

ORIGINAL STUDY

Association between intergenerational violence exposure and maternal age of menopause

Holly Foster, PhD,^{1,2} John Hagan, PhD,^{2,3} Jeanne Brooks-Gunn, PhD,⁴ and Jess Garcia, MS¹

Abstract

Objective: To investigate whether maternal violence exposure personally and through her child is associated with an earlier age of menopause, controlling for covariates.

Methods: Analyses used merged data from two related sources. Although mothers ($n = 1,466$) were interviewed in 1995 and then 20 years later (2015-17), their children were interviewed in the National Longitudinal Study of Adolescent to Adult Health repeatedly (Waves 1-4, 1994/5 to 2008-2009). Mothers reported their own age of menopause, and mothers and adolescents each reported their own exposure to violence as children and adults.

Results: A mother's own childhood physical abuse ($b = -1.60, P < .05$) and her child's sexual abuse ($b = -1.39, P < .01$) both were associated with an earlier age of menopause. Mothers who were physically abused in childhood and have a child who experienced regular sexual abuse reached menopause 8.78 years earlier than mothers without a history of personal abuse or abuse of their child.

Conclusions: Our study is the first to find that age of natural menopause is associated with intergenerational violence exposures.

Key Words: Child's physical and sexual abuse – Intergenerational influences – Menopausal timing – Personal physical abuse – Reproductive aging.

Research on women's violence exposure is timely and has myriad implications for health in mid- to later-life. The Violence Against Women Reauthorization Act passed the House in March 2021 and is proceeding to the Senate.¹ If passed into law, this Act will ensure vital resources are available to survivors in support of violence prevention and intervention efforts.² However, the COVID19 pandemic has simultaneously elevated rates of intimate partner violence (IPV)³ and increased parent-to-child aggression and child abuse risks.⁴

Violence exposure is a well-established correlate of mental and physical health problems,^{5,6} and research increasingly

reveals its connections with the pace of reproductive aging. Early mid-life menopause, particularly, before age 45, is associated with women's risks of cardiovascular disease, osteoporosis, lower bone density, and premature death.⁷⁻⁹ Menarche occurs between the ages of 8 and 14, with an average age of 12.5. Natural menopause occurs between the ages of 40 and 60, with an average age of 51 [with 12 mo elapsing since a woman's last menstrual period].^{10,11} Studies show childhood sexual abuse, and childhood physical and sexual abuse are associated with earlier menarche, with evidence most consistent for sexual abuse.¹² Associations between violence and accelerated reproductive aging in the early and later life course of women are believed to work through the disruption of the hypothalamic-pituitary-adrenal axis and the body's response to stress.¹¹

A major limitation of research on reproductive aging is that most studies focus on women's own abuse, or what research on violence exposure identifies as direct exposure, rather than indirect exposure (eg, witnessing others' abuse).¹³ Measuring only direct abuse therefore likely underestimates the overall influences of women's violence exposure on menopausal timing and may obscure insights into new avenues of intervention and prevention.

Very few studies have investigated violence against women and the timing of menopause, although some have connected childhood abuse and IPV to vasomotor menopausal symptoms

Received May 18, 2021; revised and accepted October 27, 2021.

From the ¹Texas A&M University, Department of Sociology, MS 4351 TAMU, College Station, TX; ²American Bar Foundation, 750 N Lake Shore Drive, Chicago, IL; ³Northwestern University, Department of Sociology, 1810 Chicago Ave, Evanston, IL; and ⁴Columbia University, Teachers College and College of Physicians and Surgeons, 525 W. 120th St., Box 39, New York, NY.

Funding/support: The first author acknowledges funding for analyses through a Chancellor EDGES Fellowship and Office of Vice President of Research through PESCA funding at Texas A&M University. The first and second author acknowledges funding through NSF grant support #SES-2043192.

Financial disclosures/conflicts of interest: None reported.

