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MASTERTHESIS

The Role of Depression in the Relationship between Early Pubertal Timing  
and Sexual Risk-Taking Behaviors during Adolescence.

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## Abstract

Rates of HIV infections in the Caribbean are the second highest in the world and Caribbean adolescents have been found to have a high engagement in sexual risk behaviors. The current study examines Caribbean adolescents sexual risk behaviors, and in particular the role early pubertal timing and depression play in adolescent sexual risk-taking. We also look into whether depression is a moderator or a mediator in the relationship between early maturation and sexual risk-taking. There have been no previous studies that have looked into the relationships between these three variables in a Caribbean sample. Data were drawn from 229 adolescents from two schools in the Caribbean island of St. Maarten participating in a 2-wave longitudinal study. Contrary to our expectations pubertal timing was not related to sexual risk-taking for either gender. Results showed late, but not early, maturing girls are at higher risk of developing depressive symptomatology. Depression was not found to predict girls' risky sexual behaviors. Regarding boys, no significant associations between pubertal maturation and depression were found. Depression was found to longitudinally predict boys' nonuse of protection during sex, having sex with someone unknown, and having multiple sexual partners. Finally, no significant moderation or mediation effects of depression were identified for either gender. These findings add to the literature on the impact of the timing of maturation on Caribbean girls' psychosocial development, and highlight the need to consider depressive symptomatology, especially for boys, when designing prevention and intervention strategies for the handling of the public health crisis regarding sexually transmitted infections in the Caribbean region.

*Key-words:* Sexual risk-taking, pubertal timing, depression, Caribbean adolescents, longitudinal study

The Role of Depression in the Relationship between Early Pubertal Timing and Sexual Risk-Taking Behaviors during Adolescence.

Many individuals experience their first sexual intercourse during adolescence, and this is considered to be part of normative sexual development (Steinberg, 2005). However, it seems like adolescents are also more prone to engaging in risky sexual behaviors and, as a result, more likely to experience negative health outcomes related to sexual activity, including sexually transmitted infections (STIs) and unintended pregnancies (Kaestle, Halpern, Miller, & Ford, 2005). This is especially relevant in low-income and developing regions of the world, such as the Caribbean. HIV/AIDS rates in the Caribbean region are the second highest in the world next to the sub-Saharan African region (Camara, & Cogley, 2000). Caribbean adolescents on average report having an early sexual debut at age 11 for boys and at ages 14 to 15 for girls, while their engagement in risky sexual behaviors has been found to be high, with only 16%-25% reporting using condoms consistently (Pilgrim, & Blum, 2012). Although this is a high-risk population, sexual risk-taking behaviors of Caribbean adolescents have been largely understudied. Identifying predictors of risky sexual behaviors is vital in the process of designing and applying effective prevention and intervention programmes for vulnerable populations. The current study aims to add to the existing literature by examining the relationship between early pubertal timing and sexual risk taking, as well as the role depression may play in this relationship. Both pubertal timing and depression have been found to be associated with engagement in risky sexual behaviors during adolescence (e.g., Baams, Dubas, Overbeek, & Van Aken, 2015; Ghobadzadeh, & Moore, 2018; Ullsperger, & Nikolas, 2017), as well as with each other (e.g., Galvao et al., 2014; Mendle, Harden, Brooks-Gunn, & Graber, 2010; Mendle, Turkheimer, & Emery, 2007), yet few studies have examined both factors together in relation to sexual risk taking.

Firstly, in regards to the relationship between early maturation and adolescent sexual risk taking, findings in the literature have generally been supportive. In the most recent meta-analysis Ullsperger and Nikolas (2017) found significant moderate effect sizes for the associations between early pubertal timing and sexual risk taking behaviors in male and female samples. Another meta-analysis showed that early maturing adolescents were more likely to be sexually active and also to be engaging in risky sexual behaviors, and both relationships were found to be stronger for girls compared to boys (Baams et al., 2015). Girls with a younger age at menarche were also found more likely to have an earlier sexual debut, and this association was stronger in samples with a higher percentage of Black adolescents (Baams et al., 2015). Cross-sectional and longitudinal studies with predominantly Black samples have linked early maturation to condom nonuse, substance use during sexual activity, and having multiple sexual partners (Aruda, 2011; Kogan et al., 2015). A general limitation in the literature is that many studies combine several sexual behaviors in one measure, sometimes along with other risk behaviors, or only look into sexual activity, which although potentially problematic, especially for younger adolescents, does not equal sexual risk-taking.

There has only been one study, to our knowledge, that has examined the relationship between early maturation and sexual risk in a Caribbean sample, and it only looked into age at sexual debut. Participants were Jamaican women ranging in age from 15-50 years old and early pubertal timing was found to be significantly associated with early sexual debut (Wyatt, Durvasula, Guthrie, LeFranc, & Forge, 1999). However, this was a cross-sectional study based on retrospective reports, while adolescent girls were underrepresented in the sample, thus not allowing us to draw reliable conclusions from a developmental perspective.

Secondly, early pubertal timing has also been linked to adolescent depression although the vast majority of studies have focused on Caucasian or predominantly Caucasian samples. The link has been mostly examined in girls (Mendle et al., 2007) with a fairly recent systematic review showing that early pubertal timing significantly increased the risk for depression in adolescent girls (Galvao et al., 2014). Research on boys has been limited (Mendle et al., 2010). Until recently only late maturation was thought to be linked to psychopathological outcomes in boys, while early pubertal timing was considered to be protective, mainly due to the physical and athletic advantages it provides (Graber, Lewinsohn, Seeley, & Brooks-Gunn, 1997; Mendle, & Ferrero, 2012). A recent meta-analysis, however, found significant small associations between early pubertal timing and internalizing behaviors for both boys and girls, which suggests early maturation might be a risk factor for both genders (Ullsperger, & Nikolas, 2017).

As noted above, the relationship has been less studied among Black adolescents and especially in Black boys. A cross-sectional study found that early maturing African American boys reported significantly higher depressive symptoms compared to their on-time and late maturing peers (Ge, Brody, Conger, & Simons, 2006). In a longitudinal study by Ge et al. (2003) early maturation was found to predict higher depression for boys at age 11, but not at age 13. Further research is needed to understand the impact early maturation has on Black boys' psychosocial development.

Research with Black girls has so far produced mixed results. Age at menarche was not found to predict depressive symptoms for African American and Caribbean Black girls in a cross-sectional study by Carter, Caldwell, Matusko, Antonucci, and Jackson (2011), but early maturation was linked to higher depressive symptoms in the study by Ge et al. (2006). Early pubertal timing was found to longitudinally predict

depressive symptomatology at age 13 for African American girls (Ge et al., 2003) and similar results were produced in a longitudinal study by Carter, Silverman, and Jaccard (2013). Finally, in a large longitudinal study that followed the participants from age 6 to age 15, pubertal maturation was not found to be related to African American girls' internalizing problems (DeRose, Shiyko, Foster, & Brooks-Gunn, 2011). Consequently, although there is considerable support for the link between early maturation and depression in Black girls, it is difficult to make definite conclusions, while the mixed results may reflect methodological differences between the studies.

The different ways to used assess pubertal timing may play a role. For example in a study that assessed pubertal timing both as categorical and as continuous variable, depression was associated with early continuous timing, but not with categorical timing (Negriff, Fung, & Trickett, 2008). In a predominantly Black longitudinal study perceived early maturation, but not early age at menarche, was associated with higher depressive symptoms (Michael, & Eccles, 2003). Different measures of pubertal timing could have different associations with different aspects of adolescent development. Menarche is a private event that might affect girls' social interactions to a lesser extent than visible physical changes like breast development, while perceived pubertal timing in relation to one's peers, relates more to constructs like self-esteem and how the adolescents perceive themselves and their adjustment (Carter et al., 2013). Another issue relates to population sampling in the studies. The majority of the studies with Black adolescents have been carried out in the U.S.A and Black adolescents of different cultural backgrounds are often included under the general label of African-American, overlooking the fact that different ethnic subgroups have distinct cultural values that influence how adolescents experience the pubertal transition (Carter et al., 2011). Consequently, differences in population sampling in the studies could lead to different results, due to these concealed

differences. Finally, the age of the adolescents included in the studies could play a role. Direct effects of pubertal maturation might be more visible in early to mid-adolescence but less so later on, as studies have shown that differences between early, on-time and late maturing girls could level out as they move to more advanced stages of pubertal development (Joinson, Heron, Araya, & Lewis, 2013; Mendle, Beltz, Carter, & Dorn, 2019; Natsuaki, Biehl, & Ge, 2009).

