prevalence, risk factors and clinical implications. *Clinical Psychology Review, 18*, 765-794. doi:10.1016/S0272-7358(98)00010-5

McLoyd, V. C. (1990). The impact of economic hardship on Black families and children: Psychological distress, parenting, and socioemotional development. *Child Development, 61*, 311-346. doi:10.2307/1131096

Park, R. E., Burgess, E., & McKenzie, R. D. (1925). *The City: Suggestions for investigation of human behavior in the urban environment*. Chicago, IL: University of Chicago Press.

Rankin, B. H., & Quane, J. M. (2002). Social contexts and urban adolescent outcomes: The interrelated effects of neighborhoods, families, and peers on African-American youth. *Social Problems, 49*, 79-100. doi:10.1525/sp.2002.49.1.79

Shaw, C. R., & McKay, H. D. (1942). *Juvenile delinquency and urban areas*. Chicago, IL: University of Chicago Press.

United States Congress. (1969). National Environmental Policy Act of 1969 (PL 91-190, 1 January 1970). 42 United States Code, 4321–4347, as amended.

United States Department of Health and Human Services. Substance Abuse and Mental Health Services Administration. Center for Behavioral Health Statistics and Quality. National Survey on Drug Use and Health, 2010. ICPSR32722-v1. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2011-12-05. doi:10.3886/ICPSR32722.v1

Wang, J. (2004). Rural–urban differences in the prevalence of major depression and associated impairment. *Social Psychiatry and Psychiatric Epidemiology*, *39*, 19–25. doi:10.1007/s00127-004-0698-8