Exploring the mediating and moderating roles of body-related concerns and social interactions on the association between early puberty and psychological distress in young adult women

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Received: 30 August 2018 / Accepted: 2 April 2019 / Published online: 7 May 2019

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Abstract

Objective To explore the mechanisms through which early puberty is associated with psychological distress in women aged 18–25. This cross-sectional study aims to investigate whether body-related concerns and social interactions moderate or mediate this association.

Methods Participants were compared on measures evaluating psychological distress, body image dysphoria, bulimic symptomatology and negative intimacy with best friend according to three pubertal timing groups: (1) “very early” puberty (menarche at 9 years old or less), (2) “early” puberty (menarche at 10 years old), and (3) “on-time” puberty (menarche between 11 and 13 years old). Forward stepwise multiple regressions and multiple mediation analysis were successively performed to see whether body-related concerns and peer interactions mediate or moderate the relationship between premature puberty and psychological distress.

Results Controlling for age and ethnicity, results indicated (1) that women who began puberty “very early” had significantly higher levels of psychological distress than their “on-time” counterparts; (2) the association found between very early puberty and psychological distress was mediated by body image dysphoria and negative intimacy with best friend and was moderated by bulimic symptomatology. No mediational effect was found in women whose puberty was “early”.

Conclusion These findings highlight the importance of using more than one group of early pubertal timing and the role of body and intimacy concerns in the explanation of psychological distress in women. Intervention strategies addressing the increased risk of psychological distress in women who begin puberty very early should target their body image and ability to form intimate friendships.

Résumé

Objectif Explorer les mécanismes par lesquels la puberté précoce est associée à la détresse psychologique chez les femmes âgées de 18 à 25 ans. Cette étude transversale vise à déterminer si les préoccupations liées au corps et les interactions sociales modèrent ou médient cette association.

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Méthodologie Les participantes ont été contrastées sur des mesures évaluant la détresse psychologique, la dysphorie de l'image corporelle, la symptomatologie boulimique et l'intimité négative avec la meilleure amie selon trois groupes : (1) puberté « très précoce » (ménarche à 9 ans ou moins); (2) puberté « précoce » (ménarche à 10 ans) et (3) la puberté « synchronique » (ménarche entre 11 et 13 ans). Des régressions multiples pas à pas et des analyses de médiation multiples ont ensuite été effectuées pour déterminer si les préoccupations liées au corps et les interactions avec les pairs médiaient ou modéraient la relation entre la puberté précoce et la détresse psychologique.

Résultats En contrôlant pour l'âge et l'appartenance ethnique, les résultats ont révélé : (1) que les femmes du groupe de puberté « très précoce » présentaient des niveaux de détresse psychologique significativement plus élevés que leurs homologues dont la puberté était « synchronique »; (2) l'association entre la puberté très précoce et la détresse psychologique était médiée par la dysphorie de l'image corporelle et l'intimité négative avec la meilleure amie et était modérée par la symptomatologie boulimique. Aucun effet médiateur n'a été identifié chez les femmes dont la puberté était « précoce ».

Conclusion Ces résultats soulignent l'importance d'utiliser plus d'un groupe pour définir la puberté précoce et le rôle des préoccupations de corps et d'intimité dans l'explication de la détresse psychologique chez les femmes. Les stratégies d'intervention visant à contrer le risque accru de détresse psychologique chez les femmes pour qui la puberté commence très tôt devraient cibler leur image corporelle et leur capacité à nouer des relations d'amitiés.

Keywords Early puberty · On-time puberty · Body image · Intimacy · Bulimic symptomatology · Psychological distress

Mots-clés Puberté précoce · Puberté synchronique · Image corporelle · Intimité · Symptomatologie boulimique · Détresse psychologique

Introduction

In Western societies, the vulnerability of women to negative body image is well documented (Cash et al. 2004; Moradi and Huang 2008). Negative body image (dissatisfaction or dysphoria) is associated with a range of other health concerns, including psychological distress, eating disturbances and obesity (Cassano and Fava 2002). In Québec, the highest proportion of psychological distress is found in women aged 15–24, where 45% of women compared with 27% of men are affected (Camirand et al., 2016). The early onset of puberty, that is, the onset of pubertal physical changes before those of peers of the same sex and age (Graber et al. 1996), is among the most recognized predictors of psychological distress in adolescent girls (Mendle et al. 2007). Early puberty is also associated with body dissatisfaction and eating disturbances (Mendle et al. 2007; Graber 2013). However, the support of friends through social interaction may affect the association between body dissatisfaction and negative outcomes (Benas et al. 2010).