Adolescent depression has also been found to be associated with risky sexual behaviors. A systematic review by Ghobadzadeh and Moore (2018) showed depression predicts risky sexual behaviors among African American adolescents, while a meta-analysis of HIV prevention trials with predominantly African American samples found that programmes that significantly reduced depressive symptoms were also more likely to reduce risky sexual behaviors (Lennon, Huedo-Medina, Gerwien, & Johnson, 2012). Longitudinal studies among African American adolescents have also found depression to be linked with condom nonuse, having multiple partners, having a main partner with concurrent sexual partners, and having sex under the influence of drugs or alcohol (Murphy et al., 2001; Seth et al., 2011).

The majority of the relevant studies with Caribbean adolescents are of cross-sectional design. Depression has been linked to early sexual debut, sexual activity, and risky sexual behaviors, including condom nonuse, and having multiple sexual partners (Kurtz, Douglas, & Lugo, 2005; McFarlane, Younger, Francis, Gordon-Strachan, & Wilkis, 2014; Stallworth et al., 2004; Yu et al., 2007). There are some studies, however, that have contradictory findings. In a cross-sectional study with young Bahamian adolescents depression was not associated either with future intentions to use a condom during sex, or with past condom use (Yu et al., 2006). In a large cross-sectional study with nationally representative samples from six Caribbean countries mental distress was not a significant predictor of an early sexual debut

(Peltzer, & Pengpid, 2015). However, mental distress measures do not really allow for generalizations to be made regarding the specific effects of depressive symptomatology. Another large cross-sectional study with data obtained from nine Caribbean countries also did not find depression to be associated with sexual risk outcomes (Lerand, Ireland, & Blum, 2006). This study had important limitations as well, as depression was measured by only one question, which was not validated. Generally, there is consensus that adolescent depression is a risk factor for further maladjustment, including engagement in sexual risk-taking.

To our knowledge there is only one study that has looked into the longitudinal effects of adolescent depression among Caribbean adolescents, and depression was found to predict an early sexual debut (Jayakody et al., 2011). With the current research we attempt to add to the existing literature by looking into the relationship between depression and specific sexual risk behaviors by employing a longitudinal design that will allow us to adjust for baseline sexual risk behaviors, in order to have a clearer understanding of the longitudinal associations.

Despite the associations found between adolescent depression and both early maturation and sexual risk behaviors in adolescence, and the associations between timing of puberty and sexual risk taking and depression, there are only a few studies that have examined whether both pubertal timing and depression are associated with risky sexual behavior, and none that has done so in a Caribbean sample. In a cross-sectional study with adolescents 9-13 years old depression was found to be associated with advanced sexual experience for girls, and experience of intercourse in boys, when controlling for age at menarche and oigarche respectively (Kaltiala-Heino, Kosunen, & Marttunen, 2003). Depression was not found to longitudinally predict risky sexual behaviours, when controlling for age and perceived physical maturity, but, interestingly, sexual risk behaviors predicted depressive symptoms a year later



for both boys and girls (Hallfors, Waller, Bauer, Ford, & Halpern, 2005). In a large longitudinal study age at menarche was found to predict both depressive symptoms and early sexual debut, and these associations were not found to differ across the racial and ethnic groups (Vaughan, Van Hulle, Beasley, Rodgers, & D'Onorio, 2015). Finally, Kaltiala-Heino, Fröjd, and Marttunen (2015) found that after controlling for age and age at menarche/ oigarche, baseline depression at age 15 predicted experience of intercourse two years later for girls, but not boys.

Despite indications of a connection between early pubertal timing, and sexual risk-taking, and depression, there are no existing studies to our knowledge that have specifically examined the potential role of depression in the relationship between early pubertal timing and sexual risk-taking. Thus, in addition to examining the role of timing of puberty and depressive affect in relation to sexual risk taking, we also examine whether adolescent depression modulates or explains the association between pubertal timing and adolescent risk taking. With respect to the possibility that depression modulates this relationship, a relevant theoretical perspective is the accentuation hypothesis, which posits that demanding life transitions, like early pubertal maturation, tend to magnify previous emotional and behavioral difficulties, resulting in higher levels of psychopathology (Ge and Natsuaki, 2009). Using this framework, early maturing adolescents might be more likely to face problems during adolescence, like engaging in risky sexual behaviors, if they already present with elevated depressive symptoms. With respect to the possibility that depression is an underlying mechanism through which the association between early pubertal timing on sexual risk-taking is explained, we draw from theories focusing on avoidance coping, like the diathesis stress model, which posits that vulnerable individuals engage in problematic behaviors, in order to deal with stress (Martin, Pryce, & Leeper, 2005). If this is true, depressed adolescents may engage in risky sexual

behaviors aiming at temporary distraction and relief from the distress. Early maturing adolescents are more likely to experience depressive symptoms, which in their turn lead to engaging in sexual risk-taking as means of avoidance and symptom relief.

### **Current study**

This study aims at examining the potential role of depression in the relationship between early pubertal timing and sexual risk-taking for adolescent boys and girls. We draw from a two-wave research project on adolescent risk-taking conducted on the Caribbean island of St. Maarten (Defoe, 2016).

We first examine the direct association between pubertal timing and sexual risk taking. In accordance with existing findings on Black populations we hypothesize that early pubertal timing will be associated with sexual risk-taking for both boys and girls. Secondly, we examine the association between early pubertal timing and depression. In accordance with the existing literature, we expect early pubertal timing to predict depressive symptoms at baseline and one year later, especially for girls. Existing findings in the literature regarding the relationship between early pubertal timing and boys' reported depression have not been decisive, and, as a result, our examination of the relationship in boys will be of exploratory nature. Thirdly, we examine the direct association between adolescent depressive symptoms and sexual risk behaviors, and, based on the existing findings, we expect depression will predict sexual risk for both genders. Finally, we look into the role of depression in the relationship between pubertal timing and sexual risk behaviors. Taking into account the positive associations between early pubertal timing, and depression, and sexual risk-taking detected in the existing literature, as well as theoretical viewpoints, depression could be playing a mediational role in the aforementioned relationship; that is, the association between early timing and sexual risk taking could be explained by depressive affect. It could also be that depression is a moderator in the relationship.

In this case we would expect the association between pubertal timing and sexual risk-taking will be stronger for adolescents who experience higher levels of depression compared to the ones with lower depressive affect.

## Method

### Participants

Data for this study were drawn from a two-wave longitudinal study among adolescents from the Caribbean island of St. Maarten (Defoe, 2016). The data-collections took place in January 2013 (first wave), and January 2014 (second wave). In waves 1 and 2 the sample consisted of 349 (53% female) and 284 (59.8% female) adolescents respectively. Our final sample comprised 229 adolescents (57.6% female) who participated in both data collections. An examination of the differences between completers and non-completers showed that non-completers were significantly older and more depressed at wave 1. The adolescents were between the ages 11-18 at wave 1, mean age 14.01 ( $SD=1.56$ ). In the second wave, the adolescents had a mean age of 15.00 ( $SD = 1.52$ ). At baseline, 74% of the adolescents indicated that they were born on the Dutch side of the island, whereas 8.8% were born on the French side of the island. The remaining adolescents were born on other (Dutch-) Caribbean islands, and 3.5% were born in the Netherlands. Most of the adolescents (70.6%) identified as a St. Maartener, 10.4% as Dutch-Caribbean, 9.5% as Caribbean, 5.9% as Dutch, and the remaining adolescents identified with various other ethnicities. Regarding their level of education, 26.8% followed higher general continued education. Most participants (72.8%) were educated on a lower to intermediate vocational level, while 0.4% reported following a different type of education. The majority of the participants had parents who were married (42.5%) or living together (9.6%), while 9.2% said their parents were not married. Another group had parents who were living apart (17.5%), 9.2% reported their parents used to live together in the past, and 11.8% reported their

parents were divorced. Regarding their parents' educational background, 19.7% reported their mother had a university degree. Most adolescents (36%) reported their mother had received a high school education, while 5.7% reported their mother had a primary school education. A small percent (1.3%) reported their mother had no schooling and 14.9% reported a foreign education. Regarding their father's education, 16.7% reported their father had a university degree, and 28.1% reported their father had received a high school education. A primary school education was reported by 3.5% of the participants, while a small percent (0.4%) reported their father had no schooling and 14% reported a foreign education. Finally, 22.4% reported not knowing their mother's education level and 36.8% their father's.

### **Procedure**

Participants were recruited from the two Dutch-language high-schools in St. Maarten. Both schools agreed to participate. Passive consent was used in which parents received a letter describing the study and parents could sign a form if they did not want their children to participate in the research. The participants filled out the questionnaire at their high schools during regular school hours, under supervision of trained research assistants who provided them with both verbal and written instructions. The questionnaire, took about 45-60 minutes to complete. As a reward, movie tickets and lunch vouchers were raffled among the participants.

