THE EFFECT OF ADOLESCENT COMMUNITY DISADVANTAGE AND FAMILY DYNAMICS ON DEPRESSION TRAJECTORIES FROM ADOLESCENCE TO YOUNG ADULTHOOD

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ABSTRACT

Minne Chen: The Effect of Adolescent Community Disadvantage and Family Dynamics on Depression Trajectories from Adolescence to Young Adulthood
(Under the direction of Yang Claire Yang)

Understanding the mechanisms that result in depression trajectories has becoming pressingly important for the general well-being of the population as well as for informing prevention efforts. By incorporating the space and time dimensions, this paper investigates the effects of community disadvantage and parental social support during adolescence and how they affect the depression trajectories from adolescence through young adulthood using a multi-level growth curve approach. Findings suggest that parental social support, family having fun together, and living in single-mother households during adolescence, being a member of minority racial categories, parental education, and self-rated health are all significantly associated with depressive symptoms from adolescence to young adulthood. However, community disadvantage during adolescence does not significantly influence the trajectory of depressive symptoms, or only influences the trajectory of depressive symptoms to a minimal extent taken into account all other previously stated factors, neither do the interactions between community disadvantage and family factors.

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LIST OF ABBREVIATIONS

SES	Socioeconomic status
Add Health	The National Longitudinal Study of Adolescent Health

SECTION 1: INTRODUCTION

According to the definition of the World Health Organization, depression is a common mental disorder, characterized by "sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness, and poor concentration". Being different from mood fluctuations and short-term responses to everyday stress, it can be present for a long time or occur repeatedly, impairing one's ability to function in school, work, and life, thus resulting in a decline in the quality of the nation's human capital. When the condition is most severe, it can result in suicide (WHO Fact Sheet, 2017). As a major cause of the global burden of disease (Gariépy et al., 2016), over 300 million people across all age groups suffer from depression (WHO Fact Sheet 2017). In 2016, around 3.1 million (12.8%) adolescents and around 16.2 million (6.7%) adults in the United States experienced at least one major depressive episode (National Institute of Mental Health, 2016). Thus, understanding the mechanisms that result in depression trajectories has becoming pressingly important for the general well-being of the population as well as for informing prevention efforts.

Past research has suggested that the communities in which individuals live as well as family dynamics could have a profound impact on adolescents' mental health, as family and neighborhood are the two most proximate environments for adolescents. Meanwhile, the influence from neighborhood and family during adolescence may well last into adulthood and influence developmental trajectories of depressive symptoms (Adkins et al., 2009). Therefore, it is important to look at how these different factors interplay with each other to influence individual outcomes across space and time (Entwisle, 2007, Sharkey & Elwert, 2011, Sharkey &

Faber, 2014). By incorporating the space and time dimensions, this paper investigates the effects of community disadvantage and parental social support during adolescence and how they affect the depression trajectories from adolescence through young adulthood using a multi-level growth curve approach.

SECTION 2: LITERATURE REVIEW

Section 2.1 The Effect of Living in Disadvantaged Neighborhoods on Depression

Neighborhood context is very important to the development of adolescents, as adolescents reside in and go to school around the neighborhood. Living in disadvantaged neighborhoods increases the level of depressive symptoms during adolescence in several ways. Studies suggest that community disadvantage exerts an impact on adolescent depression symptoms above and beyond family-level factors (Ross & Mirwosky, 2001; McBridge et al., 2011). Residents in disadvantaged communities frequently see signs of incivility, including drunks, prostitutes, burned-out buildings, unkept lots, noise, and graffiti (Hunter, 1978). They tend to encounter more violence and crimes. These experiences collectively cause people to feel a sense of fear (LaGrange et al., 1992). They often feel threatened of being victimized, of leaving the house or of worrying that other people might break into their homes (Aneshensel & Sucoff, 1996). This produces pressure which in turn produces a high level of adrenal hormones that negatively influences mental health (Ross & Mirowsky 2001). Meanwhile, the poor environment directly limits residents' opportunities to participate in outdoor activities. Lack of physical activities and the pleasure from exercises have been shown to increase individuals' depressive symptoms (Ross & Mirowsky 2001).

Section 2.2 The Effect of Family Dynamics on Depression

Meanwhile, research has found that family dynamics are often associated with depressive symptoms during adolescence. This study examines parental social support and family cohesiveness as two indicators of family dynamics.

Parental Social Support

Research has shown that social support from various sources protects people from depressive symptoms. Thoits (1992) suggested that insufficient social support can result in depressive symptoms regardless of the presence of stressful events. The social constructionist perspective of social support offers a similar view. The perspective suggests that social support influences health by raising people's self-esteem and self-regulation, regardless of whether they are facing stressful situations (Lakey & Cohen, 2000). Meanwhile, the "buffering hypothesis", mentioned by Cohen and Wills (1985), is more relevant to the present study. It suggests that social support moderates the influence of stressful life events on depression symptoms. This coincides with the stress and coping perspective of social support mentioned by Lakey & Cohen (2000). The perspective suggests that social support in the form of assistance or confidence make coping with stressful situation easier or at least to seem less stressful. These theories delineate the importance of supportive actions in influencing people's health.

Though adolescents are moving toward autonomy and are increasingly involved with people and issues outside family context, various studies have shown that adolescents still want their families to be close. They also benefit from supportive parents and cohesive family relationships (Feldman & Gehring, 1988; Barber & Schluterman, 2008; Laursen & Collins, 2009). A meta-analysis from 31 previous studies, though they vary in study designs, shows that social support from parents and family is most consistently associated with lower depression in children and adolescents compared to other sources of social support (Gariépy et al. 2016).

According to previous studies, parental social support often interacts with gender, sources of social support (father or mother), and family structure to influence adolescent depressive symptoms. Some studies suggest that the effect of maternal social support and paternal social

support on adolescent depressive symptoms to be equally important, while girls with low levels of parental support have significantly higher depressive symptoms than boys with similarly low levels of parental support (Needham 2008; Gariépy et al 2016). Other studies suggest that while maternal social support is an important source of protection for depression in adolescent girls, the effect does not exist among adolescent boys other than boys who live in single-mother households (Patten et al. 1997). Patten et al (1997) also took a step further to conclude that family structure is not significantly associated with adolescent depression symptoms, but the lack of social support from one parent while he or she is around matters by finding that in two parent households, lack of parental support from either parent leads to significantly higher depression in both genders. However, in households that have neither parent present, adolescents do not have significantly higher depression symptoms.

Family Cohesiveness

Other than the stress and coping perspective and the social constructionist perspective, the relationship perspective of social support suggested by Lakey & Cohen (2000) mentions that the health effect of social support cannot be separated from relationships within a family, and that bad relationships might actually result in poor social support from parents. Fiore, Becker & Coppel (1983) emphasize the importance of separating the relationship perspective (whether the relationship was upset or satisfying) and perceived supportiveness perspective. They found that conflict or a relationship full of troubles rather than social support within families, better predicts health. While traditional social support is defined as actual supportive behaviors or belief that support is available, the relationship perspective focuses more on companionship, intimacy, relationship satisfaction, cold relationships, and conflict (Lakey & Cohen, 2000). Research has found that a warm and cohesive family is closely related to adolescent health outcomes,

including physical and mental outcomes (Crespo et al., 2011). Meanwhile, families with conflicts, aggression, and even violence, are detrimental to adolescent physical and mental outcomes (Downey & Coyne, 1990; Kennedy et al., 2010). Among the findings of studies examining the effect of family relationships on depressive symptoms, family factors seem to matter more for girls than for boys. It is suggested that having a cohesive family has a stronger relationship for the mental health of girls than that of boys (Crespo et al., 2011). Some studies have suggested that in a family setting, the quality of husband-wife relationship often influences the quality of parent-child relationships and sets the foundation for overall family relationship that influences child outcomes (Crockenberg & Smith, 1982).

Other than perceived parental social support and the relationship within families, family structure is an important element of family dynamics. Some scholars have argued that neighborhood poverty is not as big as a problem for poor families with two parents, as two-parent families provide stability and order to the family members (Wilson, 1996).

Section 2.3 Depression within Multi-Level Framework: Family Dynamics as a Moderator between Neighborhood Disadvantage and Adolescent Depression

Neighborhoods do not exert a homogeneous influence on its residents. It has different influences on subsets of the residents, depending on other individual level factors and the sub-context individuals live in, such as the family (Leventhal & Brooks-Gunn, 2000). Studies have also found that while neighborhood-level factors tend to account for around 5-10% differences in child and adolescent outcomes, family factors almost always have a stronger effect on individual outcomes than neighborhood-level factors (Leventhal & Brooks-Gunn, 2000). Therefore, studies

about the specific mechanisms by which neighborhood level factors influences individuals needs to be done (Sharkey & Faber, 2014; Wodtke et al., 2011).

Ecological theory (Bronfenbrenner, 1986; Bronfenbrenner, 1994) suggests a model that explores how individual characteristics as well as the environment act interactively on one's development. According to the theory, the micro- and the meso-systems function together to influence individuals living in the systems. In this study, the microsystem refers to individual-level factors such as family structure, perceived parental social support, and family relationships, while the mesosystem refers to community-level disadvantage. The interaction happening in the microsystem is likely to influence how factors in the mesosystem impact one's development. For example, an adolescent from a socially supportive, cohesive and stable two-parent family may feel a sense of emotional security which buffers him or her from the negative impact of living in a disadvantaged community. Meanwhile, a socially unsupportive, unstable family with frequent conflict may make the adolescent more vulnerable to the negative influences from the community on his or her mental health.

Previous studies have suggested family factors as potential moderators of neighborhood effects on adolescents. Some family factors may make the influence of neighborhood risk on adolescents worse, while other protective family factors may buffer individuals from the deleterious effects of neighborhood disadvantage. Using Hierarchical Linear Modeling, Wight et al (2006) showed that community-level disadvantage has a varying impact on individual depressive symptoms above and beyond individual-level characteristics. Meanwhile, the impact of community-level disadvantage varies across individual-level characteristics. Higher perceived social support from family, friends and other adults protects adolescents from depression in less

disadvantaged communities. In more disadvantaged areas, the protective effect is weakened and there is less difference between adolescents who have higher perceived social support and adolescents who have lower perceived social support.

However, most past research examined community and family effects separately. For example, family characteristics have often been controlled in neighborhood studies in order to study their relative importance in influencing individual outcomes (Sharkey & Faber, 2014; Altonji & Mansfield, 2011). This could be misleading as the factors could interact with each other in influencing individual outcomes.

Section 2.4 Life Course Perspective on Depression Symptoms

Though Wickrama et al (2008) find no significant increase of depressive symptoms during adolescent years, more literature has agreed that there is an average increase in depressive symptoms during early adolescence which peaks in mid to late adolescence (Adkins et al., 2009), and starts to decline as adolescents enter adulthood (Brooks-Gunn and Peterson, 1991; Meadow et al., 2006; Radloff, 1991; Ge et al. 2006). Research has also found group differences in the trajectories of depressive symptoms. Some studies indicate that females start with higher levels of depressive symptoms in adolescence than males, although the difference may converge during adulthood (Adkins et al., 2009; Ge et al., 2006). Other studies find that females generally have more depressive symptoms than males do from early adolescence to adulthood (Mirowsky & Ross, 1995; Brooks-Gunn et al., 1991; Hankin et al., 1998). In terms of difference in racial groups, most studies find that minorities (i.e. Blacks, Hispanics, and Asian Americans) have higher levels of depressive symptoms from adolescence to young adulthood compared to their white counterparts. Meanwhile, people of minority racial groups are also more vulnerable to the negative effect of low early life SES and stressful life events (Garrison et al., 1990; Gore &

Aseltine, 2003; Mirowsky & Ross, 1995, Adkins et al., 2009, Greenberger & Chen., 1996). However, it's worth noting that some other studies do present contradictory findings. For example, Prelow and Guarnaccia (1997) found that white adolescents have higher depressive symptoms than minority racial groups. But Meadows, Brown and Elder (2006) suggest that the contradictions might be due to differences in treating racial categories (especially the Hispanics category) as well as in measuring depressive symptoms, and whether race/ethnicity is the focus or a control in the analysis.