In this context, exploring the roles of body-related concerns and social interactions in the link between early puberty and psychological distress seems important. However, this has never been done in a single research design (Copeland et al. 2010a). The current study will address this research gap.

Early puberty and psychological distress

Past research has theorized direct, indirect and moderated associations between pubertal timing, adjustment problems and

psychological distress (Ge et al. 2011). The Disparity Maturation and Contextual Amplification hypotheses (Ge et al. 2011) target two intermediate factors that are expected to mediate or amplify risks of maladjustment in early pubertal girls: body-related concerns (e.g., concerns associated with weight gain) and social interactions (e.g., social context, deficient interactions) (Negri and Susman 2011).

Empirically, research has mainly explored the direct but not the mediated or moderated associations between early puberty and psychological distress in girls (Michaud et al. 2006). In adult women, the few existing studies have solely focused on direct relationships and produced conflicting results. While some found significant associations (Copeland et al. 2010a) between early puberty and psychological distress, others did not (Lien et al. 2006). Consideration of indirect relationships between these factors may explain these findings.

Given the Disparity Maturation and Contextual Amplification hypotheses, it is plausible that body-related concerns and social interactions are intermediate factors responsible for adjustment problems in adult women and not only in girls who begin puberty early. In the literature, body-related concerns and social interactions are the most frequently associated factors with psychological distress in adult women (Graber et al. 2004; Copeland et al. 2010b). Indeed, body dissatisfaction is seen as amplifying the link between negative support from peers and distress in women (Benas et al. 2010). In addition, body-related concerns and poor social interactions are often associated with the adverse effects of precocious puberty in girls (Mendle et al. 2007; Compian et al. 2009). Hence, it seems relevant to summarize studies linking (1)

early puberty with body-related concerns and social interactions and (2) body-related concerns and social interactions with psychological distress.

Early puberty and its relation to body-related concerns and social interactions

Research has shown that early puberty is associated with a negative body image (dissatisfaction or dysphoria) (Graber 2013). The increase in body fat during puberty appears earlier in these girls than in their age-matched peers and distances them from the cultural beauty ideal of thinness (Mendle et al. 2007). Girls who begin puberty early tend to experience the most body dissatisfaction, the highest dietary concerns, the strongest desire to be thin and the highest rates of bulimic symptoms, compared with girls and boys whose puberty is either on time or late (McNicholas et al. 2012). In addition, they have higher prevalence of self-harm behaviours during puberty (Patton et al. 2007).

As for social interactions, early pubertal timing in girls has been linked to more impaired relationships with peers, compared with girls with an “on-time” or “late” puberty (Compian et al. 2009). As adults, females who started puberty early report lower relationship quality and life satisfaction (Graber et al. 2004). Problems with peer relationships (e.g., low intimacy with friends) are significantly associated with body image dissatisfaction (Schutz and Paxton 2007). In addition, early puberty is linked with poor relationship with one’s mother, interactions which magnify the negative effects associated with early puberty (Mendle et al. 2007; Ge et al. 2011).

Body-related concerns, social interactions and their relation to psychological distress

Researchers have consistently reported strong associations between negative body image and psychological distress in both girls and women (Brausch and Gutierrez 2009). Women and teenage girls who are convinced that they do not match the ideal of thinness are more likely to experience body image problems and psychological distress (Negri and Susman 2011; Stice et al. 2000). Trying to attain the ideal and failing can increase their risk of psychological distress, body image disturbances and binge eating (Copeland et al. 2010b). In turn, depressed mood may influence body dissatisfaction (Burt and Stein 2002), further complicating the relationship between psychological distress and physical factors.