### **Measures**

*Pubertal timing* was assessed using the Pubertal Development Scale (PDS; Petersen, Crockett, Richards, & Boxer, 1988). Participants were asked to rate their development on several characteristics, including growth spurt in height, body hair, and skin change for both boys and girls; facial hair growth and voice change in boys only; and breast development and menarche in girls only. Regarding boys, Cronbach's alpha was  $\alpha=.76$  indicating good reliability. Z-scores were then computed

within each age group resulting in a pubertal timing score for boys, with higher scores indicating an earlier timing. For girls, Cronbach's alpha was  $\alpha=.53$  indicating low reliability of the scale. For this reason we used age at menarche to measure girls' pubertal timing, assessed by one item ("*How old were you when you first menstruated?*").

*Depression* was assessed using the Depressive Mood List (DML; Kandel, & Davies, 1982). This is a six-item scale, where the participants were asked to rate how often they had "*been bothered or troubled*" by each of six states within the past six months, e.g. "*feeling too tired to do things*"; "*having trouble going to sleep or staying asleep*". Frequency was rated on a five-point Likert scale ranging from 0= *never* to 4= *very often*. Scale reliability was good for both waves: for the first wave Cronbach's alpha was  $\alpha=.76$ , and for the second wave Cronbach's alpha was  $\alpha=.81$ .

*Sexual risk-taking behaviors* were measured by 4 items of the Cognitive Appraisal of Risky Events questionnaire (CARE; Fromme, Katz, & Rivet, 1997). Items referred to the participants' condom use, contraception use, having had sexual intercourse with someone they didn't know well, and having had sexual intercourse with multiple partners, instead of one regular partner, e.g. "*Did you ever have sex with someone you just met (and barely know)?*". Frequency of the behavior was rated on a five-point Likert scale ranging from 0= *never* to 4= *very often*. Scale reliability was low for both boys and girls and in both waves. In the first wave for boys Cronbach's alpha was  $\alpha=.52$ , and for girls Cronbach's alpha was  $\alpha=.44$ . In the second wave for boys Cronbach's alpha was  $\alpha=.38$ , and for girls Cronbach's alpha was  $\alpha=.12$ . An examination of the Pearson correlations between the scale's items for boys revealed significant positive associations between the condom nonuse and contraception nonuse items in wave 1 ( $r(28) = .39, p = .03$ ) and wave 2 ( $r(39) = .47, p = .002$ ). These two items were then combined in one scale reflecting risk related to protection

nonuse. The remaining two items were significantly correlated in wave 2 but not at wave 1, and thus were assessed as separate sexual risk outcomes. Regarding girls there were significant correlations identified between the scale's items for the first wave, but not the second. For this reason in our analyses we used the four individual items separately as sexual risk outcomes for girls. Sexual risk scores were calculated for participants who ever had sex across the two waves, where 15 boys and 16 girls, who became sexually active during the study, got scores of zero for baseline sexual risk, and also seven boys and eight girls, who reported being sexually active during the first wave but not the second, received scores of zero for wave 2 sexual risk. Finally, scores were calculated separately for all the participants, where the non-sexually active received sexual risk scores of zero.

### **Strategy of analysis**

To test our hypotheses that early pubertal timing would be linked to depression and sexual risk-taking, a set of simple linear regressions were employed. To examine the role of depression in the relationship between early pubertal timing and sexual risk-taking mediation and moderation analyses were conducted.

More specifically, the software 'IBM SPSS Statistics 21' was used for the analyses. In order to examine the degree to which early pubertal timing and depression could predict adolescent sexual risk-taking a multiple regression analysis was conducted. All predictors were centered prior to creating interaction terms and inclusion in the regression analyses. On the first step of the regression the sexual risk taking variables and the age reported in the first wave of the study were entered as control variables, and on the second step the pubertal timing and the depression variables reported during the first wave were entered. In order to examine whether the relationship between early pubertal timing and sexual risk-taking is moderated by depression during wave one, in the last step of the regression the interaction between

pubertal timing and depression was entered. In order to examine whether the link between early pubertal timing and sexual risk-taking is mediated by depression during the first wave, a series of bootstrap- macro multiple regression analysis were conducted. The bootstrapping procedures (Preacher, & Hayes, 2008) were implemented using a macro program for SPSS.

The analyses were conducted separately for both genders, taking into account findings in the existing literature suggesting that the trajectories resulting from early pubertal timing may be different for boys and girls. Finally, analyses were done in two ways: first with the participants who ever had sex , and, secondly, also including those who remained non-sexually active across both waves (who received a score of zero for sexual risk).

## **Results**

### **Descriptive statistics and bivariate analyses**

The means and standard deviations for all independent and dependent variables for both waves are shown in Table 1 for boys and in Table 2 for girls. Pearson correlations were calculated, separately for boys and girls, and are shown in Tables 3 and 4. In boys, a small negative association was found between pubertal timing and baseline protection nonuse, when all boys were included in the analyses, indicating that boys with a later timing were more likely to report not using protection at baseline. Baseline depression was positively associated with boys' risky sexual behaviors one year later. Among girls, a small positive association was found for age at menarche and contraceptive nonuse at baseline, indicating girls with a later age at menarche were more likely to not use contraceptives. Baseline depression was also positively associated with contraceptive nonuse at baseline. Regarding sexual activity, 31 boys and 33 girls at baseline, and 40 boys and 41 girls at wave two

reported having had sexual intercourse. Across the two waves 48 boys and 49 girls reported experience of intercourse.

**Table 1***Descriptive Statistics for Boys*

Variable	Boys who ever had sex ( <i>N</i> = 48)		All boys ( <i>N</i> = 97)	
	<i>M</i> ( <i>SD</i> )		<i>M</i> ( <i>SD</i> )	
	W1	W2	W1	W2
Pubertal timing	-.17 (.97)	-	.00 (.97)	-
Depression	1.73 (.73)	1.62 (.66)	1.54 (.69)	1.60 (.68)
Protection nonuse	.92 (1.2)	1.20 (1.25)	.44 (.97)	.59 (1.05)
Sex with someone unknown	1.09 (1.4)	.83 (1.25)	.52 (1.10)	.40 (.97)
Multiple partners	1.00 (1.39)	.96 (1.30)	.47 (1.08)	.47 (1.02)

**Table 2***Descriptive Statistics for Girls*

Variable	Girls who ever had sex ( <i>N</i> = 49)		All girls ( <i>N</i> = 132)	
	<i>M</i> ( <i>SD</i> )		<i>M</i> ( <i>SD</i> )	
	W1	W2	W1	W2
Age at menarche	12.17 (1.29)	-	11.76 (1.22)	-
Depression	1.75 (.63)	2.07 (.80)	1.67 (.73)	1.91 (.80)
Condom nonuse	.53 (1.16)	.65 (1.20)	.20 (.75)	.24 (.80)
Contraceptive nonuse	1.96 (1.89)	2.59 (1.74)	.72 (1.48)	.97 (1.65)
Sex with someone unknown	.24 (.85)	.18 (.67)	.09 (.52)	.07 (.42)
Multiple partners	.15 (.47)	.24 (.60)	.06 (.29)	.09 (.38)



**Table 3***Pearson Correlations of All Independent and Dependent Variables for Boys*

	1	2	3	4	5	6	7	8	9
1 Pubertal timing	-	.09	.05	-.23*	-.05	-.05	.08	.03	.02
2 W1 Depression	.09	-	.63***	.07	.39***	.11	.38***	.18	.45***
3 W2 Depression	.14	.55***	-	-.04	.12	.14	.04	.19	.08
4 W1 Protection nonuse	-.23	-.11	-.09	-	.44***	.59***	.17	.49***	.24*
5 W2 Protection nonuse	.11	.38*	.20	.23	-	.32**	.26*	.37***	.37***
6 W1 Sex with someone unknown	.06	-.06	.23	.46**	.05	-	.42***	.65***	.31**
7 W2 Sex with someone unknown	.25	.39*	.08	-.03	.02	.26	-	.45***	.61***
8 W1 Multiple partners	.17	.08	.31	.35*	.16	.55***	.31*	-	.51***
9 W2 Multiple partners	.17	.50**	.15	.02	.14	.10	.51***	.38*	-

*Note.* Below the diagonal are the correlations for boys who ever had sex and above the diagonal are the correlations for all boys.