The life course perspective is a longitudinal approach which emphasizes developmental trajectories along different stages of life and how social factors in the changing ecologies as well as individual traits lead to the path of these trajectories (Elder 1998, Elder et al. 2003). A number of studies has found that early life disadvantages could have a profound influence on later physical and mental health trajectories (Wickrama et al. 2003; McLeod & Almazan 2003; Elder & Liker 1982). This is compatible with the social causation model which suggests that inadequate parental social support and disadvantage during early life can result in higher depressive symptoms at a later age (Bradley & Corwyn 2002, Needham 2008, Wickrama et al 2005).

Meanwhile, the social selection model suggests that having poor mental health during early life can lead to stressful social pathways. This means that an adolescent with higher depressive symptoms may be trapped in disadvantage when they grow up as they have developed fewer necessary skills and competencies to reach their desired goals, and evidence has shown that they obtain less social support from within and outside the family with less resources available (Miech et al 1999; Needham 2008). These could in turn contribute to continued depressive symptoms directly or indirectly through the disruption of timing in transitions (Wickrama et al.

2005; McLeod & Kaiser 2004). This cycle of disadvantage and depressive symptoms leading to each other is consistent with the life-course perspective. Some other studies have suggested that early life disadvantage could directly lead to stressful social pathways and disrupted transitions (Gore, Aseltine & Schilling 2007; O'Rand & Hamil-Luker 2005; Pearlin et al. 2005). This is consistent with cumulative disadvantage theory in the life course perspective in which disadvantages in early life lead to disadvantages in later life, which in turn could have a negative impact on depressive symptoms at a later age.

Research has found that individual's experience during adolescence, including where they live, alters their developmental trajectories and has consequences later in life. The consequences ranging from obesity, worse cognitive ability, and higher risk for cardiovascular disease (Liu & Umberson, 2015; Sharkey & Elwert, 2011; Barker, 1995). For example, living in a disadvantaged community can influence the cognitive trajectories of African American children (Sampson et al., 2008). In terms of depression trajectories, studies have found that growing up in a disadvantaged community can negatively impact adolescents' trajectories of depressive symptoms as they further enter young adulthood. Though the impact becomes weaker over time, early life SES can also have a lasting impact on trajectories of depressive symptoms (Adkins et al. 2009). Both studies done by Goosby (2013) and Wheaton & Clarke (2003) suggest that there might be long-term effects on depressive symptoms from earlier exposure to neighborhood disadvantage.

However, past research exhibits several limitations. First, while many studies have been done to examine depressive symptoms during adolescence and during the transition into young adulthood, and while many researches tend to be cross-sectional or to study how contemporary

factors influences one's depressive symptoms, relatively few have studied the long-term effects of neighborhood and family factors during adolescence on trajectories of depressive symptoms. Some other studies with longitudinal features are usually done in two time-points circumstances instead of analyzing depressive symptoms as trajectories. Second, though some previous studies have examined how family factors moderate the negative influence of community disadvantage on adolescent depressive symptoms, studies on this topic generally are lacking. Problems such as only including both biological families and all other families as categories of family structure omit other important categories such as single mother households and single father households. Including single parent households is important as they represent large proportion of US families. Third, past research has often examined parental social support, family relationships, and family structure separately, although evidence has shown that family cohesiveness might be a different construct than parental social support.

The present study has several strengths. First, this study focuses on how factors during adolescence could have a long term impact on the trajectories of depressive symptoms. While many studies have focused on how contemporary factors influence one's depressive symptoms during adolescence, this study closes the gap in the literature by taking into account both the "space" in which adolescents live and the "timing" of their development in studying developmental trajectories of depressive symptoms. Second, the present study includes both quantitative and qualitative aspects within family relationships. Quantitative aspect within family relationships refers to the family structure, while qualitative aspect within family relationships refers to whether parents provide enough social support and whether family relationships are full of happiness comparing to family relationships that are full of conflicts. Third, the present study accentuates the buffering hypothesis by assessing how family factors protect mental health from

the upper level contextual factors, and whether the interactive effect of contextual level factors and individual level factors (including family factors and individual characteristics) have long-term associations with depressive symptom trajectories.

SECTION 3: HYPOTHESES

Based on past findings, the study generates three hypotheses.

1. Community disadvantage is associated with greater levels of depressive symptoms across adolescence and young adulthood.
2. However, strong parental social support, a more cohesive family environment, and two biological parent household structure buffer adolescents from the deleterious effect of living in a disadvantaged neighborhood. Specifically, adolescents who have strong parental support, a more cohesive family environment, and two biological parent household structure tend to have lower levels of depressive symptoms across adolescence and young adulthood than their counterparts who have weak parental social support, a less cohesive family environment, and single-parent household structure.
3. Girls are more sensitive to these family and community factors than boys. Community disadvantage and living in problematic families tend to have a worse effect on girls' depressive symptoms than on boys'.

SECTION 4: DATA

This research uses data from the National Longitudinal Study of Adolescent Health (Add Health). It is a longitudinal study of a nationally representative sample of adolescents. The adolescents were followed through adolescence and the transition to adulthood with four in-home interviews. The first wave of interviews was conducted when the adolescents were in grades 7-12 in 1994-95. The subsequent waves of interviews were conducted in 1996 (Wave II), 2001-2002 (Wave III), and 2008 (Wave IV). The response rates of the four waves of interviews were 79%, 88%, 77% and 80%. The respondents had an average age of 15.6 years old in Wave I, 16.3 years old in Wave II, 21.9 years old in Wave III, and 28.5 years old in Wave IV.

The data particularly suit the proposed study for two reasons. First, Add Health Wave I Contextual Database provides a series of Census county, tract, and block group-level data that are linked to the respondent's ID in the Wave I in home survey. This allows the study to execute a multi-level analysis taking into account meso-level community disadvantage of the adolescents and the micro-level family factors. Second, the longitudinal nature of the data enables the current study to draw measures of depressive symptoms from adolescence through young adulthood to examine how the influence from neighborhood and family factors during adolescence changes both the starting level of depressive symptoms and the trajectory of depressive symptoms from adolescence to young adulthood.

The Wave I data originally consist of 18,924 cases with weights. Respondents who are of age 11, 12 in Wave I, and respondents who are older than age 31 (N=1,122) are deleted due to the small sample size of each of these age categories. These respondents are either students that

are too young or students that are too old in middle school in Wave I. According to Allison (2002), assuming missing-completely-at-random (MCAR), observations with missing values can be deleted as long as the total amount of missing values is small. Missing values across variables in the current study thus result in a list-wise deletion of 871 (4.9%) cases, resulting in 16,931 cases from Wave I. A large portion of the missing values are from missing community-level disadvantage indicators (either through missing geocodes or through unstable estimates), missing family happiness indicators, and missing parental education indicators. Wave II contains 12,424 follow-up interviews from Wave I. Wave III consists of 12,890 cases, and Wave IV consists of 13,312 cases respectively. 8665 respondents (51%), 5181 respondents (31%), 2269 respondents (13%), and 816 respondents (5%) are present in all four waves, three waves, two waves, and the first wave only.

This study will use the depressive symptom score from Wave I, II, III, and IV. Time-varying control variables including age and respondent self-rated health will be drawn from Wave I, II, III, and IV. Other variables, including gender, race, community-level disadvantage, parental social support, family structure, and parental education are drawn from Wave I of the study.

This study focuses on how community and family factors during adolescence influences the development of depressive trajectories of individuals from adolescence to young adulthood. Therefore, if too many respondents move between Wave I and Wave II when they are still in adolescence, the results might be biased. According to the MOVER indicator in the Wave I contextual data file, about 69% respondents did not change residence between Wave I and II, and about 27% respondents who participated in Wave I did not participate in Wave II. About 1% moved within the same census tract, while only about 3% respondents moved to a different

census tract, a different county, a different state, or an unknown location. The number of respondents who moved to a different census tract, a different county, a different state, or an unknown location is negligible.

SECTION 5: MEASUREMENT

- Depression

Add Health uses a feeling scale that is nearly identical to the Center for Epidemiologic Studies Depression (CES-D) screener (Radloff 1977). The question asks "How often was each of the following things true during the past seven days?" A total of 9 items were identical across Waves I, II, III and IV. The 9 items include "You were bothered by things that usually don't bother you", "You could not shake off the blues, even with help from your family and your friends", "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 sad", and "You felt that people dislike you". Two of the nine items "You felt that you were just as good as other people", and "You enjoyed life" are reverse coded to achieve consistency.

Each item has a 4-point scale indicating the respondents' frequency of having each symptom over the past 7 days (0=Never or Rarely, 1=Sometimes, 2=A lot of the time, 3=Most of the time or all of the time). A composite score indicating the level of respondents' depressive symptoms is created based on the total score of these 9 items at all four waves. The score ranges from 0 to 27, with 0 indicating no depressive symptoms and 27 indicating the most severe level of depressive symptoms.

- Community-level disadvantage

According to Ross & Mirowsky (2001), neighborhood disorder is characterized by physical disorder, such as vandalism and damaged buildings, and social disorder, such as crime, conflicts, and drug use. Past research has not reached an agreement on how neighborhood effects should be

operationalized and measured and relatively few studies have provided a definition of disadvantaged neighborhood (Sharkey & Faber, 2014). Most previous studies have defined neighborhood poverty operationally by creating a composite score from various indicators. These indicators typically include census county/tract/block group data assessing the proportion of persons living in poverty, the proportion of households with public assistance, the proportion of residents aged 25 years and above without a high school diploma or equivalency, the proportion of men unemployed, proportion of single-parent households, and the proportion of adults in service occupations (Wickrama & Bryant, 2003; Cummings, 2014; Gordon, 2016; Murry et al., 2011; Wight et al., 2008). Some studies included questions asking if there was graffiti or teenagers fighting in the neighborhood as indicators of disadvantaged community when not using Census data (Natsuaki et al., 2007). Other studies included both physical indicators such as the presence of graffiti and garbage and social indicators such as if people offer help to each other and the level of neighborhood safety (Ford & Rechel, 2012). Beyers et al (2003) suggest that the characteristics of individuals living in the neighborhood and the relationship of the individuals within the neighborhood describe the neighborhood. The relationships individuals can form is often dependent on the characteristics of the individuals. Neighborhoods with a high proportion of rented rather than owned households and a high proportion of households that have moved within the past 5 years usually have less social capital, while neighborhoods with a high proportion of individuals in poverty tend to have less collective efficacy (Sampson et al 1999).