Concerning social interactions, poor peer relationships are significantly associated with psychological distress in girls and women (Frey et al. 2004). In the same vein, studies have shown that levels of distress are significantly higher among women with low emotional independence from their mothers (Gurreri et al. 2018).

Given associations between, on the one hand, early puberty with body-related concerns and social interactions, and on the other, body-related concern and social interactions with psychological distress, we hypothesize that body-related concerns and or social interactions: (1) play a moderating role or (2) play a mediating role between precocious puberty and psychological distress. Contrary to the typical approach centred on the study of direct effects, it seems essential to also examine the possible indirect impact of early puberty on psychological distress.

The current study

The objective of the current study is to explore in women whether body-related concerns and peer/family interactions moderate or mediate the association between early puberty and psychological distress. The intent is to identify factors to be targeted by interventions and to promote the development of services that are designed for girls and women facing recurring adaptation problems related to their early pubertal timing.

Methods

Participants and procedures

A total of 6373 French-speaking women aged 18–25 ($M = 21.3$) participated in this study. Participants were fitted retrospectively into three pubertal groups: (1) menarche at 9 years old or less ($n = 199$ participants), (2) menarche at 10 years old ($n = 408$ participants) and (3) menarche between 11 and 13 years old ($n = 4705$ participants). Women with menarche at ≥ 14 years old ($n = 1054$) were excluded from the analysis as women who start puberty late are at lower risk of psychological distress than those who start early (Graber et al. 2004). Participants were mostly recruited from educational settings in the greater Montréal area, including professional schools, adult education institutions, colleges and universities.

In the first wave of recruitment, the research team contacted the school board of each institution to solicit their participation. Classes of institutions agreeing to participate were visited by a research assistant who described the project and invited women aged between 18 and 25 to complete the questionnaire (outside of school hours) and sign a written consent form. Questionnaires were recovered in class one week later. In the second wave of recruitment, a leaflet containing the website address giving access to the consent form and online survey was distributed in new classes. In addition, for universities, an email was sent to all students. In total, 1275 paper questionnaires (20%) and 5098 online questionnaires (80%) were collected. The study was approved by the University of Quebec in Montreal’s Research Ethics Board.

Measurements

A self-administered questionnaire of approximately 60 minutes duration was used to collect the socio-demographic characteristics of the sample (age, region, occupation, civil status, ethnicity and geographic characteristics), the independent variable (i.e., pubertal timing, defined in relation to age of first menstruation) and a set of dependent and potentially mediating or moderating variables.

Pubertal timing

Pubertal timing, as is common, was measured in relation to (1) age at menarche and (2) self-reported menarche (Graber et al., 1996; Negri & Susman, 2011). It was assessed by the following question: “At what age did you have your first menstrual period?” The pubertal timing groups followed the work of Stattin and Magnusson (1990). Thus, the “on-time” group included participants who first menstruated at between 11 and 13 years of age and the “late” puberty group (excluded from the current study) encompassed participants who menstruated at ≥ 14 years old. We also heeded the recommendation by Sultan et al. (2005) to distinguish different premature puberty timings. Two premature puberty groups were therefore created: “very early” (menarche at 9 years old or less) and “early” (menarche at 10 years old). The former can be indicative of “central precocious puberty” (Sultan et al. 2005). However, this diagnosis was not required for inclusion because the study is not concerned with the causes of premature puberty.

The questionnaire also included scales to evaluate psychological distress, body-related concerns (body image, risk of bulimia, self-harm) and interpersonal interactions with peers and family (mother).

Psychological distress

The French version of the *Psychological Distress Scale* (IDPESQ14) (Préville et al. 1992) is an adaptation of the Psychiatric Symptom Index (Ilfeld 1976). Its 14 items are coded on a 4-point Likert scale ranging from (1) never to (4) very often, with higher scores indicating increased severity of distress. It contains items measuring symptoms of depression (5 items), anxiety (3 items), irritability (4 items) and cognitive problems (2 items). The IDPESQ14 was used in the provincial Santé Québec surveys (1988, 1992–1993 and 1998) and provides clinical thresholds for several populations, including young women (35.71) (Boyer et al. 1993). In the current study, this scale showed high internal consistency ($\alpha = .90$).

