A Longitudinal Assessment of Early Pubertal Timing as a Predictor of Psychosocial Changes in Adolescent Girls With and Without Spina Bifida

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Objective A longitudinal comparison of adolescent girls with and without spina bifida (SB), regarding the effects of early pubertal timing on girls' depressive symptoms, mother–daughter conflict, and emotional distancing. **Methods** 62 mother–daughter dyads (31 with SB and 31 without) reported on psychosocial outcomes at 5 time points (ages 8/9 to 16/17 years). **Results** A pubertal timing × SB status interaction predicted emotional distancing (T2), conflict (T2, T5), and depressive symptoms (T4), such that early maturing girls without SB reported the greatest increase in each outcome. Main effects of pubertal timing predicted emotional distancing (T4), conflict (T4), and depressive symptoms (T2, T3, T5). Findings were not always consistent across reporters, assessments of pubertal timing, and time-points. **Conclusions** Although early maturing girls in both groups may experience greater psychosocial difficulties, early maturing girls without SB may be most at-risk. The somewhat reduced impact of early pubertal timing in girls with SB is discussed.

Key words adolescents; family functioning; longitudinal research; spina bifida.

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Introduction

Puberty is a major developmental milestone in adolescence, not only physically and biologically, but also socially and psychologically. In fact, deviations from typical timing of this developmental milestone are often associated with poor psychosocial outcomes. For instance, previous research has found a direct relationship between early pubertal timing in females and higher levels of depressive symptoms compared to their on-time peers (e.g., Mendle, Harden, Brooks-Gunn, & Graber, 2010; Stice, Presnell, & Bearman, 2001). In general, researchers have concluded that early pubertal timing is a risk factor for poor psychosocial development in females and late pubertal timing is a risk factor for males (Graber, Seely, Brooks-Gunn, & Lewinsohn, 2004). Changes in the parent–child relationship also occur around the time of the child's pubertal development. For instance, during adolescence, there is usually a shift in social support, where the child withdraws from her family (mother, father, etc.) and begins to rely more on peers (Steinberg, 1988). As well, pubertal development can lead to increases in conflict between parent and child (Kashy, Donnellan, Burt, & McGue, 2008).

The impact of pubertal timing in children with a chronic illness or a neurological condition may be particularly complex. Although neuro-anatomical causes of precocious puberty are more common in males, neurological abnormalities, such as gliomas, hematomas, or subarachnoid cysts, are reportedly the cause of precocious puberty in about 10–20% of girls (Kaplowitz, 2002). Additionally, early pubertal timing may be associated with the onset of neurological disorders (Plazzi et al., 2006; Ramagopalan et al., 2009) and the presentation of

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neurological disorders may depend on whether a child is pre- or postpuberty (Chabas et al., 2008; Verrotti et al., 2009). For these reasons, pubertal timing is a particularly salient developmental construct in youth with neurological disorders. Chronic illnesses, such as spina bifida (SB) or cystic fibrosis, can expedite or delay the timing of pubertal development (Holmbeck, 2002a; Lock, 1998), respectively. Thus, the incidence of off-time pubertal development may be more common in children with chronic illnesses. While precocious puberty is still rare, girls with SB experience early menarche more often than their typically developing peers (Hubbard, 1996; McLone & Ito, 1998). Since early pubertal timing may be more common, it is important to understand if it poses the same psychosocial risks in girls with this condition.

Pubertal timing is difficult to assess in girls. The timing and course of pubertal development, from budding breast development and sparse pubic hair growth to menarche and a mature physique, is highly variable across girls. To determine whether a girl is early, on-time, or late a child or parent can be asked for their estimate of pubertal timing. Alternatively, researchers may compare the age at which a significant pubertal event occurred to population norms. For instance, reported age of first menstruation could be compared to normative data from a large population-based sample. Unfortunately, many researchers assess pubertal timing retrospectively (e.g., Ramagopalan et al., 2009). While this method is considered reliable, the validity of the report is dependent upon the accuracy of the subjects' recollection. Thus, it follows that the further the reporter is from the event, the less accurate the report may be. The current study provides an example of a longitudinal, prospective method of assessing pubertal timing in girls with SB.

SB is a birth defect occurring in approximately 18 in every 100,000 live births (Centers for Disease Control and Prevention [CDC], 2008). For children with SB, the spine does not completely close during gestation, which produces a spinal lesion. This condition is treated at birth; however, irreversible damage can occur to the neural tissue (lipomeningocele), spinal coverings (meningocele), and the spinal cord (myelomeningocele). Due to this damage, children with SB often have urological and bowel difficulties necessitating the use of a catheter, establishment of a bowel program, and maintenance of a specific diet. As well, the physical ability of the child depends on the location of the lesion: the higher the lesion, the more pervasive the physical disability. Many children with SB rely on the aid of braces, crutches, or a wheelchair to ambulate. In addition to lesion level-related health complications, malformations of CNS structures (e.g., Chiari II malformation and delayed maturation of gray and white matter) and hydrocephalus (excess fluid in the ventricles of the brain due to a blockage in the flow of cerebral spinal fluid to/from the brain) are particularly common for children with myelomeningocele. These neurological insults often cause cognitive issues for children with SB, such as low to low average intelligence, deficits in nonverbal abilities, math skills, short-term memory, and attention (Fletcher & Dennis, 2009). Such cognitive weaknesses may make youth with SB less responsive to ongoing physical changes that they experience, such as the changes of puberty.

Since females with SB are more likely to begin puberty early and because higher rates of depressive symptoms are more common for early-maturing girls (Mendle et al., 2010; Stice et al., 2001), depressive symptoms should be a concern in this population. However, the current literature describes mixed findings. Some researchers have found an increased prevalence of depressive symptoms in children with SB (Ammerman et al., 1998; Appleton et al., 1997), while other researchers have not (Holmbeck et al., 2003). A literature review produced only one study (a doctoral dissertation) that has examined puberty and depressive symptoms in girls with SB. Specifically, Hubbard (1996) suggests that early maturation may not be associated with higher rates of depressive symptoms in girls with SB. While the Hubbard study examined the level of pubertal maturation instead of timing of maturation, it is interesting that the connection between pubertal development and depressive symptoms was not as robust for children with SB.

