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# Contextual Amplification or Attenuation of the Impact of Pubertal Timing on Mexican-origin Boys' Mental Health Symptoms

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## Abstract

**Purpose—**To examine the role of neighborhood contextual variation in the putative association between pubertal timing and internalizing and externalizing symptoms among Mexican-origin boys.

**Method—**In a sample of 7th grade Mexican-origin boys ($N$ = 353; $\bar{x}_{age}$ = 12.8 years) we assessed a range of secondary sexual characteristics, internalizing, and externalizing symptoms. Reports on all secondary sexual characteristics were collapsed and age-standardized to represent total pubertal timing. We also distinguished between the timing of physical changes driven by adrenal versus gonadal maturation. Boys' residential addresses were geocoded and American Community Survey data were used to describe neighborhoods along two dimensions: ethnic concentration and socioeconomic disadvantage. Three years later (in 10th grade) we re-assessed internalizing and externalizing symptoms. We examined the moderating influence of neighborhood ethnic concentration and neighborhood socioeconomic disadvantage on the prospective associations between puberty timing (total, gonadal, adrenal) and internalizing and externalizing symptoms.

**Results—**Earlier total pubertal timing predicted increases in externalizing symptoms, but only when Mexican-origin boys lived in neighborhoods low on ethnic concentration. Total timing results for externalizing symptoms were replicated for adrenal timing. Further, early adrenal timing predicted increases in internalizing symptoms, but again, only when boys lived in neighborhoods low on ethnic concentration. No effects were observed for gonadal timing specifically.

**Conclusions—**Early pubertal timing, especially advanced physical changes initiated and regulated by adrenal maturation, have important implications for Mexican-origin boys'



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internalizing and externalizing symptoms, but these implications depend on neighborhood characteristics. Ethnically concentrated neighborhoods are protective for early-maturing Mexican-origin boys.

The timing of puberty has important implications for adolescent mental health problems and scholars continue to emphasize the importance of filling major gaps in this literature (1). For example, the mental health implications of pubertal timing for Mexican-origin boys, a large and rapidly growing population with high rates of mental health symptomatology (2, 3), are not well documented (4). Some studies suggest racial/ethnic differences in timing effects (5); others show contextual differences in timing effects (6, 7). Ethnicity and context, however, are highly intertwined and difficult to disentangle (1). We examined the prospective implications of pubertal timing on Mexican-origin boys' internalizing (i.e., mood and anxiety) and externalizing (i.e., behavior problem) symptoms. We also examined aspects of the neighborhood context as potential amplifiers or attenuators of timing effects in an ethnically homogenous, socioeconomically diverse sample. Studies employing socioeconomically diverse samples of single ethnic groups present unique opportunities to disentangle ethnic differences from contextual differences in timing effects (1). We examined timing relative to pubertal maturation generally, and relative to specific physical changes driven by adrenal versus gonadal maturational separately.

Two theoretical perspectives have been used to describe timing effects across gender and ethnic groups, although additional theoretical and empirical considerations support a within-group examination of timing effects among Mexican-origin boys. The *developmental readiness hypothesis* implicates early timing as a risk factor for internalizing and externalizing symptomatology; the *maturation deviance hypothesis* implicates any off-time development (early or late) as risky (8). Both hypotheses involve multiple psychosocial, biological, and psychobiological factors as underlying mechanisms for observed timing effects (8). Because Latinos are a heterogeneous group and because the relevant factors are not randomly distributed across populations, an ethnically homogenous investigation is warranted. Psychosocially, the timing of pubertal development reflects the coming of age experience and associated changes in social expectations and behavioral norms (8). The nature of this experience varies by cultural, social, and contextual factors (9). Among Latino and Mexican-origin families with adolescent-aged boys, scholars have documented high levels of parental control (10), and parental support of pubertal sons (11), along with higher levels of exposure to disadvantaged neighborhood contexts relative to their non-Latino counterparts (12). Biologically, the relation between timing and symptomatology may reflect hormonal processes that organize neural circuits in the brain and, perhaps, alter stress sensitivity (13). Yet Mexican origin adolescent boys have both higher (e.g., testosterone) and lower (e.g., estradiol) levels of relevant hormone concentrations compared to African- and European-American boys (14). Psychobiologically, off-time youth may feel different or misunderstood because they navigate normative hormonal challenges at non-normative times (8). For Mexican-origin boys, who are uniquely susceptible to broader sociocultural aspects of social differencing (15), off-time maturation may represent one more way they feel different from the broader adolescent population. The amalgamation of these factors may produce a context of male adolescent development to which prior findings do not generalize.

