Published in final edited form as:

Res Nurs Health. 2011 June ; 34(3): 176–191. doi:10.1002/nur.20429.

Trajectories of Depressive Symptoms from Adolescence to Young Adulthood: Chinese Americans vs. Non-Hispanic Whites

Angela Chia-Chen Chen, PhD, RN, PMHNP-BC[Assistant Professor],

College of Nursing & Health Innovation, Arizona State University, 500 N. 3rd Street Phoenix, AZ 85004, Office: (602) 496-0832; Fax: (602) 496-0886

Steven Haas, PhD[Assistant Professor],

School of Social and Family Dynamics Arizona State University

Mary Rogers Gillmore, PhD[Professor], and

School of Social Work, Arizona State University

Albert Kopak, PhD[Assistant Professor]

Department of Criminology and Criminal Justice, Western Carolina University

Abstract

We examined age, sex, and race/ethnicity differences in trajectories of depressive symptom from adolescence to early adulthood; we also tested whether socioeconomic status and acculturation were associated with the differences. The findings suggest that adolescents over age 15 had a higher level and faster decline in depressive symptoms than their younger counterparts; females had higher level and a faster decline in depressive symptoms than males. Chinese American females had the highest depressive symptoms sustained across 7 years; Chinese American males over age 15 had higher depressive symptoms than their White male counterparts. Neither socioeconomic status nor acculturation was significantly associated with the differences in the trajectories. Our findings suggest a need for greater attention to Chinese American adolescents' psychological well-being.

Keywords

Depressive symptoms; Chinese American; White; Latent growth curve modeling; Health disparities

According to findings from the 2007 National Survey on Drug Use and Health, 8% of adolescents aged 12 to 17 experienced a major depressive episode in 2004, but only 39% of these depressed youth received treatment for depression (Substance Abuse and Mental Health Services Administration, 2007). Untreated depression is associated with suicide, the third leading cause of death in adolescents (Bridge, Goldstein, & Brent, 2006). Not only is depression linked to higher mortality, it also results in considerable cost to the individual, his or her family, and society (World Health Organization, n.d.). Depression during early adolescence can have serious long-term consequences. It is associated with poor health (both interviewer-rated and self-perceived), increased work impairment due to poor physical health, and higher use of health care at young adulthood, even after controlling for depression at young adulthood (Keenan-Miller, Hammen, & Brennan, 2007).

Research findings suggest there are racial/ethnic disparities in the incidence of depression and depressive symptoms. Lorenzo, Frost, and Reinherz (2000) found that relative to White adolescents, Asian American adolescents had higher levels of depressive symptoms, were more withdrawn, and experienced more social problems. Findings from the Youth Risk Behavior Survey, a national survey with a representative sample, indicated that about 28% of Asian American high school students had depressed feelings that interfered with their daily activities (Centers for Disease Control and Prevention, 2003). Of these Asian American high school students 19% had made a suicide plan and 11% reported having made at least one suicide attempt. Although Asian Americans were the fastest growing racial/ethnic group in the United States between 2005 and 2006 (U.S. Bureau of the Census, 2008), there has been limited research on the mental health of Asian American youth.

Asian Americans are regarded as a “model minority” (Kitano, 1969), meaning they work hard, behave well, and can take of themselves. This label may lead to adverse effects on their psychological health because they are not seen as at risk, and may create a barrier to availability of social and health services (Chang & Sue, 2003; Choi & Lahey, 2006; Tang, 2007). Following the mass shootings by an Asian American student at Virginia Polytechnic Institute and State University (commonly known as Virginia Tech) on April 16, 2007, the Asian American Psychological Association issued a statement to highlight the value of mental health services as a step toward preventing such incidents. Asian American mental health experts have voiced concerns about Asian Americans’ underuse of mental health services due to cultural beliefs about mental illness, suggesting that more culturally competent mental health services are needed to address this issue (Kaiser Health Disparities Report, 2007). It is therefore important to understand the trajectories of depressive symptoms among Asian American youth to ensure early detection and treatment.

Factors Associated with Youth Depressive Symptoms

Age and adolescent development

Adolescence is a period in life marked with many changes in biological, cognitive, psychological, and social characteristics (Christie & Viner, 2005). It is often conceptualized as having three stages: early (ages 11- 14), middle (ages 15-17), and late (ages 18-21). Biological, cognitive, psychological, and social development can differ at each stage of adolescence (early, middle, and late) and by sex (females vs. males; see details in Christie & Viner, 2005). Some scholars have reported that depressive symptoms decline from adolescence to young adulthood (Meadows, Brown, & Elder, 2006; Needham, 2007); others have found a curvilinear pattern of depressive symptoms over time (Ge, Natsuaki, & Conger, 2006; Natsuaki, Biehl, & Ge, 2009). Ge and colleagues (2006) reported that both males’ and females’ depressive symptoms increased during early to middle adolescence and declined in late adolescence to young adulthood. Natsuaki and colleagues (2009) reported an inverse U-shape for adolescents’ depressed mood between ages 12 and 23, with a peak in middle adolescence.

