ORIGINAL ARTICLE

Longitudinal Effects of Self-Report Pubertal Timing and Menarcheal Age on Adolescent Psychological and Behavioral Outcomes in Female Youths from Northern Taiwan

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Background: Early puberty is linked to adverse developmental outcomes in adolescents in Western societies. However, little is known about this relationship in an East Asian context. In addition, whether the impact of subjective pubertal timing (PT) and menarcheal age (MA) on adolescent psychosocial development persists into early adulthood remains unclear and is worthy of investigation.
Methods: A subset of data was retrieved from the Taiwan Youth Project, which recruited and followed a longitudinal cohort of 7th- and 9th-grade female Taiwanese students from 2000 to 2007. Subjective PT was defined using the Pubertal Developmental Scale (PDS), which mainly measures pubertal changes. MA was recalled by participants themselves. Various psychological and behavioral factors were recorded and measured until the age of 20, including the use of alcohol and cigarettes, psychological well-being, sexual activity, and socially problematic behaviors. A χ^2 test for linear-by-linear association and one-way analysis of variance followed by multivariate regression models were used to dissect the differential effects of PT and MA in the association with the outcome variables.
Results: In total, 1545 female participants with an average age of 14.5 ($\pm$1.1) years were deemed valid for analysis. Among them, 257 (16.6%) participants perceived themselves as

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having early PT, defined as more than 1 standard deviation above the mean PDS score, and 82 (5.3%) had early MA (occurring before the 4th grade). In univariate analysis, participants with early PT had higher rates of smoking and sexual activity, and MA was not related to their psychobehavioral outcomes. After multivariate adjustment, only late PT was significantly correlated with lower amounts of cigarette smoking and sexual activity before the age of 20.

Conclusion: Conceptual and actual pubertal developments may be differentially associated with psychobehavioral outcomes among young Taiwanese girls. Clinical attention should be given to adolescent self-perception of sexual maturation and developmental guidance provided accordingly.

1. Introduction

Adolescence is an important transition period between childhood and adulthood, as it is usually accompanied by sexual maturation and physical growth as well as psychological and cognitive changes necessary for coping with tasks in later adult life.[1] The effects of pubertal transition during adolescence on subsequent health and well-being are profound and decisive. During the phase of physical maturation after the initiation of puberty, a cascade of endocrine actions propels adolescents to peak in growth, strength, and fitness.[2] Adolescents are generally perceived to be healthy but at risk for various and diverse psychological and behavioral health problems.[3]

An increase in mental health issues among young people has changed public health concerns regarding problems including depression, psychosomatic syndromes, substance abuse, antisocial behaviors, and risky sexual behaviors.[4,5] Research has particularly focused on the association between the onset and progression of sexual maturation and psychological and behavioral health consequences.[1,6] The biological mechanisms that underlie these associations, which are still being investigated, may involve a complex interaction between gonadal hormones and neurobehavioral changes.[7,8] Adolescents with early sexual maturation, that is, earlier onset of pubertal changes than their same-sex peers, are potentially at risk due to a greater tendency toward externalizing and internalizing problems.[9,10] For example, early-maturing girls tend to affiliate with behaviorally troublesome peers and older male friends, sometimes leading to delinquent behavior and increased sexual activity.[11,12] Most previous studies in this field have used either self-report ratings regarding physical changes or menarcheal age (MA) as a proxy for the onset of sexual maturation. Self-report ratings give the raters' *perception* of pubertal development rather than their *actual* pubertal stage.[13] Only actual maturation, denoted by such physical changes as the occurrence of menarche, indicates actual neuroendocrine actions. The way a girl perceives her own sexual maturation could be multifactorial, going beyond a mere awareness of physical changes. For example, early-maturing adolescents are expected to behave more like adults and take on more social responsibility. Because the two measures are conceptually different, during puberty they may lead to different psychological and behavioral outcomes.