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

**Table 4***Pearson Correlations of All Independent and Dependent Variables for Girls*

	1	2	3	4	5	6	7	8	9	10	11
1 Age at menarche	-	.05	.16	.17	.10	.19*	.16	.09	.06	.04	.01
2 W1 Depression	.26	-	.66***	.18	.00	.21*	-.00	.02	.06	.10	.12
3 W2 Depression	.23	.69***	-	.20*	.14	.22*	.09	-.08	.12	.12	.13
4 W1 Condom nonuse	.12	.31*	.25	-	.13	.47***	.27**	.33***	.28**	.57***	.05
5 W2 Condom nonuse	.01	-.06	.13	-.02	-	.34***	.38***	.14	.16	.25**	.15
6 W1 Contraceptive nonuse	.04	.40*	.27	.35*	.11	-	.41***	.26**	.21*	.38***	.28**
7 W2 Contraceptive nonuse	-.07	-.19	-.05	.00	.13	-.19	-	.13	.23**	.28**	.36***
8 W1 Sex with someone unknown	.05	.01	-.19	.28	.05	.15	-.08	-	.55***	.55***	.28**
9 W2 Sex with someone unknown	.01	.09	.15	.23	.08	.09	.10	.53***	-	.49***	.35***
10 W1 Multiple partners	-.04	.19	.14	.53***	.16	.29*	.14	.52***	.46**	-	.32***
11 W2 Multiple partners	-.10	.19	.14	-.06	.03	.13	.20	.23	.30*	.26	-

*Note.* Below the diagonal are the correlations for girls who ever had sex across both waves, and above the diagonal are the correlations for all

girls. \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

**Early pubertal timing, depression and sexual risk**

In order to examine whether early pubertal timing and depression longitudinally predict engagement in risky sexual behaviors, hierarchical multiple regression analyses were conducted separately for boys and girls and in two ways, first including only the adolescents who ever had sex during the study, and then including all the adolescents. Age and baseline sexual risk scores were entered in the first step of the analysis as control variables. In order to examine whether depression moderates the relationship between pubertal timing and sexual risk-taking, an interaction term of depression and pubertal timing was entered in the last step of the regression analysis. All predictors were centered prior to inclusion to the analyses. Prior to the analyses for sexual risk outcomes the assumptions of normality, homoscedasticity, linearity, and multi-collinearity were examined and were all found to be met, with the exception of homoscedasticity which was not met in any analysis for boys or girls. For this reason a log-10 transformation was performed for each outcome variable. The transformation did not improve the distributions, and thus we report the analyses with the untransformed data.

**Boys' protection nonuse.** We first conducted the analysis including only the boys, who reported experience of intercourse. As shown in Table 5, none of the predictor variables was longitudinally associated with protection nonuse, and no moderation effects were identified.

We then reran the analysis including all boys, and in the first step of the regression, baseline protection nonuse scores accounted for a significant amount of variance in wave two protection nonuse scores,  $R^2 = .17$ ,  $F(2, 71) = 7.48$ ,  $p = .001$ . In the second step, pubertal timing was not a significant predictor, but depression accounted for a significant proportion of the variance in protection nonuse,  $b = .32$ ,  $p =$

.004; Overall Model  $\Delta R^2 = .10$ ,  $\Delta F(2, 69) = 4.63$ ,  $p = .013$ . Finally, in the third step, the interaction term between pubertal timing and depression did not account for a significant proportion of the variance in protection nonuse, and thus no moderation effects were identified; Overall Model  $\Delta R^2 = .03$ ,  $\Delta F(1, 68) = 2.58$ ,  $p = .113$ .

**Table 5**

*Multiple Linear Regression with Longitudinal Predictors of Boys' Protection Nonuse*

Variable	Boys who ever had sex ( $N = 35$ )								
	Model 1			Model 2			Model 3		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Age	-.04	.16	-.05	-.06	.15	-.06	-.11	.15	-.12
W1 Protection nonuse	.17	.18	.16	.23	.18	.22	.31	.17	.30
Pubertal timing				.18	.21	.15	.35	.21	.29
W1 Depression				.66	.31	.37*	.39	.31	.22
Pubertal timing x Depression							-.52	.28	-.38
$R^2$		.03			.20			.30	
F for change in $R^2$		.50			3.06			4.25	
	All boys ( $N = 74$ )								
Age	.13	.08	.19	.08	.08	.11	.06	.07	.09
W1 Protection nonuse	.37	.12	.34**	.35	.12	.33**	.38	.12	.35**
Pubertal timing				.04	.11	.04	.04	.11	.04
W1 Depression				.48	.16	.32**	.42	.16	.28*
Pubertal timing x Depression							-.22	.14	-.17
$R^2$		.17			.27			.30	
F for change in $R^2$		7.48***			4.63*			.03	

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

**Boys' intercourse with someone unknown.** As shown in Table 6, when only the boys who ever had sex were included in the analysis, none of the predictor

variables explained a significant amount of variance in wave 2 reports of having sex with someone unknown, and no moderation effects were identified.

We then reran the analyses including all the boys. In the first step age, and baseline casual sexual activity scores explained a significant amount of variance in wave 2 reports of having sex with someone unknown; Overall model:  $R^2 = .27$ ,  $F(2, 70) = 13.04$ ,  $p < .001$ . In the second step of the regression pubertal timing was not a significant predictor. Depression was found to predict a significant amount of the variance in intercourse with a stranger,  $b = .25$ ,  $p = .019$ ; Overall model  $\Delta R^2 = .06$ ,  $\Delta F(2, 68) = 3.25$ ,  $p = .05$ . Finally, no moderation effects were identified; Overall Model  $\Delta R^2 = .01$ ,  $\Delta F(1, 67) = .71$ ,  $p = .402$ .

**Boys' multiple partners.** As shown in Table 7, when only the boys who ever had sex were included in the analysis, in the first step baseline sexual risk scores explained a significant amount of variance in wave 2 reports of having multiple partners,  $R^2 = .22$ ,  $F(2, 31) = 4.37$ ,  $p = .021$ . In the second step, pubertal timing was not a significant predictor, but baseline depression was,  $b = .44$ ,  $t(29) = 2.97$ ,  $p = .006$ ; Overall Model  $\Delta R^2 = .19$ ,  $\Delta F(2, 29) = 4.67$ ,  $p = .017$ . In the third step no moderation effects were identified; Overall Model  $\Delta R^2 = .01$ ,  $\Delta F(1, 28) = .34$ ,  $p = .564$ .

We then reran the analyses including all the boys. In the first step age, and baseline sexual risk scores significantly predicted wave 2 reports of multiple partners; for age  $b = .29$ ,  $p = .005$ ; for baseline sexual risk scores  $b = .45$ ,  $p < .001$ ; Overall Model  $R^2 = .35$ ,  $F(2, 70) = 19.13$ ,  $p < .001$ . Pubertal timing was not a significant predictor, but depression was,  $b = .30$ ,  $t(68) = 3.11$ ,  $p = .003$ ; Overall Model  $\Delta R^2 = .08$ ,  $\Delta F(2, 68) = 4.88$ ,  $p = .010$ . Finally, no moderation effects were identified in the third step; Overall Model  $\Delta R^2 = .00$ ,  $\Delta F(1, 67) = .48$ ,  $p = .490$ .

**Table 6**

*Multiple Linear Regression with Longitudinal Predictors of Boys Engaging in Intercourse with Someone Unknown*

Variable	Boys who ever had sex ( $N = 34$ )								
	Model 1			Model 2			Model 3		
	$B$	$SE B$	$\beta$	$B$	$SE B$	$\beta$	$B$	$SE B$	$\beta$
Age	.09	.17	.09	.06	.16	.06	.08	.17	.08
W1 sex with someone unknown	.36	.19	.33	.33	.18	.30	.34	.18	.31
Pubertal timing				.21	.21	.16	.17	.23	.13
W1 Depression				.61	.32	.31	.67	.35	.35
Pubertal timing x Depression							.13	.28	.09
$R^2$		.11			.25			.26	
F for change in $R^2$		1.95			2.67			.22	
	All boys ( $N = 73$ )								
Age	.14	.08	.13*	.09	.08	.13	.10	.08	.14
W1 sex with someone unknown	.48	.12	.44***	.45	.11	.41***	.45	.11	.41***
Pubertal timing				.06	.10	.06	.06	.10	.06
W1 Depression				.39	.16	.25*	.41	.16	.27*
Pubertal timing x Depression							.11	.14	.09
$R^2$		.27			.34			.34	
F for change in $R^2$		13.04***			3.25*			.71	

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

**Table 7**

*Multiple Linear Regression with Longitudinal Predictors of Boys' Multiple Sexual Partners*

Variable	Boys who ever had sex ( $N = 34$ )								
	Model 1			Model 2			Model 3		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Age	.26	.16	.25	.25	.15	.24	.23	.15	.22
W1 multiple partners	.40	.16	.39*	.31	.15	.30*	.31	.15	.30*
Pubertal timing				.06	.20	.04	.10	.21	.07
W1 Depression				.88	.30	.44**	.80	.32	.40*
Pubertal timing x Depression							-.15	.25	-.10
R <sup>2</sup>		.22			.41			.42	
F for change in R <sup>2</sup>		4.40*			4.68*			.34	
	All boys ( $N = 73$ )								
Age	.22	.07	.29**	.17	.07	.23*	.17	.07	.22*
W1 multiple partners	.46	.10	.45***	.40	.10	.39***	.40	.10	.39***
Pubertal timing				-.01	.10	-.01	-.01	.10	-.01
W1 Depression				.48	.16	.30**	.46	.16	.29**
Pubertal timing x Depression							-.09	.13	-.07
R <sup>2</sup>		.35			.44			.66	
F for change in R <sup>2</sup>		19.13***			4.88*			.48	

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

**Girls' risky sexual behaviors.** Neither age at menarche, nor depression were found to longitudinally predict sexual risk outcomes for girls, when only those who had experienced sexual intercourse, or when all girls were included in the analysis. An overview of the results is shown in Tables 1A, 2A, 3A, and 4A that can be found in the Appendix. Baseline sexual risk scores were found to significantly predict girls'

contraception nonuse, engaging in intercourse with someone unknown, and having multiple sexual partners one year later. Age was also found to significantly predict contraception nonuse at the second wave for the total sample, with older girls more likely to report nonuse. Finally, no significant moderation effects of depression were identified.