Sex

Empirical evidence suggests that depressive symptoms differ by sex, with adolescent females usually experiencing higher levels of depressive symptoms than their male counterparts. Explanations for the sex differences in adolescents’ depressive symptoms include multiple factors, for instance, biological effects (puberty and hormonal effects; Ge, Conger, & Elder, 2001; Mendle, Harden, Brooks-Gunn, & Graber, 2010; Natsuaki et al., 2009). Also well documented are cognitive differences between adolescent males and females in terms of depressive symptoms resulting from changes in body image during puberty (Erkolahti, Ilonen, Saarijärvi, & Terho, 2003; Hyde, Mezulis, & Abramson, 2008).

Céspedes and Huey (2008) reported that stress from differing gender role expectations for adolescent males and females may contribute to females' higher level of depressive symptoms; sex differences may also account for varying vulnerability to the negative effects of stress (Charbonneau, Mezulis, & Hyde, 2009; Hyde et al., 2008). Other possible explanations for sex difference in depressive symptoms include changing relationships among friends and family (Hankin, Mermelstein, & Roesch, 2007) and involvement in romantic relationships at younger ages (Natsuaki et al., 2009). None of these studies focused on Chinese American adolescents; the sex difference in depressive symptoms among Chinese American adolescents needs further exploration.

Race and ethnicity

Findings from limited empirical studies that compare depressive symptoms between Asian American and White adolescents and young adults are mixed. Using data from the National Longitudinal Study of Health, Brown, Meadows, and Elder (2007) compared the trajectories of depressive symptoms among a representative sample of White, Black, Hispanic, and Asian Americans from adolescence to young adulthood. They found that both Asian males and females reported higher levels of depressive symptoms over time than their White same-sex counterparts. In a study conducted by Costello, Swendsen, Rose, and Dierker (2008) among adolescents and young adults 12-25 years old, ethnic minority status (Asian American, Pacific Islander, Black, Hispanic) was a risk factor associated with depressive symptoms. In one of the earliest studies comparing depressed mood between Asian American and White college students, Greenberger and Chen (1996) found that Asian American students reported more depressive symptoms than White students. In contrast, Roberts, Roberts, and Chen (1997) reported a lower prevalence of DSM-IV major depression in Chinese American students than in their White middle-school counterparts. Depressive symptoms are not the same as clinical depression, however, which may account for the difference. Moreover, these inconsistent findings may result from the use of small convenience samples, different depressive symptoms measures, or the grouping of disparate subcultures within the Asian American group.

Socioeconomic status

Differences in the prevalence of depression between Asian American and non-Hispanic White adolescents may stem from factors other than demographic characteristics, including family socioeconomic status (SES). Lower SES has been shown to have a negative effect on psychological health, potentially due to the increased individual vulnerability and decreased resources that are associated with poverty (e.g., Chen, Keith, Airriess, Li, & Leong, 2007; Chen, Keith, Leong, et al., 2007). Goodman, Slap, and Huang (2003) found that lower household income and lower parental education were significantly associated with depressive symptoms among adolescents. Costello and colleagues (2008) reported lower SES as a risk factor associated with depressive symptoms among individuals 12-25 years old.

Acculturation

Examination of the influence of acculturation and generational status on Asian American youths' psychological well-being has produced inconsistent findings. Some researchers (e.g., Juang & Cookston, 2009) found that first-generation or less acculturated Asian immigrant adolescents were less depressed than their U.S.-born or more acculturated peers; others (e.g., Yeh, 2003) found the opposite. Willgerodt and Thompson (2006) reported that generational status, a proxy measure of level of acculturation, predicted Chinese American adolescents' somatic symptoms and substance use, but not depressive symptoms.

The aforementioned findings have provided important insights into psychological health of Asian American adolescents and young adults. Most studies, however, combined various Asian heritage subgroups into a single category, despite evidence that important within-group cultural and immigration histories differ in ways that may contribute to different health outcomes (Willgerodt & Thompson, 2006). Because Chinese Americans represent the largest subgroup of Asian Americans in the United States (U.S. Bureau of the Census, 2008), and the number of other Asian American subgroups in our sample was too small to permit reliable analyses, we restricted our analysis to Chinese Americans to avoid the problem of grouping together youth from disparate subcultures.

Furthermore, most previous studies were cross-sectional; such designs are not able to capture developmental changes in depressive symptoms. The current study extends prior research by using longitudinal data from a nationally representative sample to: (a) describe the level and rate of change over time of depressive symptoms among Chinese Americans and Whites from adolescence to early adulthood, (b) determine whether the level and rate of change of depressive symptoms from adolescence to early adulthood differ by age, sex, and race/ethnicity, and (c) test whether family SES and acculturation are associated with the level and rate of change of depressive symptoms over time in the target groups. Taken together, the initial level and rate of change over time in depressive symptoms is termed a “trajectory.”