Concerning the different distributions of psychosocial, biological, and psychobiological factors across populations, our first aim was to document timing effects on internalizing/externalizing symptoms among Mexican-origin boys. Recognizing the dearth of research on timing effects among Mexican-origin boys, we review research on pan-racial/ethnic, Latino, and Mexican-origin samples of boys. Regarding pan-racial/ethnic samples and internalizing symptoms: several studies suggest that early timing is a risk factor (16, 17), others suggest

that both early and late timing confer risk (5, 18), and some show no associations (19). Evidence for externalizing symptoms is more consistent with developmental readiness (1), but there are exceptions consistent with maturation deviance (20), or no timing effects (21). One study found that Latinos were most susceptible to late timing effects (5). Two studies found that Latino (22) or Mexican origin (9) boys experienced early timing risk similar to non-Latinos, but neither study design was capable of detecting late-timing effects. Overall, findings support the need for studies capable of detecting late and early timing effects (8). Finally, Mexican-origin boys tend to develop later than European- and African-American boys (23), placing them behind all girls and most boys. In light of this review, we hypothesized that being late relative to same age, co-ethnic peers may be especially risky for Mexican-origin boys.

Our second aim was to examine neighborhood context as a potential amplifier or attenuator of timing effects. Mexican-origin families are disproportionately exposed to poor, socioeconomically disadvantaged neighborhoods (12). Neighborhoods, via their opportunities, norms, expectations, and reward/punishment structures, can alter the effects of off-time development (6, 7). Socioeconomically disadvantaged neighborhoods are thought to lack clear expectations for youth behavior and social support resources; they are also associated with chronic stress (24). Exposure to multiple stressors simultaneously can increase existing vulnerabilities, like off-time development (7). Indeed, neighborhood disadvantage amplified the effects of early timing in pan-racial/ethnic samples (6, 7). Ethnically concentrated neighborhoods, however, may represent supportive contexts for Mexican-origin adolescents because norms surrounding traditional views toward parental authority, youth monitoring, positive behaviors, and sexual behavior are promoted in Latino neighborhoods, despite high poverty rates (25, 26). Consistent with this perspective, neighborhood ethnic concentration attenuated the relation between early timing and depression for Mexican-origin girls (4). Consequently, research on contextual differences among Mexican-origin boys should consider that socioeconomic disadvantage may amplify pubertal timing effects, or ethnic concentration may attenuate them.

Community-based research can effectively differentiate between gonadal and adrenal hormonal signals of physical development (27) and doing so may inform future clinical research (4). Many community-based studies rely on assessments of global physical changes (16, 17) that are initiated and regulated by two related, but distinct maturational processes: adrenarche and gonadarche. Adrenal maturation initiates/regulates pubic hair growth and skin changes; gonadal maturation initiates/regulates growth spurts, deepening of voice, and facial hair growth (27). The global approach undermines the potential for synergies between clinic and community-based research because the former increasingly relies on direct assessments of hormones related to specific maturational processes and documents unique contributions of adrenal and gonadal maturation to internalizing and externalizing symptoms (28–30). Given that each method has its corresponding strengths and weaknesses, scholars should work to promote synergies across these approaches in an effort to maximally benefit the knowledge base.

We examined whether there were contextual differences in timing effects on internalizing and externalizing symptoms among a diverse sample of Mexican-origin middle school boys. We were well situated to capture timing effects consistent with maturation deviance or developmental readiness because we could detect both early and late timing in middle school. We examined two aspects of context: neighborhood socioeconomic disadvantage and Latino ethnic concentration. To provide the most direct comparison to prior community work (6) we examined pubertal timing vis-à-vis a global assessment of physical changes. To recognize clinical contributions (28, 30) and facilitate synergies between community-based and clinic-based scholarship, we differentiated between gonadal and adrenal hormonal

signals of development by examining timing vis-à-vis a adrenal and gonadal maturation separately (4, 27).