As previously mentioned, parent–child conflict has also been shown to escalate during adolescence, a time in which pubertal development typically takes place (Kashy et al., 2008; Laursen, Coy, & Collins, 1998). Parent–child disagreements can occur when a child's request for greater independence is not granted by his/her parent. These disagreements may lead to conflict during adolescence as parent and child negotiate previously set roles and expectations (Hill, 1998; Smetana, Campione-Barr, & Metzger, 2006; see Holmbeck, 1996 for a review). While the conflict can bring about temporary strain on the relationship, it also can lead to greater independence for the adolescent. However, families of children with SB tend not to demonstrate this increase in parent-child conflict during puberty (Coakley et al. 2002; Jandasek et al., 2009). Coakley and colleagues (2002) suggested that families of children with SB may be less reactive to pubertal changes than families of typically developing youth. Thus, previous research suggests that, among early maturing girls, girls without SB may experience increases in

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mother-daughter conflict during adolescence, while girls with SB may not.

Emotional distancing, the decline in the level of reliance on one's parents for emotional support, is also a common response of children during adolescence. Montemayor (1983) suggests that adolescents often deal with conflict by distancing or disengaging from parents. Indeed, studies have found that pubertal maturity is associated with a lessening of attachments with parents and other family members (Papini, Roggman, & Anderson, 1991; Patton et al., 2008). In particular, one study found that females who had reached early pubertal maturity displayed greater striving for separation from their mothers than their peers (Weichold, Buttig, & Silbereisen, 2008). Thus, past research suggests that girls who are early maturing might exhibit greater increases in emotional distancing from parents than their on-time- or late-maturing peers. However, it appears that children with SB do not experience the same process of emotional distancing during puberty. Previous studies have shown that among families of children with SB, levels of family cohesion remain constant during the pubertal transition (Jandasek et al., 2009). Based on these findings, we predicted that girls without SB would experience increased emotional distancing from their parents as a result of early pubertal timing, while girls with SB would not.

The majority of studies that have examined the effects of pubertal timing and development on psychosocial outcomes have employed cross-sectional data, specifically at time points during early or middle adolescence, yet some exceptions do exist (Kaltiala-Heino, Marttunen, Rantanen, & Rimpela, 2003). For example, one study found that at the age of 24 years, women who had experienced earlier pubertal timing had greater levels of psychosocial symptoms (e.g., poor family and social relationships and lower levels of life satisfaction) as well as higher rates of lifetime mental disorders compared to women who had began pubertal development on time or late (Graber, et al., 2004). Other studies analyzing longitudinal data have found increases in psychosocial problems in mid-adolescence (but not in late adolescence or early adulthood) among early maturing girls (Copeland et al., 2010; Johansson & Ritzen, 2005; Lien, Haavet, &Dalgard, 2010). Thus, this previous research suggests that the impact of early puberty on psychosocial adjustment may be a transitory concern, occurring only during middle adolescence before leveling out in late adolescence.

Still, there exist no longitudinal studies of pediatric samples across the adolescent developmental period. As a result, the effects of early pubertal timing on late adolescent outcomes are not well understood for children with chronic illnesses. In terms of autonomy development and agreement on decision-making autonomy, children with SB seem to be on a similar trajectory as typically developing children, although such development appears to be delayed by a few years (Friedman, Holmbeck, DeLucia, Jandasek, & Zebracki, 2009; Devine, Wasserman, Gershenson, Holmbeck, & Essner, 2011). Thus, girls with SB may show a similar, but delayed pattern for the effects of early pubertal timing on psychosocial outcomes (perhaps occurring later in adolescence). On the other hand, compared to typically developing children, changes in conflict and cohesion over adolescence are not as dramatic for children with SB (Coakley et al., 2002; Jandasek et al., 2009). Thus, rather than being delayed, it is possible that early maturing girls with SB may never show an increase in conflict (as has been found in early maturing girls without SB).

The current study aims to examine the effects of pubertal timing on these psychosocial issues in mid and late adolescence by assessing group differences between early maturing girls with and without SB longitudinally across the adolescent developmental period. This study extends the Coakley and colleagues (2002) study, which only examined the first two time-points. Our first hypothesis was that the relationship between pubertal timing and depressive symptoms, parent–child conflict, or emotional distancing would depend on group status (presence or absence of SB). More specifically, the association between early pubertal timing and each of these psychosocial outcomes was expected to be stronger for girls without SB (Figure 1). Our second hypothesis was that the interaction between pubertal timing and SB status would be most salient in middle adolescence [T3 (age 12–13 years) to T4 (age 14–15 years)], such that puberty would be most highly associated with these outcomes for girls without SB and during the middle adolescent data collection.

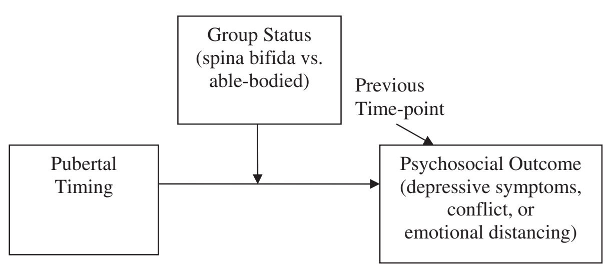

Figure 1. Model for psychosocial outcomes in early pubertal girls: moderation.