Address correspondence to: Holly Foster, PhD, Texas A&M University, Department of Sociology, MS 4351 TAMU, College Station, TX.

E-mail: hfoster@tamu.edu

(eg, hot flashes and night sweats).¹⁴⁻¹⁶ A large Australian study found women's IPV (ever) *accelerates* menopause (age <45) by 1.54 times compared to on-time menopause (age 50-51).¹⁷ Yet, an American study found women's childhood or adolescent experiences of, or fear of, physical or sexual abuse *slowed* the onset of perimenopause, as did a first abuse experience in adulthood.¹⁸ Therefore, research is suggestive of associations between women's abuse and the timing of menopause, but with some inconsistencies. We hypothesize that a mother's own physical childhood abuse experience is associated with earlier menopause, consistent with what is known about its association with menarche.

Research on violence, Geronimus^{19,20} weathering hypothesis, and research on allostatic load²¹ suggest that as stress accumulates over the life course there is accelerated wear-and-tear on bodily systems and heightened coping demands. Together these lead to an earlier onset of health problems and mortality. The weathering perspective includes an intergenerational component, in line with a focus on indirect violence exposure. Showing how intergenerational weathering works, a study found neonatal mortality patterns emerge differently by race: among Black women, it increases with age, although it decreases among White women.¹⁹ Since Black women face heightened economic stress and racial discrimination compared to White women, they may experience earlier health declines.¹⁹ We hypothesize that earlier menopause will be influenced by a mother's child's experience of childhood violence.

Taking these components together, we propose and test a new mid-life intergenerational weathering hypothesis of women's reproductive aging, predicting that both maternal and child violence exposures will independently accelerate maternal menopausal timing, controlling for other influences. We test this hypothesis using merged information from the National

Longitudinal Study of Adolescent to Adult Health (Add Health), along with the Add Health Parent Study (AHPS) which was inclusive of measures of the Add Health respondent's own mother's physical IPV (received from a spouse or partner), her own childhood physical abuse and her menopausal timing.

Covariates

Other influences on women's timing of menopause and violence exposure include socio-economic status, educational levels, race/ethnicity, health factors including smoking, obesity and poor health, and marital status.^{11,22,23} We further incorporate maternal incarceration as another type of threatening and deprivational experience²⁴ with health consequences for women.^{25,26} Finally, child gender is a correlate of child physical and sexual violence exposure.^{27,28}

METHODS

Data

Our analyses merged information on mother's children participating in four waves of the Add Health (Wave 1 in 1994-95 to Wave 4 in 2008/9)^{29,30} with biological, step and adoptive mothers participating at both waves of the AHPS at two waves (Wave I, AHPS, 1994-95 and Wave II, AHPS, 2015-2017).³¹⁻³³ The Add Health data is a large comprehensive longitudinal survey of adolescent development, and the AHPS is a survey of social, behavioral, and health information gathered from a probability sample of the Add Health parents who were originally interviewed in 1995, or Wave I of Add Health.²⁸ The temporal relationship between these two data sets is shown in Figure 1. The response rate for the Wave II of AHPS was 65% (with parent ages between 55 and 70 years old) and 85% at AHPS Wave I (with parent ages between 30 and 50 years old).³² Variables on the mother's child are drawn

Add Health Study Year (response rate)	In-Home Adolescent to Adult Longitudinal Sample	Add Health Parent Study (AHPS)	Parent Ages (AHPS)
Wave 1 (W1) 1994-95 (79%)	Adolescents in Grades 7-12 (average age 15)	Wave I 1995	Ages 35-50, average: 42 years old
Wave 2 (W2) 1996 (88.6%)	Adolescents in Grades 8-12		
Wave 3 (W3) 2001-02 (77.4%)	Young Adults (ages 18-26)		
Wave 4 (W4) 2008-09 (80.3%)	Adults (ages 24-32)		
Wave 5 (W5) 2016-18 (71.8%)	Adults (ages 33-43)	Wave II 2015-17	Ages 55-70, average: 62 years old

FIG. 1. Synopsis of the National Longitudinal Study of Adolescent to Adult Health (Add Health) and the Add Health Parent Study (AHPS) and their connections ($n=2,013$ parents, with 2,247 children). Shading indicates data waves included in our study. Source: <https://addhealth.cpc.unc.edu/documentation/study-design/>. Accessed April 21, 2021.