In this study, I selected 6 census tract-level indicators from the Add Health Wave I Contextual Database to construct two measures of community disadvantage. The items include the proportion of persons living in poverty, the proportion of households with public assistance, the proportion of residents aged 25 years and above without a high school diploma or

equivalency, the unemployment rate for males, the proportion of female headed households, and the proportion of adults in service occupations. The values of these items range from 0 to 1. The first measure of community disadvantage is constructed through calculating the number of items that are in the upper quartile (75% and above). The resulting community disadvantage measure ranges from 0 item that is in the upper quartile (least disadvantaged) to 6 items that are in the upper quartile (most disadvantaged.) The second measure of community disadvantage treats community disadvantage as a latent variable, and a Confirmatory Factor Analysis (CFA) will be performed to create a community disadvantage factor score from the various indicators. Census tract identifier is from the Wave I Neighborhood data file. The second measure serves as a sensitivity test for the first measure. The detailed procedure of constructing the community disadvantage factor score is in Appendix 8.

- Perceived parental social support

Perceived parental social support is measured from both co-residing mothers and co-residing fathers. It is constructed from 5 items available in the Wave 1 In-Home Survey. Two of the indicators include "How close do you feel to your mother/father figure", and "How much do you think the resident mother/father cares about you". These two items have a 5-point scale (1=Not at all, 2=Very little, 3=Somewhat, 4=Quite a bit, 5=Very much). The other three items ask the respondents whether they agree or disagree with the following statements: "Most of the time, your mother/father is warm and loving toward you", "You are satisfied with the way your mother/father and you communicate with each other", and "Overall, you are satisfied with your relationship with your mother/father". These three items have a 5-point scale as well (1=Strongly agree, 2=Agree, 3=Neither agree nor disagree, 4=Disagree, 5=Strongly disagree). The three items with the scale from strongly agree to strongly disagree are reverse coded. An average of

the five items was calculated to indicate perceived social support from mother/father. Then, the average of the social support from both fathers and mothers are taken as the average perceived parental social support. For adolescents who only have one resident parent, the perceived social support from that resident parent is taken as the average perceived parent social support. The resulting score ranges from 1 to 5, with 1 indicating least perceived social support and 5 indicating most perceived social support.

- Family happiness

Family happiness is used to indicate whether the family has a cohesive relationship. It is measured by the question "How much do you feel that your family had fun together" from the Wave I In-Home questionnaire. The value of the indicator ranges from 1 to 5 (1=Not at all, 2=Very little, 3=Somewhat, 4=Quite a bit, 5=Very much).

- Control variables

Control variables includes race, age, gender, family structure, self-reported health, and parental educational attainment.

Race is constructed into 5 categories (1=Non-Hispanic White, 2=Non-Hispanic Black, 3=Hispanic, 4=Asian, 5=Other)

Age is coded in years in Waves I, II, III, and IV.

Gender is coded as 0=Male and 1=Female

Family structure is obtained from the Add Health constructed data file. It has 5 categories (1=Two biological parents, 2=Two parents, 3=Single Mother, 4=Single Father, 5=Other).

Self-reported health has a scale of 1-5 (1=Excellent, 2=Very good, 3=Good, 4=Fair, and 5=Poor).

Parental educational attainment is used as an indicator of respondents' socioeconomic status in adolescence and a predictor of respondents' socioeconomic status in young adulthood. Parental educational attainment records the higher educational achievement between mother figure and father figure if data for both are present. If data for only one of the parents are available, educational attainment for this parent is recorded. Both respondent educational attainment and parental educational attainment is coded into four categories: 1=Less than high school diploma, 2=High school diploma, 3=Some college, 4=College graduate or more.

SECTION 6: ANALYTIC STRATEGY

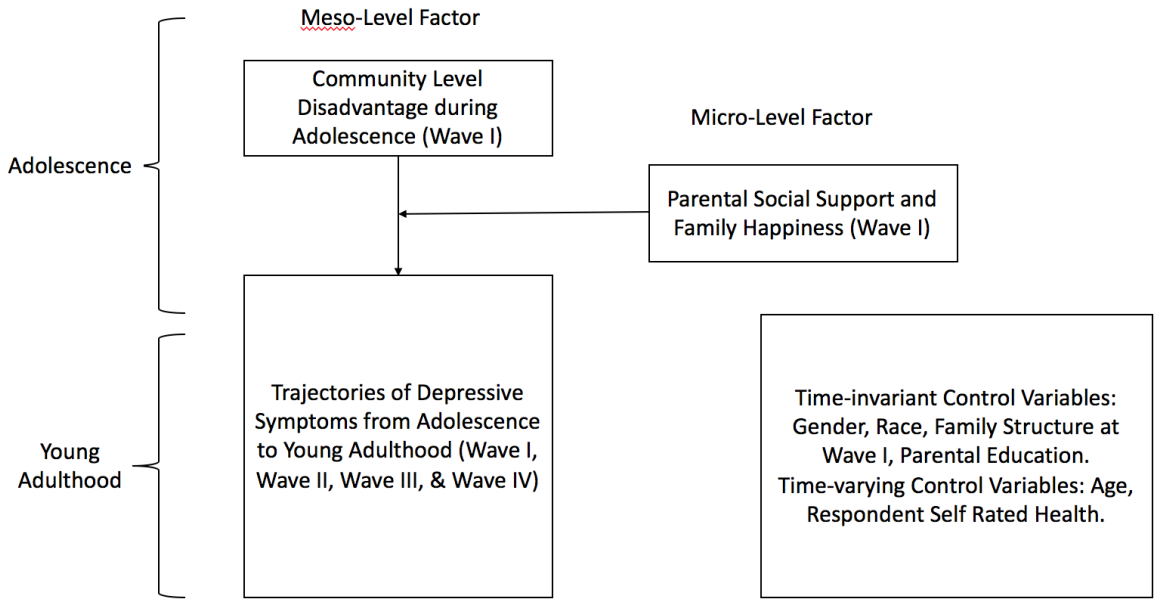

Figure 1 Conceptual Model of Multi-Level Growth Curve (Note: Respondent Education has been deleted from the time-varying control variables)

Multilevel growth curve analysis has two advantages. The growth curve part of the model makes it possible to examine the trajectories of depressive symptoms using repeated measures of the outcome variable from individuals across time. Meanwhile, the multilevel feature disentangles the processes of the development of depressive symptoms by including both higher-level community factors and lower-level family and individual factors, and attributing the unexplained variability of trajectories of depressive symptoms to factors at these two levels. In particular, it assumes that individuals have something in common by residing in community and

families that are similar, and thus develop similar levels of depressive symptoms by residing in similar communities and households.

The current model includes community-level disadvantage at Wave I, parental social support and family happiness at Wave I, and the full set of time-invariant and time-varying control variables to predict individuals' starting level (intercept), linear (slope), and nonlinear growth of trajectories of depressive symptoms. In particular, parental social support and family happiness at Wave I serve as moderators of the relationship between community-level disadvantage at Wave I and trajectories of depressive symptoms. This study analyzes the effects on the initial level of depressive symptoms, the rate of change of depressive symptoms, as well as on the peak age of depressive symptoms using depression score from Wave I, II, III & IV. In addition, this study also tests the moderating effects of gender, as I expect the depression trajectory to differ for males and females. The impact of neighborhood and family factors on depression trajectories may differ by sex as well.

Section 6.1: Model Specification

$$\text{Level 1:} \quad Y_{kij} = \pi_{0ij} + \pi_{1ij}(\text{Age})_{kij} + \pi_{2ij}(\text{Age}^2)_{kij} \ldots + \pi_{pij}(\text{Age}^p)_{kij} + e_{kij}$$

$$\text{Level2:} \quad \pi_{oij} = \beta_{ooj} + \beta_{oqj} X_{oij} + r_{oij}$$

$$\text{Level3:} \quad \beta_{ooj} = \gamma_{ooo} + \gamma_{oos} W_{sj} + u_{ooj}$$

Age is centered by subtracting 15 (the mean age in Wave 1). In the model, Level 1 accounts for variance within individuals and describes the trajectories of depressive symptoms within each individual across time. Y_{kij} is the depressive symptoms score at age k for individual i in community j. π_{0ij} is the depressive symptoms score of individual ij at age 11, π_{1ij} is the linear slope of individual$_{ij}$, and π_{pij} is the quadratic/cubic etc. slope of individual$_{ij}$. e_{tij} is the random

error for the individual i at age t in community j.

Level 2 describes the trajectories of depressive symptoms across the individuals in each community. π_{0ij} accounts for the effect from the individuals within each community. β_{00j} is the intercept for community j. X_{0ij} represents the individual factors (family factors and individual control variables) as well as the interaction of individual factors and the community disadvantage of individual i in community j, and β_{0qj} is the linear slope of these individual level factors. r_{0ij} is the random effect that is unaccounted for from each individual by the factors that have already been included in the study. The Level 2 model is used to predict the intercept in the Level 1 model.

Level 3 accounts for variance between communities, and describes the difference in the trajectories of depressive between communities. The level 3 model is used to predict the intercept in the Level 2 Model. β_{00j} is predicted by neighborhood-level characteristics. γ_{000} is the intercept of the model. γ_{00s} is the linear slope of the neighborhood level characters, W_{sj}. u_{00j} is the random effect that is unaccounted for from each neighborhood by the neighborhood level factors that have already been included.

Section 6.2: Using Fixed Effects or Random Effects (Mixed Effects) Model

Using fixed effects model removes the time-constant explanatory variables prior to estimation. However, although time-constant explanatory variables cannot be added to the model by themselves, they can be included in interaction terms with other variables. On the opposite, random effects (mixed effects) model assumes that all unobserved effect is uncorrelated with all explanatory variables (Woodridge, 2015). In this model, the controls seem to be pretty comprehensive so that we can assume that any leftover variation that is not included in the

control variables does not cause correlation between the errors and the explanatory variables. Also, most key explanatory variables in this study are constant across waves. The Hausman test might be performed and a rejection suggests using fixed effects estimation as random effects assumptions are false. According to Curran & Willoughby (2003) and Guo & Hipp (2004), random effects (mixed effects) models, including multilevel models, are often used to analyze developmental trajectories across time periods and the predictors of the trajectories.

Section 6.3: Correcting for design effects of the Survey

In Add Health data, the observations are not independent and identically distributed because Add Health study design employed a clustered sample in which the clusters were sampled with unequal probability (Chen & Chantala, 2014). Analyses could be potentially biased when characteristics related to being selected into the sample also influences the dependent variable. For example, as high SES blacks are over-sampled in Add Health study, estimates of the depressive symptoms of the Blacks might be biased if high SES is potentially related to less depressive symptoms. To obtain the correct estimation, analyses need to take into account the special sample design of clustering, stratification, and sampling weights. Only taking into account weights produces correct point estimates, such as ratios, totals, and means, and unbiased estimates of parameters in a regression model. In order to obtain correct variances, standard errors, and confidence intervals, analyses need to adjust for all factors including clustering, stratification, weights, and design type (Chen & Chantala, 2014).