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Methods

Participants

The focus of the current study was on mothers and daughters from a larger, longitudinal study on family processes during the adolescent transition for children with SB (Holmbeck, Coakley, Hommeyer, Shapera, & Westhoven, 2002; Holmbeck et al., 2003). The current study included only female adolescents, as female pubertal development was assessed using age of first menarche, which is one of the most reliable ways of assessing self-reported pubertal development (Smolak, Krieg, Hayward, Shisslak, & Taylor, 2007) and there is no such distinctive event to mark a male's pubertal development. Families of children with SB, ages 8 or 9 years, were recruited from four sources: a children's hospital, a children's hospital that exclusively serves children with physical disabilities, a university-based medical center, and a statewide SB association (see Holmbeck et al., 2003 for specific recruitment methods). Children of families who declined participation ($n = 64$) did not differ from those who did participate ($n = 70$) with respect to lesion level [$\chi^2(2, n = 116) = 0.62$, $p > .05$], or type of SB (myelomeningocele vs. lipomeningocele) [$\chi^2(1, n = 119) = 1.63$, $p > .05$]. A matched comparison sample was attained by recruiting typically developing children from schools where the first 42 children with SB were enrolled (see Holmbeck et al., 2003 for details of the matching process). The final sample included 68 families of children with SB (37 males, 31 females; M age = 8.34) and 68 families with typically developing children (37 males, 31 females; $M = 8.49$), who were matched on 10 demographic variables. While the original study included all family members, the current study focused only on mothers and daughters and thus included only the 62 families with daughters: 31 with SB and 31 typically developing (see Table I for demographic information).

For children with SB, medical information about their physical status was gathered from the mother's questionnaire and from the child's medical chart (a medical chart release was acquired during the home visit). For the 31 participants with SB, 84% had a diagnosis of myelomeningocele and 16% had lipomeningocele. As well, over half of the children had spinal lesions in the lumbosacral or lumbar level (64%), 29% had sacral level lesions, and 7% had thoracic level lesions. Mother report indicated that most of the children had a shunt (68%). Of those children with a shunt, 67% had reportedly experienced at least one shunt revision by T5, and 55% had had at least one shunt replacement. Most of the children needed assistance with ambulation either in the form of braces (58%) or a wheelchair (13%).

Data were collected from families every two years. The current study included data from the first five time points (Time 1 through Time 5), when the children were ages 8–17 years (8 or 9 at Time 1, 10 or 11 at Time 2, 12 or 13 at Time 3, 14 or 15 at Time 4, and 16 or 17 at Time 5). Not all of the original 62 families participated at every time point but retention rates were satisfactory: at Time 2, 30 SB and 30 comparison (C) families participated; at Time 3, 28 SB and 30 C families participated; at Time 4, 26 SB and 30 C families participated; and at Time 5, 23 SB and 29 C families participated. For the SB group, families that dropped out of the study by Time 5 did not differ on any basic demographic variables (child age, child ethnicity, and family SES) from families that remained in the study. For the comparison group, families that dropped from the study by Time 5 had significantly younger children ($M = 8.00$, $SD = 0.00$) than families that remained in the study ($M = 8.52$, $SD = 0.51$) [$t(28) = -5.48$, $p < .05$].

Procedure

This study was approved by university and hospital Institutional Review Boards. Trained graduate and

Table I. *Demographic Variables for the Current Sample at Time 1*

Demographic characteristics	SB	Comparison	Statistical test
Child age in years, M (SD)	8.39 (0.50)	8.48 (0.51)	$t(60) = -0.76$
Child ethnicity			
White, n (%)	25 (80.65)	28 (90.32)	$\chi^2(1) = 1.17$
Other, n (%)	6 (19.35)	3 (9.68)	
Pubertal timing group (based on menarche)			
Early, n (%)	11 (35.48)	7 (22.58)	$\chi^2(1) = 1.25$
Other, n (%)	20 (64.52)	24 (77.42)	
Hollingshead SES, M (SD)	43.02 (12.32)	47.21 (11.70)	$t(59) = -1.36$

Note. $n = 31$ for each sample. The current sample only included females. The Hollingshead (1975) Four Factor Index of socioeconomic status (SES) is based on a composite of maternal education, paternal education, maternal occupational status, and paternal occupational status. All statistics were nonsignificant.

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undergraduate research assistants collected data from participants during home visits that lasted about 3 hr. Families were compensated at each visit: $50 for Time 1 and $75 for Times 2 through 5. After obtaining consent from the parents and assent from the child, families were asked to complete several questionnaires and participate in one hour of semi-structured interaction tasks that were audiotaped and videotaped. To maintain confidentiality, family members were asked to fill out the questionnaires independently. As well, to ensure that the child understood the questionnaires, research assistants read each question aloud and any Likert scale responses were displayed on a laminated card for the child to choose from.

Families also participated in several video-taped interaction tasks: a warm-up task, an unfamiliar board game task (designed specifically for this study), a conflict task (Smetana et al., 1991), and the structured family interaction task (Ferreira, 1963). Only the last three tasks were used in the current study and they were counterbalanced for each family (see Holmbeck et al., 2003, for a description of these tasks).

Measures

Pubertal Timing

Specific items from the Pubertal Development Scale (PDS, Petersen, Crocket, Richards, & Boxer, 1988) were used to assess pubertal timing in two ways: subjectively and objectively. The PDS is a questionnaire measure of sex-specific pubertal development.

To assess pubertal timing objectively, the age at first reported menstruation was used to determine whether the child was ''early'' or ''on-time or late.'' Since items about pubertal development were not included in the child's questionnaire until Time 3, mother report was used. The age of first menstruation was assessed at the time point for which menarche was first reported. If the parent reported that menarche had occurred, they also reported the month and year when menarche first occurred (see Figure 2 for a detailed description of this process). If the family participated at a given time point, but the mother did not complete this item, then father report was used. If both mother and father report were missing, than the child report of age of first menstruation was used at Time 3 and beyond. In all cases, early pubertal timing was determined based on the specific age when the child began menstruation.