### **Associations between pubertal timing and depression**

In order to examine the hypothesis that early pubertal timing would concurrently and longitudinally predict depression, hierarchical regression analyses were conducted. For the cross-sectional associations age was entered in the first step as a covariate. For the longitudinal associations baseline depression was also entered as control variable. Prior to the analyses the assumptions of normality, homoscedasticity, linearity, and multi-collinearity were examined and were all found to be met. An overview of the results is shown in Tables 8 and 9. For boys, pubertal timing was not found to significantly predict depressive symptoms neither concurrently, nor longitudinally. For girls age at menarche was not found to significantly predict depression at baseline, but a small positive association was found for depression at wave 2.



**Table 8**

*Multiple Linear Regression with Cross-sectional Predictors of Depression Scores at Baseline for Boys and Girls*

Variable	Boys ( <i>N</i> = 78)					
	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Age	.11	.05	.24*	.11	.05	.24*
Pubertal timing				.05	.08	.08
R <sup>2</sup>		.06			.06	
F for change in R <sup>2</sup>		4.60*			.51	
Variable	Girls ( <i>N</i> = 107)					
	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Age	.04	.05	.08	.03	.05	.08
Pubertal timing				.02	.06	.03
R <sup>2</sup>		.01			.01	
F for change in R <sup>2</sup>		.81			.07	

Note: \* $p < .05$ .

**Table 9**

*Multiple Linear Regression with Longitudinal Predictors of Depression Scores at Wave Two for Boys and Girls*

Variable	Boys ( <i>N</i> = 74)					
	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Age	-.04	.05	-.09	-.04	.05	-.09
W1 Depression	.65	.10	.64***	.64	.10	.64***
Pubertal timing				.02	.06	.03
R <sup>2</sup>		.40			.37	
F for change in R <sup>2</sup>		23.30***			.07	
Variable	Girls ( <i>N</i> = 101)					
	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Age	.00	.04	.01	-.02	.04	-.05
W1 Depression	.73	.09	.64***	.73	.09	.64***
Pubertal timing				.11	.05	.17*
R <sup>2</sup>		.41			.44	
F for change in R <sup>2</sup>		34.04***			4.45*	

Note: \* $p < .05$ . \*\*\* $p < .001$

### **Depression as mediator in the relationship between pubertal timing and sexual risk-taking**

Finally, in order to investigate whether baseline depression is a mediator in the relationship between pubertal timing and sexual risk, simple mediation analyses were conducted using PROCESS, with age and baseline sexual risk scores used as covariates. No significant indirect effects were identified. An overview of the mediation effects of depression on the relationship is shown in Table 5A for boys and Table 6A for girls that can be found in the Appendix.

### **Discussion**

The present study aimed at examining the role early pubertal timing and depression may play in Caribbean adolescents' engagement in risky sexual behaviors. Although these variables have been found to be related, there have been no relevant studies conducted specifically on Caribbean populations. We also examined whether depression may be modulating or mediating the relationship between early maturation and sexual risk drawing from theoretical backgrounds like the accentuation hypothesis and the diathesis stress model. No associations between pubertal timing and sexual risk were found for either gender. Later age at menarche longitudinally predicted depression for girls, but there was no association between pubertal timing and boys' depression. Depression was found to longitudinally predict sexual risk behaviors among boys but not for girls. Finally, no significant moderating or mediating effects of depression in the relationship between timing of maturation and sexual risk-taking were identified for either gender.

Firstly, we hypothesized that early pubertal timing would be a longitudinal predictor of risky sexual behaviors for both boys and girls. Contrary to our expectations this hypothesis was not supported in our sample. In fact, although late

pubertal timing was associated with higher baseline protection nonuse for boys and higher baseline contraceptive nonuse for girls on the bivariate level, there were no significant longitudinal associations identified for either gender in the bivariate or the multivariate regression analyses. To our knowledge there have been no prior studies that have examined the link between pubertal maturation and specific sexual risk behaviors in Caribbean populations. The only relevant study had looked into age at sexual debut, and found early age at menarche to predict an earlier debut among Jamaican women (Wyatt et al., 1999). However, although an early sexual debut is potentially problematic it is not enough to infer sexual risk-taking. Consequently, further research is needed in order to draw reliable conclusions about the nature of this relationship among Caribbean adolescents. Nevertheless, our findings suggest that there are other factors that influence Caribbean adolescents' engagement in sexual risk behaviors, which were not assessed in the current study. A systematic review identified family risk factors, such as a low quality parent-adolescent relationship, low monitoring, experience of violence, substance abuse and mental health problems in the family to play an important role in Caribbean adolescents' sexual behaviors (Pilgrim, & Blum, 2012). The fact that our sample consisted only of high-school students might also have played a role in the low reported sexual risk behaviors because only 42.36% of students reported having had sex. This lack of power might have contributed to the lack of significance in our results. School enrollment was identified as the most important protective factor to sexual risk-taking alongside frequent attendance at religious services in a population-based study with Jamaican adolescents (Ishida, Stupp, & McDonald, 2011). In the current study all students were enrolled in school and therefore our sample might not represent the adolescents who are especially vulnerable to engaging in sexual risk behaviors. We

suggest that future research also includes adolescents not attending school, in order to have a clearer understanding of the potential buffering role of education.

Secondly, we hypothesized that early pubertal timing would predict depressive symptoms at baseline and one year later especially for girls. This hypothesis was also not supported in our findings. Late but not early age at menarche was longitudinally associated with depression among girls in our sample. Although existing research on the effects of late maturation on girls' psychosocial development is limited, there have been some studies that also suggest late maturation might be potentially problematic for Black girls' psychosocial development (Carter, Jaccard, Silverman, & Pina, 2009; Carter, Silverman, & Jaccard, 2013; Michael, & Eccles, 2003; Siegel, Yancey, Aneshensel, & Schuler, 1999). Our results in part support the off-timing hypothesis of pubertal maturation, which posits that adolescents who mature either earlier or later than their peers are more prone to maladjustive developmental outcomes due to their deviation from their peers (Alsaker, & Flammer, 2020, para. 2.2). It has been suggested that pubertal maturation may be linked to adolescent girls' depression through its effects on body mass and more specifically through the way adolescent girls perceive these changes and the extent to which they are satisfied with their bodies (Ackard, & Peterson, 2001; Paxton, Neumark-Sztainer, Hannan, & Eisenberg, 2006). In relation to this, research has shown that Black girls hold favorable attitudes towards these physical changes and the increase in their body mass, and place high value on maturity and a more adult-like appearance (O'Sullivan, Meyer-Balzburg, & Watkins, 2000). It is possible that Black girls who develop later are not satisfied with the pace of their development due to their bodies remaining more child-like in comparison to their peers. If having a more developed body is valued among their

peers, not having one, when the majority of other girls do, could mean these girls face teasing, or feel excluded, which could explain the link identified in our study.

With regards to boys, the examination of the relationship between early maturation and depression was of exploratory nature, as relevant literature has been limited and with inconsistent results. Our results showed that boys' pubertal timing was not associated with depression either concurrently, or longitudinally. It has previously been suggested that early maturation is not particularly problematic for boys' development as it comes with an increase in muscle mass and athletic advantages that are valued in the context of traditional gender norms for boys (Graber, et al., 1997; Mendle, & Ferrero, 2012). Additionally, a study with African American adolescents that also used the PDS to measure pubertal development, as we did, showed that early maturing boys did indeed manifest higher depressive symptoms compared to their peers at age 11 but their symptoms subsided by age 13, which suggests that the time of measurement may play a role in the identified associations (Ge et al., 2003). Taking into account that the mean age in our sample at wave 1 was 14 years, we might have missed the period when pubertal timing is most impactful on boys' psychosocial adjustment, and thus suggest that future research on Caribbean adolescent boys includes more measurements from early to late adolescence in order to have a better understanding of the developmental trajectories involved.