For studies using multi-level models, Add Health includes a weight component for the school level and the individual level data. Though there is no weight component variable for community level data in Add Health, according to Christ (2014), only schools violate the

independence assumption as a geographic level. This means that studies do not need to correct for clustering at geographic levels other than the school level. However, Add Health data does not provide three-level weights, and the current version of Stata is not able to scale weights for three level models. The XTMIXED command I use for the multi-level models is not supported by the SVY command to account for complex survey settings. This study therefore decides to run the three-level model (community-individual-repeated measures within individuals) without applying weights and correcting for other design characteristics (See Appendix 2&3). Sensitivity tests will be done using a three level model with two-level longitudinal weights SCHWT1 and W4_WC (See Table 2.5 in Chen & Chantala (2014)). The full output is presented in Appendix 4. In this model, those without Wave 4 weights are dropped, thus reducing the sample size at Wave I to 9,421. List-wise deletion of observations with missing values further reduces the sample size at Wave I to 9,227. Meanwhile, Chen & Chantala (2014) also suggest that researchers should choose to use single-level model and single-level weight if one's interest is in incorporating higher-level variables, but not in getting estimates about the random effects part, even if the study is longitudinal. Therefore, another sensitivity test will be done using a single-level model in which the community characteristics become individual characteristics. The single-level model incorporates the survey design characteristics using SVY command in Stata (See Appendix 5).

According to Add Health User Guide (Chen & Chantala, 2014), the choice of sampling weight in longitudinal analysis is determined by the data collected at the most recent wave (as in the sensitivity test in Appendix 4). However, using Wave I weights is suggested if age, instead of wave, serves as the time-parameter of the study, and anyone with one or more observations

contributes to the data. Therefore, in the single-level sensitivity test in Appendix 5, the sampling weight variable to use for multilevel models incorporating data from Wave I, II, III, and IV is GSWGT1.

SECTION 7: DESCRIPTIVE STATISTICS

Based on Table 1, Wave I consists of 16,931 cases of depressive symptoms records, Waves II, III, & IV contains 12,424, 12,890, and 13,312 cases at follow-up interviews.

In the sample, the age ranges from 13 years old to 18 years old in Wave I and 24 years old to 31 years old in Wave IV. About half of the sample is female. 52% and 21% of the sample are Non-Hispanic Whites and Non-Hispanic Blacks respectively. About 16.7% respondents are of Hispanic background.

The mean of depressive symptoms declines significantly from Wave I when age ranges from 13-18 to Wave III when age ranges from 18-27. This evidence supports past literature which suggests that depressive symptoms tend to decline as adolescents enter young adulthood (Brooks-Gunn and Peterson 1991, Meadow et al 2006, Radloff 1991; Ge et al. 2006). However, surprisingly, the mean of depressive symptoms increases again at Wave IV when respondents' ages ranges from 24 to 31. Coincidentally, respondents' self-rated health follows the same pattern. Respondents reported much better self-rated health at Wave III than at the previous two Waves, and reported the worst health in general at Wave IV.

Respondents generally reports high social support from the resident parent(s) as the mean is over 4 on a 1-5 scale. The indicator which describes whether the families are having fun together sees slightly more variation as the average is 3.7 and 10%, 27%, 35%, and 26% respondents reported "very little", "somewhat", "quite a bit", and "very much" respectively. About half of the

respondents live in two-biological parent families during adolescence. A considerable number of respondents live in two parent families (18.68%) and single mother families (21.66) respectively.

Descriptive Statistics by Wave

Variable	Obs	**Mean**/Percentage	Std. Dev.	Min	Max
Age at Wave 1	**16,931**	**15.65**	**1.56**	**13**	**18**
Age at Wave 2	**12,424**	**16.38**	**1.46**	**14**	**20**
Age at Wave 3	**12,890**	**21.96**	**1.62**	**18**	**27**
Age at Wave 4	**13,312**	**28.51**	**1.60**	**24**	**31**
Gender	**16,931**				
0=Male	8,285	48.93%			
1=Female	8,646	51.07%			
Race	**16,931**				
1=Non-Hispanic White	8,778	51.85%			
2=Non-Hispanic Black	3,620	21.38%			
3=Hispanics	2,821	16.66%			
4=Asian	1,236	7.30%			
5=Other	476	2.81%			
Depressive Symptoms at Wave 1	**16,931**	**5.91**	**4.26**	**0**	**27**
Depressive Symptoms at Wave 2	**12,424**	**5.87**	**4.25**	**0**	**27**
Depressive Symptoms at Wave3	**12,890**	**4.59**	**4.08**	**0**	**26**
Depressive Symptoms at Wave4	**13,312**	**5.22**	**4.09**	**0**	**27**
Community Disadvantage at Wave 1 (Number of Items in Upper Quartile)	**16,931**	**1.50**	**1.97**	**0**	**6**
Community Disadvantage at Wave 1 (Factor Score)	**16,931**	**0.00**	**0.04**	**-0.07**	**0.32**
Average Parental Social Support at Wave 1	**16,931**	**4.33**	**0.63**	**1**	**5**
Family Having Fun Together at Wave 1	**16,931**	**3.70**	**1.02**	**1**	**5**
Family Structure at Wave 1	**16,931**				
1=TwoBiological Parents	8,938	52.79%			
2=Two Parents	3,163	18.68%			
3=Single Mother	3,667	21.66%			
4=Single Father	517	3.05%			
5=Other	646	3.82%			
Parental Education	**16,931**	**2.88**	**1.04**	**1**	**4**
Respondent Self-Rated Health at Wave 1	**16,931**	**2.11**	**0.90**	**1**	**5**
Respondent Self-Rated Health at Wave 2	**12,424**	**2.09**	**0.90**	**1**	**5**
Respondent Self-Rated Health at Wave 3	**12,890**	**1.98**	**0.86**	**1**	**5**
Respondent Self-Rated Health at Wave 4	**13,312**	**2.33**	**0.91**	**1**	**5**

Table 1 Univariate Descriptive Statistics by Wave

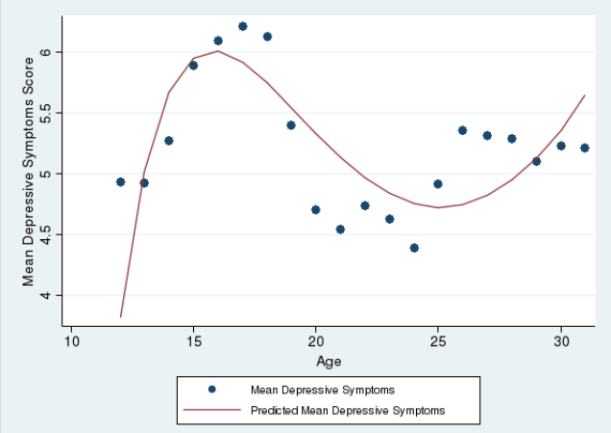

Figure 2 Age Mean Trajectory of Depressive Symptoms, estimating a fractional polynomial of degree 3

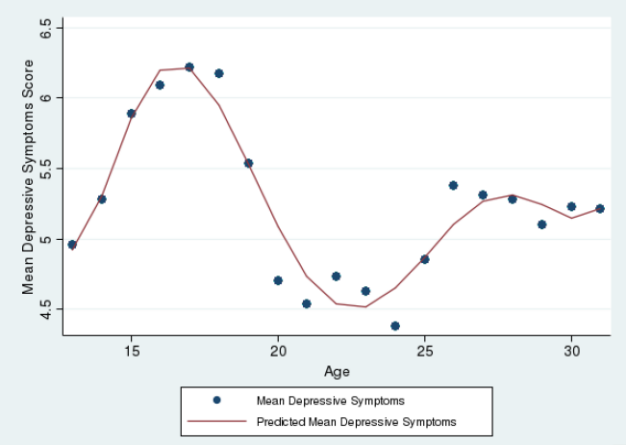

Figure 3 Age Mean Trajectory of Depressive Symptoms, estimating a fractional polynomial of degree 6

Figure 2 and Figure 3 show two graphs of age mean trajectory of depressive symptoms, estimated by a fractional polynomial of degree 3 and 6 respectively. Overall, the mean depressive symptoms increase during adolescence, peak at around age 17-18, and decrease as adolescents enter young adulthood. However, the mean depressive symptoms tend to increase again after it reaches a lowest point at around age 24, and seems to stabilize afterwards. Meanwhile, estimating by a fractional polynomial of degree 6 seems to produce a better fit of age mean depressive symptoms than estimating by a fractional polynomial of degree 3.

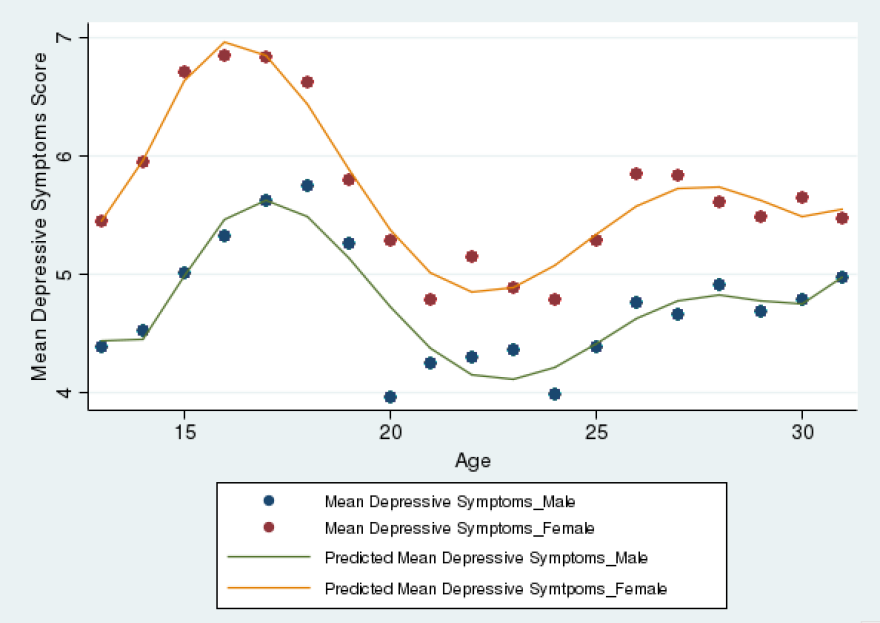

Figure 4 Age Mean Trajectory of Depressive Symptoms by Gender

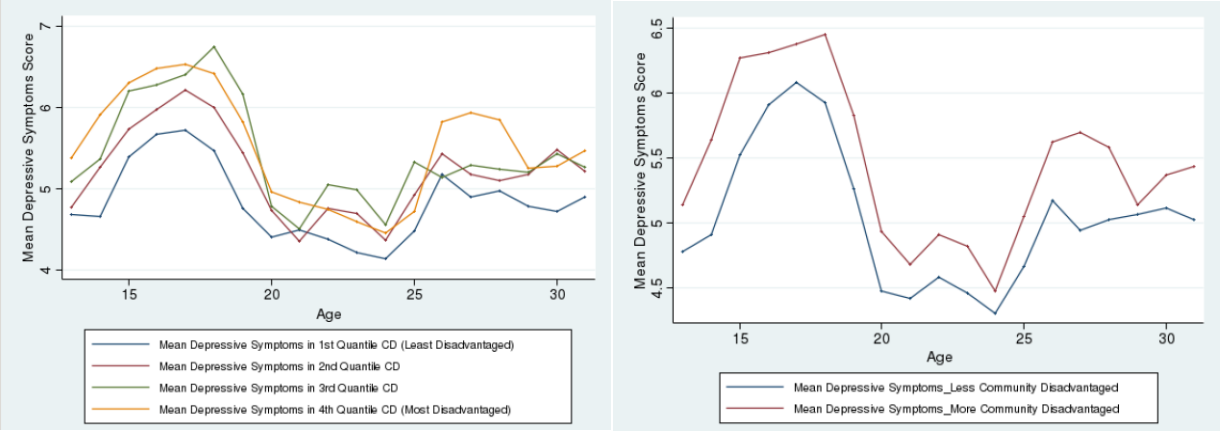

Figure 5 Age Mean Trajectory of Depressive Symptoms by Community Disadvantage Measures

Figure 4 and Figure 5 show graphs of age mean trajectory of depressive symptoms by gender and community disadvantage measures. Based on Figure 4, females have significantly higher depressive symptoms then males. However, the shape of the curves does not vary much by gender, except that the decrease of depressive symptoms is slightly sharper for females as they enter young adulthood. Similarly, the "second surge" at around age 24 for females seems to be slightly larger than for males. After the respondents reach age 30, the depressive symptoms show a possible slight decrease for females and a possible continued increase for males from late

20s to early 30s. Therefore, it is possible that the depressive symptoms for males and females converge during adulthood (Adkins et al., 2009; Ge et al., 2006). However, the present study is not able to lend support to this argument given that the data stops at early 30s and that the depressive symptoms for males and females have not yet converged.