Body-related concerns

The *Situational Inventory of Body Image Dysphoria* (SIBID) questionnaire is a unique assessment of negative emotions experienced about one’s body in specific contexts (such as physical self-focus, social comparisons, eating, sexual intimacy and appearance alterations) (Cash 2002). The 20 items of the short-form questionnaire are rated on a 4-point Likert scale (0 = never to 4 = always). High scores indicate high levels of body image dysphoria. This scale was chosen because of its uniqueness, widespread use in the field of body image affect measurement and the accumulated evidence of its good psychometric properties (Cash et al. 2004). A French version of the SIBID questionnaire was derived for this study, following a recognized methodology for the translation of psychological questionnaires (Vallerand 1989). The original English version, the forward translation and the back-translated versions were compared and approved as equivalent. In the current study, the overall SIBID score of the French version showed high internal consistency ($\alpha = .96$).

The *Bulimia Subscale* of the *Disordered Eating Attitudes Test* (EAT-26) (Garner et al. 1982) measures concerns about feeding and induced vomiting. The EAT-26 includes two other subscales: dieting (13 items) and oral control (7 items). Items of the EAT-26 are rated on a Likert scale ranging from 1 = never to 6 = always. The higher the score, the more severe the eating disorder. In the current study, the *Bulimia Subscale* showed acceptable internal consistency ($\alpha = .78$).

Guided by the literature (Ge et al. 2011), *self-harm behaviours* were assessed with the following question: “Did you deliberately injure or damage your body directly?” Participants who responded “yes” were asked a second question: “During the last year, how many: (1) scratches, (2) bruises, (3) cuts, (4) burns, (5) bites, did you inflict on yourself?” (continuous variable).

Peer and family interactions

The *Psychological Separation Inventory* (PSI) (Hoffman 1984) was used to measure *emotional independence from the mother*. It is composed of 17 items (e.g., “I make decisions based on the approval of my mother”) rated on a Likert scale ranging from 1 = it is not at all like me to 6 = it is really like me. Low scores correspond to high levels of emotional independence from the mother. In the current study, the scale showed high internal consistency ($\alpha = .91$).

The *Negative Intimacy* subscale of the *Personal Assessment of Intimacy in Relationships* scale-Modified version (PAIR-M) (Thériault 1998) was used to measure avoidant attitudes toward emotional proximity with one’s best friend. This scale is a modified version of the Personal Assessment of Intimacy in Relationships (PAIR) (Schaefer and Olson 1981). The higher the score, the lower the level of intimacy. The 18 items of the

PAIR-M are rated on a Likert scale ranging from 0 = never to 6 = always. In the current study, the internal consistency of the scale was .68 which could be considered “acceptable” (Cronbach 1951).

Socio-demographic variables

Socio-demographic variables included self-reported age (continuous variable), ethnicity, marital status, level of education and civil status. Ethnicity was accessed by the following question: “To what ethnic group do you belong?: (1) Aboriginal; (2) Middle Eastern or Asian; (3) Black American; (4) Latin American; (5) Caucasian or (6) Other”. Studies have shown that Caucasian females reach puberty later than African-Americans and earlier than Asians (Wu et al. 2002).

Statistical analyses

Descriptive statistics are presented for each pubertal group. Continuous variables are presented as means and standard deviations and categorical variables are presented as frequencies and percentages. For illustrative purposes, the means of each group were compared with one-way analyses of variance and Tukey’s post hoc multiple comparisons. Proportions were compared with Pearson’s chi-square statistics. Bonferroni corrections were also used to counteract the multiple comparisons.

The premature puberty groups are hypothesized to be associated with different mediators and moderators. To test this, dummies were made for each group to isolate them in different models. First, forward stepwise multiple regression analyses (using psychological distress as the dependent variable) were performed to see whether body-related concerns and peer/family interactions were potential mediators in the relationship between premature puberty (“very early” and “early” puberty) and psychological distress, while controlling for confounding factors (age as a continuous variable and ethnic groups entered in the order presented in the “Methods” section). The goodness of fit of the final models was verified to check homoscedasticity, the normality of residuals and multicollinearity with the usual statistics and graphics (Hosmer-Lemeshow statistics, normal probability plots and variance inflation factors). Outlying dependent variables were tested with studentized deleted residuals, and outlying profiles for the independent variables were tested with hat matrix leverage values. Influential cases were mainly tested with Cook’s distances. Remedial measures (e.g., transformations) were not necessary. All analyses were performed using SPSS V.23 (SPSS Inc., Chicago, USA).