## Method

Focusing on timing in middle school, we used data come from the second (7th grade) and third (10th grade) waves of a study of culture, context and adolescent development among Mexican-origin families in a Southwestern state. Study procedures [detailed elsewhere, (31)] were approved by the University's Institutional Review Board. Spanish and English recruitment materials explaining the project and asking parents to indicate interest were sent home with 5th grade students in schools selected to represent the cultural and economic diversity of the region (beginning Fall 2004). Interested families were screened for eligibility (Table 1). In-home computer-assisted personal interviews, in participants' preferred language, were complete with 73.2% ($N$=749) of eligible families. Analyses confirm that the sample was comparable to the Mexican-origin regional population from which it was drawn on parent education, family income, and family structure; the sample did have a somewhat higher percentage of parents born in Mexico and preferring Spanish than census data suggest (31). For the current study, participants were interviewed in the 7th and 10th grades (see Table 1 for attrition analyses). Each participating family member was paid $50 and $55 for participating in respective waves. The current study focuses on the families with a male participating child ($n$=383) who were living in the U.S. at 7th grade ($n$=353, see Table 2).

*Pubertal timing* was assessed during 7th grade using boys' reports on the Pubertal Development Scale (PDS), a widely used non-invasive measure with established reliability and validity (32). Boys reported on their growth by responding to five items on a four-point Likert-type scale [(1) *no* to (4) *changes/growth seems completed*]. To offer a comparison to previous work (33) we scored the PDS by computing a mean for all items ($\alpha$ = .79). We also scored adrenal (skin changes, pubic hair) and gonadal (growth spurt, deepening of voice, facial hair) events separately (27). The adrenal and gonadal PDS scoring algorithms developed and validated by Shirtcliff and colleagues reflect the timing of physical changes associated with underlying hormones and predict basal hormone levels as effectively as physical examinations (27). We within-age standardized raw scores to create a variable that assessed timing: higher scores indicated earlier maturation relative to same-age peers (4). For descriptive purposes, boys with age-adjusted scores $\geq 1$ are "early" and boys with scores $\leq -1$ are "late" (6). In the 7th grade, 15.0%, 22.9%, and 19.5% of boys were early, and 18.4%, 24.1%, and 19.5% were late for total, adrenal, and gonadal timing, respectively.

*Seventh grade neighborhood* context was assessed using American Community Survey (ACS) data for each boy's census tract ($n$ = 155). We operationalized socioeconomic disadvantage by standardizing and summing the percentage of families below the poverty level, unemployed, female-headed households, and households with public assistance ($\alpha$ = .71) (4, 6). Ethnic concentration was assessed using ACS estimates of the percent of the population identified as Latino (4).

*Internalizing and externalizing symptoms* were assessed in 7th and 10th grade using the Diagnostic Interview Schedule for Children (34), a standardized instrument that has demonstrated reliability and validity across Spanish and English-speaking populations. Symptom counts for anxiety and mood disorders (e.g., *trouble sleeping*, *feeling restless when worried*) were summed for internalizing and counts for oppositional defiance disorder, conduct disorder, and attention deficit hyperactivity disorder (e.g., *blaming others*, *damaging others' property*, *losing things*) were summed for externalizing, offering comparisons to prior timing work (17) and consistent with psychometric work presented elsewhere (35).

Mothers/caretakers and youth were administered schedules independently. Using standard scoring algorithms that maximize test-retest reliability and criterion validity (34), their reports were combined.

### Analyses

We examined intraclass correlations and design effects of study variables; results suggested the minimal clustering of boys in neighborhoods did not produce bias. We used overdispersed Poisson regression (because initial Poisson regression model testing indicated Pearson chi-square statistics substantially larger than 1.00) to estimate the moderating role of neighborhood context on the association between 7th grade pubertal timing and 10th grade symptoms. We controlled for (a) demographic variables, including 7th grade age, family income (1= ≤ $5,000 to 20= ≥ $95,001), and adolescent nativity (0=*U.S.*, 1=*Mexico*), that have documented implications for timing and/or adolescent symptoms (2, 3); and (b) 7th grade symptoms. Importantly, any observed effects of 7th grade timing on 10th grade symptoms cannot be explained by existing differences in symptom levels at 7th grade. Quadratic effects of total, adrenal, and gonadal timing were examined, which permitted the detection of curvilinear associations between timing and outcomes, such that both early and late timing predicted increased symptoms. Moderation by neighborhood disadvantage and ethnic concentration were examined separately. The rate of missing observations across variables ranged from 0% to 11.6%. We employed multiple imputation, using IVEware, to handle missing values (36). We performed all analyses using SAS PROC GLIMMIX (SAS Institute) and used PROC MIANALYZE to pool estimates and standard errors.

