

Published in final edited form as:

*Ann Epidemiol.* 2011 June ; 21(6): 461–465. doi:10.1016/j.annepidem.2011.01.009.

## Childhood Hair Product Use and Earlier Age at Menarche in a Racially Diverse Study Population: A Pilot Study

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### Abstract

**Purpose**—Previous studies suggest that hair products containing endocrine disrupting chemicals could alter puberty. We evaluated the association between childhood hair product use and age at menarche in a racially diverse study population.

**Methods**—We recruited 300 African-American, African-Caribbean, Hispanic, and white women from the New York City metropolitan area who were between 18 and 77 years of age. Data were collected retrospectively on hair oil, lotion, leave-in conditioner, perm, and other types of hair products used prior to age 13. Recalled age at menarche ranged from 8 to 19 years. We used multivariable binomial regression to evaluate the association between hair product use and age at menarche (< 12 versus ≥12), adjusting for potential confounders.

**Results**—African-Americans were more likely to use hair products and reached menarche earlier than other racial/ethnic groups. Women reporting childhood hair oil use had a risk ratio of 1.4 (95% CI: 1.1-1.9) for earlier menarche, adjusting for race/ethnicity and year of birth. Hair perm users had an increased risk for earlier menarche (adjusted risk ratio: 1.4, 95% CI: 1.1-1.8). Other types of hair products assessed in this study were not associated with earlier menarche.

**Conclusions**—Childhood hair oil and perm use were associated with earlier menarche. If replicated, these results suggest that hair product use may be important to measure in evaluating earlier age at menarche.

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## Keywords

menarche; African-American; Hispanic; urban population; cosmetics; endocrine disruptors

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## Introduction

Hair products, some of which contain placenta, estrogen and endocrine disrupting chemicals (EDCs), such as mono-ethyl phthalate or methylparaben, are more commonly used by women and minorities [1-2]. These products are often applied to hair and scalp and left on for a long duration of time [1-5]. While there is no evidence that exposure to chemicals in hair products impacts disease risk, a case series suggested that use of these hormonally-active products accelerated pubertal development in children as young as 14 months old [4]. If these products can alter the onset of puberty, by being absorbed through the skin, they may also be able to accelerate the onset of menarche possibly through increased estrogenic activity of exogenous estrogens or certain EDCs. This acceleration could lead to an earlier age at menarche, a risk factor for breast cancer [6-7]. Furthermore, frequency and length of time of the exposure to these products should be considered, as this may also impact age at menarche. Given these findings, we examined the association between childhood hair product use and age at menarche. We hypothesized that the use of hair products would be associated with earlier age at menarche, especially among women who used the products for an extended period of time during childhood.

## Methods

### Design

The Greater New York Hair Products Study was a cross-sectional pilot study designed to evaluate the patterns of current hair product use among four racial/ethnic groups of women. As part of the study interview, we asked women to recall their childhood use of hair products.

### Study Subjects

A convenience sample of women was recruited from nail and hair salons, churches, workplaces, restaurants/cafes, and laundromats in 2004-2005. Locations were selected from the New York City telephone book and personal contacts. Women were eligible if they self-identified as African-American (United States-born descendants of United States slaves), African-Caribbean (black and born in the Caribbean or descendants of people born in the Caribbean), Hispanic, or White. Participants had to speak English and be older than age 18. A total of 326 women participated in this study. Twenty-six women were excluded due to missing data. The total sample size that we analyzed was 300.

### Data Collection

During the in-person interviews lasting 15-20 minutes, each participant was provided a hair products label book, which served as a memory aid based on previously conducted focus groups. The questionnaire, label book, and study protocol were approved by Columbia University's Institutional Review Board.

**Childhood Hair Products**—Study participants were asked about their use of several types of hair products prior to age 13, specifically: “Did you use hair oils, hair lotions, leave-in conditioners, root stimulators, perms/relaxers, prescriptions, and any other types of hair products. (See Figure 1 for definitions). Responses were recorded as *ever* or *never use*. If participants reported *ever use* of a certain product type, they were asked about the brand name and duration of use of each product. We did not include root stimulators in the analysis, given that these products were not on the market during our study participants’ childhood. Too few study participants used prescription products and were not included in this analysis. Data on the specific EDC content of the recalled hair products was not available.