TABLE 1. Descriptive statistics on biological mothers of child respondent in multi-wave longitudinal Add Health Study (W1:1994/95 to W4:2008/9) (Parent Study, W1:1995, WII:2015-17) ($n = 1,466$)

	Mean	Std. Deviation	Range	% Missing
<i>Maternal Dependent Variable (AHPS WII: 2015/17)</i>				
Age at Menopause	47.88	7.98	5-64	0%
Age at Menopause v.II (age truncated, $n = 1,462$)	47.99	7.69	20-64	0%
Age at Menopause v.III (age truncated, $n = 1,368$)	49.30	6.12	35-64	0%
<i>Maternal Violence Exposure (AHPS WII: 2015/17)</i>				
Mother's Own Physical Childhood Abuse	13%	—	0-1	0.5%
Mother's own Intimate Partner Physical Abuse	16%	—	0-1	0.6%
<i>Maternal Characteristics (AHPS WII: 2015/17)</i>				
Incarcerated (ever)	4%	—	0-1	0.5%
Age	62.29	5.42	49-81	0%
Education (highest grade level)	2.84	1.12	0-5	1%
Black/African American ^a	13%	—	0-1	0.2%
Latinx/Hispanic	10%	—	0-1	0.2%
Other race/ethnicity	5%	—	0-1	0.2%
Married ^b	67%	—	0-1	0%
<i>Maternal Characteristics (AHPS W1: 1995)</i>				
Smoker	28%	—	0-1	1.8%
Self-Rated Health	3.70	1.00	1-5	1.7%
Obesity	20%	—	0-1	0.8%
Received Welfare	8%	—	0-1	2.2%
Married ^b	75%	—	0-1	1.6%
<i>Child Characteristics (Add Health, W4: 2008/9)</i>				
Gender (female ^c)	51%	—	0-1	0%
<i>Child's Violence Exposure (Add Health, W4: 2008/9)</i>				
Sexual Abuse<18	0.13	.65	0-5	1%
Emotional Abuse<18	1.32	1.74	0-5	1%
Physical Abuse <18	0.41	1.14	0-5	1%
Current Intimate Partner Violence (past year) (High Latent Class vs Low)	16%	—	0-1	0%
General Violence (past year) (High Latent Class vs. Low)	13%	—	0-1	0%
Forced Sex	8%	—	0-1	0.5%

AHPS, Add Health Parent Study; Add Health; National Longitudinal Study of Adolescent to Adult Health.

Reference categories: ^aWhite; ^bnot married; ^cmale.

from Add Health Wave 1 or (W1) (1994-95) (with a 79% response rate, and child average age of 15) and Add Health Wave 4 or (W4) (2008/9) (with a 80.3% response rate, adult child age range of 24-32 years).^{31,32}

A total of 2,013 parents were interviewed from the parent study (AHPS). These parents had 2,244 children.³¹ These analyses use only biological mothers of an adult child ($n = 1,772$) who had reached menopause by Wave II of AHPS (2015-2017) ($n = 1,679$), and who reported age at menopause. Our analytic sample therefore includes $n = 1,466$ mothers of adult children in a current intimate relationship, and therefore able to provide information on IPV (at Wave 4) (Table 1).

Measures

Maternal Age of Menopause was measured at Wave II of AHPS (2015-17) by asking women to self-report: "about how old were you when you finished going through menopause, that is, had your last menstrual period?" (age 5 and younger to 64 and older). For sensitivity purposes, we created two other versions of this variable: one where the values of 5 and younger were recoded as missing (4 cases) (analytic $N = 1,462$), and another where those reporting menopause before age 35 were recoded as missing, affecting about 7% of the sample (analytic $N = 1,368$).