Thirdly, we hypothesized that depression would longitudinally predict sexual risk for both genders. This hypothesis was confirmed for boys but not girls. Baseline depression was found to predict boys' protection nonuse during sex, having sex with someone unknown, and having multiple sexual partners one year later. This corroborates previous findings that have found an association of depression with sexual risk behaviors in Caribbean adolescent boys (Kurtz et al., 2005; McFarlane et

al., 2014; Stallworth et al., 2004; Yu et al., 2007). This is an important finding, especially when considering that depression among adolescents often goes unnoticed due to its manifestation through irritable rather than depressed mood (Thapar, Collishaw, Pine, & Thapar, 2012). It also highlights the need for future prevention and intervention efforts to take into account and target potential mood difficulties, especially for boys, which is also supported by previous research (Lennon et al., 2012). Depressed boys could be engaging in more sexual risk behaviors as a way to cope with their negative emotions, and to experience intimacy, as depression has been found to be inversely associated with social support (Rueger, Malecki, Pyun, Aycocck, & Coyle, 2016). Another possible explanation is that depressed adolescents may be more vulnerable to peer pressure, which has been previously identified to play a role in Caribbean adolescents' engagement in sexual activity (Pilgrim, & Blum, 2012). It may be that depressed adolescents experience low self-efficacy regarding factors like safe sex negotiation and refusal of alcohol or drugs. In relation to that, depression has also been linked with alcohol and substance use which in their turn have also been linked to sexual risk-taking due to the disinhibiting effect they have (Lehrer, Shrier, Gortmaker, & Buka, 2006).

Finally, this is the first study to our knowledge that explored the potential moderational and mediational role of depression in the relationship between early maturation and sexual risk behaviors during adolescence. Our analyses did not reveal any significant moderating or mediational effects of depression in the relationship, for either gender. With respect to moderation, we found no effect of depression on the relationship between early timing and sexual risk-taking. This result contradicts the accentuation hypothesis according to which we would expect that the association between early timing and sexual risk would be stronger for adolescents who were

more depressed. Data in our study, however, were collected at a time point when the majority of the participants would have already entered puberty, and this is especially relevant regarding the accentuation hypothesis, which posits that it is pre-pubertal vulnerabilities that are magnified due to the stressful nature of pubertal maturation (Ge and Natsuaki, 2009). We suggest that future examinations of the accentuation hypothesis for sexual-risk taking follow participants from earlier stages of their development until mid- to late-adolescence in order to capture the effects of transitioning into puberty while taking into account pre-pubertal differences among the participants. With respect to mediation, no indirect effects of depression were identified. Given the lack of associations between pubertal timing and baseline depression, and sexual risk-taking it was not surprising. Nevertheless, our data do not support the hypothesis that sexual risk-taking is a coping behavior of early maturing adolescents in the Caribbean. Taking into account the associations between early timing, depression, and age at sexual debut identified in previous studies that have examined all three variables (Kaltiala-Heino et al, 2015; Kaltiala-Heino et al., 2003; Vaughan et al., 2015) it is possible that depression could explain the relationship between early maturation and sexual initiation. This is also in line with the diathesis-stress model, on which we based our examination, in the sense that sexual activity in general, instead of sexual risk-taking, could prove to be a coping mechanism employed by early maturers. As this was the first study to look into the mediating effects of depression in the relationship between early maturation and sexual risk, further research is needed to come to a more reliable conclusion.

This study has important strengths. First of all this is the first study to our knowledge to examine how the timing of pubertal maturation relates to engagement in specific sexual risk behaviors, as well as the role depression plays in the relationship

in a Caribbean sample. We also employed a 2-wave longitudinal design. There have not been many longitudinal studies, especially in the Caribbean, and our study adds to the existing literature by allowing us to gain a better understanding of the examined associations by controlling for baseline levels of risk variables.

With regards to the limitations in our study, an important one is that some of the assumptions in our regression analyses were not met, which means our results should be interpreted with caution. However, the multivariate regression results were in line with the associations identified on the bivariate level, which provides further support to their reliability. Another possible limitation is the fact that the majority of the participants in our study were at an age when they would have already gone through puberty, which might have limited our ability to identify the direct effects of the timing of maturation. Future studies could include more waves of data starting from earlier stages in puberty and following participants until later stages in adolescence. Finally, there were some measurement limitations as the sexual risk outcomes were assessed by single-item measures due to the low reliability of the overall scale, which means we cannot be sure of the reliability of these measures.

In conclusion, this study adds to the existing literature of sexual risk behaviors among Caribbean adolescents and their link to pubertal maturation and psychopathology. Existing research has largely focused on early maturation as a risk factor for psychopathology, but our research showed that among Caribbean girls late maturation might be particularly problematic, which is something future studies should further explore. Our findings also have important implications for the handling of the serious public health crisis of sexually transmitted infections and diseases in the Caribbean region. Our results show depressed adolescent boys may be especially vulnerable to engaging in sexual risk-taking. Adolescent depression often goes



unnoticed due to its manifestation through irritability and the fact that many adolescents fall below the clinical threshold (Thapar et al., 2012). This is something future efforts in STD/ HIV prevention need to consider, especially when taking into account that depression is also linked with further maladjustment issues that have also been found to be linked with sexual risk-taking, like alcohol and drug use (Lehrer et al., 2006). Future prevention efforts can consider increasing mental health literacy among adolescents, which can help them recognize depressive symptoms and seek help, as well as teaching alternative and healthier ways to cope. Teaching teachers and parents to recognize signs of depression could also help prevent further deterioration. In addition, workers in health clinics, where adolescents turn to get tested for STI's, can be trained to recognize symptoms of depression and encourage adolescents to seek help, connecting them with the available mental health services.

### References

- Ackard, D. M., & Peterson, C. B. (2001). Association between puberty and disordered eating, body image, and other psychological variables. *International Journal of Eating Disorders*, 29(2), 187-194.
- Alsaker, F. D., & Flammer, A., (2020) Pubertal maturation. In S. Jackson & L. Goossens (Eds.), *Handbook of adolescent development*. Psychology Press.  
<https://books.google.gr/books?id=JHd0DwAAQBAJ&lpg=PT57&dq=Handbook%20of%20Adolescent%20Development%20edited%20by%20Sandy%20Jackson%2C%20Luc%20Goossens&lr&pg=PT4#v=onepage&q&f=false>
- Aruda, M. M. (2011). Predictors of unprotected intercourse for female adolescents measured at their request for a pregnancy test. *Journal of Pediatric Nursing*, 26(3), 216-223.
- Baams, L., Dubas, J. S., Overbeek, G., & Van Aken, M. A. (2015). Transitions in body and behavior: A meta-analytic study on the relationship between pubertal development and adolescent sexual behavior. *Journal of Adolescent Health*, 56(6), 586-598.
- Camara, B., & Copley, A. G. (2000). An overview of the AIDS/HIV/STD situation in the Caribbean. In *The Caribbean AIDS Epidemic* (pp. 1-21). University of the West Indies Press.
- Carter, R., Caldwell, C. H., Matusko, N., Antonucci, T., & Jackson, J. S. (2011). Ethnicity, perceived pubertal timing, externalizing behaviors, and depressive symptoms among black adolescent girls. *Journal of Youth and Adolescence*, 40(10), 1394-1406.

- Carter, R., Jaccard, J., Silverman, W. K., & Pina, A. A. (2009). Pubertal timing and its link to behavioral and emotional problems among 'at-risk' African American adolescent girls. *Journal of adolescence*, *32*(3), 467-481.
- Carter, R., Silverman, W. K., & Jaccard, J. (2013). Race and perceived pubertal transition effects on girls' depressive symptoms and delinquent behaviors. *Journal of Youth and Adolescence*, *42*(8), 1155-1168.
- Defoe, I. N. (2016). *The puzzle of adolescent risk taking: An experimental-longitudinal investigation of individual, social and cultural influences* (Doctoral dissertation, Utrecht University).
- DeRose, L. M., Shiyko, M. P., Foster, H., & Brooks-Gunn, J. (2011). Associations between menarcheal timing and behavioral developmental trajectories for girls from age 6 to age 15. *Journal of Youth and Adolescence*, *40*(10), 1329-1342.
- Fromme, K., Katz, E. C., & Rivet, K. (1997). Outcome expectancies and risk-taking behavior. *Cognitive Therapy and Research*, *21*(4), 421-442.
- Galvao, T. F., Silva, M. T., Zimmermann, I. R., Souza, K. M., Martins, S. S., & Pereira, M. G. (2014). Pubertal timing in girls and depression: a systematic review. *Journal of Affective Disorders*, *155*, 13-19.
- Ge, X., & Natsuaki, M. N. (2009). In search of explanations for early pubertal timing effects on developmental psychopathology. *Current Directions in Psychological Science*, *18*(6), 327-331.
- Ge, X., Brody, G. H., Conger, R. D., & Simons, R. L. (2006). Pubertal maturation and African American children's internalizing and externalizing symptoms. *Journal of Youth and Adolescence*, *35*(4), 528-537.
- Ge, X., Kim, I. J., Brody, G. H., Conger, R. D., Simons, R. L., Gibbons, F. X., & Cutrona, C. E. (2003). It's about timing and change: pubertal transition effects