## Results

Table 3 provides zero-order correlations. Total, adrenal, and gonadal timing in 7th grade were positively correlated with 10th grade internalizing symptoms; 7th grade total and adrenal timing were positively correlated with 10th grade externalizing symptoms; neighborhood disadvantage was positively correlated with ethnic concentration. In all initial models the quadratic timing terms were not significant and were dropped.

Multivariate results are presented in Table 4. Across all models, boys born in Mexico had significantly lower levels of internalizing symptoms than their counterparts born in the U.S and 7th grade symptoms predicted 10th grade symptoms. No nativity effect was observed for externalizing symptoms. There was no main effect of total timing on internalizing or externalizing symptoms. Ethnic concentration, however, did moderate the relation between total timing and externalizing symptoms. In neighborhoods high on ethnic concentration there was no effect of timing on externalizing ($\gamma = -.06$, SE=.06, *ns*); timing predicted increases in externalizing symptoms ($\gamma = .13$, SE=.07, $p < .10$) in neighborhoods low on ethnic concentration. Neighborhood disadvantage did not moderate the relation between timing and symptoms. We replicated total timing models using gonadal and adrenal timing. Gonadal timing did not predict changes in internalizing or externalizing symptoms and results were not moderated by neighborhood variables.

We found a main effect of 7th grade adrenal timing on 10th grade internalizing symptoms. This main effect, however, was moderated by ethnic concentration (Figure 1a). There was no relation between adrenal timing and internalizing symptoms in neighborhoods high on ethnic concentration ($\gamma = .002$, SE=.05, *ns*); in neighborhoods low on ethnic concentration adrenal timing predicted increases in internalizing symptoms ($\gamma$=.16, SE =.06, $p < .01$). For externalizing, the main effect of adrenal timing was marginally significant ($\gamma$=.08, SE =.04, $p < .10$) and the adrenal timing by ethnic concentration interaction was also significant (Figure 1b). There was no relation between adrenal timing and externalizing in ethnically concentrated neighborhoods ($\gamma = -.06$, SE =.06, *ns*), but earlier timing predicted increased

externalizing symptoms in neighborhoods low on ethnic concentration ($\gamma$ =.21, SE =.07, $p$ < .01). Neighborhood disadvantage did not moderate adrenal timing effects.

## Discussion

This is the first study to examine the moderating influence of neighborhood context on the prospective association of pubertal timing with male adolescents' internalizing and externalizing symptoms. The study used an economically diverse sample of Mexican-origin boys in middle school; controlled for differences in initial symptom levels, nativity, age, and family income; examined these associations using three indicators of pubertal timing; and, by virtue of its ethnically homogenous design, ruled out ethnic differences as an alternate explanation for observed neighborhood contextual differences in timing effects (1). Our findings support the developmental readiness hypothesis, but also suggest that the exact nature of early timing effects depends on the context in which youth live and the underlying hormonal processes being signaled by physical maturation. Early pubertal timing, especially advanced physical development associated with adrenal maturation, predicted significant increases in internalizing and externalizing symptoms, except when early-maturing Mexican-origin boys lived in neighborhoods high on ethnic concentration. Our findings (a) run contrary to our expectations that late timing may be especially salient, (b) support neighborhood ethnic concentration as an attenuator, and (c) provide areas for further research on pubertal hormones among Mexican-origin boys.

Mexican-origin boys tend to develop later than European- and African-American boys (23) and prior research by Seigel et al. that included a pan-Latino subsample found that Latinos were most susceptible to late timing effects (5). In the present study, we only observed early timing effects. First, we assessed timing based on the sample distribution of boys' reports on specific physical markers of pubertal development (17). Siegel et al. used a single item to assess perceived timing, not physical changes. Second, when theorizing about timing, it may be worthwhile to consider the appropriate comparison group: we compared Mexican-origin boys to their co-ethnic peers and, despite patterns of later development among this ethnic group (23), still found that early timing mattered. Consequently, future work should consider seriously whether pan-racial/ethnic comparisons are meaningful, or whether co-ethnic comparisons may be more meaningful. This work, and prior (4, 37), suggests that definitions and implications of early timing may best be considered within-group.