Conceptual Framework

This study was guided by developmental theories, social stress theory, and acculturative stress theory to understand how demographic variables (age, sex, race/ethnicity), family SES, and level of acculturation influence the trajectories of depressive symptoms for Chinese American and White adolescents over time. Based on developmental theories, pubertal transition, increased involvement in romantic relationships, and stressors associated with these new changes can put individuals in the middle adolescence stage at a higher risk for developing depressive symptoms than in the late adolescence stage (Ge et al., 2001; Natsuaki et al., 2009).

From the perspective of social stress theory, an individual's disadvantaged social status and lack of resources or opportunities are determined by his or her social and economic class, race/ethnicity, age, and sex. A disadvantaged social status can expose individuals to higher level of stress and consequently affect their health outcomes (Pearlin, 1989). An integrated model of minority children's development proposed by García Coll and colleagues (1996) highlights the importance of taking into account minority youths' social position, reflected in characteristics such as race/ethnicity, class, and sex, to understand their developmental outcomes.

The acculturative stress theory (Berry, Kim, Minde, & Mok, 1987) suggests that individuals may experience unique stressors during the acculturation process, such as lowered mental health status, identity confusion, or marginality. For immigrants, acculturation represents an important step towards adaptation to the host country; it is often marked by significant acculturative stress and other adjustment issues (Organista, Organista, & Kurasaki, 2002; Xie, Xia, & Zhou, 2004). Because immigrant youth usually assimilate to the host country faster than their parents, the differential modes and rates of acculturation or cultural orientation among different family members may increase intergenerational conflicts (e.g., Buki, Ma, Strom, & Strom, 2003; Ying & Han, 2007), which in turn may increase depressive symptoms in adolescents (Weaver & Kim, 2008).

Hypotheses

Drawing upon our prior research and the theories, we posited five hypotheses:

1. Regardless of sex and race/ethnicity, individuals in the middle adolescence stage have a higher level of depressive symptoms than those in early or late adolescence stages. That is, an increasing trajectory of depressive symptoms occurs in younger adolescents (15 years old and under); a declining trajectory of depressive symptoms occurs in older adolescents (over 15 years old);
2. Relative to males, female adolescents have higher levels of depressive symptoms over time, regardless of age or race/ethnicity;
3. Chinese Americans report higher levels of depressive symptoms than their White same-sex counterparts;
4. Compared with adolescents from families with higher SES, adolescents from families with lower SES report higher level of depressive symptoms; and
5. Less acculturated adolescents report a higher level of depressive symptoms than more acculturated adolescents.

Due to the limited understanding about the differences in the *rate of change* of depressive symptoms over time by sex, race/ethnicity, SES, and acculturation level, we explored the rates of change over time in depressive symptoms by these factors without positing hypotheses.

Method

Sample

Our data came from an ongoing study, “The National Longitudinal Study of Adolescent Health” (Add Health study). The Add Health study was designed to examine health-related behaviors (e.g., physical and mental health, risky behaviors) of 20,745 adolescents in grades 7-12; racial/ethnic minorities were oversampled (Mullan et al., 2008). Using items from standardized instruments commonly used in national and state surveys, the Add Health study includes adolescent in-home interviews, adolescent in-school questionnaires, parent questionnaires, and school administrator questionnaires.

The Add Health study used a cluster sample design in which the clusters were sampled with unequal probability. All high schools in the United States that had an 11th grade and at least 30 enrollees in the school were potential samples. From this, a systematic random sample of 80 high schools was selected proportional to enrollment size, stratified by region, urbanicity, school type, and percentage of White students. For each high school, the largest feeder school (typically a middle school) was also recruited when available. Schools with grades 7 to 12 functioned as their own feeder schools. Replacement schools within the stratum were chosen when an original selected school declined to participate. A final sample of 132 schools, including feeder schools, agreed to participate, representing 79% of the schools contacted. Approximately 200 students were selected from each school. For students who were under 18 years old, parental consent and adolescent assent were obtained prior to the administration date. Participants who were 18 years old and older were asked to read and sign an informed consent form. A series of precautions were taken to maintain confidentiality of participants’ identities, including limited data access, special care of data retrieval and storage, and destruction of data and other information when no longer in use. Detailed information about the study purpose, design, and survey questions is available at <http://www.cpc.unc.edu/projects/addhealth>.

For the adolescent in-home interview, interviewers read non-sensitive questions to adolescents, and adolescents entered their responses directly on a computer. For sensitive questions (e.g., sexual behaviors), adolescents listened to pre-recorded questions via earphones and entered their responses directly on a computer to ensure confidentiality.

Three waves of data (Waves I [1994-1995], II [1996], and III [2001-2002]) were available when we conducted this secondary data analysis. A parent or guardian of participating adolescents was interviewed only at Wave I to provide information about family composition and health-related information about the parent/guardian and the adolescent child. Wave I adolescent participants were followed over time, except those who were in the 12th grade or disabled at Wave I, or who could not participate in subsequent interviews.

In this analysis, we used data from adolescent in-home interviews from Waves I-III and the parent's report at Wave I. For simplicity, we used the term "White" to refer to non-Hispanic White. The analytic sample for this study included 403 Chinese American adolescents and 11,927 White adolescents; about half (50.2%) of the sample was female. The mean age of the adolescent sample was 15.58 years ($SD = 1.73$) at Wave I, 16.17 years ($SD = 1.64$) at Wave II, and 22.84 years ($SD = 1.72$) at Wave III. The sociodemographic characteristics of the sample are described in Table 1.