**Age at menarche**—Participants responded to the question: “How old were you when you started your period?” Age at menarche was recorded in 0.5 year intervals. Age at menarche was divided at the median for this study population: <12 years versus  $\geq$ 12 years. In a secondary analysis, we also evaluated age at menarche as <11 years and  $\geq$ 12 years. Most literature suggests that the reliability of recall for age at menarche is moderate to high [8-13].

## Statistical Methods

We constructed multivariable binomial regression models to calculate the risk ratio (RR) and 95% confidence intervals [14]. We evaluated the association between *ever use* of specific types of hair products during childhood and age at menarche. Each model contained only one type of hair product. To determine the independent association between hair product use and age at menarche, we evaluated decade of birth, race/ethnicity, recruitment site and location, and place of birth as potential confounders. Anthropometric and other childhood factors were not collected in this study. We included those variables that made a 10% change in the beta value for our hair product of interest. Our final model included race/ethnicity and decade of birth.

We evaluated extended use of hair products and age at menarche, where extended use was defined as initiating use at least two years prior to the onset of menarche. We constructed multivariable models stratified by mean and extended duration of use for each product type. As an additional analysis, we also used a stricter cut point for age at menarche (<11 years). All analyses were run using SAS v. 9.1 (Cary, NC).

## Results

Table 1 describes the characteristics of the study population. Study participants ranged in age between 18 and 77 years. Age at menarche ranged from 8 to 19 years.

Compared to women with information on race/ethnicity and childhood hair product use, women with missing data were more likely to be younger, recruited at a workplace, and born outside the U.S. Childhood hair product use significantly varied by race/ethnicity for each type of hair product ( $p<0.05$ ). African-American and African-Caribbean women reported more hair product use during childhood compared to Hispanic and white women. For example, the majority of African-American and African-Caribbean women reported

childhood hair oil use, 94% and 74%, respectively. Fewer Hispanic and white women reported use of hair oils during childhood (33% and 9%, respectively). Use of leave-in conditioners, lotions, perms, and other types of hair products was less prevalent.

While Hispanic women used hair perms for the longest duration, African-American and African-Caribbean women used all other hair products for the greatest period of time prior to age 13 years. However, only duration of hair oil use significantly varied by race/ethnicity ( $p=0.03$ ).

In Table 2, we present the main association between childhood hair product use and age at menarche. Only hair oil and perm use were significantly associated with age at menarche. Women who reported childhood hair oil use were 1.4 (95% CI: 1.1-1.7) times more likely to have an earlier age at menarche (<12 years) compared to girls who did not report using hair oils. This association remained similar (RR: 1.4 (95% CI: 1.1-1.9)), after adjusting for race/ethnicity and decade of birth. The unadjusted and adjusted associations for hair perm use and age at menarche were similar (adjusted RR 1.4 (95% CI: 1.1-1.8)). Use of hair lotion, leave-in conditioner, and other products were not associated with earlier age at menarche.

When restricting to women reporting initiating use of hair oils at least 2 years before menarche ( $n=84$ ), the risk increased to 1.8 (95% CI: 1.2-3.0) for earlier age at menarche after full adjustment, when comparing hair oil users versus non-users. When restricting to women who did not report extended use of hair oils prior to menarche ( $n=54$ ) compared to *never using* hair oils, hair oil use was not associated with age at menarche (data not shown).

Using the cut point of reaching menarche by <11 years of age in this restricted analysis, the association between hair oil use that was initiated at least 2 years before menarche and age at menarche became stronger with an adjusted RR: 5.3 (95% CI: 1.5-19.1). Few women reported use of hair perms (1%) for at least two years before menarche.

## Conclusions

In this study, childhood use of hair oils was associated with earlier recalled age at menarche, independent of year of birth and race/ethnicity. Given the cross-sectional design of this study these findings could be due to reverse causation. However, when restricting to women who recalled initiating hair oil use for a prolonged period of at least 2 years prior to the onset of menarche, we found the association between hair oil use and early menarche to be stronger. *Ever use* of hair perms was also associated with an increased risk of earlier menarche. On the other hand, hair lotions, leave-in conditioners, and other types of products, were not associated with an early menarche.