According to the developmental readiness hypotheses there are several psychosocial, biological, and psychobiological factors that might shed light on the underlying mechanisms via which earlier physical maturation influences symptoms, all of which merit closer investigation in future research. Psychosocially, early-maturing Mexican-origin boys living in neighborhoods low on ethnic concentration may be ill-equipped to deal with changes in roles and expectations that are thought to accompany maturation. As such, our results replicate prior work among Mexican-origin girls (4). Research suggests that residents of ethnically concentrated neighborhoods have more positive views of adolescents (26), and therefore may have more positive role expectations and reactions to advanced maturation. Residents of these neighborhoods also tend to engage in control and monitoring of youth (26) and support warm and supportive parenting strategies during adolescence (38). These contextual factors may support boys who are grappling with early physical maturation in the context of fewer individual-level cognitive, social, and emotional resources (8).

It is noteworthy that advanced adrenal maturation surfaced as the most salient aspect of pubertal development in predicting Mexican-origin boys' symptoms, and that this finding was consistently attenuated by neighborhood ethnic concentration. Dorn and colleagues have documented higher levels of internalizing and externalizing symptoms among those

with premature adrenarche (29). Our results suggest that physical signals of advanced adrenal maturation uniquely predict symptoms for Mexican-origin boys in non-Latino neighborhoods. These physical signals may be acting as mechanism through which HPA-axis changes affect youth (28). For example, boys and/or communities may respond differently to skin changes and pubic hair growth than they do to growth spurts, facial hair, and voice changes (4). Alternatively, these changes may be signals (27) of important HPA-axis hormonal effects on symptoms (39), as early exposure to adrenal androgens have noteworthy implications for internalizing/externalizing symptoms (29). Importantly, research on hormones consistently documents contextual moderation of the effects of adrenal hormones on symptoms (30); our results lend support to these findings in community settings.

Performing separate examinations of total, adrenal, and gonadal timing and examining contextual moderation proved to be important aspects of the study design. Some work has documented no adverse effects of puberty for boys (19). Had we not performed separate examinations of unique aspects of timing and examined moderation by neighborhood ethnic concentration, we would have replicated those findings in a sample of Mexican-origin boys. First, we only observed a main effect of timing on internalizing symptoms when we looked specifically at components of physical maturation related to adrenarche. The potentially unique role of early adrenal maturation (30) may have been overlooked in prior research that focused on global puberty assessments (16, 17). Second, examining moderation by ethnic concentration allowed us to identify the culture-specific circumstances under which early total pubertal timing and adrenal timing *did* predict increased externalizing symptoms. Notably, we did not find that socioeconomic disadvantage amplified timing effects among Mexican-origin boys. Our findings parallel prior work in Mexican-origin girls (4), but are in contrast to prior work among African American boys (6). Perhaps the protective effects of living in an ethnically concentrated neighborhood may outweigh putative negative effects of living in a socioeconomically disadvantaged neighborhood for Mexican-origin boys. Latinos living in ethnically concentrated settings tend to report less discrimination and ethnic victimization (40). Consequently, early developing Mexican-origin boys living in ethnically concentrated neighborhoods may experience fewer cultural stressors (e.g., discrimination) and may not have to negotiate as many barriers to fitting in (8) as their counterparts living in non-Latino neighborhoods.

Strengths of this study include the prospective design; the socioeconomically diverse, yet ethnically homogenous sample; multiple aspects of pubertal timing; and the culture-specific assessment of neighborhood context. Further, we controlled for earlier symptom levels, allowing us to examine the impact of 7$^{th}$ grade timing on changes in symptoms between middle school and high school. The study also has limitations. We assessed timing in the 7$^{th}$ grade, representing a single snapshot; some boys in our sample may have entered puberty shortly afterward, whereas others may have entered puberty earlier. Although the PDS is a widely used, noninvasive measure with established reliability and validity (32), it is nonetheless a subjectively reported one. Our measures were based on self-reported assessments of physical signals of adrenal and gonadal maturation. Though prior work suggests boys' reports are as good at predicting hormones as physical exams (27), future work should examine hormones specifically. Finally, we captured boys in middle school, allowing us to examine both early and late timing, which was not examined in two prior studies of Latinos and Mexican-origin boys (9, 22).