Figure 5 shows the age mean trajectory of depressive symptoms by two different community disadvantage measures. The graph on the left shows the age mean trajectory of depressive symptoms by quartiles of community disadvantage factor score. Residents of least disadvantaged are shown to have the lowest age mean depressive symptoms. Residents in the third and the fourth quartile (the more disadvantaged) have higher age mean depressive symptoms than residents in the lower quartiles, though the difference tend to be not significant. Meanwhile, the "second surge" is most conspicuous for residents who live in the most disadvantaged communities. The graph on the right confirms this finding by using a different community disadvantage indicator. Less disadvantaged community is defined as communities with two and less indicators in the upper quartile, and more disadvantaged communities is defined as communities with three and more indicators in the upper quartile.

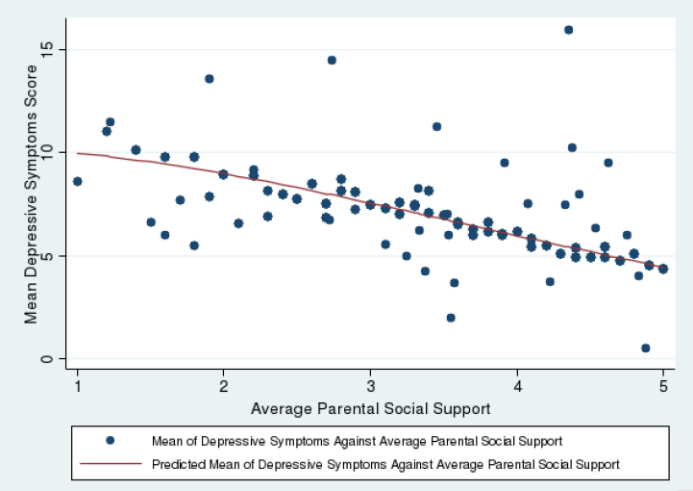

Figure 6 Mean Depressive Symptoms Score Against Average Parental Social Support

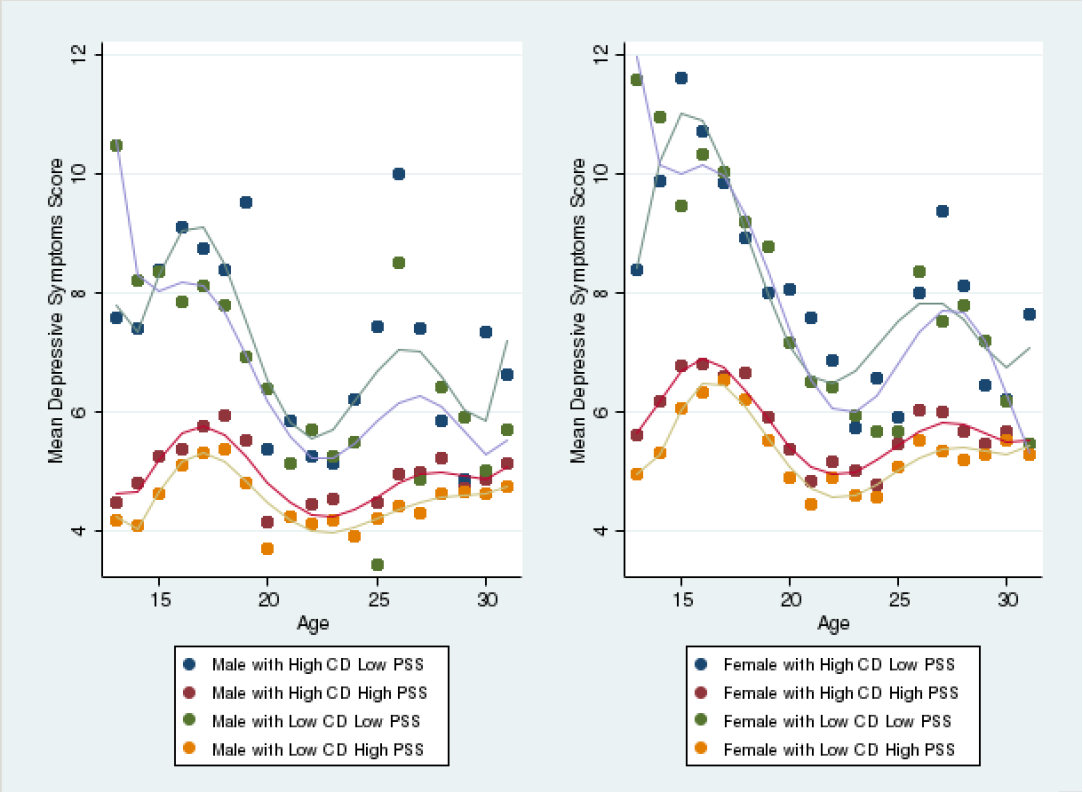

Figure 7 Age Mean Trajectory of Depressive Symptoms by Community Disadvantage, Average Parental Social Support, and Gender

According to Figure 6, average parental social support seems to be a strong predictor of depressive symptoms. Respondents with the least average parental social support has a predicted mean depressive symptoms score of 10, while respondents with the highest average parental social support has a predicted mean depressive symptoms score of 4.

Figure 7 shows the age mean trajectory of depressive symptoms by community disadvantage, average parental social support, and gender. Low average parental social support is set to average parental social support score equal or less than 3, while high average parental social support is set to average parental social support score larger than 3 (in a 1 to 5 scale). Less disadvantaged community is defined as communities with two and less indicators in the upper quartile, and more disadvantaged communities is defined as communities with three and more indicators in the upper quartile. According to the graph, respondents with

high average parental social support as well as females generally have higher depressive symptoms than respondents with low average parental social support as well as males. For respondents with low parental social support during adolescents, whether they live in a high or low community disadvantage seems to make very little difference.

SECTION 8: BIVARIATE PAIRWISE CORRELATION RESULTS

By looking at the pairwise correlation of variables in Appendix 1, we find that all variables tend to have significant relationships with depressive symptoms. Consistent with the past literature, females tend to have a significantly higher level of depressive symptoms than males (Mirowsky&Ross 1995; Brooks-Gunn et al. 1991; Hankin et al. 1998).

As expected, respondents with worse self-rated health have higher levels of depressive symptoms. Meanwhile, respondents with higher social support parents, as well as respondents who live in a family with happy relationships, tend to have lower levels of depressive symptoms, as well as better self-rated health. Higher parental education and higher respondent education are both negatively associated with level of depressive symptoms. Girls have significantly higher initial levels of depressive symptoms than boys.

SECTION 9: MULTIVARIATE ANALYSIS RESULTS

The above table shows an abbreviated output of the three-level model which does not take into account the sample design. Community disadvantage is measured by the number of items that are in the upper quartile. The full output of this table can be found in Appendix 2. Model 1-3 models the trajectories of depressive symptoms using age as the explanatory variable. Model 1 is a random intercept model with the linear term of age mean centered at 15. Model 2 is a random slope model with the linear, the quadratic, and the cubic term of age mean centered at 15. Model 3 further adds in the quartic, the quintic, and the hexic term of age mean centered at 15, based on what the previous graphs of mean age trajectories of depressive symptoms have suggested. The age terms are all significant. And Model 3 which has up to (Age mean centered at 15)^6 seems to be the best fitting model among the three models as suggested by the Likelihood Ratio (LR) Test. This confirms what the previous graphs of mean age trajectories of depressive symptoms have suggested.

Model 4 includes the community disadvantage variable on the basis of Model 3. Model 5 further includes the average parental social support, the family happiness indicator, and the family structure variable. Based on the output, having one more indicator that is in the upper quartile out of the six indicators of community disadvantage significantly increases the depressive symptoms by 0.1. Meanwhile, having higher average parental social support, indicating that the family has more fun together, and living in two biological parent families significantly reduces the depressive symptoms.

Model 6 includes the interaction between average parental social support and community disadvantage on the basis of model 5. Model 7 further adds other control variables, including gender, race, self-reported health, and parental education. Model 8 includes a full set of interactions between community disadvantage and family factors, between gender and community disadvantage, and between gender and the family factors on the basis of Model 7. The output shows that the family factors, including average parental social support, family having fun together, and family structure continue to be strongly associated with depressive symptoms. 1 unit increase in average parental social support and family having fun together is associated with 0.94 unit and 0.27 unit decrease in depressive symptom scores respectively. Meanwhile, living in a single mother household, living in a single father household, and living in other family structures is associated with 0.24, 0.57, and 0.82 unit increase in depressive symptom scores compared to the depressive symptom scores of respondents living in a two biological parent household during adolescence. Being a female is associated with 1.57 unit increase in depressive symptoms. Comparing to being a Non-Hispanic White, being a Non-Hispanic Black, being a Hispanic, being an Asian is associated with 0.45, 0.42, and 0.95 unit increase in depressive symptoms respectively. Having better self-rated health, and having higher-educated parents are both associated with lower depressive symptoms.

However, community disadvantage is no longer significant after including the interaction terms and control variables. There is no interaction between community disadvantage and almost all family factors, or the interaction between community disadvantage and gender. However, while there is no main effect for both community disadvantage and almost all family factors, there is a crossover effect for community disadvantage during adolescence and the two-parent

household category. The interaction between gender and family having fun together is also significant. A female respondent who strongly agrees that her family have fun together is associated with 0.60 [0.15*(5-1)] unit decrease in depressive symptoms compared to a female respondent who indicates that her family do not have fun together at all. Compared to a male respondent who strongly agrees that his family have fun together ([-0.27+(-0.15*0)]*5), a female respondent who strongly agrees that her family have fun together ([-0.27+(-0.15*1)]*5) is further associated with 0.75 unit decrease in depressive symptoms. Meanwhile, a girl living in a single-mother household during adolescence is associated with 0.39 unit increase in depressive symptoms comparing to a boy living in a single-mother household. Overall, males living in a single-mother household during adolescence is associated with 0.72 unit increase in depressive symptoms ([(0.24+0.39*0)*3]). However, females living in a single-mother household during adolescence is associated with 1.89 unit increase in depressive symptoms ([(0.24+0.39*1)*3]).