A recent study of 17,077 American girls was used to determine means and standard deviations for average age of first menstruation (Herman-Giddens et al., 1997). This study has been approved by the American Academy of Pediatrics as an appropriate resource for age norms of female pubertal development (Kaplowitz & Oberfield, 1999). One standard deviation below the mean age of menarche was used as a cut off for determining ''early'' status. The average age of menarche as reported by Herman-Giddens and colleagues (1997) was 12.88 with a *SD* of 1.20, so if the girl was younger than 11.68 (11 years and 8.2 months old) when menarche was first reported, then she was considered ''early.'' Any participant older than 11.68-years old at menarche was considered ''on-time or late.'' Herman-Giddens and colleagues (1997) found different norms for African American girls. Thus, these norms were used to determine early pubertal timing for African American girls in this study. For African American girls, the average age of menarche was found to be 12.16 with a *SD* of 1.21, so if the girl was younger than 10.95 (10 years and 11.4 months old) when menarche was first reported, she was considered ''early.'' Self-report of menarcheal timing has been found to be sufficiently reliable and possibly more so than using other self-report measures (Smolak et al., 2007).

Subjective reports of pubertal timing were also assessed. One item from the PDS was used to determine if parents perceived their daughter's physical development to be earlier or later than most other girls her age. Answers were provided on a Likert scale: 1 = much earlier, 2 = somewhat earlier, 3 = about the same, 4 = somewhat later, 5 = much later. For this study, we used mothers' report of subjective pubertal timing at Time 2 (ages 10–11 years) because the ''early'' group reached menarche around Time 2. Thus, the girls' physical development should have been advanced enough at this time-point for the mother to determine whether her daughter was early for her age. If the mother answered 1 or 2, the perception of her child's development was considered ''early,'' if she answered 3, 4, or 5, it was considered ''on-time or late.''

Subjective and objective reports of pubertal timing were significantly correlated for both the SB group ($\chi^2 = 4.50$, $p = .03$) and the typically developing group ($\chi^2 = 7.87$, $p = .01$). However, there were differences in each group. In the SB group, four participants were ''early'' according to their age of menarche, but they were ''on-time or late'' as reported by their mother. Moreover, four participants who were ''on-time or late'' according to their age of menarche, were described as ''early'' by their mother. In the typically developing group, three participants were ''early'' according to their age of menarche, but they were rated as ''on-time or late'' by their mother. Two participants who were ''on-time or late'' according to their age of menarche, were described as ''early'' by their mother. There is no clear evidence for why differences in objective and subjective report of pubertal

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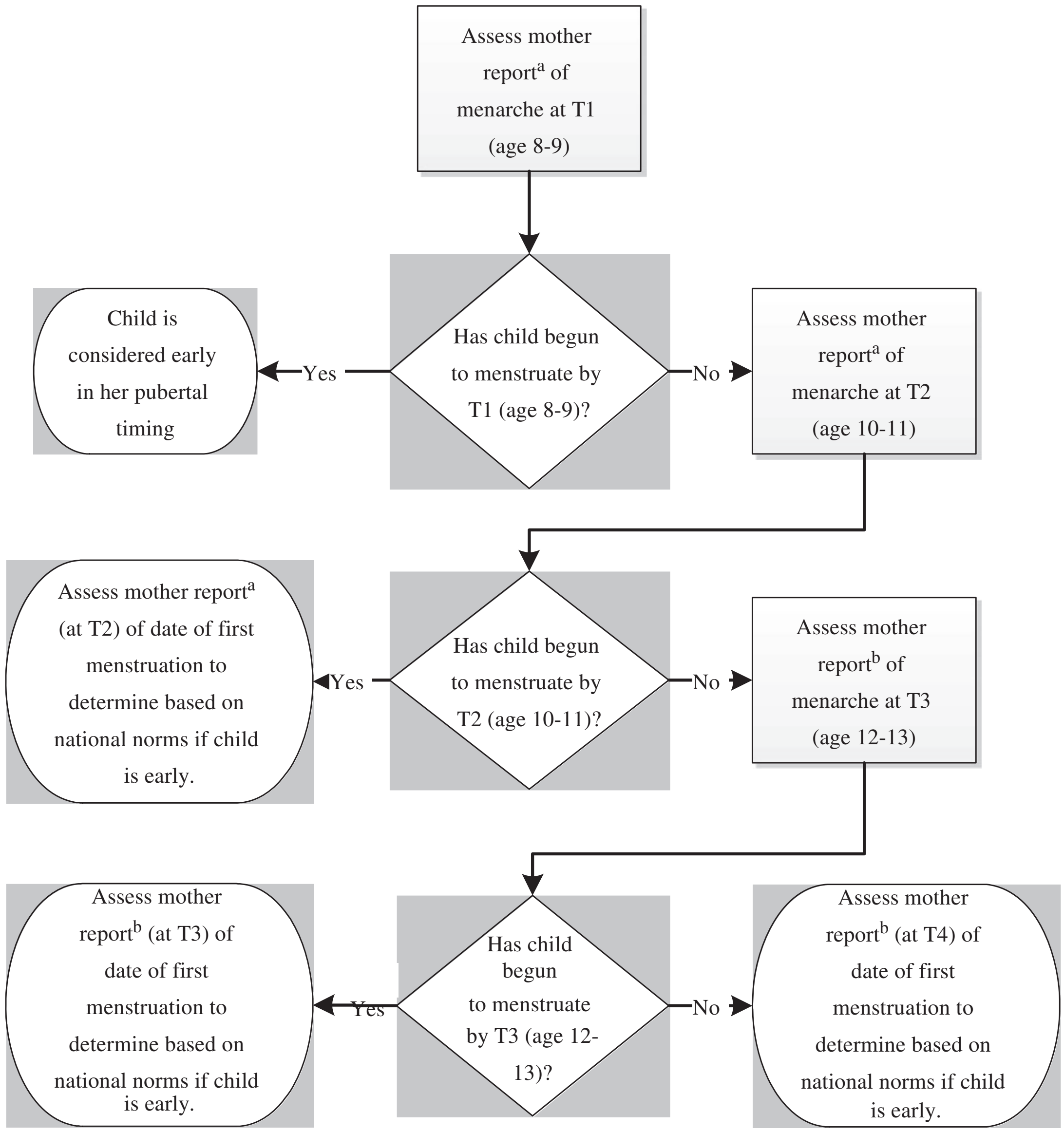

Figure 2. Process used to determine pubertal timing based on age of first menarche. [a]If mother report was not available, then father report was considered. [b]If mother and father report were not available, then child report was considered.

timing exist. It is possible that some mothers rated their daughter's pubertal timing relative to their own age of pubertal development or that of a relatives' rather than the child's peers. Due to these differences, subjective and objective pubertal timing measures were kept separate for all analyses.