Findings from the current study highlight (a) early pubertal timing as a salient risk factor for Mexican-origin boys, (b) the importance of examining contextual differences in timing effects, and (c) the importance of distinguishing between physical signals of hormonal changes driven by adrenarche and gonadarche. The current study suggests there may be

important cultural dimensions of ethnically concentrated neighborhoods that protect Mexican-origin boys from risks associated with early pubertal timing, especially early adrenal maturation. Efforts focused on supporting traditional cultural strengths in low-income Mexican-origin communities may be a way to reduce the risk of internalizing and externalizing symptoms among early-maturing Mexican-origin boys. For practitioners, our results highlight the importance of assessing sexual maturation along both adrenal and gonadal axes, as well as carefully considering the context of development when assessing individual-level risk.

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### Implications and Contribution Summary Statement

Mexican-origin boys who mature early and live in neighborhoods low on Latino ethnic concentration are at increased risk for emotional and behavioral problems in adolescence. This research has implications for clinical providers who should consider screening for broader contextual circumstances to determine the potential risk associated with boys' early puberty.

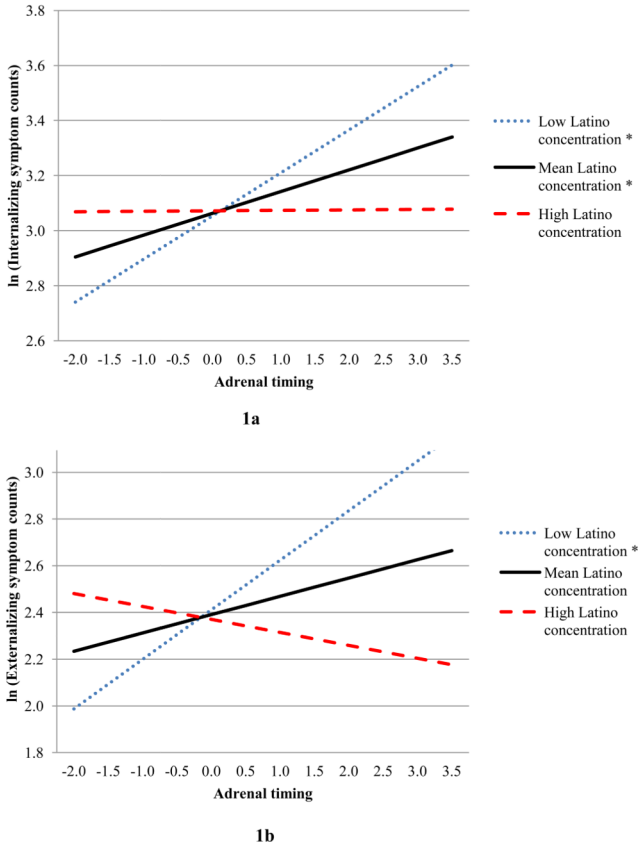


**Figure 1.**

Simple slopes plots for the association between 7th grade adrenal timing and 10th grade internalizing (1a) and externalizing (1b) symptoms (doubled then log-transformed) at low, mean, and high levels of Latino ethnic concentration. Adrenal timing scores ≥ 1 represent early timing, and scores ≤ −1 represent late timing. * indicates the slope is statistically different from zero ($p < .05$).

## Table 1

Summary of baseline eligibility criteria and 7th and 10th grade sample attrition

- Had a target 5th grader attending a sampled school.
- The participating mother was the child's biological mother, lived with the child, and was of Mexican origin.
- The child's biological father was of Mexican origin.
- The target child was not learning disabled.
- No stepfather or mother's boyfriend was living with the child (unless the boyfriend was the biological father of the target child).