Measures

Sociodemographic variables—These variables included age (in years), sex (male vs. female), race/ethnicity (Asian with Chinese background vs. White) and the highest level of parental education achieved. SES is usually indicated by education level, occupation, or household income (Adler & Newman, 2002). We used the highest education level of parents to represent family SES because it had the least missing data. Parental education was categorized as 1 (*less than a high school education*), 2 (*graduated high school*), and 3 (*more than high school*).

Acculturation—Because there is no specific acculturation measure in the Add Health study, we followed the approach of Willgerodt and Thompson (2006) and used generational status as a proxy measure for adolescents' level of acculturation. We constructed generational status by the adolescents' and parents' reports of their places of birth and ages when they first immigrated, if applicable. First-generation adolescents were defined as foreign-born youth who immigrated to the United States at or after age 6 and whose parents were foreign born. Second-generation adolescents included those who were foreign born and immigrated to the United States before age 6 or those who were born in the United States and whose parents were foreign born. Adolescents were categorized as third and higher generation if both they and their parents were born in the United States.

Depressive symptoms—The 20-item Center for Epidemiologic Studies-Depression Scale (CES-D; Radloff, 1977) is a well-validated scale that has demonstrated reliability in adolescents from various ethnic subgroups (McArdle, Johnson, Hishinuma, Miyamoto, & Andrade, 2001; Radloff, 1991), including Chinese Americans (Juang & Cookston, 2009; Weaver & Kim, 2008). In the Add Health study, a modified 19-item CES-D scale was used at both Wave I and Wave II, and a 9-item version of CES-D was used at Wave III. Similar to Needham (2007), who conducted a study using the Add Health data, we generated a depressive symptom score using the same 9 items of the CES-D for each participant from Wave I to III. The correlation between the 19-item version and the 9-item version of the CES-D was .91 at Wave I and .92 at Wave II in our sample.

The 9 items from the CES-D related to how often in the past week adolescents had experienced the following symptoms: "felt depressed," "felt sad," "were too tired to do

thing,” “could not shake off the blues even with help from your family and your friends,” “had trouble keeping mind on things,” “felt like others disliked you,” “bothered by things that don’t usually bother you,” “felt just as good as others” (reverse-coded), and “enjoyed life” (reverse-coded). Responses to the items were scored on a 4-point scale ranging from 0 (*never or rarely*) to 3 (*most of the time or all of the time*). Responses were summed to form a total score for depressive symptoms (range 0-27), with higher scores suggesting more depressive symptoms. Cronbach’s alpha ranged from .72 to .85 across groups and time in our sample.

Analytic Strategy

We used descriptive statistics to describe sample characteristics and *t*-tests to compare group differences in the mean scores of depressive symptoms. Consistent with developmental theories and prior empirical evidence, our preliminary analysis showed that depressive symptoms increased up to age 15 and then declined. For this reason, we stratified the sample by age. Younger adolescents referred to those who were 15 years old and under at Wave I; older adolescents were those who were over 15 years of age at Wave I. We describe the initial levels of depressive symptoms and the rates of change in these symptoms over time using multigroup Latent Curve Models (LCMs). LCMs are an analog of random effects/mixed models. They take mean and covariance structures into account, which allows for the modeling of both individual and group trajectories. LCMs have a number of characteristics that make them ideal for the study of changes over time (Curran & Muthén, 1999) and have been applied successfully in longitudinal studies to understand trajectories of depressive symptoms (e.g., Brown et al., 2007; Meadows et al., 2006; Needham, 2007). Furthermore, LCMs have all the traditional benefits of a latent variable structural equation modeling framework (e.g., modeling of complex error structures).

LCMs include two unobserved latent change factors, an intercept (initial level of depressive symptoms), and a slope (the rate of change in depressive symptoms over time). This combination of initial levels of symptoms and their rate of change over time constitutes a “trajectory.” According to Bollen and Curran (2006), a linear LCM of depressive symptoms (*Y*) for adolescent *i* at time *t* can be expressed as $Y_{it} = \alpha_i + \lambda_t \beta_i + \varepsilon_{it}$ where α_i and β_i respectively represent the intercept and the slope for adolescent *i*. We set the factor loadings for the slope as 0, 2, and 7 (i.e., $\lambda_t = [0, 2, 7]$) because depressive symptoms were observed at baseline and again at 2 and 7 years after baseline. ε_{it} represents adolescent and time-specific random errors. Individual intercepts (each adolescent’s baseline level of symptoms) are expressed as a function of the sample mean intercept (μ_α) and the individual deviation ($\zeta_{\alpha i}$) ($\alpha_i = \mu_\alpha + \zeta_{\alpha i}$). Individual slopes (annual rate of change in each adolescent’s symptoms over time) are similarly expressed as a function of the mean slope (μ_β) and the individual deviation ($\zeta_{\beta i}$) ($\beta_i = \mu_\beta + \zeta_{\beta i}$).