Studies on this issue are relatively scarce and inconsistent in East Asian cultures, where relationship harmony and value synchronism are highly weighted. In an earlier study of a cohort of teenage students in Hong Kong, respondents reported sex differences in the association between sexual activity and the onset of puberty, defined as menarcheal occurrence or onset of nocturnal ejaculation.[14] Only early-maturing boys reported a higher rate of sexually related activity in comparison with those who matured later; this difference was not found in girls. In another cross-sectional study conducted in Taiwan, the researchers measured the onset of puberty using self-reported ratings and found no association between pubertal staging and a wide range of emotional and behavioral problems, substance abuses, and suicidal tendencies in surveyed adolescents.[15] In a similar finding, it was noted that early-maturing Korean girls did not manifest higher levels of depression or lower self-esteem.[16] By contrast, in our previous report we found that self-rated sexual maturity status was related to adolescent psychological well-being regarding self-esteem and interpersonal relationships.[17] The inconsistent results may be due to methodological differences in defining pubertal status. In addition, another question that needs to be addressed is whether the psychosocial effects of pubertal timing (PT) on adolescent development persist into adulthood. This requires further cross-cultural validation research in an East Asian context.

Using the longitudinal data from the Taiwan Youth Project (TYP), we explored the differential effects of self-reported PT and MA on young females' psychological and behavioral development. We hypothesized that subjective perception of pubertal status played an important part in youth development.

2. Methods

2.1. Study participants

Data on female participants were retrieved from the TYP, which recruited a longitudinal cohort of 7th- and 9th-grade students in 2000 and surveyed them until 2007. The TYP was launched by the Institute of Sociology, Academia Sinica,

Taiwan, and the data sets are publicly available (www.typ.sinica.edu.tw). The sampling methods of TYP, described previously, are, in brief, multistage-stratified and class-clustered methods used on randomly selected schools and classes.[18] In total, 81 classes in each grade distributed across 40 schools were chosen [Taipei City: 16 schools; New Taipei City (previously known as Taipei County): 15 schools; and Yilan County: 9 schools]. This study used the first three waves from 2000 to 2002 to validate participants' pubertal status and Waves 6 (in 2004) and 8 (in 2007) to measure their developmental outcomes at age 20 for the 7th- and 9th-grade cohorts, respectively. We included a total of 1545 participants who completed relevant questions in the final wave of the survey. The study was approved by the Institutional Review Board of the National Cheng Kung University Hospital.

2.2. Measures

The Pubertal Developmental Scale (PDS) was used to measure the subjective evaluation of pubertal changes, including growth spurts, body hair development, skin changes, breast growth, and menarche. Except for menarche, which was a dichotomous item ("yes" or "no"), all other items were rated using a 4-point Likert scale. The detailed questions are given in Table S1 in the supplementary material online. The Chinese version of PDS has been validated and corresponds to the Tanner staging of puberty.[19] We summarized the PDS scores and standardized them within same-sex and same-age cohorts (in years). As compared with previous research, the participants were classified into three PT groups: early puberty [more than 1 standard deviation (SD) above], on-time puberty (within 1 SD either way), and late puberty (more than 1 SD below).[17,20,21]

MA was reported as the grade during which the participants experienced menarche. The average MA was 12.11 ($\pm$1.04) years among Taiwanese school girls.[22] Accordingly, early MA was defined by the presence of menarche during 4th grade (usually age 10) or earlier; late menarche was defined as the occurrence of menarche during 8th grade (usually age 14) or later; and on-time menarche began between 5th and 7th grades.

Alcohol drinking and cigarette smoking were assessed by asking participants to indicate whether they had drunk alcohol within 1 month and whether they had smoked cigarettes within 1 week. The answers were categorized into three groups: "none," "less than one time/week," and "more than one time/week" for alcohol drinking; and "none," "less than one pack per week," and "more than one pack per week" for cigarette smoking. In the multivariate regression analysis, their answers were further recoded into a binary variable with "no" or "yes."

Sexual activity was assessed using the self-report question: "Have you ever had a sexual intercourse?" Responses were dichotomized into "yes" and "no." Those having sexual behaviors were further asked to report the age at their first sexual intercourse.

Socially problematic behaviors that participants were asked to report on for the previous year included "breaking items," "stealing," "cheating," "playing mahjong," "dangerous driving," "reading pornographic books or watching pornographic films," "using illicit drugs," and "chewing betel nut." Responses were dichotomized into "yes" and "no" and then summed up to create a single scale that indicated the degree of behavior problems. A higher score represents a greater quantity of problematic activity.