| **Sample attrition** | Families who participated vs who did not at 7th grade | Families who participated vs who did not at 10th grade |
|---|---|---|
| Child characteristics | | |
| Gender | $\chi^2$ (1) = .458, *ns.* | $\chi^2$ (1) = .617, *ns.* |
| Age at baseline | $t$ (747) = .539, *ns.* | $t$ (134.36) = 1.487, *ns.* |
| Generational status | $\chi^2$ (1) = .271, *ns.* | $\chi^2$ (3) = 5.787, *ns.* |
| Language of interview | $\chi^2$ (1) = .237, *ns.* | $\chi^2$ (1) = 2.480, *ns.* |
| Mother characteristics | | |
| Marital status at baseline | $\chi^2$ (1) = 1.550, *ns.* | $\chi^2$ (1) = .381, *ns.* |
| Age at baseline | $t$ (747) = −1.194, *ns.* | $t$ (747) = −1.777, *ns.* |
| Generational status | $\chi^2$ (1) = 2.135, *ns.* | $\chi^2$ (3) = 3.698, *ns.* |
| Father characteristics | | |
| Age at baseline | $t$ (461) = .557, *ns.* | $t$ (461) = −1.133, *ns.* |
| Generational status | $\chi^2$ (1) = .020, *ns.* | $\chi^2$ (1) = .002, *ns.* |

Note. Independent *t*-tests (or Welch's *t*-test when the assumption of homogeneity of variances was violated) were used to compare families on participant ages at baseline; chi-square tests of independence were used to compare families on other variables.

## Table 2

Descriptive statistics for the sample of Mexican-origin boys (N = 353)

| | % | Range | Mean | SD |
|---|---|---|---|---|
| Internalizing symptoms | | 1.00 – 117.00 | 25.24 | 14.93 |
| Externalizing symptoms | | .00 – 60.00 | 12.43 | 10.39 |
| Total pubertal status | | 1.00 – 4.00 | 2.09 | .62 |
| Total pubertal timing | | −1.98 – 3.21 | 0.00 | 1.00 |
| Adrenal status | | 1.00 – 5.00 | 2.41 | 1.13 |
| Adrenal timing | | −1.36 – 2.31 | 0.00 | 1.00 |
| Gonadal status | | 1.00 – 5.00 | 2.80 | 1.27 |
| Gonadal timing | | −1.57 –1.79 | 0.00 | 1.00 |
| Family income (in $5,000) | | 1 – 20 | 7.67 | 4.69 |
| Age (years) | | 11.75 – 14.33 | 12.83 | .47 |
| Age (years) at 10$^{th}$ grade | | 14.67 – 17.17 | 15.87 | .45 |
| Born in the United States | 68.0 | | | |
| Interviewed in English | 90.9 | | | |
| Neighborhood disadvantage | | −5.36 – 13.91 | 0.00 | 2.92 |
| % families below poverty level | | .00 – 56.87 | 16.75 | 11.86 |
| % unemployed | | .00 – 18.17 | 7.43 | 3.27 |
| % female-headed households | | .82 – 43.40 | 14.82 | 7.99 |
| % households with public assistance | | .00 – 15.38 | 2.57 | 2.19 |
| Neighborhood ethnic concentration (%) | | 8.15 – 96.12 | 50.91 | 25.17 |

Note. Unless otherwise noted, descriptive are for 7$^{th}$ grade variables. Internalizing and externalizing symptoms were doubled to allow for the fit of a count model. Status variables represent raw scores on the PDS and PDS adrenal/gonadal subscales. Timing variables represent within-age standardized scores. Neighborhood disadvantage is a summed composite of four standardized (mean = 0; SD = 1) scores from the American Community Survey data (% of families below the poverty level, % of the population aged ≥16 years in the labor force who were unemployed,% of female-headed households, and % households on public assistance). Internalizing symptoms, externalizing symptoms, and family income at 7$^{th}$ grade each had 1 case missing; all other variables had complete data at 7$^{th}$.

**Table 3**

Bivariate correlations among study variables

| Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Internalizing symptoms (7th grade) | 1.00 | | | | | | | | | | |
| 2. Internalizing symptoms (10th grade) | .49 *** | 1.00 | | | | | | | | | |
| 3. Externalizing symptoms (7th grade) | .55 *** | .30 *** | 1.00 | | | | | | | | |
| 4. Externalizing symptoms (10th grade) | .23 *** | .64 *** | .46 *** | 1.00 | | | | | | | |
| 5. Total pubertal timing | .14 * | .17 ** | .15 ** | .12 * | 1.00 | | | | | | |
| 6. Adrenal timing | .08 | .13 * | .12 * | .12 * | .82 *** | 1.00 | | | | | |
| 7. Gonadal timing | .07 | .14 * | .08 | .10 | .84 *** | .59 *** | 1.00 | | | | |
| 8. Family annual income | −.05 | −.06 | −.06 | −.08 | −.02 | −.05 | .01 | 1.00 | | | |
| 9. Age | .05 | .04 | .06 | .04 | .09 | .07 | .11 * | −.09 | 1.00 | | |
| 10. Neighborhood disadvantage | .04 | .04 | .02 | .03 | −.08 | −.07 | −.08 | −.27 *** | −.03 | 1.00 | |
| 11. Ethnic concentration | −.05 | −.05 | −.02 | −.03 | −.10 | −.11 | −.12 * | −.36 *** | .03 | .59 *** | 1.00 |