Depressive Symptoms

Using data from each time-point, child depressive symptoms were measured in two ways: child and mother report. Child report was included as internalizing symptoms are often more accurately reported by children than by their parents (Klein, Dougherty, & Olino, 2005). However, in the original sample, participants with SB had a significantly lower mean IQ than the typically developing group (Holmbeck et al., 2002). Thus, mother report of child depressive symptoms was also included because of the possibility that mother report may be more valid for younger children with SB.

Child report of depressive symptoms was assessed using the mean of raw scores from the Child Depression Inventory (CDI; Kovacs, 1992). The CDI is a 27-item measure that provides three possible choices, ranging in degree of depressive symptomatology, for each item. This measure was found to have acceptable alphas in the current study ($\alpha = .77$ for SB sample and $\alpha = .85$ for comparison group).

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As well, the item-level mean score for each group (possible range = 0–2) was in the average range ($M = 1.29$, $SD = .23$ for SB sample and $M = 1.25$, $SD = .22$ for the comparison group).

Using data from each time-point, mother report of the child's depressive symptoms was based on the mean of raw scores from mother's responses to the Child Behavior Checklist (CBCL). The CBCL is a 113-item parent-based report of the child's internalizing and externalizing symptoms. For each item, parents were asked to determine if the statement is ''not true,'' ''somewhat or sometimes true,'' or ''very true or often true'' for their children. As a whole, the CBCL has demonstrated excellent reliability and validity (Achenbach, 1991). To measure child depressive symptoms, a depression subscale of the CBCL was used. The depression scale (CBCL-D) was adapted from one of the original subscales (i.e., ''Anxious-Depressed'' subscale) of the CBCL to focus particularly on depressive symptoms rather than more broadly on internalizing symptoms (Clarke et al, 1992). The CBCL-D is composed of 15 items, such as ''cries a lot,'' or ''doesn't eat well.'' The depression subscale (possible range = 0–2) showed satisfactory reliability for both groups in this study ($\alpha = .81$ for SB group; $\alpha = .85$ for typically developing group).

Parent–Child Conflict (Questionnaire Data)

Using data from each time-point, parent–child conflict was assessed in two ways: using questionnaire data and data from coded video interactions between child and parent. Since the mother–daughter dyad was the focus of this study, questionnaire-based parent-child conflict was assessed using only mother and child reporters.

The Parent–Adolescent Conflict Scale (PAC), a brief version of the Issues Checklist (IC; Robin & Foster, 1989), was completed by mothers and daughters, separately. The PAC measures family conflict by asking for information about 15 issues commonly discussed in adolescence (e.g., whether I do chores around the house). For each issue, the respondent was asked whether the issue was discussed in the past 2 weeks and if so, how many times the issue was discussed and how intense the discussions were (reported on a 5-point Likert scale from ''calm'' to ''angry''). The intensity scores were averaged to yield an overall measure of parent–child conflict for each reporter (mother and daughter). Alpha coefficients could not be computed for this measure, as each family answered only items that they have personally discussed (i.e., one family may argue about doing chores while another family may argue about how the child spends time after school). Thus, each respondent did not answer every item.

Parent–Child Conflict (Observational Data)

Using data at every time-point, the family interaction tasks were employed in these analyses. Tasks were coded by trained research assistants, using a macro-coding scheme adapted for this project by Holmbeck, Belvedere, Gorey-Ferguson, and Schneider (1995) and based on a system developed by Smetana, Yau, Restrepo, and Braeges (1991). Coders viewed one interaction task at a time and then rated the interaction on a variety of dimensions, scored on a 5-point Likert scale. The level of conflict was assessed separately for each family dyad (mother–child, father–child, and mother–father). Only data for the mother–child dyad were included in this study. Each task was rated by two coders and their ratings were averaged to obtain a conflict score for the mother–daughter dyad. The mother–daughter conflict score for each of three interaction tasks were combined to obtain an overall mother–daughter conflict dimension score for each participant.

Graduate and undergraduate students were trained for approximately 10 hr until they obtained at least 90% agreement with an expert coder. The coding manual included descriptions of each dimension and behavioral examples for each point on the Likert scale. None of the coders were aware of the specific hypotheses of this study, but they were aware of whether or not the child had SB. Satisfactory interrater reliability was found between coders on the mother–child conflict item in this study (ICCs = .73–.77).

Emotional Distancing

A composite score of three subscales of the Emotional Autonomy Scale, a self-report questionnaire measure, was used to assess emotional distancing at each time-point (EA: Steinberg & Silverberg, 1986; subscales: Parental Deidealization, Nondependency on Parents, and Individuation). The EA was originally created to assess emotional autonomy, but it appears to actually assess emotional detachment, or distancing, rather than autonomy (Ryan & Lynch, 1989). For further discussion on this topic, see Schmitz and Baer (2001). The EA scale was completed by each participant regarding her mother and father separately. Since this study focused on the mother–daughter dyad, only the EA scale pertaining to the child's mother was used in this study. The EA was found to have acceptable alphas in the current study: .69 for children with SB and .72 for typically developing children.