Second, potential mediators previously identified as statistically significant were further tested for mediation, while controlling for confounding factors (age and ethnic groups) and keeping puberty in the models as an independent

variable. Knowing that the indirect effects are skewed, a bootstrap approach was used (instead of Sobel’s test) to estimate indirect and direct effects. Mediation analyses were performed using the SPSS Macro Process, as developed by Hayes (2013).

Results

Group description

The confidence intervals of psychological distress for each pubertal group and the statistical power of tests for the effect of “very early” and “early” puberty on psychological distress are described in the Appendix.

The demographics and characteristics of the groups are presented in Table 1. Some of the variables are mediators retained in the first “forward” stepwise multiple regressions (““Very early” puberty and psychological distress” and ““Early” puberty and psychological distress” sections). All variables were similar between groups except psychological distress (IDPESQ14), body image dysphoria (SIBID) and education, when controlling for type 1 error with the Bonferroni correction.

Mean psychological distress in the “very early” puberty group (42.6) was significantly higher ($p = 0.007$) than in the “early” and “on-time” puberty groups (38.1 and 38.0, respectively). The difference remained significant following the Tukey post hoc testing. Mean body image dysphoria was highest in the “very early” puberty group ($M = 1.835$) and lowest in the “on-time” group ($M = 1.672$) ($p = 0.004$), with the differences remaining significant after the Tukey post hoc testing. Education profiles were different between groups ($p < 0.001$); a higher percentage of university-educated participants and a lower percentage of college-educated participants were found in the “on-time” group, relative to all other groups.

“Very early” puberty and psychological distress

The following analyses concern the effect of “very early” puberty (menarche ≤ 9 years old) versus “on-time” puberty (menarche between 11 and 13 years) on psychological distress. Results of the forward stepwise multiple regressions are presented in Table 2, and the results of the mediation analyses are shown in Table 3.

The first step (Table 2) involved searching for potential mediators in a multiple regression model containing control variables (age and ethnicity), the “very early” puberty variable (1 = yes, 0 = no) and a moderator for “very early” puberty. Using a forward stepwise approach, four co-variables (potential mediators) were statistically associated with psychological distress ($p < 0.001$). Higher body image dysphoria and self-harm were associated with greater psychological distress. Increased negative intimacy and emotional independence

Table 1 Comparison of means and standard deviations between young adult women with different puberty groups: very early (menarche at 9 years old and less), early (menarche at 10 years old) and on-time (menarche between 11 and 13 years old)

Puberty (age at menarche)	(≤ 9 years) (N = 199)	(10 years) (N = 408)	(11–13 years) (N = 4705)	<i>p</i> value
Continuous variables	Mean ± SD	Mean ± SD	Mean ± SD	
Age	21.2 ± 2.2	21.2 ± 2.1	21.3 ± 2.1	0.213
Psychological distress	42.6 ± 22.3	38.1 ± 2.5	38.0 ± 2.1	0.007
Body image dysphoria	1.835 ± .842	1.768 ± .846	1.672 ± .828	0.004
Self-harm	5.80 ± 19.93	4.18 ± 18.64	4.08 ± 21.75	0.543
Negative intimacy	4.59 ± .86	4.66 ± .83	4.71 ± .78	0.062
Emotional independence/mother	37.0 ± 14.2	38.9 ± 13.2	39.4 ± 12.9	0.033
Bulimic symptomatology	.228 ± .417	.222 ± .421	.205 ± .417	0.568
Categorical variables	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Living, in Montreal	154 (77.4%)	337 (82.6%)	3918 (83.3%)	0.101
Education				
Professional school	12 (6.0%)	35 (8.6%)	262 (5.6%)	< 0.001
Adult education	12 (6.0%)	10 (2.5%)	122 (2.6%)	
College	47 (23.6%)	92 (22.5%)	844 (17.9%)	
University	120 (6.3%)	251 (61.5%)	3306 (7.3%)	
Others	8 (4.0%)	20 (4.9%)	170 (3.6%)	
Ethnicity, born in Quebec	151 (75.9%)	286 (7.1%)	3409 (72.5%)	0.317
Marital status				
Living alone	73 (36.7%)	153 (37.5%)	1744 (37.1%)	0.501
Relationship (A)	70 (35.2%)	140 (34.3%)	1762 (37.4%)	
Relationship (B)	55 (27.6%)	112 (27.5%)	1147 (24.4%)	