In this study, the rate of missing data for depressive symptoms ranged from 0.01% to 28% for the White group and 0% to 25.2% for the Chinese American group across waves due to sample attrition. Missing data estimation was accomplished using Full Information Maximum Likelihood (FIML) in Mplus 5.2 (Muthén & Muthén, 1998-2007). This approach estimates missing data by using all information available for each case. FIML is superior to listwise/pairwise deletion because it provides asymptotically consistent and efficient parameter estimates under the less restrictive assumption. FIML requires that the data are missing at random (MAR); listwise/pairwise deletion requires the more restrictive assumption that data are missing completely at random (MCAR; Bollen & Curran, 2006). FIML also has advantages over multiple imputation methods because it is used easily within existing software packages and yields a single set of estimates, standard errors, and model fit indices that do not differ depending on the nature and number of imputed data sets (Bollen & Curran).

We used a multigroup LCM approach to test group differences in trajectories of depressive symptoms by imposing equality constraints on intercepts and slopes across groups and observing whether such constraints significantly altered model fit. If imposing such a constraint resulted in a significant decline in model fit, then we would conclude that the intercepts or slopes varied significantly between groups. We first conducted omnibus tests for age (pooling across sex and race/ethnicity), sex (pooling across age and race/ethnicity), and racial/ethnic differences (pooling across age and sex). We then tested for racial/ethnic differences within age-sex strata. Combined, these comparisons illuminated racial/ethnic differences in trajectories of depressive symptoms and whether these differences varied by sex and age. Last, we tested whether SES and level of acculturation were associated with these differences. All models controlled for within group correlations between baseline levels of depressive symptoms and the rates of change in these symptoms over time. The following statistics suggest a reasonable model fit for the unconstrained model: (a) nonsignificant χ^2 , (b) comparative fit index (CFI) > .90, and (c) Root-Mean-Square error of approximation (RMSEA) < .08 (Browne & Cudeck, 1993; MacCallum, Browne, & Sugawara, 1996; Steiger, 1989).

We used the Satorra-Bentler scaled chi-square test to evaluate differences between models with different added constraints after we found the unconstrained model a good fit. This test takes the traditional normal-theory chi-square statistic and divides it by a scaling correction, yielding a better approximate chi-square under non-normality. This method has been shown to be superior to traditional goodness-of-fit tests to compare nested multigroup growth models estimated via FIML (Satorra & Bentler, 2001).

Results

The model fit indices suggested an adequate fit of the measurement model across time (CFI = .99; RMSEA = .04). Findings related to hypotheses 1-3 regarding age, sex, and racial/ethnic differences are presented in Tables 1-3 and Figure 1. Table 1 provides sample characteristics and the depressive symptoms by age, sex, and race/ethnicity across time. Table 2 presents latent intercepts and slopes estimates of the LCMs for each age-sex-racial/ethnicity subgroup. Table 3 includes model comparison results of age, sex, and racial/ethnic differences in depressive symptoms trajectories. The predicted trajectories of depressive symptoms for each age-sex-racial/ethnicity subgroup are presented in Figure 1.

As shown in Table 1, depressive symptoms generally declined over time. Consistent with hypothesis 1, younger adolescents (aged 15 and under at Wave I), however, reported slight increases in depressive symptoms between Waves I and II before experiencing subsequent declines. Compared with older adolescents (aged over 15 at Wave I), younger adolescents reported slightly lower initial levels of depressive symptoms but had higher levels of depressive symptoms after being followed for 7 years. Adolescent females had higher levels of depressive symptoms compared with males, and this pattern was consistent across racial/ethnic and age groups, as predicted by hypothesis 2. Among females, Chinese American adolescents aged 15 and younger reported higher mean depressive symptoms than their White counterparts at Wave II (6.95 vs. 5.99; $p < .05$). The same pattern was found between Chinese American and White males aged 15 and younger (5.18 vs. 4.46; $p < .05$). Furthermore, Chinese American male adolescents over age 15 had higher mean depressive symptoms than their White counterparts at Wave I, II, and III (6.26 vs. 5.28; 6.53 vs. 5.11; 4.44 vs. 3.85; all $p < .05$). These findings support hypothesis 3.

In Table 2, we present the latent curve parameters (mean latent intercepts, slopes, and their slope variances) of a multigroup LCM that allowed each age-sex-ethnicity group to have its own unique latent trajectory. The unconstrained model showed acceptable fit ($\chi^2_{[8]} = 74.56$;

CFI = .98; RMSEA = .07). The general pattern observed in Table 1 was confirmed in the model-based predicted trajectories. Greater initial depressive symptoms were observed for older adolescents than for the younger adolescents, for females than for males, and for Chinese Americans than for Whites. All groups experienced a decline in depressive symptoms over time. Greater declines, however, were observed for older adolescents and for females (see predicted trajectories in Figure 1).