Psychological well-being was measured according to a total of 16 major physical and psychological symptoms using a measurement system, which was developed based on the Center for Epidemiologic Studies Depression scale.[23] This scale has been validated in multiple languages and extensively applied in clinical and epidemiological research regarding depression and psychological well-being evaluation worldwide.[17,24,25] The symptoms that typically represent adolescent mental health-related investigations include "headaches," "dizziness," "loneliness," "depression," "worriedness," "feeling like hurting others," "feeling like arguing with others," "feeling like screaming," "insomnia," "waking up early," "light sleeping," "muscle pain," "feeling numb," "feeling like something is stuck in your throat," "feeling weak," and "having suicidal feelings."[17,26] A 5-point Likert's scale from 0 to 4 was used to score these items and all the item scores were summed up at the end. The higher the score, the more psychologically troubled the respondent may be considered.

Socioeconomic covariates in this study included location of home and family income. The three areas where the students lived were Taipei City, New Taipei City, and Yilan County. The urbanization level was highest in Taipei City and lowest in Yilan County. Monthly family income was subdivided into three groups: "New Taiwan dollar (NTD) 30,000 or less," "NTD 30,001–60000," and "NTD 60,001 or more."

2.3. Statistical analysis

The demographic characteristics were summarized using descriptive statistics. The effects of pubertal status, examined separately on the basis of PT and MA, were assessed using analysis of variance and χ^2 test, as appropriate. For example, a χ^2 test for linear-by-linear association was used to examine the prevalence of smoking, drinking, and sexual activity; analysis of variance was used to compare the number of socially problematic behaviors and depression levels across different groups. Furthermore, we used multivariate logistic regression models to elaborate the differential impacts of PT and MA on the psychological and behavioral development outcomes. A Spearman correlation test was used to examine collinearity between PT and MA. Model 1 mutually tested the effects of PT and MA. Model 2 added socioeconomic covariates for adjustment. Model 3 used multigroup analysis to examine the interaction effects of PT and MA. We then regrouped our participants into nine groups according to their PT and MA status and the group with both on-time PT and MA was used as the reference for this interaction term. Odds ratios (ORs) with 95% confidence intervals (95% CI) were calculated for these models. We conducted all statistical analyses using SPSS version 17.0 (SPSS, Chicago, IL, USA).

3. Results

In total, 1545 adolescent girls with an average age of 14.5 ($\pm$1.1) years were analyzed (Table 1). The mean PDS score

Table 1 Demographic information of participants (N = 1545).

	N (%)
Age at recruitment (y)	
13	442 (28.6)
14	201 (13.0)
15	583 (37.7)
16	319 (20.6)
Location	
Taipei City	567 (36.7)
New Taipei City	617 (39.9)
Yilan County	361 (23.4)
Family monthly income (NTD)*	
<30,000	214 (14.7)
30,000–60,000	674 (46.3)
>60,000	568 (39.0)
Menarcheal age	
3rd grade or earlier	26 (1.7)
4th grade	56 (3.6)
5th grade	276 (17.9)
6th grade	596 (38.6)
7th grade	429 (27.8)
8th grade	122 (7.9)
9th grade or later	50 (2.6)
PDS score, mean (±SD)	2.15 (±0.38)

NTD = New Taiwan dollar; PDS = Pubertal Developmental Scale; SD = standard deviation.
  * Missing values were excluded from the denominator.

was 2.15 (±0.38). Accordingly, 257 (16.6%) of the analyzed participants were assigned to the early PT group, and 229 (14.8%) to the late PT group based on their standardized PDS scores. A great majority (84.3%) reported menarche occurring between 5th and 7th grades, with 5.3% experiencing menarche in the 4th grade or earlier and the other 10.4% in the 8th grade or later. The correlation between PDS scores and MA was significant yet low (Spearman ρ = 0.195, p < 0.001).

3.1. Smoking, drinking, and sexual activity

In univariate analysis, subjectively perceived PT proved to be significantly associated with the prevalence of cigarette smoking and sexual activity at age 20 (Table 2). The highest smoking rate (8.5%) was in the early PT group as compared with those in the on-time (6.9%) and late (3.5%) PT groups. Early PT female participants also reported a higher occurrence (21.4%) of sexual activity than their on-time (18.4%) and late (10.5%) PT peers. A total of 265 of 274 participants (96.7%) who had sexual behaviors reported the age at their first intercourse. In terms of early sexual behavior defined by the onset before the age of 18, early PT females still had a higher occurrence (9.3%) than their on-time (7.3%) and late (3.1%) PT peers (F = 7.164, p = 0.007). However, no significant difference was noted in the association between MA and cigarette smoking, alcohol drinking, and sexual activity. In the multivariate regression analysis, only late PT was independently and negatively associated with sexual activity, whereas the significance of the association