The variation in these associations may reflect greater EDC or estrogen content in hair oils and perms compared to other types of products. For example, hair oils may contain more methylparaben or mono-ethyl phthalate, than other types of hair products. If these chemicals are more likely to alter menarche, then we may expect to see a stronger association between hair oil use and earlier age at menarche. Alternatively, use of hair oils and perms could be a surrogate for using other types of products containing EDCs, such as body lotions or nail

polish. It is also possible that use of these products is a surrogate for other unmeasured environmental factors.

Given the racial/ethnic differences in hair product use, African-American and - Caribbean girls may be more likely to be exposed to estrogens or EDCs, such as phthalates and parabens contained in hair products [3]. Based on data from the National Health and Nutrition Examination Survey, African-American girls between 6-11 years of age have double the mono-ethyl phthalate levels compared to children of other racial/ethnic groups [15]. Interestingly, African-American girls are also more likely to reach menarche earlier than other racial/ethnic groups [16-18]. Exposure to EDCs from hair products may explain some of these variations in age at menarche.

Additionally, in adult studies phthalates have been shown to be associated with increased risk of obesity [19-21]. While this association is yet to be evaluated in children, larger body size is associated with earlier age at menarche [22]. Thus, increased body size or fatness may mediate the association between hair product use and age at menarche. While the present study does not have data on pre-pubertal body size, future studies may be able to examine the role of this potential mediator of the association between hair product use and earlier age at menarche.

Our study has several limitations that warrant consideration. First, we used a retrospective assessment of age at menarche. We did not have other measures of pubertal development. However, we restricted our analysis to girls who had initiated hair product use at least two years prior to the onset of menarche and found stronger associations between product use and age at menarche. We also did not have data on childhood body size, childhood socioeconomic status, and other important variables that may be related to age at menarche. We also used convenience sampling techniques, which could bias our study results. In addition, the current study did not have historic samples of hair products to test for estrogen or EDCs, such as phthalates or parabens. However, chemicals such as parabens have been added to cosmetic products for over 70 years [23]. Given our broad age range, the chemical composition of hair products may have changed over time. As such a prospective study would provide more definitive confirmation of our findings. Nevertheless, these results suggest that the use of certain types of hair products could impact age at menarche.

Despite these limitations, this novel study contains the following strengths: 1) use of an extensive hair products study questionnaire and label book, which were informed by racially/ethnically diverse focus groups, 2) an assessment of the association between duration of hair product use and age at menarche, and 3) an evaluation of the research question in a racially/ethnically diverse study population, including both African-American and African Caribbean women who differed in prevalence of hair product use and age at menarche.

Future studies should evaluate this research question prospectively and test the chemical composition of hair products to ensure that the results are not due to information or selection bias. Further information is needed on the estrogenic activity of hair products, as well as alterations in circulating estrogen levels in pre-pubertal children who use these products.

These findings warrant further investigation to determine whether hair product use could be a modifiable risk factor for earlier age at menarche.

## Acknowledgments

We would like to thank the following individuals for their contributions to the Greater New York Hair Products Study: Taroya Sargent-Kirk, Teresa Janevic, Kellee White, Gonzalo Maldonado, Ghasi Phillips, Sharon Schwartz, Charles Metcalf, and all of the study participants. This work was supported by The Jean Sindab African-American Breast Cancer Project pilot grant.

## List of abbreviations

<b>EDC</b>	Endocrine Disrupting Chemicals
<b>RR</b>	Risk Ratio
<b>CI</b>	Confidence Interval
<b>Ref.</b>	Reference