The output using community disadvantage factor score in the three-level model without weights (See Appendix 3), and the output using a three-level model with weights and a single-level models are generally similar to the three-level output using number of items in the upper quartile as an indicator of community disadvantage. Some discrepancies are that in the three-level model with weights, the interaction term between social support and gender is significant, instead of the interaction term between family having fun and gender, while in the single-level model, neither interactions are significant. In the single-level model, the community disadvantage indicator is significant, however, the variable does not go in the desired direction. In general, parental social support, family having fun together, and living in single-mother households during adolescence, being a member of minority racial categories, parental education, and self-rated health are all significantly associated with depressive symptoms from

adolescence to young adulthood. The interaction terms tend to be insignificant, except the interactions (though unstable) between parental social support, family happiness, living in two-parent or single-mother households, and gender.

	Model4	Model5	Model6	Model7	Model8
Fixed-effects Parameters					
Age15 (Age mean-centered at 15) Linear Term	0.38***	0.34***	0.34***	0.32***	0.32***
Age15 Quadratic Term	-0.08***	-0.06***	-0.06***	-0.07***	-0.07***
Age15 Cubic Term	-0.04***	-0.04***	-0.04***	-0.03***	-0.03***
Age15 Quartic Term	0.01***	0.01***	0.01***	0.01***	0.01***
Age15 Quintic Term	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***
Age15 Hexic Term	0.00***	0.00***	0.00***	0.00***	0.00***
Community Disadvantage_No. of Items in Upper Quartile	0.12***	0.10***	-0.04	-0.12	-0.14
Average Parental Social Support		-1.20***	-1.25***	-1.01**	-0.94***
Family Having Fun Together		-0.36***	-0.36***	-0.34***	-0.27***
Family Structure					
Two Biological Parents		-	-	-	-
Two Parents		0.28***	0.28***	0.25***	-0.07
Single Mother		0.68***	0.68***	0.46***	0.24*
Single Father		0.53***	0.52***	0.47***	0.57**
Other		1.15***	1.15***	0.86***	0.82***
Gender					
Male				-	-
Female				0.76***	1.57***
Race					
Non-Hispanic White				-	-
Non-Hispanic Black				0.45***	0.45***
Hispanics				0.44***	0.42***
Asian				0.96***	0.95***
Other				0.35**	0.36**
Self-Rated Health				0.86***	0.86***
Parental Education				-0.27***	-0.27***
Average Parental Social Support X Community Disadvantage			0.03	0.03	0.03

Family Having fun X Community Disadvantage					0.01
Family Structure X Community Disadvantage					
Two Parents					0.08**
Single Mother					0.02
Single Father					-0.06
Other					-0.05
Gender X Average Parental Social Support					
Female					-0.09
Gender X Family Having Fun Together					
Female					-0.15**
Gender X Family Structure					
Female X Two Parents					0.43***
Female X Single Mother					0.39**
Female X Single Father					-0.01
Female X Other					0.37
Gender X Commuity Disadvantage					
Female					-0.04
_cons	5.65***	11.98***	12.15***	9.42***	9.13***

Table 2 Abbreviated Output for Three-Level Model Using No. of Items in Upper Quartile as Community Disadvantage Indicator

SECTION 10: DISCUSSION

Contrary to Hypothesis 1 and 2, community disadvantage during adolescence does not significantly influence the trajectory of depressive symptoms, or only influences the trajectory of depressive symptoms to a minimal extent. Meanwhile, as community disadvantage during adolescence does not affect the trajectory of depressive symptoms, average parental social support, Hypothesis 2 could not be supported either. Family factors during adolescence do not moderate the relationship between community disadvantage during adolescence and the trajectory of one's depressive symptoms. Hypothesis 3 is correct in the sense that family having fun, family social support, and living in two-biological parent households might be associated with more alleviation of depressive symptoms to girls than boys.

Overall, family factors during adolescence tend to have a much stronger effect on depressive symptoms trajectories than community level factors. Average perceived parental social support, family cohesiveness, and family structure are all significantly correlated with depressive symptoms and exhibit a lasting impact on trajectories of depressive symptoms even in young adulthood. The effect from community environment during adolescence looks to be minimal after taking into account family level factors. Adolescents who live in more disadvantaged communities but have high average parental social support could still have much lower depressive symptoms from adolescence to young adulthood than adolescents who have less disadvantaged communities but have low average parental social support. The interaction terms between community disadvantage during adolescence and the family factors therefore do not exist. Meanwhile, the interaction between gender and family factors exists, but is not entirely

robust in the sensitivity tests. Individual level factors such as age, race, gender, parental education, and self-rated health are strongly associated with trajectories of depressive symptoms as well. Therefore, the result of the present study challenges the ecological theory (Bronfenbrenner, 1986; Bronfenbrenner, 1994), while provides further support for the life-course perspective (Elder, 1998, Elder et al., 2003).

It is interesting to note that according to the graphs, disadvantaged adolescents, namely adolescents who have lived in most disadvantaged communities, who have the least parental social support, and females, have a more conspicuous "second surge" after they have reached 25 years old. This might be because, align with the social causation model and social selection model, these adolescents experience poor mental health due to disadvantages during adolescence, which transfer into disadvantages when they grow up as they have developed fewer necessary skills and competencies to reach their desired goals (Miech et al 1999; Needham 2008). This in turn results in higher depressive symptoms as they make the transition from college to work, or enter marriage, at around age 25 (Wickrama et al. 2005; McLeod & Kaiser 2004).

The study exhibits several limitations. First, given the complexity of the Add Health study design, the complexity of the three-level random effects model, as well as the limitation of current data and software package, the models are not perfect in terms of correcting for survey design and applying weights. However, sensitivity tests have been done to minimize the potential inaccuracy. Second, the current study assumes missing completely at random and uses list-wise deletion for cases with missing values. In the future, multiple imputation could be done to treat the missing values. This could prevent information loss to a large extent as well. Third, average parental social support was used

as an indicator of social support from parents. However, this measure does not indicate the source of the social support, and social support from father and mother might have different effects for boys and girls. Fourth, I acknowledge that even after controlling for various factors such as age and sex, the study still has unobserved factors, such as parental mental health, that could not be fully controlled.

In future studies, perceived social support could be constructed as social support from fathers and social support from mothers, thereby differentiating the source of social support. Meanwhile, they could interact with family structure to investigate what kind of social support is important for girls and boys, based on the family structure. Second, the current family cohesiveness takes into account only whether the respondents think that their families are having fun together. However, future family cohesiveness measure could take into account more dimensions, such as whether the families have conflict, aggression, and violence. Third, despite further studying the mechanisms linking to the "second surge" at around age 25, the age range in the current study sample does not allow a strong prediction about the future directions of the trajectories of depressive symptoms. It might stabilize, decrease again, or continues to increase as respondents reach their 30s. Through data from future waves of Add Health, or studies that has older age ranges of respondents, studies could continue to study the trajectories of depressive symptoms of mid-aged adults.

APPENDIX 1: PAIRWISE CORRELATION OF VARIABLES

	Depression	CD_FS	CD_Cat	Avg PSS	Fam Hap	Gender	Race	Age	Fam Str	P Edu	SRH
Depression	1.00										
CD_Factor Score	**0.07**	1.00									
CD_N of 75% above	**0.05**	**0.90**	1.00								
Avg PSS	**-0.23**	**0.02**	**0.02**	1.00							
Family Hapiness	**-0.19**	**0.03**	**0.03**	**0.53**	1.00						
Gender	**0.12**	**0.02**	**0.02**	**-0.11**	**-0.02**	1.00					
Race	**0.09**	**0.18**	**0.16**	**-0.04**	**-0.02**	**-0.01**	1.00				
Age	**-0.07**	0.00	**-0.01**	**-0.05**	**-0.04**	**0.01**	0.01	1.00			
Family Structure	**0.10**	**0.21**	**0.20**	**-0.02**	**-0.04**	**0.02**	**0.04**	0.00	1.00		
Parental Edu	**-0.11**	**-0.27**	**-0.24**	**0.03**	**0.01**	**-0.03**	**-0.11**	-0.01	**-0.16**	1.00	
Self-Rated Health	**0.27**	**0.05**	**0.04**	**-0.14**	**-0.12**	**0.08**	**0.05**	**0.09**	**0.06**	**-0.11**	1.00

APPENDIX 2: FULL STATA OUTPUT OF THE 3-LEVEL MODEL USING COMMUNITY DISADVANTAGE_ NO. OF ITEMS IN UPPER QUARTILE (WITHOUT ACCOUNTING FOR SURVEY DESIGN CHARACTERISTICS)

	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8
Fixed-effects Parameters								
Age15 (Age mean-centered at 15) Linear Term	-0.06***	0.02	0.38***	0.38***	0.34***	0.34***	0.32***	0.32***
Age15 Quadratic Term		-0.03***	-0.08***	-0.08***	-0.06***	-0.06***	-0.07***	-0.07***
Age15 Cubic Term		0.00***	-0.04***	-0.04***	-0.04***	-0.04***	-0.03***	-0.03***
Age15 Quartic Term			0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
Age15 Quintic Term			-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***
Age15 Hexic Term			0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
Community Disadvantage_No. of Items in Upper Quartile				0.12***	0.10***	-0.04	-0.12	-0.14
Average Parental Social Support					-1.20***	-1.25***	-1.01**	-0.94***
Family Having Fun Together					-0.36***	-0.36***	-0.34***	-0.27***
Family Structure								
Two Biological Parents					-	-	-	-
Two Parents					0.28***	0.28***	0.25***	-0.07
Single Mother					0.68***	0.68***	0.46***	0.24*
Single Father					0.53***	0.52***	0.47***	0.57**
Other					1.15***	1.15***	0.86***	0.82***
Gender								
Male							-	-
Female							0.76***	1.57***
Race								
Non-Hispanic White							-	-
Non-Hispanic Black							0.45***	0.45***

Hispanics							0.44***	0.42***
Asian							0.96***	0.95***
Other							0.35**	0.36**
Self Rated Health							0.86***	0.86***
Parental Education							-0.27***	-0.27***
Average Parental Social Support X Community Disadvantage						0.03	0.03	0.03
Family Having fun X Community Disadvantage								0.01
Family Structure X Community Disadvantage								
Two Parents								0.08**
Single Mother								0.02
Single Father								-0.06
Other								-0.05
Gender X Average Parental Social Support								
Female								-0.09
Gender X Family Having Fun Together								
Female								-0.15**
Gender X Family Structure								
Female X Two Parents								0.43***
Female X Single Mother								0.39**
Female X Single Father								-0.01
Female X Other								0.37
Gender X Commuity Disadvantage								
Female								-0.04
_cons	5.77***	5.91***	5.86***	5.65***	11.98***	12.15***	9.42***	9.13***

Random-effects Parameters								
Tract ID								
sd(_cons)		0.65	0.63	0.58	0.52	0.50	0.33	0.32
Individual ID								
sd(age15)		0.19	0.19	0.19	0.19	0.19	0.18	0.18
sd(_cons)	2.61	2.98	2.97	2.96	2.64	2.63	2.44	2.44
corr(age15,_cons)		-0.53	-0.52	-0.52	-0.44	-0.44	-0.45	-0.45
sd(Residual)	3.30	3.07	3.05	3.05	3.06	3.06	3.04	3.04

APPENDIX 3: FULL STATA OUTPUT OF THE 3-LEVEL MODEL USING COMMUNITY DISADVANTAGE_FACTOR SCORE (WITHOUT ACCOUNTING FOR SURVEY DESIGN CHARACTERISTICS)