- on symptoms of major depression among African American youths. *Developmental psychology*, 39(3), 430.
- Ghobadzadeh, M., & Moore, D. (2018). Association between Depressed Mood and Youth Condom/Contraceptive Nonuse: A Systematic Review of Literature. *Issues in Mental Health Nursing*, 39(2), 102-116.
- Graber, J. A., Lewinsohn, P. M., Seeley, J. R., & Brooks-Gunn, J. (1997). Is psychopathology associated with the timing of pubertal development?. *Journal of the American Academy of Child & Adolescent Psychiatry*, 36(12), 1768-1776.
- Hallfors, D. D., Waller, M. W., Bauer, D., Ford, C. A., & Halpern, C. T. (2005). Which comes first in adolescence—sex and drugs or depression ?. *American Journal of Preventive Medicine*, 29(3), 163-170.
- Ishida, K., Stupp, P., & McDonald, O. (2011). Prevalence and correlates of sexual risk behaviors among Jamaican adolescents. *International perspectives on sexual and reproductive health*, 6-15.
- Jayakody, A., Sinha, S., Tyler, K., Khadr, S. N., Clark, C., Klineberg, E., ... & Roberts, H. (2011). Early sexual risk among black and minority ethnicity teenagers: a mixed methods study. *Journal of Adolescent Health*, 48(5), 499-506.
- Joinson, C., Heron, J., Araya, R., & Lewis, G. (2013). Early menarche and depressive symptoms from adolescence to young adulthood in a UK cohort. *Journal of the American Academy of Child & Adolescent Psychiatry*, 52(6), 591-598.
- Kaestle, C. E., Halpern, C. T., Miller, W. C., & Ford, C. A. (2005). Young age at first sexual intercourse and sexually transmitted infections in adolescents and young adults. *American Journal of Epidemiology*, 161(8), 774-780.

- Kaltiala-Heino, R., Fröjd, S., & Marttunen, M. (2015). Depression, conduct disorder, smoking and alcohol use as predictors of sexual activity in middle adolescence: a longitudinal study. *Health Psychology and Behavioral Medicine, 3*(1), 25-39.
- Kaltiala-Heino, R., Kosunen, E., & Rimpelä, M. (2003). Pubertal timing, sexual behaviour and self-reported depression in middle adolescence. *Journal of Adolescence, 26*(5), 531-545.
- Kandel, D. B., & Davies, M. (1982). Epidemiology of depressive mood in adolescents: An empirical study. *Archives of General Psychiatry, 39*(10), 1205-1212.
- Kogan, S. M., Cho, J., Simons, L. G., Allen, K. A., Beach, S. R., Simons, R. L., & Gibbons, F. X. (2015). Pubertal timing and sexual risk behaviors among rural African American male youth: Testing a model based on life history theory. *Archives of Sexual Behavior, 44*(3), 609-618.
- Kurtz, S. P., Douglas, K. G., & Lugo, Y. (2005). Sexual risks and concerns about AIDS among adolescents in Anguilla. *AIDS Care, 17*(sup1), 36-44.
- Lehrer, J. A., Shrier, L. A., Gortmaker, S., & Buka, S. (2006). Depressive symptoms as a longitudinal predictor of sexual risk behaviors among US middle and high school students. *Pediatrics, 118*(1), 189-200.
- Lennon, C. A., Huedo-Medina, T. B., Gerwien, D. P., & Johnson, B. T. (2012). A role for depression in sexual risk reduction for women? A meta-analysis of HIV prevention trials with depression outcomes. *Social Science & Medicine, 75*(4), 688-698.

- Lerand, S. J., Ireland, M., & Blum, R. W. (2006). Individual and environmental impacts on sexual health of Caribbean youth. *The Scientific World Journal*, 6, 707-717.
- Martin, J. I., Pryce, J. G., & Leeper, J. D. (2005). Avoidance coping and HIV risk behavior among gay men. *Health & Social Work*, 30(3), 193-201.
- McFarlane, S., Younger, N., Francis, D., Gordon-Strachan, G., & Wilks, R. (2014). Risk behaviours and adolescent depression in Jamaica. *International Journal of Adolescence and Youth*, 19(4), 458-467.
- Mendle, J., & Ferrero, J. (2012). Detrimental psychological outcomes associated with pubertal timing in adolescent boys. *Developmental Review*, 32(1), 49-66.
- Mendle, J., Beltz, A. M., Carter, R., & Dorn, L. D. (2019). Understanding puberty and its measurement: ideas for research in a new generation. *Journal of Research on Adolescence*, 29(1), 82-95.
- Mendle, J., Harden, K. P., Brooks-Gunn, J., & Graber, J. A. (2010). Development's tortoise and hare: pubertal timing, pubertal tempo, and depressive symptoms in boys and girls. *Developmental Psychology*, 46(5), 1341.
- Mendle, J., Turkheimer, E., & Emery, R. E. (2007). Detrimental psychological outcomes associated with early pubertal timing in adolescent girls. *Developmental Review*, 27(2), 151-171.
- Michael, A., & Eccles, J. C. (2003). When coming of age means coming undone: Links between puberty and psychosocial adjustment among European American and African American girls. In C. Hayward (Ed.), *Gender differences at puberty* (pp. 277–303). New York: Cambridge University Press.
- Michael, A., & Eccles, J. C. (2003). When coming of age means coming undone: Links between puberty and psychosocial adjustment among European

- American and African American girls. In C. Hayward (Ed.), *Gender differences at puberty* (pp. 277–303). Cambridge University Press.
- Murphy, D. A., Durako, S. J., Moscicki, A. B., Vermund, S. H., Ma, Y., Schwarz, D. F., Muenz, L. R., & Adolescent Medicine HIV/AIDS Research Network. (2001). No change in health risk behaviors over time among HIV infected adolescents in care: role of psychological distress. *Journal of Adolescent Health, 29*(3), 57-63.
- Natsuaki, M. N., Biehl, M. C., & Ge, X. (2009). Trajectories of depressed mood from early adolescence to young adulthood: The effects of pubertal timing and adolescent dating. *Journal of Research on Adolescence, 19*(1), 47-74.
- Negriff, S., Fung, M. T., & Trickett, P. K. (2008). Self-rated pubertal development, depressive symptoms and delinquency: Measurement issues and moderation by gender and maltreatment. *Journal of youth and adolescence, 37*(6), 736-746.
- O’Sullivan, L. F., Meyer-Balshburg, H. F., & Watkins, B. X. (2000). Social cognitions associated with pubertal development in a sample of urban, low-income, African-American and Latina girls and mothers. *Journal of Adolescent Health, 27*(4), 227-235.
- Paxton, S. J., Neumark-Sztainer, D., Hannan, P. J., & Eisenberg, M. E. (2006). Body dissatisfaction prospectively predicts depressive mood and low self-esteem in adolescent girls and boys. *Journal of clinical child and adolescent psychology, 35*(4), 539-549.
- Peltzer, K., & Pengpid, S. (2015). Early sexual debut and associated factors among in-school adolescents in six Caribbean countries. *The West Indian Medical Journal, 64*(4), 351.

- Petersen, A. C., Crockett, L., Richards, M., & Boxer, A. (1988). A self-report measure of pubertal status: Reliability, validity, and initial norms. *Journal of Youth and Adolescence, 17*(2), 117-133.
- Pilgrim, N. A., & Blum, R. W. (2012). Protective and risk factors associated with adolescent sexual and reproductive health in the English-speaking Caribbean: a literature review. *Journal of Adolescent Health, 50*(1), 5-23.
- Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior research methods, 40*(3), 879-891.
- Rueger, S. Y., Malecki, C. K., Pyun, Y., Aycock, C., & Coyle, S. (2016). A meta-analytic review of the association between perceived social support and depression in childhood and adolescence. *Psychological Bulletin, 142*(10), 1017.
- Seth, P., Patel, S. N., Sales, J. M., DiClemente, R. J., Wingood, G. M., & Rose, E. S. (2011). The impact of depressive symptomatology on risky sexual behavior and sexual communication among African American female adolescents. *Psychology, Health & Medicine, 16*(3), 346-356.
- Siegel, J. M., Yancey, A. K., Aneshensel, C. S., & Schuler, R. (1999). Body image, perceived pubertal timing, and adolescent mental health. *Journal of adolescent health, 25*(2), 155-165.
- Stallworth, J., Roofe, M., Clark, L. F., Ehiri, J. E., Mukherjee, S., Person, S., & Jolly, P. E. (2004). Predictors of sexual involvement among adolescents in rural Jamaica. *International Journal of Adolescent Medicine and Health, 16*(2), 165-178.