## References

- Li ST, et al. Hormone-containing hair product use in prepubertal children. *Arch Pediatr Adolesc Med.* 2002; 156(1):85–6. [PubMed: 11772198]
- Tiwary CM. A survey of use of hormone/placenta-containing hair preparations by parents and/or children attending pediatric clinics. *Mil Med.* 1997; 162(4):252–6. [PubMed: 9110549]
- Donovan M, et al. Personal care products that contain estrogens or xenoestrogens may increase breast cancer risk. *Med Hypotheses.* 2007; 68(4):756–66. [PubMed: 17127015]
- Tiwary CM. Premature sexual development in children following the use of estrogen- or placenta-containing hair products. *Clin Pediatr (Phila).* 1998; 37(12):733–9. [PubMed: 9864648]
- Tiwary CM, Ward JA. Use of hair products containing hormone or placenta by US military personnel. *J Pediatr Endocrinol Metab.* 2003; 16(7):1025–32. [PubMed: 14513880]
- Apter D, Vihko R. Early menarche, a risk factor for breast cancer, indicates early onset of ovulatory cycles. *J Clin Endocrinol Metab.* 1983; 57(1):82–6. [PubMed: 6222061]
- Zacharias L, Wurtman RJ. Age at menarche. Genetic and environmental influences. *N Engl J Med.* 1969; 280(16):868–75. [PubMed: 4887077]
- Ko KP, et al. [Reliability of a questionnaire for women's reproductive history]. *J Prev Med Public Health.* 2008; 41(3):181–5. [PubMed: 18515995]
- Must A, et al. Recall of early menstrual history and menarcheal body size: after 30 years, how well do women remember? *Am J Epidemiol.* 2002; 155(7):672–9. [PubMed: 11914195]
- Cooper R, et al. Validity of age at menarche self-reported in adulthood. *J Epidemiol Community Health.* 2006; 60(11):993–7. [PubMed: 17053289]
- Damon A, Bajema CJ. Age at menarche: Accuracy of recall after thirty-nine years. *Hum Biol.* 1974; 46(3):381–4. [PubMed: 4426599]
- Damon A, et al. Age at menarche of mothers and daughters, with a note on accuracy of recall. *Hum Biol.* 1969; 41(2):160–75. [PubMed: 5808780]
- Livson N, Mc ND. The accuracy of recalled age of menarche. *Hum Biol.* 1962; 34:218–21. [PubMed: 13931081]
- Spiegelman D, Hertzmark E. Easy SAS calculations for risk or prevalence ratios and differences. *Am J Epidemiol.* 2005; 162(3):199–200. [PubMed: 15987728]
- Silva MJ, et al. Urinary levels of seven phthalate metabolites in the U.S. population from the National Health and Nutrition Examination Survey (NHANES) 1999–2000. *Environ Health Perspect.* 2004; 112(3):331–8. [PubMed: 14998749]

16. Chumlea WC, et al. Age at menarche and racial comparisons in US girls. *Pediatrics*. 2003; 111(1): 110–3. [PubMed: 12509562]
17. Herman-Giddens ME, et al. Secondary sexual characteristics and menses in young girls seen in office practice: a study from the Pediatric Research in Office Settings network. *Pediatrics*. 1997; 99(4):505–12. [PubMed: 9093289]
18. Sun SS, et al. National estimates of the timing of sexual maturation and racial differences among US children. *Pediatrics*. 2002; 110(5):911–9. [PubMed: 12415029]
19. Grun F, Blumberg B. Endocrine disrupters as obesogens. *Mol Cell Endocrinol*. 2009; 304(1-2):19–29. [PubMed: 19433244]
20. Ben-Jonathan N, Hugo ER, Brandebourg TD. Effects of bisphenol A on adipokine release from human adipose tissue: Implications for the metabolic syndrome. *Mol Cell Endocrinol*. 2009; 304(1-2):49–54. [PubMed: 19433247]
21. Newbold RR, Padilla-Banks E, Jefferson WN. Environmental estrogens and obesity. *Mol Cell Endocrinol*. 2009; 304(1-2):84–9. [PubMed: 19433252]
22. Freedman DS, et al. The relation of menarcheal age to obesity in childhood and adulthood: the Bogalusa heart study. *BMC Pediatr*. 2003; 3:3. [PubMed: 12723990]
23. Witorsch RJ, Thomas JA. Personal care products and endocrine disruption: A critical review of the literature. *Crit Rev Toxicol*. 2010; 40(Suppl 3):1–30. [PubMed: 20932229]



**Hair oil:** A solid or gel-like, petroleum-based product with an oily consistency used for the hair or scalp. The substance can be used at room temperature or heated.

**Hair lotion:** A liquid product with an oily consistency used for the hair or scalp. These products can also have a creamy-like consistency.

**Hair leave-in conditioner:** A water-based moisturizer made for long-term application to the hair or scalp. These products are not rinsed out immediately and are placed on the hair or scalp usually until the next time a person shampoos their hair.