	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8
Fixed-effects Parameters								
Age15 (Age mean-centered at 15) Linear Term	-0.06***	0.02	0.38***	0.38***	0.34***	0.34***	0.32***	0.32***
Age15 Quadratic Term		-0.03***	-0.08***	-0.08***	-0.06***	-0.06***	-0.07***	-0.07***
Age15 Cubic Term		0.00***	-0.04***	-0.04***	-0.04***	-0.04***	-0.03***	-0.03***
Age15 Quartic Term			0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
Age15 Quintic Term			-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***
Age15 Hexic Term			0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
Community Disadvantage_Factor Score				6.12***	5.02***	-2.94	-7.21*	-7.09
Average Parental Social Support					-1.21***	-1.21***	-0.97***	-0.90***
Family Having Fun Together					-0.36***	-0.36***	-0.34***	-0.26***
Family Structure								
Two Biological Parents (Reference)					-	-	-	-
Two Parents					0.28***	0.28***	0.26***	0.04
Single Mother					0.67***	0.67***	0.46***	0.25**
Single Father					0.53***	0.53***	0.48***	0.46**
Other					1.15***	1.15***	0.86***	0.74***
Gender								
Male (Reference)							-	-
Female							0.76***	1.51***
Race								
Non-Hispanic White (Reference)							-	-
Non-Hispanic Black							0.44***	0.44***

Hispanics							0.43***	0.41***
Asian							0.96***	0.94***
Other							0.35**	0.35**
Self Rated Health							0.86***	0.86***
Parental Education							-0.27***	-0.26***
Average Parental Social Support X Community Disadvantage						1.84*	1.91*	1.62
Family Having fun X Community Disadvantage								0.49
Family Structure X Community Disadvantage								
Two Parents								3.57*
Single Mother								0.10
Single Father								-1.38
Other								-3.56
Gender X Average Parental Social Support								
Female								-0.087
Gender X Family Having Fun Together								
Female								-0.15**
Gender X Family Structure								
Female X Two Parents								0.44***
Female X Single Mother								0.41***
Female X Single Father								-0.00
Female X Other								0.38
Gender X Commuity Disadvantage								
Female								-2.48*
_cons	5.77***	5.91***	5.86***	5.84***	12.14***	12.15***	9.42***	8.93***

Random-effects Parameters								
Tract ID								
sd(_cons)		0.62	0.62	0.56	0.50	0.50	0.33	0.32
Individual ID								
sd(age15)		0.19	0.19	0.19	0.19	0.19	0.18	0.18
sd(_cons)	2.61	2.98	2.97	2.96	2.64	2.63	2.44	2.44
corr(age15,_cons)		-0.53	-0.52	-0.52	-0.44	-0.44	-0.45	-0.45
sd(Residual)	3.30	3.07	3.05	3.05	3.06	3.06	3.04	3.04

APPENDIX 4: FULL STATA OUTPUT OF THE 3-LEVEL MODEL (WITH 2-LEVEL WEIGHTS)

	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8
Fixed-effects Parameters								
Age15 (Age mean-centered at 15) Linear Term	-0.05***	-0.16***	0.05	0.05	0.05	0.05	0.06	0.06
Age15 Quadratic Term		-0.02**	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
Age15 Cubic Term		0.00***	-0.02***	-0.02**	-0.02***	-0.02***	-0.02**	-0.02**
Age15 Quartic Term			0.00**	0.00***	0.01***	0.00***	0.00**	0.00**
Age15 Quintic Term			-0.00**	-0.00**	-0.00**	0.00**	-0.00*	-0.00*
Age15 Hexic Term			0.00*	0.00*	0.00*	0.00*	0.00	0.00
Community Disadvantage_No. of Items in Upper Quartile				0.16***	0.12***	-0.02	-0.11	-0.17
Average Parental Social Support					-1.27***	-1.32***	-1.09***	-0.80***
Family Having Fun Together					-0.36***	-0.36***	-0.35***	-0.35***
Family Structure								
Two Biological Parents					-	-	-	-
Two Parents					0.33**	0.33**	0.25*	0.14
Single Mother					0.88***	0.88***	0.61***	0.39**
Single Father					0.65	0.65	0.60*	0.02
Other					0.97***	0.97***	0.52*	1.15**
Gender								
Male							-	-
Female							0.79***	2.70***
Race								
Non-Hispanic White							-	-
Non-Hispanic Black							0.66***	0.64***
Hispanics							0.48**	0.46**
Asian							0.86***	0.86***

Other							0.34	0.34
Self Rated Health							0.62***	0.62***
Parental Education							-0.34***	-0.34***
Average Parental Social Support X Community Disadvantage						0.03	0.03	0.03
Family Having fun X Community Disadvantage								0.015
Family Structure X Community Disadvantage								
Two Parents								0.04
Single Mother								0.05
Single Father								0.17
Other								-0.10
Gender X Average Parental Social Support								
Female								-0.44**
Gender X Family Having Fun Together								
Female								-0.03
Gender X Family Structure								
Female X Two Parents								0.66*
Female X Single Mother								0.25
Female X Single Father								0.65
Female X Other								-0.42
Gender X Commuity Disadvantage								
Female								-0.02
_cons	5.21***	5.63***	5.54***	5.31***	12.12***	12.33***	10.58***	9.37***
Random-effects Parameters								
PSUID								

	sd(_cons)	0.65	0.62	0.62	0.52	0.40	0.40	0.29	0.29
Individual ID									
	sd(age15)		0.34	0.33	0.33	0.33	0.33	0.32	0.32
	sd(_cons)	2.81	3.55	3.51	3.50	3.23	3.23	3.07	3.07
	corr(age15,_cons)		-0.58	-0.57	-0.57	-0.55	-0.55	-0.56	-0.57
	sd(Residual)	2.85	2.17	2.17	2.17	2.17	2.17	2.15	2.15

APPENDIX 5: FULL STATA OUTPUT OF THE SINGLE LEVEL MODEL (ACCOUNTING FOR SURVEY DESIGN CHARACTERISTICS)

	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8
Fixed-effects Parameters								
Age15 (Age mean-centered at 15) Linear Term	-0.04***	0.13***	0.44***	0.44***	0.34***	0.34***	0.33***	0.33***
Age15 Quadratic Term		-0.05***	-0.11***	-0.11***	-0.07***	-0.07***	-0.07***	-0.07***
Age15 Cubic Term		0.00***	-0.03***	-0.03***	-0.04***	-0.04***	-0.03***	-0.03***
Age15 Quartic Term			0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
Age15 Quintic Term			-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***
Age15 Hexic Term			0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
Community Disadvantage_No. of Items in Upper Quartile				0.16***	0.13***	-0.17	-0.29**	-0.30**
Average Parental Social Support					-1.22***	-1.32***	-1.06**	-0.93***
Family Having Fun Together					-0.40***	-0.39***	-0.36***	-0.38***
Family Structure								
Two Biological Parents					-	-	-	-
Two Parents					0.32***	0.31***	0.23**	-0.14
Single Mother					0.78***	0.76***	0.43***	0.30*
Single Father					0.61***	0.60***	0.47**	0.42
Other					1.20***	1.18***	0.76***	0.57
Gender								
Male							-	-
Female							0.77***	1.56**
Race								
Non-Hispanic White							-	-
Non-Hispanic Black							0.65***	0.65***
Hispanics							0.63***	0.62***

Asian							0.76***	0.76***
Other							0.46*	0.49*
Self Rated Health							1.03***	1.03***
Parental Education							-0.30***	-0.30***
Average Parental Social Support X Community Disadvantage						0.07	0.07**	0.05*
Family Having fun X Community Disadvantage								0.02
Family Structure X Community Disadvantage								
Two Parents								0.09
Single Mother								0.01
Single Father								-0.02
Other								-0.02
Gender X Average Parental Social Support								
Female								-0.17
Gender X Family Having Fun Together								
Female								-0.04
Gender X Family Structure								
Female X Two Parents								0.52***
Female X Single Mother								0.27
Female X Single Father								0.23
Female X Other								0.51
Gender X Commuity Disadvantage								
Female								-0.05
_cons	5.49***	5.59***	5.70***	5.47***	12.07***	12.52***	9.59***	9.14***

Design df =128

	F(1, 128) = 43.44	F(3, 126) = 46.63	F(6, 123) = 73.93	F(7, 122) = 67.88	F(13, 116) = 108.63	F(14, 115) = 99.47	F(21, 108) = 131.84	F(33, 96) = 85.40
Prob > F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-squared	0.0027	0.0087	0.0171	0.0227	0.0907	0.0912	0.1615	0.1628

No of Observation=63,264
Population size=75,140,484
Subpop. No of observation=55,960
Subpop. size=65,648,098

APPENDIX 6: LIST OF VARIABLES

	Variable Name	Value labels
Study ID	aid	
Wave	Wave	1=Wave I 2=Wave II 3=Wave III 4=Wave IV
Depressive Symptoms	depres	0-27, 0 indicating no depressive symptoms
Community Disadvantage Measure 1 (Number of Items in Upper Quartile)	cd_75	0-6, 0 indicating least community disadvantage, 6 indicating most community disadvantage
Community Disadvantage Measure 2 (Factor Score)	cdfscore	
Average Parental Social Support	pss_avg	1-5, 1 indicating the least social support from mother
Family Having Fun	relhap	1=Not At All 2=Very Little 3=Somewhat 4=Quite A Bit 5=Very Much
Family Structure	famstr	1=Two Biological Parents 2=Two Parents 3=Single Mother 4=Single Father 5=Others
Race/Ethnicity	race	1=Hispanic or Latino 2=Black 3=Asian 4=Native American 5=Other 6=White
Gender	gender	1=Female 0=Male
Parental Education	pedu	1=Less than High School 2=High School Diploma 3=Some College 4=College Degree or More
R's Self Rated Health	srh	1="Excellent" 2="Very good" 3="Good" 4="Fair" 5="Poor"
Age	age	Integer age in years

APPENDIX 7: INDICATORS OF DEPRESSION WI-IV

	W1	W2	W3	W4
You were bothered by things that usually don't bother you	H1FS1	H2FS1	H3SP5	H4MH18
You could not shake off the blues, even with help from your family and your friends.	H1FS3	H2FS3	H3SP6	H4MH19
You felt you were just as good as other people. (reverse coded)	H1FS4	H2FS4	H3SP7	H4MH20
You had trouble keeping your mind on what you were doing.	H1FS5	H2FS5	H3SP8	H4MH21
You felt depressed.	H1FS6	H2FS6	H3SP9	H4MH22
You felt that you were too tired to do things.	H1FS7	H2FS7	H3SP10	H4MH23
You enjoyed life. (reverse coded)	H1FS15	H2FS15	H3SP11	H4MH25
You felt sad.	H1FS16	H2FS16	H3SP12	H4MH26
You felt that people disliked you, during the past seven days.	H1FS17	H2FS17	H3SP13	H4MH27

APPENDIX 8: CONFIRMATORY FACTORS ANALYSIS FOR COMMUNITY DISADVANTAGE

The Confirmatory Factors Analysis (CFA) is used to calculate the community disadvantage factor score from the census tract level community disadvantage indicators. CFA is a multivariate statistical procedure that is used to test how well the measured variables represent the latent construct. Community disadvantage, in our context, is a latent variable, and the present study uses 6 indicators of the latent construct.

An Exploratory Factor Analysis indicates that the 6 indicators load well under one construct.