Maternal Childhood Physical Violence was measured by asking at Wave II of AHPS: "As a child, were you ever badly

beaten up by your parents or the people who raised you?" Affirmative responses were indicated by the respondent as "Yes" (coded 1); "No" (coded 0). *Maternal Intimate Physical Partner Violence* (IPV) was also measured at Wave II (2015-17) through the question: "Were you ever badly beaten up by a spouse or romantic partner?" Yes (1); No (0).

Mother's Child's Childhood Abuse (Add Health Wave 4 in 2008/9) was measured retrospectively through the questions: "Before your 18th birthday: 1) how often did a parent or other adult caregiver say things that really hurt your feelings or made you feel like you were not wanted or loved?; 2) how often did a parent or adult caregiver hit you with a fist, kick you, or throw you down on the floor, into a wall, or down stairs?; and 3) how often did a parent or other adult caregiver touch you in a sexual way, force you to touch him or her in a sexual way, or force you to have sexual relations?" Childhood abuse variables are used in their original form, with responses scaled as one time (1); two times (2); 3 to 5 times (3); 6 to 10 times (4); more than 10 times (5); those indicating "this has never happened" were recoded to 0. For subsequent sensitivity analyses, the mother's child's childhood abuse variables were dichotomized as any abuse (1) compared to no abuse (0) (see Figure 2).

Mother's Child's Sexual Abuse (Add Health Wave 4) was measured as "have you ever been physically forced to have any type of sexual activity against your will (where this was