Bonferroni corrections for an overall $\alpha = .05$; ANOVAs $\alpha = .01$ for psychological distress and $\alpha = .005$ for other variables; chi-squares $\alpha = .01$ for all variables; Bonferroni significant *p* values are in bold characters; *Relationship (A)*, not living with his/her romantic partner; *Relationship (B)*, living with his/her romantic partner

Table 2 Multiple regression model for predicting psychological distress from “very early” puberty (menarche at 9 years old or less: 1 = yes; 0 = no), potential mediators, moderators and control variables

	B	SE (B)	<i>p</i> value
Constants	51.7	3.55	< 0.001
Control variables			
Age (year)	−.294	.135	0.030
Ethnicity (others)	2.261	.642	< 0.001
Independent variable			
“Very early” puberty (≤ 9 years old)	1.508	1.555	0.332
Potential mediators			
Body image dysphoria	8.723	.392	< 0.001
Self-harm	.091	.014	< 0.001
Negative intimacy/peers	− 2.835	.364	< 0.001
Emotional independence/mother	−.101	.022	< 0.001
Moderators			
Bulimic symptomatology	5.049	.743	< 0.001
“Very early” puberty * Bulimic symptomatology	7.188	3.222	0.026

$R^2 = 0.235$

from the mother were associated with lower psychological distress. In this model, “very early” puberty (= 1) was statistically associated with higher levels of psychological distress, but through bulimic symptomatology ($p = 0.026$). The more severe the bulimic symptomatology, the stronger the association. The model, presented in Table 2, explained 23.5% ($R^2 = 0.235$) of the total variation in psychological distress.

During the second step of the analysis (Table 3), the four co-variables previously identified as associated with psychological distress were tested for mediation. Two qualified as mediators (see Table 3). Body image dysphoria and negative intimacy with peers were positive mediators for “very early” puberty’s effect on psychological distress. The conditional direct effect of “very early” puberty on psychological distress remained significant ($p < 0.01$) but only for higher values of bulimic symptomatology. The model presented in Table 3 explained 22.5% ($R^2 = 0.225$) of the total variation in psychological distress.

“Early” puberty and psychological distress

These next analyses concern the effect of “early” puberty (menarche at 10 years old) on psychological distress

Table 3 Multiple mediator effects when predicting psychological distress from “very early” puberty (menarche at 9 years old or less: 1 = yes; 0 = no) and moderators, while controlling for age and ethnic groups

Indirect effect of “very early” puberty on psychological distress			
Mediators	<i>B</i>	<i>SE (B)</i>	Bias corrected 95% CI (from bootstrap)
Body image dysphoria	1.466	.600	2.846
Negative intimacy/peers	.461	.200	.369
			.123
Conditional direct effect of “very early” puberty on psychological distress at different values of bulimic symptomatology			
Moderator values	<i>B</i>	<i>SE (B)</i>	<i>p</i> value
Bulimic symptomatology = .0	2.148	1.557	0.168
Bulimic symptomatology = .2	3.553	1.372	0.010
Bulimic symptomatology = .6	6.409	1.850	< 0.001

$$R^2 = 0.225$$

compared with “on-time” puberty (menarche at 11–13 years old). The results of the forward stepwise multiple regressions are presented in Table 4. Contrary to results on the “very early” puberty group, no moderation was found for the “early” group.