We next conducted formal tests for age, sex, and racial/ethnic differences in depressive symptom trajectories (see the results in the “younger vs. older,” “female vs. male,” and “Chinese American vs. White” in the top half of Table 3). We first estimated an unconstrained model that allowed for separate latent intercepts and slopes for adolescents aged 15 and under and those over age 15, pooling across race/ethnicity and sex. We then imposed an age invariance constraint on the latent intercept, assuming that younger and older adolescents had the same level of depressive symptoms at baseline. Adding this constraint resulted in a dramatic *decline* in model fit from a chi-square value of 69.15 to 153.23 with one additional degree of freedom ($p < .001$). Because the decline in model fit was statistically significant, the assumption of equal intercepts for younger and older adolescents was rejected. Imposing similar age invariance on latent slopes also resulted in a significant decline in model fit ($p < .001$). The results suggested that younger and older adolescents had significantly different levels of depressive symptoms at baseline and significantly different rates of change in depressive symptoms over time. We then tested for sex (female vs. male) and racial/ethnic (Chinese American vs. White) differences in depressive symptoms trajectories in the same fashion. For sex comparisons, the results revealed that males and females had significantly different levels of depressive symptoms at baseline and experienced differential rates of decline in the symptoms, with the rate of decline more rapid for females (both $p < .001$). For racial/ethnic comparisons, we found that Chinese American and White adolescents had significantly different levels of depressive symptoms at baseline ($p < .001$). Constraining the slopes to be invariant between the two racial/ethnic groups, however, resulted in a significant *improvement* in model fit. This suggested that the rates of change (i.e., slopes) for the depressive symptoms for Chinese Americans and Whites were parallel. Thus, the difference in the depressive symptoms trajectories between these two racial/ethnic groups remained unchanged over time.

We then tested for racial/ethnic differences within age-sex strata by estimating a fully stratified model (see the results in the “Age, sex, and racial/ethnic comparisons” in the bottom half of Table 3). For younger adolescents, Chinese Americans and Whites had similar depressive symptoms trajectories and the pattern was the same for males and females. Among older adolescents, the only significant difference we found was that Chinese American males had higher initial levels of depressive symptoms than White males.

Last, we tested whether the differences in depressive symptom trajectories were associated with SES and level of acculturation. Contrary to hypotheses 4 and 5, our findings suggested that neither variable had an appreciable effect either on individual depressive symptom trajectories or on group differences in trajectories.

Discussion

Consistent with developmental theories and prior research findings (Ge et al., 2006; Natsuaki et al., 2009), we found that adolescents in the middle stage of adolescence reported a higher level of depressive symptoms than adolescents at early or late stages. The declines in depressive symptoms for younger adolescents were either slight or flat over time, while older adolescents experienced greater declines in depressive symptoms during the transition into young adulthood. These findings were true across both sexes and for both White and

Chinese American groups. These findings reveal that for some adolescents, depressive symptoms may resolve over time. Future researchers should examine contributing factors that distinguish between those adolescents for whom depressive symptoms evolve into clinical depression and those for whom symptoms recede or disappear, so that early intervention can be implemented.

Our results also showed that adolescent females had higher levels of depressive symptoms than males across age groups and time in Chinese American and White groups, supporting our hypothesis. Although the literature has provided evidence to explain sex differences in adolescents' depressive symptoms, racial/ethnic differences were not taken into account in these analyses (e.g., Ge et al., 2006; Meadows et al., 2006; Needham, 2007). Our findings confirmed that sex differences in depressive symptom trajectories exist in *both* Chinese American and White groups and for younger and older age adolescents.

We also found that the depressive symptoms declined faster over time among females relative to males. This finding is inconsistent with results reported by Meadows et al. (2006), in which they found no sex differences in the rate of change of depressive symptoms. The mechanism accounting for the greater decline in depressive symptoms for adolescent females relative to males as they age into early adulthood is not clear. Perhaps the biological changes among females during puberty, and the stress associated with these biological changes, stabilize in young adulthood. It is also possible that, over time, females develop better coping strategies to deal with stress than do males. Regression to the mean is another potential explanation for the greater decline in depressive symptoms over time among females compared to males. Future research is needed to investigate whether perceived stress associated with biological changes and coping strategies function similarly or differently among females and males in these two racial/ethnic groups.

Based on the social stress theory (Pearlin, 1989), an individual's stress level and health outcome can be affected by his/her disadvantaged social status, determined by the sociodemographic characteristics such as race/ethnicity. Although both racial/ethnic groups showed declining trajectories of depressive symptoms over time, the older Chinese American male adolescents continued to report higher rates of depressive symptoms than their same-sex White counterparts when they reached early adulthood. Perceived discrimination may contribute to the higher rate of depressive symptoms among Chinese American adolescents and young adults. Researchers have found that racial/ethnic discrimination is a salient feature of Asian American adolescents' daily experiences (Juang & Cookston, 2009; Qin, Way, & Mukherjee, 2008; Rosenbloom & Way, 2004). Moreover, perceived racial/ethnic discrimination has been linked to depressive symptoms among Asian American adolescents (Huynh & Fulgui, 2010) and Chinese American adolescents (Benner & Kim, 2009; Juang & Cookston, 2009). Furthermore, Asian American adolescents perceive increased discrimination during the high school years (Greene, Way, & Pahl, 2006); in adulthood perceived racial/ethnic discrimination decreases with age (Kessler, Mickelson, & Williams, 1999). The trajectory of perceived racial/ethnic discrimination among Asian American adolescents found in prior studies is similar to the trajectory of depressive symptoms among older Chinese American male adolescents found in the current study. This may suggest a relationship between perceived discrimination and depressive symptoms in Asian American male adolescents. Because we were not able to test the relationship between perceived racial/ethnic discrimination and depressive symptoms, future research should be conducted to explore this relationship.