Note. The correlation coefficients were based on listwise deletion (N = 312), but all other analyses were done using the full sample (N = 353).

* $p < .05$,

** $p < .01$,

*** $p < .001$.

**Table 4**

Unstandardized overdispersed Poisson regression model coefficients predicting Mexican-origin boys' internalizing and externalizing symptoms (N = 353)

| | Internalizing symptoms | | | Externalizing symptoms | | |
|---|---|---|---|---|---|---|
| | **Total puberty models Coefficient (SE)** | **Adrenal models Coefficient (SE)** | **Gonadal models Coefficient (SE)** | **Total puberty models Coefficient (SE)** | **Adrenal models Coefficient (SE)** | **Gonadal models Coefficient (SE)** |
| Moderation by neighborhood disadvantage | | | | | | |
| Intercept | 3.07 (.04)*** | 3.07 (.04)*** | 3.07 (.04)*** | 2.41 (.05)*** | 2.40 (.05)*** | 2.41 (.05)*** |
| Age | .05 (.08) | .05 (.08) | .05 (.08) | .05 (.09) | .05 (.09) | .06 (.09) |
| Family income | −.01 (.008) | −.01 (.008) | −.01 (.008) | −.02 (.01) | −.02 (.01) | −.02 (.01) |
| Nativity | −.19 (.08)* | −.19 (.08)* | −.20 (.08)* | −.14 (.10) | −.13 (.10) | −.14 (.10) |
| 7th grade symptoms | .02 (.002)*** | .02 (.002)*** | .02 (.002)*** | .04 (.003)*** | .04 (.003)*** | .04 (.003)*** |
| Timing | .05 (.04) | .08 (.03)* | .04 (.04) | .03 (.04) | .07 (.04) | .03 (.04) |
| Neighborhood disadvantage | .002 (.01) | .001 (.01) | .003 (.01) | .002 (.02) | .002 (.02) | .004 (.02) |
| Timing × Latino concentration | −.01 (.01) | −.02 (.01) | −.01 (.01) | −.01 (.02) | −.03 (.01) | −.004 (.02) |
| Moderation by neighborhood ethnic concentration | | | | | | |
| Intercept | 3.07 (.05)*** | 3.06 (.05)*** | 3.07 (.05)*** | 2.41 (.05)*** | 2.39 (.05)*** | 2.41 (.05)*** |
| Age | .05 (.08) | .05 (.08) | .06 (.08) | .06 (.09) | .06 (.09) | .06 (.09) |
| Family income | −.01 (.01) | −.01 (.009) | −.01 (.009) | −.02 (.01) | −.02 (.01) | −.02 (.01) |
| Nativity | −.20 (.08)* | −.19 (.08)* | −.20 (.08)* | −.15 (.10) | −.13 (.10) | −.15 (.10) |
| 7th grade symptoms | .02 (.002)*** | .02 (.002)*** | .02 (.002)*** | .04 (.003)*** | .04 (.003)*** | .04 (.003)*** |
| Timing | .05 (.04) | .08 (.04)* | .04 (.04) | .03 (.04) | .08 (.04) | .03 (.04) |
| Latino concentration | .000 (.002) | .000 (.002) | .000 (.002) | −.001 (.002) | −.001 (.002) | −.001 (.002) |
| Timing × ethnic concentration | −.001 (.002) | −.003 (.001)* | −.002 (.002) | −.004 (.002)* | −.01 (.002)** | −.003 (.002) |

Note. The internalizing and externalizing symptoms were doubled to allow for the fit of a count model.

* $p < .05$,

** $p < .01$,

*** $p < .001$.