- Steinberg, L. (2005). Cognitive and affective development in adolescence. *Trends in Cognitive Sciences*, 9(2), 69-74.
- Thapar, A., Collishaw, S., Pine, D. S., & Thapar, A. K. (2012). Depression in adolescence. *The Lancet*, 379(9820), 1056-1067.
- Ullsperger, J. M., & Nikolas, M. A. (2017). A meta-analytic review of the association between pubertal timing and psychopathology in adolescence: Are there sex differences in risk?. *Psychological Bulletin*, 143(9), 903.
- Vaughan, E. B., Van Hulle, C. A., Beasley, W. H., Rodgers, J. L., & D'Onofrio, B. M. (2015). Clarifying the associations between age at menarche and adolescent emotional and behavioral problems. *Journal of Youth and Adolescence*, 44(4), 922-939.
- Wyatt, G., Durvasula, R. S., Guthrie, D., LeFranc, E., & Forge, N. (1999). Correlates of first intercourse among women in Jamaica. *Archives of Sexual Behavior*, 28(2), 139-157.
- Yu, S., Clemens, R., Yang, H., Li, X., Stanton, B., Deveaux, L., Lunn, S., Cottrell, L., & Harris, C. (2006). Youth and parental perceptions of parental monitoring and parent-adolescent communication, youth depression, and youth risk behaviors. *Social Behavior and Personality: an International Journal*, 34(10), 1297-1310.
- Yu, S., Deveaux, L., Lunn, S., Liu, H., Brathwaite, N., Li, X., Cottrell, L., Marshall, S. & Stanton, B. (2007). At greatest risk: pre-and early adolescent Bahamian youth experiencing anal intercourse. *International Journal of STD & AIDS*, 18(6), 396-401.

## Appendix

**Table 1A**  
*Multiple Linear Regression with Longitudinal Predictors of Girls' Condom Nonuse*

Variable	Girls who ever had sex ( $N = 40$ )								
	Model 1			Model 2			Model 3		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Age	.04	.15	.04	.04	.15	.04	.03	.15	.04
W1 Condom nonuse	-.14	.19	-.12	-.15	.21	-.13	-.17	.21	-.15
Age at menarche				-.00	.17	-.00	-.06	.17	-.06
W1 Depression				.08	.39	.04	-.05	.41	-.02
Age at menarche x Depression							.27	.27	.20
$R^2$		.02			.02			.05	
F for change in $R^2$		.31			.02			1.00	
	All girls ( $N = 105$ )								
Age	.11	.05	.20*	.10	.06	.19	.11	.05	.20
W1 Condom nonuse	.01	.12	.01	-.00	.12	.00	-.04	.12	-.03
Age at menarche				.03	.07	.05	.03	.07	.04
W1 Depression				.00	.12	.00	.02	.12	.01
Age at menarche x Depression							.16	.10	.16
$R^2$		.04			.04			.07	
F for change in $R^2$		2.22			.11			2.47	

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

**Table 2A**  
*Multiple Linear Regression with Longitudinal Predictors of Girl's  
 Contraceptive Nonuse*

Variable	Girls who ever had sex (N =40)								
	Model 1			Model 2			Model 3		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Age	.13	.20	.11	.15	.20	.12	.15	.21	.12
W1 Contraceptive nonuse	-.15	.15	-.16	-.07	.18	-.08	-.68	.18	-.07
Age at menarche				-.17	.22	-.13	-.15	.24	-.12
W1 Depression				-.42	.58	-.15	-.37	.61	-.13
Age at menarche x Depression							-.11	.37	-.06
R <sup>2</sup>		.04			.08			.08	
F for change in R <sup>2</sup>		.77			.78			.09	
All girls (N =108)									
Age	.29	.09	.28**	.30	.09	.29**	.30	.10	.29**
W1 Contraceptive nonuse	.39	.09	.36***	.43	.10	.40***	.44	.10	.41***
Age at menarche				-.05	.12	-.03	-.04	.12	-.03
W1 Depression				-.35	.21	-.15	-.36	.21	-.15
Age at menarche x Depression							-.06	.17	-.03
R <sup>2</sup>		.27			.29			.29	
F for change in R <sup>2</sup>		18.56***			1.52			.12	

\**p*<.05. \*\**p*<.01. \*\*\**p*<.001.

**Table 3A**

*Multiple Linear Regression with Longitudinal Predictors of Girls Engaging in Intercourse with Someone Unknown*

Variable	Girls who ever had sex ( $N=39$ )								
	Model 1			Model 2			Model 3		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Age	.10	.07	.20	.11	.07	.22	.11	.07	.22
W1 Sex with someone unknown	.43	.11	.54***	.42	.11	.54***	.42	.11	.53**
Age at menarche				-.07	.07	-.13	-.07	.08	-.12
W1 Depression				.20	.18	.15	.20	.19	.16
Age at menarche x Depression							-.01	.12	-.01
R <sup>2</sup>		.36			.39			.39	
F for change in R <sup>2</sup>		10.21***			.85			.00	
	All girls ( $N=104$ )								
Age	.04	.02	.13	.04	.02	.15	.04	.02	.15
W1 Sex with someone unknown	.45	.06	.56***	.45	.06	.57***	.45	.06	.57***
Age at menarche				-.02	.03	-.07	-.02	.03	-.07
W1 Depression				.03	.05	.05	.03	.05	.05
Age at menarche x Depression							.02	.04	.04
R <sup>2</sup>		.37			.37			.37	
F for change in R <sup>2</sup>		28.78***			.51			.20	

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

**Table 4A**  
*Multiple Linear Regression with Longitudinal Predictors of Girls Having Multiple Sexual Partners*

Variable	Girls who ever had sex ( $N = 39$ )								
	Model 1			Model 2			Model 3		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Age	-.01	.06	-.03	-.00	.07	-.01	-.00	.07	-.00
W1 Multiple sexual partners	.41	.18	.36*	.38	.19	.32	.38	.19	.33
Age at menarche				-.05	.07	-.12	-.04	.07	-.09
W1 Depression				.12	.17	.12	.15	.18	.15
Age at menarche x Depression							-.07	.11	-.11
$R^2$		.13			.15			.16	
F for change in $R^2$		2.63			.42			.37	
	All girls ( $N = 104$ )								
Age	.02	.02	.08	.02	.02	.08	.02	.02	.08
W1 Multiple sexual partners	.46	.11	.39***	.46	.11	.39***	.46	.11	.39***
Age at menarche				-.01	.03	-.04	-.01	.03	-.04
W1 Depression				.02	.05	.04	.02	.05	.03
Age at menarche x Depression							-0.1	.04	-.03
$R^2$		.16			.17			.17	
F for change in $R^2$		9.89***			.16			.09	

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

**Table 5A**

*Mediation Effects of Wave 1 Depression on the Relationship between Pubertal Timing and Wave 2 Sexual Risk Outcomes for Boys.*

Effect	Dependent Variable	N	b	95% CI	
				Lower	Upper
Total	Protection nonuse	35	.24	-.20	.68
		74	.07	-.15	.30
Direct			.18	-.25	.60
			.04	-.18	.25
Indirect (mediation)			.06	-.09	.33
			.04	-.03	.16
Total	Intercourse with someone unknown	34	.27	-.17	.72
		73	.09	-.12	.29
Direct			.21	-.23	.64
			.06	-.15	.26
Indirect (mediation)			.06	-.09	.39
			.03	-.03	.15
Total	Multiple partners	34	.14	-.31	.58
		73	.02	-.18	.23
Direct			.06	-.34	.46
			-.01	-.21	.19
Indirect (mediation)			.08	-.12	.40
			.04	-.21	.19

*Note:* The results of the analyses including only the boys who ever had sex are shown in the first line and the results of the analyses with all boys in the second line.

**Table 6A**

*Mediation Effects of Wave 1 Depression on the Relationship between Age at menarche and Wave 2 Sexual Risk Outcomes for Girls.*

Effect	Dependent Variable	N	b	95% CI	
				Lower	Upper
Total	Condom nonuse	40	.01	-.32	.33
		105	.03	-.11	.17
Direct			-.00	-.34	.33
			.03	-.11	.17
Indirect (mediation)			.01	-.06	.16
			.00	-.02	.01
Total	Contraceptives nonuse	40	-.22	-.64	.21
		105	-.04	-.28	.20
Direct			-.17	-.62	.27
			-.05	-.28	.19
Indirect (mediation)			-.04	-.24	.05
			.01	-.03	.06
Total	Intercourse with someone unknown	39	-.05	-.19	.10
		14	-.02	-.08	.03
Direct			-.07	-.22	.08
			-.02	-.08	.04
Indirect (mediation)			.02	-.00	.14
			-.00	-.01	.00
Total	Multiple partners	39	-.04	-.17	.10
		104	-.01	-.07	.04
Direct			-.05	-.19	.09
			-.01	-.07	.04
Indirect (mediation)			.01	-.01	.09
			-.00	-.01	.00

*Note:* The results of the analyses including only the girls who were sexually active are shown in the first line and the results of the analyses with all girls in the second line