between PT and cigarette smoking was attenuated after adjusting for socioeconomic covariates (Table 3). In Model 3, where the participants were regrouped according to their PT and MA, those with late PT and on-time MA were less likely to engage in sex (adjusted OR = 0.49, 95% CI = 0.29–0.83). No association was found between the living area and behavioral outcomes (p = 0.113, 0.325, 0.756 for drinking, smoking, and sexual behavior, respectively). As compared to those with family monthly income of less than NTD 30,000, those with higher family incomes were negatively associated with sexual behaviors (adjusted OR = 0.60, 95% CI = 0.41–0.89 for those with family monthly income between NTD 30,000–60,000; and adjusted OR = 0.62, 95% CI = 0.43–0.90 for those with family monthly income of NTD 60,000 or more).

3.2. Socially problematic behavior and psychological well-being

No significant association was found between either PT or MA and socially problematic behavior and psychological well-being in these youths (Table 4). However, having sexual behaviors before the age of 20 is associated with an increased use of tobacco and alcohol, more problematic behaviors, and poorer psychological well-being (Table S2 in the supplementary material online).

4. Discussion

Given the substantial evidence showing a link between early sexual maturation and adverse developmental outcomes in adolescents in Western societies,[9–12] few studies have considered the distinctive concepts and effects of *perceptual* and *actual* pubertal development. We clearly demonstrated differential effects of self-reported PT and MA on the psychological and behavioral tendencies of a group of female adolescents. Furthermore, our research extended the current literature of the association between puberty and development to an Asian context, a field that has been less explored in this aspect. Of particular importance, subjective PT, rather than MA, stood out as the most salient factor associated with the initiation of sexual activity in Taiwanese youths.

The PDS has been validated and widely applied in research on adolescent health and development, regardless of ethnicity and social context.[11,17,19,20] The standardized scale is highly correlated with medical provider reports of Tanner stages, a well-established staging system of pubertal progression.[19,27] However, our analysis clearly showed a suboptimal correlation between the scale and MA, another well-defined indicator of sexual maturation. This raises two concerns regarding the use of a self-report scale in the evaluation of adolescent pubertal status. First, the progression of puberty is complex and also involves a delicate network of neurohormonal interactions.[7,8] The tempo of sexual maturation varies among individuals; thus, an early onset of pubertal development may not precisely predict an early menarche.[28] Assessing the physical changes at a single time point may fail to represent the entire process of pubertal progression accurately, along with which an adolescent may encounter different and diverse psychosocial

Table 2 Univariate association between pubertal timing/menarcheal age and cigarette smoking, alcohol drinking, and sex behavior before age 20.

	PT group				MA group			
	Early	On-time	Late	p	Early	On-time	Late	p
	N (%)	N (%)	N (%)		N (%)	N (%)	N (%)	
Smoking				0.039				0.714
No	235 (91.5)	986 (93.1)	221 (96.5)		79 (96.4)	1210 (93.0)	153 (94.5)	
<1 pack/wk	6 (2.3)	16 (1.5)	2 (0.9)		2 (2.4)	20 (1.5)	2 (1.2)	
>1 pack/wk	16 (6.2)	57 (5.4)	6 (2.6)		1 (1.2)	71 (5.5)	7 (4.3)	
Drinking				0.234				0.873
No	194 (75.5)	811 (76.6)	184 (80.3)		66 (80.5)	998 (76.7)	125 (77.2)	
<1 time/wk	15 (19.8)	214 (20.2)	36 (15.7)		12 (14.6)	255 (19.6)	34 (21.0)	
>1 time/wk	21 (4.7)	34 (3.2)	9 (3.9)		4 (4.9)	48 (3.7)	3 (1.9)	
Sex behavior				0.002				0.166
No	202 (78.6)	864 (81.6)	205 (89.5)		68 (82.9)	1061 (81.6)	142 (87.7)	
Yes	55 (21.4)	195 (18.4)	24 (10.5)		14 (17.1)	240 (18.4)	20 (12.3)	

MA = menarcheal age; PT = pubertal timing.

challenges.[29] Pubertal tempo was not consistently estimated in most previous studies. To overcome this weakness, a particular concern was given to variations in measurements and timings, requiring a longitudinal data set of pubertal records as well as advances in statistical modeling to describe developmental trajectory and psychosocial impacts of PT and tempo.[28] Second, the self-report ratings are the adolescents' subjective evaluations of their physical changes. The interpretations may therefore be biased by personal perceptions that are formulated

Table 3 Multivariate binary regression analysis of association between pubertal timing/menarcheal age and cigarette smoking, alcohol drinking, and sex behavior before age 20.