The acculturative stress theory (Berry et al., 1987) suggests that immigrants may have worse mental health outcomes related to stressors experienced during the acculturation process. Empirical evidence, however, is inconsistent regarding the effect of acculturation and

generational status on adolescents' psychological health, including depressive symptoms (Juang & Cookston, 2009; Willgerodt & Thompson, 2006; Yeh, 2003). Generational status was not related to depressive symptoms among the Chinese American adolescents in our sample, consistent with previous research (Juang & Cookston, 2009; Willgerodt & Thompson, 2006). The small proportion of first-generation adolescents in our overall sample (1.84%) could have limited the power to detect such differences. A study with adolescents who have more diverse acculturation levels is warranted to unravel these complex relationships.

Limitations

The present study has limitations.. Because our primary purpose was to describe trajectories of depressive symptoms from adolescence to young adulthood, we did not explore the full range of factors found to be associated with depressive symptoms in prior research, such as pubertal timing (Ge et al., 2001; Mendle et al., 2010; Natsuaki et al., 2009), and family and parent factors (Costello et al., 2008; Juang, Syed, & Takagi, 2007; Meadows et al., 2006). Stressful life events (Ge et al., 2006; Meadows et al., 2006), discrimination (Benner & Kim, 2009; Huynh & Fuligni, 2010; Juang & Cookston, 2009), and substance use (Costello et al., 2008; Fleming, Masor, Mazza, Abbott, & Catalano, 2008; Needham, 2007) also have been associated with adolescent depressive symptoms but were not included in the current analysis. Future researchers should incorporate these factors to examine trajectories of depressive symptoms among adolescents, in particular Chinese Americans.

Our focus was on trajectories of depressive symptoms as opposed to diagnosing clinical depression. It was thus important to use the same measure for depressive symptoms across time. Because different versions of the CES-D scale were administered at different data collection time points in the Add Health study, we generated depressive symptom scores using the 9 items asked consistently across time. The 9 items used in the Add Health study survey were not completely consistent with the items included in other validated short-form CES-D scales (e.g., Cole, Rabin, Smith, & Kaufman, 2004; Santor & Coyne, 1997). Nevertheless, the strong correlation coefficients between the 19-item version and the 9-item version of the CES-D at Wave I and II in our sample suggest that the scores based on the long- and short-form CES-D were comparable. Future research is warranted to examine the psychometric properties of the 9-item version CES-D used in the Add Health study.

The Add Health study was administered in English and therefore could have excluded some non-English-speaking adolescents. Due to the study design, our sample included only adolescents who were in schools and adolescents who endorsed a single race/ethnicity as describing them best. We had a relatively smaller sample of younger Chinese American females ($n = 89$) compared to other subgroups, which may have limited the power to detect group differences in depressive symptom scores. A larger, representative sample of younger Chinese American females is warranted to examine the trajectories of depressive symptoms in future research. We did not adjust for the design effect as the weights developed for the whole sample may not be applicable to the subsample used in this analysis. These restrictions may limit the generalizability of our study findings.

Because the acculturation process is often complex and multidimensional (Padilla, 1980), generational status measured by adolescents and their parents' birthplace can only present one facet of acculturation. A more comprehensive acculturation measure that assesses language use, food and music preferences, choices of friends, and the celebration of cultural rituals and holidays is needed to understand the influence of acculturation on adolescents' depressive symptoms. With these caveats in mind, we believe that the advantages of the Add Health data set outweigh its limitations for studying depressive symptoms trajectories.

Conclusions

Researchers (e.g., Choi, 2007; Choi & Lahey, 2006) have warned that reliance on academic achievement as the sole indicator of Asian American youth's well-being can be misleading; they also note the importance of examining subgroup differences among Asian Americans. The "model minority" stereotype applied to Asian Americans, including Chinese Americans, may limit resources, services, and policy attention needed by this population. Our findings provide a unique contribution to the body of literature addressing health disparities in depressive symptoms and point to the need for greater attention to the psychological well-being of Chinese American adolescents, one of the fastest growing and understudied minority groups in the United States.

Acknowledgments

Acknowledgement of financial and other support: This study was supported by Grant Number P20MD002316 from the National Center on Minority Health and Health Disparities. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Center on Minority Health and Health Disparities or the National Institutes of Health.