**Hair perm:** A chemical applied to the hair, allowed to sit, and then rinsed out to alter the natural curliness or straightness of the hair for an extended period of time.

**Other hair products:** Any type of vitamin, essential oil, vegetable oil, produce, or grocery item used on the hair or scalp, such as vitamin E oil, egg, or olive oil.

**Figure 1.**  
Hair products definitions



**Table 1**Study population characteristics and *ever usage* of hair products prior to age 13

	<i>Ever used hair products in childhood</i>	<i>Never used hair products in childhood</i>	<b>p-value</b>
<b>Total</b>	<b>209 (69.7)</b>	<b>91 (30.3)</b>	
<b>Median (SD)</b>			
<b>Age at interview (range: 18-77 years)</b>	34 (13.5)	2 (2.2)30 (12.5)	0.02
<b>Age at menarche (range 8-19 years)</b>	12 (1.8)	12 (1.4)	0.15
<b>n (%)</b>			
<b>Race/ethnicity</b>			<0.0001
African-American	94 (45.0)	2 (2.2)	
African-Caribbean	66 (31.6)	2 (2.2)	
Hispanic	28 (13.4)	27 (29.7)	
White	21 (10.0)	60 (65.9)	
<b>Recruitment Site</b>			<0.0001
Brooklyn	75 (35.9)	4 (4.7)	
Harlem	67 (32.0)	4 (4.7)	
Washington Heights	28 (13.4)	18 (20.9)	
Northern New Jersey	15 (7.2)	0 (0)	
Upper East or West Side	24 (11.5)	60 (69.7)	
<b>Location</b>			<0.0001
Nail salon	85 (40.7)	52 (57.1)	
Hair salon	45 (21.5)	1 (1.1)	
Church	11 (5.3)	0 (0)	
Workplace	27 (12.9)	14 (15.4)	
Other	41 (19.6)	24 (26.4)	
<b>Place of birth</b>			0.64
U.S. born	143 (68.8)	65 (71.4)	
Born outside U.S.	65 (31.2)	26 (28.6)	

**Table 2**

Association between age at hair product use prior to age 13 and age at menarche before  $\leq 12$  years in the Greater New York Hair Products Study, 2004-2005

Childhood Hair Product Use	N%	Unadjusted	Adjusted	Adjusted
		RR (95% CI)	Multivariable RR <sup>a</sup> (95% CI)	Multivariable RR <sup>b</sup> (95% CI)
<i>Ever</i>	209 (69.7)	1.2 (0.9-1.5)	1.2 (1.0-1.5)	1.0 (0.8-1.4)
<i>Never</i>	91 (30.3)	Ref.	Ref.	Ref.
<b>Hair oils</b>				
<b>Yes</b>	165 (55.0)	<b>1.4 (1.1-1.7)</b>	<b>1.5 (1.2-1.8)</b>	<b>1.4 (1.1-1.9)</b>
<b>No</b>	135 (45.0)	Ref.	Ref.	Ref.
<b>Hair lotions</b>				
<b>Yes</b>	34 (11.3)	1.2 (0.9-1.6)	1.2 (0.9-1.5)	1.1 (0.8-1.4)
<b>No</b>	266 (88.7)	Ref.	Ref.	Ref.
<b>Leave-in conditioners</b>				
<b>Yes</b>	45 (15.0)	1.2 (1.0-1.5)	1.3 (1.0-1.6)	1.3 (1.0-1.6)
<b>No</b>	255 (85.0)	Ref.	Ref.	Ref.
<b>Perms/Relaxers</b>				
<b>Yes</b>	50 (16.7)	<b>1.4 (1.2-1.7)</b>	<b>1.5 (1.1-1.8)</b>	<b>1.4 (1.1-1.8)</b>
<b>No</b>	250 (83.3)	Ref.	Ref.	Ref.
<b>Other</b>				
<b>Yes</b>	38 (12.7)	0.8 (0.5-1.1)	0.8 (0.5-1.2)	0.7 (0.6-1.2)
<b>No</b>	262 (87.3)	Ref.	Ref.	Ref.

<sup>a</sup> Adjusted for year of birth

<sup>b</sup> Adjusted for year of birth and race/ethnicity