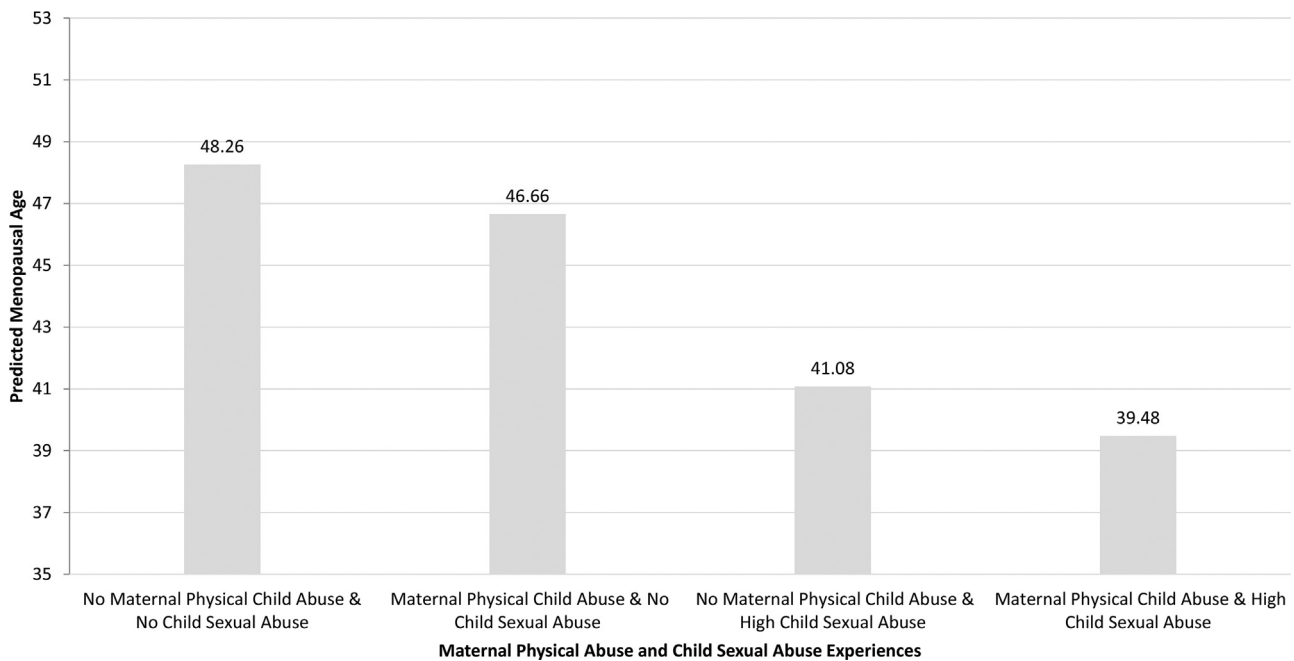


FIG. 2. Predicted maternal age of menopause from her own childhood physical abuse and levels of her child's sexual abuse (with all other control variables in Model 4 held at their means) ($n = 1,466$).

not perpetrated by a parent or adult caregiver)?” Yes (1); No (0). This variable was also used in its original form as above for the other childhood abuse items.

Mother's Child's Intimate Partner Violence (Wave 4) was measured by asking how often a current partner had ever: 1) slapped/slap, hit or kicked/kick you?; 2) made/make you have sexual relations with him/her when you didn't want to?; and 3) threatened/threaten you with violence, pushed/push or shoved/shove you, or thrown/throw something at you that could hurt? ³⁴ We used latent class analysis to determine types of IPV exposure, ^{35,36} with the mother's adult child experiencing higher and lower levels of IPV. The latent class probabilities indicate 84% of mother's adult child had low IPV (0), whereas 16% had high IPV (1). The two class model was preferred to a one class model (AIC two class=3375.62 compared to AIC one class=4069.86; BIC two class=3414.65 compared to BIC one class=4086.58). The conditional probabilities of experiencing each of the above forms of IPV respectively among those with high IPV are 0.74, 0.22, 0.88 whereas those with low IPV have conditional probabilities of 0.004, 0.02, 0.06. Therefore, those in the high IPV group are more likely to face physical violence than sexual, and have higher probabilities of exposure to all three types than those in the low IPV group.

Mother's Child's General Abuse (Wave 4) was measured by asking about street abuse: which of the following things happened in the past 12 months? (Yes = 1; No = 0): 1) Someone stole something from you worth more than \$50; 2) Someone pulled a knife or gun on you; 3) Someone shot or stabbed you; 4) Someone slapped, hit, choked, or kicked you; 5) You were beaten up; and 6) You saw someone shoot or stab another person. Latent class probabilities indicated 87% had

low general violence (0) and 13% had high levels (1). A latent class analysis of these dichotomous measures indicated a two class model was preferred to a one class model (eg, BIC 5962.80 vs 10121.88; AIC 5889.90 vs 10088.23). The conditional probabilities indicate that those in the high violence latent class have conditional probabilities of all exposures over 0.75, whereas those in the low violence latent class have probabilities of <0.10 on all with only a slightly higher probability of having had something stolen from them (0.20).

Maternal covariates from Wave II of AHPS (2015-2017) were measured as: 1) *Incarceration*: “Have you ever been incarcerated, that is, spent time in a jail, prison, juvenile detention center, or other correctional facility?” Yes (1); No (0); 2) *Maternal age* was calculated in years; 3) *Maternal education* was self-reported: “What is the highest grade of school or year of college you completed?” ranging from no formal education (0); grades 1-11 (1); high school (2); some college (3); college grad (4); and post college (5).; 4) *Maternal race/ethnicity* was measured with three dummy variables to indicate maternal self-identification as Black/African American, Latinx/Hispanic, or being of another race/ethnicity (Other) with the non-Latinx White group serving as the reference category; and 5) *Maternal marital status* (Wave II AHPS) was determined by self-reports indicating whether they were married or living with same partner in 2015-2017 and in 1995, with Yes (1); No (0). Responses to this question were combined with responses to: “Are you currently-married, widowed, divorced, legally separated, or have you never been married?” Responses of married or cohabiting to the first question, or currently married in the second question, were coded (1).