As in the “**Very early” puberty and psychological distress**” section, a search for potential mediators was performed using a multiple regression model containing control variables (age, ethnicity) and the “on-time” variable (1 = yes; 0 = no). Using a forward stepwise approach, five potential mediators were statistically associated with psychological distress ($p < 0.001$). Increases in body image dysphoria, self-harm and risk of bulimia were associated with higher levels of psychological distress, while increases in negative intimacy with one’s best friend and emotional independence from the mother were associated with lower levels. In this model, “early” puberty was not associated with psychological distress ($p = 0.835$). The model explained 22.9% ($R^2 = 0.229$) of the total variation in psychological distress.

Table 4 Multiple regression model for predicting psychological distress from “early” puberty (menarche at 10 years old: 1 = yes; 0 = no), potential mediators and control variables

	<i>B</i>	<i>SE (B)</i>	<i>p</i> value
Constant	52.3	3.51	< 0.001
Control variables			
Age (year)	– .301	.134	0.025
Ethnic (others)	2.040	.632	0.001
Independent variable			
“Early” puberty (10 years old)	– .208	1.000	0.835
Potential mediators			
Body image dysphoria	8.412	.376	< 0.001
Self-injuries	.090	.014	< 0.001
Negative intimacy/peers	– 2.823	.359	< 0.001
Emotional independence/mother	– .113	.022	< 0.001
Bulimic symptomatology	5.360	.719	< 0.001

$$R^2 = 0.229$$

The five co-variables associated with psychological distress at the first stage of the analysis were further tested for mediation, but no evidence was found of their being mediators for “early” puberty.

Discussion

Women between 18 and 25 years of age who had a “very early” menarche (9 years old and less) had higher levels of psychological distress, while women who had “early” menarche (10 years old) did not. These findings suggest that using a single encompassing group of premature pubertal timing, typical of past research, might lack discriminative power.

The main finding of this study is that two sets of mechanisms link premature puberty and psychological distress in women aged 18–25. The first involves the interaction of age at menarche and bulimic symptomatology in women who had a “very early” menarche. Confirming our first hypothesis, these findings support two previously documented, independent positive associations: one between eating disturbances and mood problems (Stice et al. 2000) and the other between premature pubertal timing and eating disturbances, in undergraduate and/or adult women (McNicholas et al. 2012). However, according to our results, not all women whose menarche arrives prematurely are at risk of bulimic symptomatology or eating disorders, only those whose age at menarche was 9 years old or less.

A second set of mechanisms is a mediating one. Concerns about the body (body image dysphoria) and social interactions (negative intimacy with one’s best friend) were found to mediate the puberty-distress relationship in women who had a “very early” menarche. Confirming our second hypothesis, these results further corroborate research linking (1) poor interpersonal relationships to psychological distress (Stattin and Magnusson 1990); (2) early puberty to difficult interpersonal relationships (Compian et al. 2009); (3) body image and eating disorders to psychological distress (Stice et al. 2000); and

(4) early pubertal timing to body image problems (Mendle et al. 2007).

How can we explain that women who started puberty “very early” showed the highest levels of psychological distress, body image dysphoria and risk of bulimia? Drawing on Stattin and Magnusson (1990), it is possible that the earlier the menarche, the more the physical, cognitive and emotional development of girls is desynchronized. As a result, they have less time than girls who mature “on-time” to develop skills to adequately cope with the changes of puberty (Mendle et al. 2007; Stice et al. 2000). As adults, they report lower relationship quality and life satisfaction (Graber et al. 2004).

From a public health perspective, these results identify potential levers for action to reduce the risk of psychological distress in women, in general, and specifically, in female youth and adults with a very early onset of puberty. They show the importance of developing early detection tools for early pubertal girls. They also underscore the importance of recognizing and understanding the contribution of positive body image and social interactions, when designing strategies, tools or training programs to reduce the risks of psychological distress in girls and women whose puberty begins very early. The macro environment must be targeted to prevent psychological distress in these girls and women. It must address not only how they see themselves but how others (friends, parents) perceive them and their bodies. Perceived peer affiliation significantly predicts girls’ body image concerns, body dissatisfaction and restrained eating (Schutz and Paxton 2007; Gerner and Wilson 2005). In addition, studies have shown that positive parenting and communication moderate the risk that girls who begin puberty prematurely engage in externalizing behaviours (delinquency and aggression) (Mrug et al. 2008) and improve adolescent self-esteem and mental health (Austin 2012; Owens et al. 2003).