	Smoking	Drinking	Sex behavior
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Model 1			
PT group			
Early	1.30 (0.79–2.15)	1.08 (0.78–1.48)	1.20 (0.86–1.29)
Late	0.50 (0.24–1.05)	0.80 (0.56–1.14)	0.53* (0.34–0.84)
MA group			
Early	0.48 (0.15–1.56)	0.79 (0.50–1.39)	0.88 (0.49–1.60)
Late	0.85 (0.42–1.72)	1.00 (0.68–1.48)	0.67 (0.41–1.09)
Model 2			
PT group			
Early	1.36 (0.81–2.28)	1.08 (0.78–0.50)	1.27 (0.90–1.80)
Late	0.50 (0.29–1.14)	0.83 (0.57–1.20)	0.53* (0.33–0.85)
MA group			
Early	0.36 (0.09–1.52)	0.76 (0.42–1.40)	0.78 (0.40–1.51)
Late	0.86 (0.42–1.75)	1.01 (0.68–1.50)	0.69 (0.42–1.13)
Model 3			
Combination group			
Early PT × early MA	0.58 (0.08–4.41)	1.06 (0.41–2.72)	1.18 (0.43–3.326)
Early PT × on-time MA	1.37 (0.80–2.36)	1.00 (0.76–1.43)	1.18 (0.81–1.72)
Early PT × late MA	0.84 (0.11–6.52)	1.63 (0.60–4.43)	1.32 (0.43–4.08)
On-time PT × early MA	0	0.37 (0.13–1.06)	0.49 (0.17–1.40)
On-time PT × on-time MA	Reference	Reference	Reference
On-time PT × late MA	0.96 (0.43–2.17)	1.10 (0.68–1.76)	0.62 (0.34–1.14)
Late PT × early MA	1.52 (0.19–12.3)	2.15 (0.60–7.76)	1.08 (0.23–5.17)
Late PT × on-time MA	0.50 (0.21–1.17)	0.85 (0.56–1.27)	0.49* (0.29–0.83)
Late PT × late MA	0.33 (0.05–2.46)	0.46 (0.18–1.18)	0.34 (0.10–1.11)

Models 2 and 3 added socioeconomic covariates for adjustment.
CI = confidence interval; MA = menarcheal age; OR = odds ratio; PT = pubertal timing.
* $p < 0.01$.

Table 4 Mean scores of socially problematic behaviors and depression across different pubertal timing/menarcheal age groups.

Mean (±SD)	PT group				MA group			
	Early	On-time	Late	p	Early	On-time	Late	p
Problematic behaviors	0.69 (±1.21)	0.73 (±1.23)	0.73 (±1.23)	0.896	0.69 (±1.03)	0.71 (±1.23)	0.84 (1.37)	0.514
Depression	10.31 (±8.93)	10.21 (±9.25)	9.11 (±8.07)	0.268	10.74 (±8.93)	9.95 (±9.17)	10.84 (±7.82)	0.453

MA = menarcheal age; PT = pubertal timing; SD = standard deviation.

through the experiences of peer comparisons.[30] The *perceptual* and *actual* pubertal development should be regarded as different constructs, as different theoretical mechanisms may underlie the links to developmental outcomes.[13] The findings in our study support the notion that perceived PT *per se* is related to the participants' health-compromising behaviors, irrespective of the timing of menarche.[31] Further research should continue to investigate how teenagers' own perception of pubertal development interacts with their actual maturation to better understand the complex relationship between puberty and psychosocial outcomes.