Demographics

Mother questionnaire data were used to assess the child's age, gender, and ethnicity.

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Analytic strategy

ANCOVA analyses were used to test the hypotheses of this study (rather than structural equation modeling given the sample size of the current study; Cohen, Cohen, West, & Aiken, 2002). A power analysis was used to assess whether the sample size was appropriate for the following statistical analyses (Aiken & West, 1991; Cohen, 1992). Since this study focused only on female children and their mothers, power was computed based on the number of families with female children, $n = 62$ (31 SB, 31 typically developing). The current study had the sample size necessary to detect a large effect size, considering the most complex analyses (Cohen, 1992).

To test the first hypothesis, procedures were followed as outlined by Aiken and West (1991) for testing interactions. The predictors were pubertal timing (subjective or objective), group status (SB or comparison), and the interaction term: pubertal timing × group status. The dependent variable was either depressive symptoms (mother or child report), parent–child conflict (observed, mother report, or child report), or emotional distancing, controlling for the dependent variable at the previous time-point. Mother and child report for conflict and depressive symptoms were not significantly correlated at every time-point; thus, these measures were analyzed separately. All regressions were run separately for each pubertal timing variable, for each dependent variable, and at each time-point (1–2, 2–3, 3–4, and 4–5), yielding a total of 48 equations. If a significant moderation effect was found for any of the 48 interaction equations, post hoc analyses of simple slopes were conducted to test the nature of the interaction (Holmbeck, 2002b). Additionally, outliers, constituted by a z-score greater than 3.29 were excluded from analyses (Tabachnick & Fidell). There were a total of five data points removed, each from a different outcome. Skewness analyses were conducted for all continuous variables, at each time-point, and separately for each group (SB and C; Tabachnick & Fidell, 2007). For the SB group, mother report of depressive symptoms at T4 and mother report of conflict at T5 were positively skewed. For the comparison group, mother report of depressive symptoms T3 and T5 were also positively skewed. Since these measures were not skewed at every time-point, no adjustments were made.

Results

Hypothesis 1

Our first hypothesis was that the relationship between pubertal timing and depressive symptoms, parent–child conflict, or emotional distancing would depend on group status (presence or absence of SB). More specifically, the association between early pubertal timing and each of these psychosocial outcomes was expected to be strongest for girls without SB (Figure 1).

Pubertal Timing and Depressive Symptoms

For the objective measure of pubertal timing (age of first menarche), there were significant main effects for pubertal timing [$F(1,49) = 4.60$, $p < .05$] and SB status [$F(1,49) = 5.29$, $p < .05$] in predicting mother reported depressive symptoms at T3, controlling for depressive symptoms at T2. Mothers reported a greater level of depressive symptoms for early maturing girls (Early [E]: $M = 0.28$, $SD = 0.22$, On-time/late [O/L]: $M = 0.13$, $SD = 0.17$) and for girls with SB (SB: $M = 0.25$, $SD = 0.21$, Comparison [C]: $M = 0.10$, $SD = 0.15$) (Table II). For the subjective measure of pubertal timing, there was a main effect of pubertal timing predicting mother report of child depressive symptoms at T2 [$F(1,49) = 9.21$, $p < .05$] and T5 [$F(1,45) = 4.13$, $p < .05$]. More specifically, mothers of early maturing girls reported greater levels of depressive symptoms than mothers of girls who were reportedly on-time or late (T2: E: $M = 0.34$, $SD = 0.19$, O/L: $M = 0.15$, $SD = 0.18$; T5: E: $M = 0.43$, $SD = 0.33$, O/L: $M = 0.16$, $SD = 0.22$). Additionally, there was a significant Group x Pubertal Timing interaction in predicting child-reported depressive symptoms at T4 [$F(1,50) = 4.22$, $p < .05$], suggesting that the association between pubertal timing and depressive symptoms depended on whether the girl had SB (Table II). A follow-up one-way ANOVA was used to interpret the interaction. The residual of depressive symptoms from the previous time-point to the current time-point was entered as the DV (i.e., residual of child-reported depressive symptoms from T3 to T4). The post hoc ANOVA for child reported depressive symptoms (T3 to T4) revealed a significant difference between girls with and without SB, but only for the early pubertal timing group. More specifically, early maturing girls without SB reported the greatest increase in depressive symptoms (means are reported as unstandardized residuals) [C: $M = 0.12$ $SD = 0.20$, SB: $M = -0.09$, $SD = 0.13$, $F(1,13) = 6.30$, $p < .05$] (Table II). These findings partially supported the hypothesis.

Pubertal Timing and Parent–Child Conflict

For the objective measure of pubertal timing, there was a significant main effect of SB status in predicting observed mother–daughter conflict at T2 [$F(1,51) = 6.21$, $p < .05$, C: $M = 1.80$ $SD = 0.48$, SB: $M = 1.64$, $SD = 0.34$] and T4 [$F(1,41) = 4.64$, $p < .05$, C: $M = 1.93$, $SD = 0.64$, SB:

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Table II. *Groups With Highest Levels of Psychosocial Outcomes Based on Interactions With or Main Effects of Pubertal Timing*

Outcome	Time 2, age 10–11 years	Time 3, age 12–13 years	Time 4, age 14–15 years	Time 5, age 16–17 years
Child Report				
Emotional distancing	Early maturing girls w/out SB (subj)		Early maturing girls (subj)	
Conflict			Early maturing girls (subj)	
Depressive symptoms			Early maturing girls w/out SB (subj)	
Mother Report				
Conflict				Early maturing girls w/out SB (obj) On-time/late maturing girls with SB (subj)
Depressive symptoms	Early maturing girls (subj)	Early maturing girls (obj)		Early maturing girls (subj)
Observed				
Conflict	Early maturing girls w/out SB (obj and subj)			

Note. w/out = without; subj = mother-reported subjective pubertal timing; obj = objective pubertal timing based on menarche.