This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill, and funded by grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 23 other federal agencies and foundations. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Information on how to obtain the Add Health data files is available on the Add Health website (<http://www.cpc.unc.edu/addhealth>). No direct support was received from grant P01-HD31921 for this analysis.

The authors express their appreciation to Dr. Laura Szalacha and Dr. Nancy Moore for their comments on earlier versions of this article.

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Figure 1.
Predicted depressive symptom trajectories by age, gender, and race/ethnicity.

Table 1

Descriptive Statistics for Depressive Symptoms by Age, Sex, and Race/Ethnicity

	Chinese American Females		Chinese American Males		White Females		White Males	
	Age 15 and under (n = 89)	Age over 15 (n = 97)	Age 15 and under (n = 102)	Age over 15 (n = 115)	Age 15 and under (n = 2,967)	Age over 15 (n = 3,038)	Age 15 and under (n = 2,664)	Age over 15 (n = 3,256)
Mean age (SD; range)	14.11 (.88; 12-15)	16.82 (.78; 16-19)	14.07 (.99; 12-15)	17.08 (1.04; 16-20)	13.98 (.95; 11-15)	16.96 (.86; 16-21)	14.07 (.93; 11-15)	16.99 (.89; 16-21)
Parental education (%)								
Less than high school	10.71	16.28	8.70	13.21	8.42	10.60	7.56	9.33
High school	28.57	11.28	18.48	27.36	31.27	30.58	31.96	30.08
More than high school	60.71	72.09	72.83	59.43	60.31	58.82	60.48	60.59
Generational status (%)								
First generation	11.48	26.32	9.72	27.59	1.01	2.56	0.72	2.44
Second generation	47.54	56.14	69.45	46.55	27.86	28.13	25.72	27.45
Third generation and beyond	40.98	17.54	20.83	25.86	71.13	69.31	73.56	70.11
Mean depressive symptoms score (SD; range)								
Wave I	6.33 (4.13; 0-17)	6.73 (4.63; 0-21)	4.62 (3.15; 0-15)	6.26 (3.57; 0-17)	5.89 (4.52; 0-27)	6.58 (4.61; 0-26)	4.45 (3.42; 0-24)	5.28 (3.96; 0-25)
Wave II	6.95 (4.87; 0-21)	6.48 (4.53; 0-19)	5.18 (3.76; 0-19)	6.53 (3.62; 0-19)	5.99 (4.50; 0-25)	6.31 (4.49; 0-24)	4.46 (3.51; 0-27)	5.11 (3.92; 0-27)
Wave III	5.23 (3.75; 0-18)	4.86 (4.14; 0-21)	4.49 (3.27; 0-18)	4.44 (4.23; 0-20)	4.84 (4.27; 0-24)	4.69 (4.19; 0-25)	3.86 (3.52; 0-26)	3.85 (3.57; 0-23)

Table 2

Parameter Estimates for Latent Intercepts and Slopes by Age, Sex and Race/Ethnicity

Group	<i>n</i>	Mean Latent Intercept	Intercept Variance	Mean Latent Slope	Slope Variance
Chinese males 15 & under	102	4.78	4.50	-.03	.00
Chinese males over 15	115	6.42	7.31	-.25	.04
Chinese females 15 & under	89	6.35	16.29	-.14	.29
Chinese females over 15	97	6.81	12.34	-.27	.11
White males 15 & under	2,664	4.50	7.06	-.08	.10
White males over 15	3,256	5.34	10.23	-.21	.14
White females 15 & under	2,967	6.01	12.99	-.16	.18
White females over 15	3,038	6.64	13.97	-.27	.13

Table 3

Model Comparison of Age, Sex and Racial/Ethnic Differences in Depressive Symptoms Trajectories

	Model chi-square	df	Scaling correction factor	Chi-square difference ^a
Younger vs. older adolescent				
Unconstrained model	69.15	2	0.93	--
Constrained intercepts	153.23	3	0.97	80.07**
Constrained slopes	146.48	3	0.97	72.80**
Female vs. male				
Unconstrained model	62.19	2	0.94	--
Constrained intercepts	417.29	3	0.95	361.61**
Constrained slopes	82.09	3	0.98	18.61**
Chinese American vs. White				
Unconstrained model	68.07	2	0.90	--
Constrained intercepts	76.76	3	0.87	10.89**
Constrained slopes	62.40	3	0.98	-4.93*
Age, sex, and racial/ethnic comparisons				
Unconstrained model	74.82	8	0.93	--
Chinese American males vs. White males 15 & under				
Intercepts	76.73	9	0.91	2.33
Slopes	73.91	9	0.95	-0.78
Chinese American females vs. White females 15 & under				
Intercepts	76.02	9	0.92	1.40
Slopes	72.77	9	0.95	-1.74
Chinese American males vs. White males over 15 years old				
Intercepts	86.31	9	0.92	13.46**
Slopes	72.41	9	0.96	-1.92
Chinese American females vs. White females over 15 years old				
Intercepts	74.95	9	0.93	0.15
Slopes	73.11	9	0.95	-1.51

Note.

^aSatorra-Bentler test*
 $p < .05$.**
 $p < .001$