Exploratory Factor Analysis of Community Disadvantage Indicators

Variable	Factor1	Uniqueness
Proportion of female headed households	0.8173	0.332
Proportion of households with public assistance	0.9244	0.1456
Proportion of persons living in poverty	0.9186	0.1562
Proportion of residents aged 25 years and above without a high school diploma or equivalency	0.7924	0.3721
Unemployment rate for males	0.8228	0.3229
Proportion of adults in service occupations	0.7688	0.4089

Model I (Figure 2), proposed for Confirmatory Factors Analysis assumes that the residuals of each observed variable are uncorrelated. This serves as the "base model" for comparison. After running the first model, the modification indices (MI) output of STATA shows that by allowing the residuals of the proportion of female headed households and the proportion of residents aged 25 years and above without a high school diploma or equivalency to correlate, the Chi-square statistics of the Likelihood Ratio Test of the model

versus the saturated model will decrease significantly by 4151.35. Therefore, Model II (Figure 3) allows the residual of the following items to correlate:

1. Proportion of female headed households and proportion of residents aged 25 years and above without a high school diploma or equivalency.

After running the second model, the modification indices (MI) output of STATA shows that by further allowing the residuals of the following items to correlate, the Chi-square statistics of the Likelihood Ratio Test of the model versus the saturated model will again decrease significantly from the second model:

1. Proportion of households with public assistance and unemployment rate for males;
2. Proportion of persons living in poverty and proportion of residents aged 25 years and above without a high school diploma or equivalency;
3. Proportion of residents aged 25 years and above without a high school diploma or equivalency and unemployment rate for males;
4. Proportion of persons living in poverty and proportion of adults in service occupations;
5. Proportion of households with public assistance and proportion of persons living in poverty.

Therefore, Model III (Figure 4) allows the residuals of the above pairs of items to correlate.

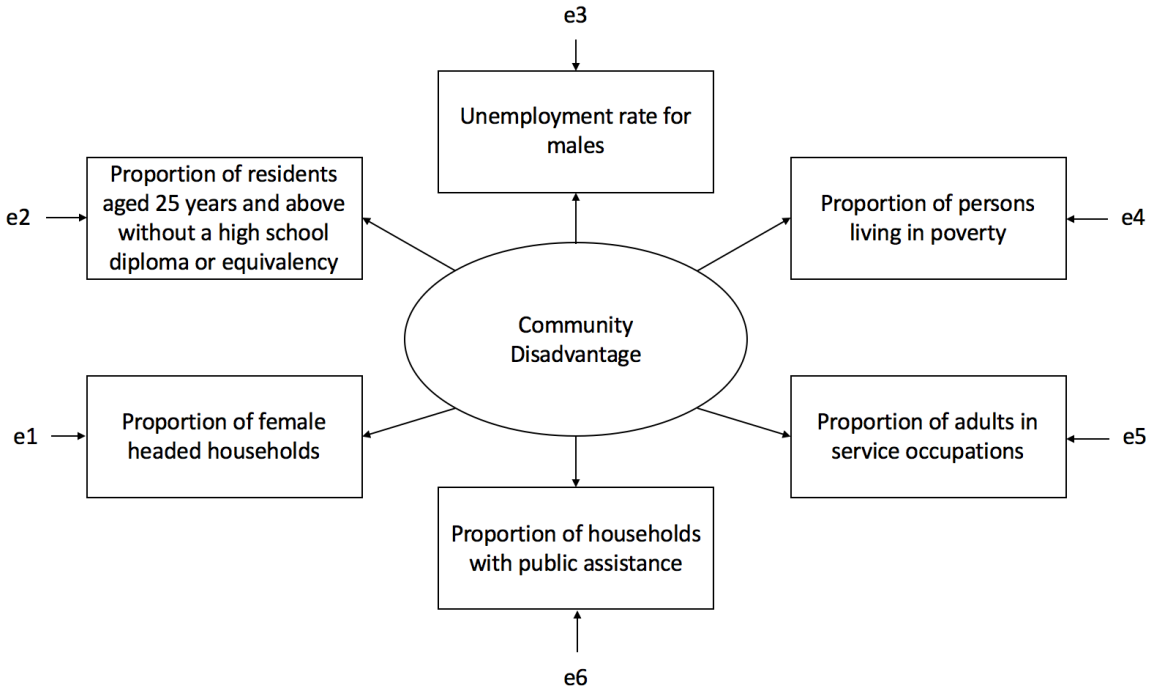

Figure A1Confirmatory Factors Analysis of Community Disadvantage_Model I

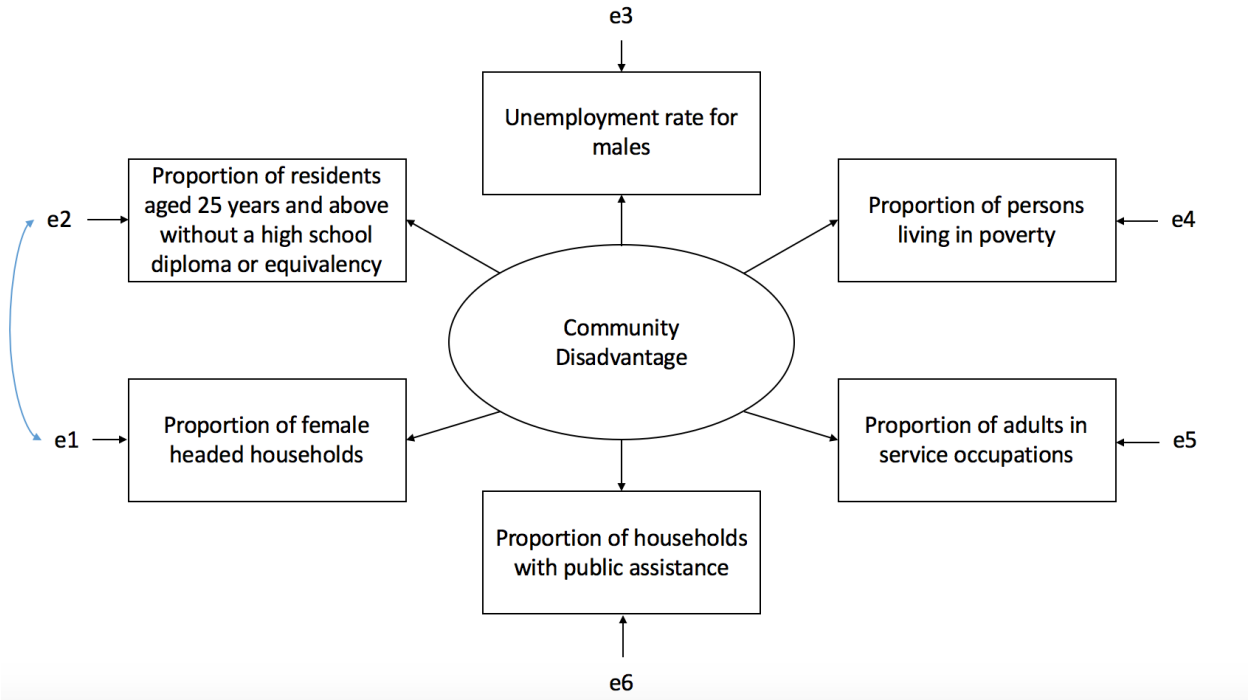

Figure A2 Confirmatory Factors Analysis of Community Disadvantage_Model II

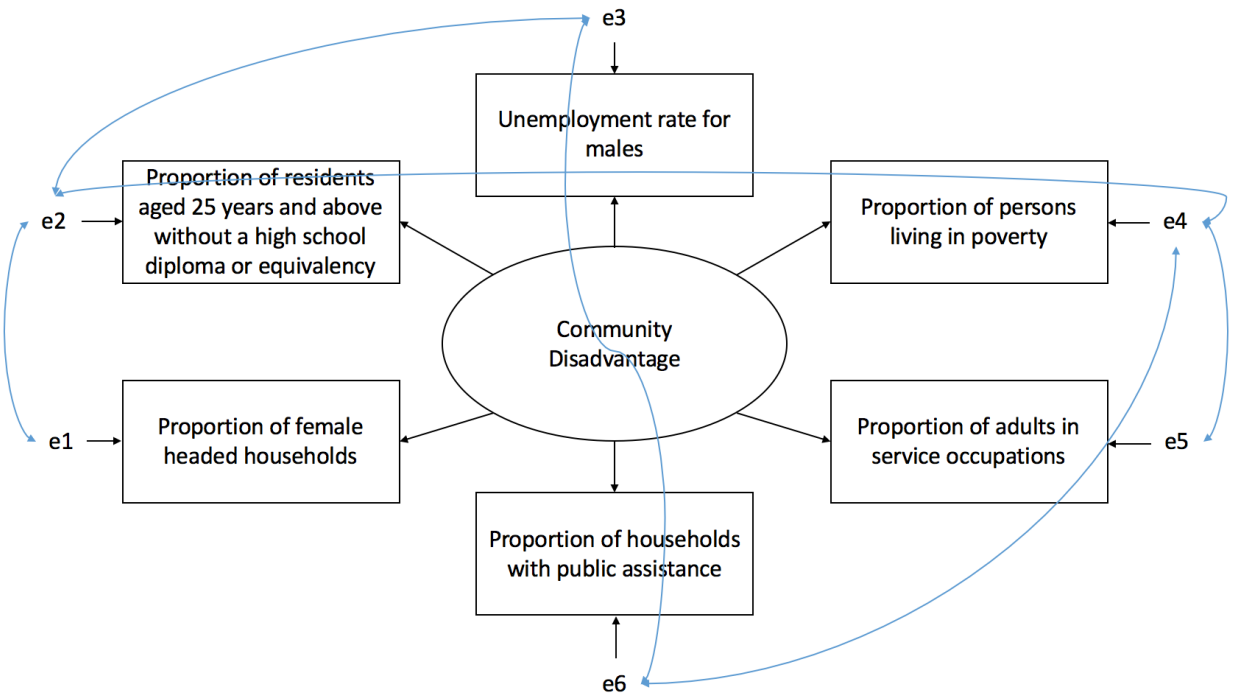

Figure A3 Confirmatory Factors Analysis of Community Disadvantage_Model III

Fit statistic		Model I	Model II	Model III
Likelihood ratio				
	chi2_ms(9)	5728.767	587.792	51.799
	p > chi2	0.000	0	0
	chi2_bs(15)	89472.435	89472.435	89552.832
	p > chi2	0.000	0	0
RMSEA		0.179	0.061	0.029
BIC		-3.54E+05	-3.59E+05	-3.60E+05
CFI		0.936	0.994	0.999
TLI		0.893	0.988	0.997

Table A1 Confirmatory Factors Analysis of Community Disadvantage_Model III

The Chi-square fit statistics are significant across all three models. However, it is difficult to get a non-significant Chi-square fit statistic given a sample size as large as this (N=19795). Of all three models, model 3 seems to be the best-fitting model. The RMSEA is 0.020, which is below 0.05, indicating that the model is a good fit. The cut-offs of RMSEA are questionable if the sample size is small; but in this case, the cut-offs are not questionable (Chen et al. 2008). But cautious thinking needs to be applied here as Chen et al. (2008) also

suggest that RMSEA cutoffs might be too generous in really large samples like this study. The Comparative fit index (CFI) and the Tucker-Lewis Index (TLI) are 0.999 and 0.997 respectively, indicating that the model is an ideal fit. Therefore, Model III is used to calculate the factor score for community disadvantage.

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