$M = 1.66$, $SD = 0.35$]. However, at T2 there was also a significant Group × Pubertal Timing interaction [$F(1,51) = 5.74$, $p < .05$], suggesting that the association between early pubertal timing and observed conflict was moderated by SB status (Table II). A follow-up, one-way ANOVA revealed that among early maturing girls, girls without SB showed a significantly greater increase in observed conflict than girls with SB (means are reported as unstandardized residuals) [C: $M = -0.21$ $SD = 0.27$, SB: $M = 0.36$, $SD = 0.58$, $F(1,15) = 7.79$, $p < .05$].

For the subjective measure of pubertal timing, there was a significant main effect of pubertal timing in predicting child reported conflict at T4 [$F(1,41) = 7.18$, $p < .05$], such that early maturing girls reported higher levels of conflict than on-time or late maturing girls (E: $M = 2.08$, $SD = 0.58$, O/L: $M = 1.80$, $SD = 0.78$). Mother reported conflict at T5 was predicted by SB status [$F(1,41) = 4.75$, $p < .05$, C: $M = 1.78$, $SD = 0.56$, SB: $M = 1.59$, $SD = 0.56$], and by a Group × Pubertal Timing interaction between pubertal timing and SB status [$F(1,41) = 8.40$, $p < .05$] (Table II). Post hoc analyses showed that for girls with SB, those who were early maturing showed a decrease in mother reported conflict from T4 to T5, while on-time/late maturing girls showed an increase (means are reported as unstandardized residuals) [E: $M = -0.31$ $SD = 0.35$, O/L: $M = 0.16$, $SD = 0.55$, $F(1,18) = 4.80$, $p < .05$]. Observed conflict at T4 was also predicted by SB status [$F(1, 41) = 4.66$, $p < .05$], such that girls with SB displayed a lower level of conflict (C: $M = 1.93$, $SD = 0.64$, SB: $M = 1.66$, $SD = 0.35$). Additionally, a Group × Pubertal Timing interaction was significant in predicting observed conflict at T2 [$F(1,50) = 4.15$, $p < .05$] (Table II). Follow-up analyses revealed that among early maturing girls, girls without SB showed a greater increase in observed conflict from T1 to T2 [C: $M = 0.20$, $SD = 0.67$, SB: $M = -0.29$, $SD = 0.18$, $F(1,15) = 5.47$, $p < .05$]. Thus, the findings partially supported the hypothesis.

Pubertal Timing and Emotional Distancing

There were no significant or main effects when objective pubertal timing was used as a predictor of change in emotional distancing. For subjective pubertal timing, the main effect of pubertal timing was significant in predicting emotional distancing at T4 [$F(1,50) = 4.01$, $p = .05$]. In particular, girls who were early in their pubertal timing reported greater levels of emotional distancing than on-time or late maturing girls (E: $M = 2.93$, $SD = 0.46$, O/L: $M = 2.67$, $SD = 0.60$). Also, the Pubertal Timing × Group interaction was significant in predicting emotional distancing at T2 [$F(1,53) = 4.93$, $p < .05$] (Table II). Post hoc analyses revealed no main effects when participants were separated into groups, suggesting a crossed interaction. Still, among early maturing girls, those without SB reported the greatest increase in emotional distancing from T1 to T2 (means are reported as unstandardized residual) (C: $M = 0.33$, $SD = 0.68$, SB: $M = -0.13$, $SD = 0.40$). These findings partially supported the hypothesis.

Hypothesis 2

It was hypothesized that the interaction between pubertal timing and SB status would be most salient in middle

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adolescence. Specifically, the association between early pubertal timing and psychosocial outcomes was predicted to be stronger for girls without SB and during the middle adolescent time-period (T3–T4). This hypothesis was tested by examining which time points produced the most significant interactions and main effects for pubertal timing (Table II). At T2, a significant interaction predicted child-reported emotional distancing and observed conflict, and a main effect of pubertal timing predicted mother-reported depressive symptoms. For T3, pubertal timing predicted mother-reported depressive symptoms. For child report at T4, a Group × Subjective Pubertal Timing interaction was found for depressive symptoms and a main effect of pubertal timing was found for emotional distancing and conflict. At T5, mother-reported conflict was predicted by a Group × Subjective Pubertal Timing interaction and a pubertal timing main effect. In general, the findings for the interaction effects suggest that this hypothesis was not supported since the significant interactions did not occur exclusively during middle adolescence.

Discussion

This study expanded upon the current literature by exploring associations between pubertal timing and psychosocial outcomes across middle and late adolescence, in girls with and without SB (Coakley et al., 2002). Previous research has examined the impact of early pubertal timing on family variables and depressive symptoms in girls (Steinberg, 1988; Kashy et al., 2008). However, it was expected that this association might differ in a pediatric population, particularly because girls with SB have different psychosocial experiences during the period of adolescence. This study had several strengths. First, the study explored family variables, such as conflict and emotional distancing, in addition to cooccurring depressive symptoms. Second, this study also employed a longitudinal multi-method, multi-source design. Third, our investigation permitted an examination of specific time points during early, middle, and late adolescence with longitudinal data. Finally, we assessed family conflict from the perspective of multiple reporters.

This study examined group status (SB vs. typically developing) as a moderator to determine if the effects of pubertal timing vary when considering whether the participant has SB. It was predicted that the relationship between early pubertal timing and higher rates of depressive symptoms, conflict, and emotional distancing would be stronger for typically developing youth. Findings from the current study partially supported these hypotheses. A Group × Pubertal Timing interaction was found in predicting child-reported emotional distancing (T2), observed conflict (T2), child-reported depressive symptoms (T4), and mother-reported conflict (T5) (Table II). Thus, while interactions were found to support the hypotheses, they were not always consistent across time points or reporters. Still, early maturing girls without SB consistently showed the greatest increase in problematic psychosocial outcomes for most significant interactions (Table II). Findings from the current study replicate findings on pubertal timing and family relationships in the early adolescent time-period (Coakley et al., 2002).