Recent research exploring the effect of PT on adolescent development has focused on longer-term outcomes. As the *developmental readiness hypothesis* has proposed, early maturation potentially confers risks for psychological and behavioral problems because early-maturing adolescents may not have adequate coping strategies for life challenges brought about by puberty.[10,12] An unresolved issue is whether these adverse effects should be regarded as temporary maladjustment within a developmental norm or if their effects persist beyond adolescence.[1,32] Our analysis provides evidence of a discriminative effect in terms of psychological and behavioral outcomes in young adulthood. We found that PT was related to sexual activity, but that it was not associated with substance use, psychological well-being, or problematic behaviors. Several longitudinal studies examining this issue also support our findings that negative effects of early puberty on adolescent psychosocial problems may dissipate by late adolescence or young adulthood, except for some problems among certain subgroups.[33–36] The attenuation of effects may be attributable to recuperation from psychosocial distress encountered by the early-maturing adolescents and/or problems they may have catching up in internalizing and externalizing problems inherent to adolescence experienced by their on-time and late-maturing peers throughout the entire socialization process.[33] This partly explains our finding that only a marginal difference was noted in sexual behaviors when these problems were addressed at age 20. Another important factor that may moderate the impact of early sexual maturation on adolescent development that was previously found in substantial research conducted in Western societies is likely the Asian social context, where family cohesion and school participation are highly emphasized. As collectivism is a prevalent social value in Taiwan, adolescents are taught to be obedient to authority and their elders to promote relational harmony and refrain from trouble making.[37] Stringent parental monitoring and long hours spent in schoolwork and educational activities were also shown to restrict adolescents from unfavorable social exposure, thus attenuating the possible adverse effects conferred by early PT.[3,18,36,38,39] Under such a condition, the survey conducted on Taiwanese adolescent students was unable to demonstrate the remarkable contrast in psychobehavioral outcomes among early-maturing females that was found in previous research, except for late-maturing peers who significantly delayed initiating sexual behavior. However, having sex before the age of 20 was highly correlated with adverse habitual and problematic behaviors in young adulthood. Clinicians who work with adolescents should therefore be aware of adolescent sexual maturation and associated behaviors and accordingly provide guidance or intervene in a timely fashion, as previous studies showed that these behaviors may self-propagate if left unaddressed.[40,41]

Given the complexity of the link between adolescent development and behaviors, many social or individual factors, such as peer influence and educational achievement, may mediate and/or moderate adolescent substance use and sexual behaviors as well as the effect of PT.[6,9,11,13,38,40,41] We only included family income and living area as the proxy measures of socioeconomic status and found a significant role of family income in adolescent sexual behavior. Other possible confounding factors beyond this study may explain the variance in adolescent behavioral outcomes before and after multivariate adjustments. This observation also highlights a research need to expand current knowledge of the mechanism linking PT and adolescent psychobehavioral development to develop effective intervention targeting those with possible risks.

This study has some limitations. First, the survey on psychological and behavioral items was self-reported. Fear of repercussions may have prevented participants who engaged in these behaviors from reporting them faithfully. In particular, female smoking and drinking are socially frowned upon, and hence may be underreported in the survey, although this reporting bias may be partially compensated for by the questionnaires being anonymous. Second, age was not indicated, and only grades at menarche were represented in this study. Participants of the same grade were assumed to be generally the same age (±12 months). This assumption may bias the determination of MA, if there are students who had to retake a grade or had an early admission. However, the bias may be negligible, as the number of students who miss enrollment in elementary school when they are at the proper age is generally small. Recall bias might also exist when participants were retrospectively asked to report their MA, although most of them were within the first few years after

menarche. This study may also be limited by the lack of information on externalizing behaviors from other sources. There was also no formal psychological interview provided by trained professionals with valid tools. Lastly, other potentially relevant contextual or personal factors such as social or geographical background and intellectual function, which may explain the timing effects that are linked to adolescent developmental outcomes, were not examined in our study. For example, whether these results, based on the recruitment exclusively taking place in northern Taiwan, can be generalizable to the entire Taiwan adolescent population may require further study.

In conclusion, perceived late PT may be a protective factor for the development of early sexual behavior in young adulthood, while the effect of PT on smoking is attenuated after adjustment for socioeconomic variables such as family income. This finding suggests a more complex interaction underlying the association relationship, which may involve socioeconomic status and geographical background. From a clinical perspective, health-care professionals should be aware of and thoroughly investigate the impact of PT and progression on adolescent psychosocial development. By doing so, they will be able to provide appropriate developmental guidance to foster a healthier life trajectory for adolescents, particularly those at risk. Because this area of research is still limited in an East Asian context, further studies are needed to explore the risk and protective factors that could mediate or moderate the adverse developmental outcomes before implementation of intervention programs that are more suitable for local social contexts.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

Acknowledgments

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.pedneo.2016.04.004.