Strategies, tools and training programs should aim at reinforcing parenting skills and the social networks of these girls and women. Parents and peers must work alongside professionals of the health, education and psychosocial service sectors at improving the way girls and women see themselves. School nurses, educators, physicians and parents should receive assistance to identify young girls with premature menarche and direct them toward appropriate prevention programs. Women who begin puberty early should benefit from specialized support programs, which address depressed mood but also body image dysphoria, food preoccupations and intimacy issues with significant peers.

Meeting the sample size requirements (see Appendix), the statistical power of our study allowed us to go beyond the conflicting results reported on early puberty in adult women. Our findings confirm that adult women and not only

adolescent girls (Seedat et al. 2009) are affected by premature puberty (Graber 2013).

However, the cross-sectional design of this study and its unrepresentative sample of young women in Quebec prevent us from making causal inferences and generalizations. Another limitation is that other confounders could explain some associations found. Among these is the pre-pubertal body mass index (BMI). A high pre-pubertal BMI has been linked with early puberty in girls (Kaplowitz et al. 2001). Considering the thinness ideal that our society sets for women, pre-pubertal girls with obesity may be particularly at risk of body image dissatisfaction and psychological distress. Other possible confounders are family adversity, problematic parent-child relationships, problems at school, antisocial-aggressive behaviours and feelings of rejection (Brendgen et al. 2000). These are related to deviant relationships with peers in adolescence, which are associated with internalizing problems, including depression (Fergusson et al. 2003), and with early pubertal development (Ge et al. 2011).

Future longitudinal studies are needed to replicate the current study and to explore the link between body-related concerns and intimacy deficits and examine how these deficits fluctuate over time. The current study provides elements to support the *Maturation Disparity Hypothesis* and *Contextual Amplification* (Kaplowitz et al. 2001) which stresses intermediate factors as mediating or moderating the relationship between premature puberty and adjustment problems in girls.

Conclusion

The originality of this study lies in the specific nature of the population studied (adult versus adolescent) and in the complexity of its objectives, focused on examining mediating and moderating factors. Furthermore, it relied on a large sample, used more than one category of premature puberty timing and controlled for important demographic variables such as ethnicity. In terms of practical implications, intervention strategies addressing the increased risk of psychological distress in women who begin puberty very early should target their body image and ability to form intimate friendships.

Funding information The research presented in this paper was funded by the Social Sciences and Humanities Research Council of Canada (# 410-2006-2427).

Compliance with ethical standards The study was approved by the University of Quebec in Montreal’s Research Ethics Board.

Conflict of interest The authors declare that they have no conflict of interest.

Appendix

Sample size requirements

Confidence intervals for psychological distress for the “very early” and the “early” puberty groups

In our population, we expected the proportions of participants in the “very early” puberty group (menarche at 9 years old or less) and in the “early” puberty group (menarche at 10 years) to approximate 4% and 8%, respectively. In previous studies (Préville, Potvin, & Boyer, 1995), the standard deviation of psychological distress scores seems to vary between 20 and 25 units. For the “very early” puberty group, considering sample sizes varying from 126 to 196 women, a two-sided 95% confidence interval for psychological distress will extend the observed mean by 3.5 units on each side (assuming that the standard deviation will vary from 20 to 25 units, and using an asymptotic normal approximation). For the “early” puberty group, expecting twice as many women than in the “very early” group and using the same approach, a two-sided 95% confidence interval for psychological distress will extend the observed mean by 2.5 units on each side, with sample sizes varying from 252 to 392 women. These results mean that the number of women needed for the current study should be between 3150 and 4900 women, approximately, including 2772 to 4312 women in the “on-time” puberty group.

Power of testing for the effect of “very early” and “early” puberty on psychological distress

A multiple linear regression model that includes 10 covariates with a squared multiple correlation R^2 of 0.10 and a sample size of 3150 (4900) women will have 95% power to detect (at a 0.01 significance level) an increase in R^2 of 0.5% (0.3%), when including a dummy variable (0.1) representing early puberty.

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