Coakley and colleagues (2002) suggested three possible explanations for why the impact of pubertal timing is reduced for children with SB. First, families of children with SB may be less responsive to pubertal changes in the adolescent. Second, families of children with SB may maintain closer family relationships to aid in adherence to a medical regimen. Alternatively, it is possible that children with SB maintain closer family relationships because they rely more heavily on their parents for support. Indeed, previous research suggests that children with SB are less independent (Friedman et al., 2009). Cognitive issues such as low to low average intelligence (Wills, Holmbeck, Dillon, & McClone, 1990) and poor executive functioning (Fletcher, Ostermaier, Cirino, & Dennis, 2008) have been associated with less independence in children with SB (Heffelfinger et al., 2008). Thus, it is possible that parents of children with SB maintain closer relationships with their children because such children are less independent due to their cognitive challenges. Third, changes in family relationships may occur later in adolescence for children with SB. The first two explanations are still plausible considering the findings from the current study. However, findings did not support the notion that changes in the family relationship are delayed for adolescents with SB.

In addition, it is possible that girls with SB respond differently to pubertal timing and familial stressors due to cognitive weaknesses. Findings in this study suggest that, early maturing girls with SB report similar levels of emotional distancing and conflict as typically developing girls, but they also report fewer cooccurring depressive symptoms (Table II). It is possible that, due to cognitive limitations, girls with SB do not recognize depressive symptoms within themselves, which would require higher level meta-cognitive abilities. Alternatively, it is possible that girls with SB do not experience as many depressive symptoms because they do not comprehend the implications of cooccurring family conflict and emotional distancing.

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In addition to the hypothesized interaction, findings also included significant main-effects of pubertal timing in predicting psychosocial outcomes. Such main effects would indicate that associations between pubertal timing and outcomes are not dissimilar across groups. Early pubertal timing predicted child-reported emotional distancing (T4), child-reported conflict (T4), and mother reported depressive symptoms (T2, T3, and T5). These main effects suggest that early pubertal timing is a significant predictor of these psychosocial outcomes, regardless of SB status. Thus, it is possible that early maturing girls, in both groups, may be at greater risk for psychosocial issues in adolescence. This finding is consistent with previous studies that suggest that early pubertal timing is a risk factor for poor psychosocial outcomes in girls (Conley & Rudolph, 2009; Kashy et al., 2008; Weichold et al., 2008). These findings suggest that early maturing girls with or without SB are at greater risk for developing psychosocial problems in adolescence. However, when looking across all of the findings in this study, the significant effects for girls with SB are not as dramatic (Table II).

The current study also focused on the course of the psychosocial outcomes across adolescence. The association between early pubertal timing and psychosocial outcomes was predicted to be stronger for girls without SB, particularly during middle adolescence. Only one interaction supported this hypothesis. In looking at child-reported depressive symptoms, there was a significant Group × Pubertal Timing interaction in middle adolescence (age 12/13–14/15 years), such that early maturing girls without SB reported the greatest increase in depressive symptoms (Table II). The main effects for child-reported conflict and emotional distancing suggested that early maturing girls, regardless of SB status reported greater changes in the parent–child relationship in mid-adolescence (age 12/13–14/15 years). These findings are consistent with the previous literature that suggests that early maturing girls experience greater psychosocial problems during middle adolescence than in early or late adolescence (Copeland et al., 2010; Johansson & Ritzen, 2005; Lien et al., 2010). Still, findings from other reporters (mother and observational) did not follow this same pattern (Table II).

In the current literature, different pubertal timing measures are used across studies. The current study found different results for two measures of pubertal timing: age of first menarche, which was assessed using an objective measure, and mother report of pubertal timing, a subjective measure which estimates perceived pubertal timing based on the appearance of the child due to pubertal changes. Because different measurements of pubertal timing can elicit different results, it is difficult to compare findings across past studies. Thus, it is important for future research in this area to move toward more standardized methods of defining and measuring pubertal timing.

There are several limitations in the current study that could be improved upon in future research. First, the study's small sample size limited the statistical power. Thus, the analyses in this study could detect only large effects. Because the study was longitudinal in nature and all outcome variables were controlled for at the previous time point, it is possible that many of the effect sizes were small. Future researchers could benefit from a larger sample size that would allow for the detection of smaller effects. While it is difficult to obtain a large sample size in a pediatric population, this could be achieved via collaborations across multiple sites. Another limitation of the current study was the failure to recruit more diverse participants, as the majority of participants were Caucasian. This is especially important for future research on children with SB, considering the high rate of SB in Hispanic populations (Lary & Edmonds, 1996). Thus, the findings of this study may not generalize to the larger population of children with SB. As well, the findings of this study may not generalize to other pediatric populations (i.e., diabetes, cystic fibrosis, etc.), as CNS malformations and subsequent cognitive issues are unique to SB. While this study did incorporate longitudinal analyses, the time frame was limited to adolescence (ages 8–17 years). This time period was chosen because of its relevance to pubertal development. However, depressive symptoms in individuals with SB have been shown to escalate into adulthood (Bellin et al., 2010).

Overall, results suggest that girls who are early maturing may experience an increase in mother–child conflict and emotional distancing over the course of adolescence, regardless of SB status. Thus, clinicians working with girls who are early in their pubertal development should screen for these issues in the parent-child relationship. Interventions for early maturing girls and their parents could focus on preserving the parent–child relationship and effective communication skills. These types of interventions may be particularly important for early maturing girls with SB, as communication and parent involvement are important as they work to manage their medical regimen. Still, the effects of early pubertal timing were not as dramatic for girls with SB. Thus, more research is needed to explore parental awareness of pubertal development in girls with spina bifida as well as the potential impact of cognitive weakness on an adolescent's experience of developmental milestones.

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