Five maternal covariates were drawn from Wave 1 of Add Health (1994/5) corresponding to Wave I of the Parent Study:

1) *Marital Status* (Wave I of AHPS) was dichotomized as: what is your current marital status? Married (1); all others (0); 2) *Welfare Receipt* was measured as receiving public assistance: Yes (1); No (0); 3) *Maternal Smoking* was measured as Yes (1); No (0); 4) *Maternal Self-rated Health* was measured as “how is your general physical health?” with responses reverse coded from poor (1) to excellent (5); 5) *Maternal Obesity* was measured from parent reports of whether the child’s biological mother was obese: Yes (1); No (0). Finally, the child’s gender was determined from an indicator of their biological sex (Add Health Wave 4): female (1); male (0).

Analysis

Ordinary least squares (OLS) multiple regression models of maternal age of menopause were conducted in Stata 16.1³⁷ with multiple imputation (20 data sets) on missing covariates.³⁸ As indicated in Table 1, there was little missing data. Since our analyses are intergenerational, with mother-adult child pairs focused on violence influences on maternal outcomes, child-level weights were appropriate and applied.³⁹ After the OLS regression analyses results reported in Table 2, we conducted a series of sensitivity analyses to test their robustness to alternate variable construction of menopausal timing and the mother’s child’s childhood abuse.

RESULTS

Models 1-2 in Table 2 show the results of maternal menopausal timing regressed on maternal IPV and her own experiences of physical abuse in childhood, controlling for maternal covariates in Model 1 [from Wave II of the AHPS], and then maternal covariates at both time points (Model 2, AHPS Wave I in 1995) and her child’s gender. Both models show maternal childhood physical abuse is negatively associated with maternal age of menopause (b , or the linear regression coefficient, $= -1.90$, $P < 0.05$ in Model 1), and ($b = -1.70$, $P < 0.05$ in Model 2), controlling for covariates. In both models, intimate partner physical abuse does not have a significant association ($b = -0.80$, $P > 0.10$).

Model 3 begins to test the *mid-life intergenerational weathering hypothesis* by incorporating her child’s experiences of sexual abuse. A higher frequency of child sexual abuse is negatively and significantly associated with maternal age of menopause ($b = -1.35$, $P < 0.01$), controlling for all covariates in prior models. Furthermore, maternal childhood physical abuse continues to be negatively associated with maternal age of menopause in this model ($b = -1.67$, $P < 0.05$). The significant associations between both maternal and child abuse and an earlier maternal age of menopause support the mid-life intergenerational weathering hypothesis.

TABLE 2. OLS Regression of maternal menopausal age (2015/17) on her own physical violence exposure and her child’s violence exposure net of covariates (multiple imputation, 20 data sets) ($n = 1,466$) [b , (sb)]

	Model 1			Model 2			Model 3			Model 4		
	β	Std. error	P	β	Std. error	P	β	Std. error	P	β	Std. error	P
<i>Maternal Abuse</i>												
Childhood Physical Abuse	-1.90	0.80	<0.05	-1.70	0.79	<0.05	-1.67	0.80	<0.05	-1.60	0.79	<0.05
Intimate Partner Physical Abuse	-0.80	0.72		-0.02	0.71		0.04	0.72		-0.01	0.72	
<i>Child’s Abuse</i>												
Sexual Abuse <18 ^a							-1.35	0.49	<0.01	-1.39	0.49	<0.01
Emotional Abuse <18 ^a							0.04	0.14		0.07	0.15	
Physical Abuse <18 ^a							0.08	0.22		0.11	0.22	
Intimate Partner Violence										-0.42	0.72	
Physically Forced Sex										-1.65	0.95	
Other Violence										-0.50	0.66	
<i>Maternal Covariates (2015–17)</i>												
Age	0.27	0.04	<0.001	0.25	0.04	<0.001	0.25	0.04	<0.001	0.25	0.04	<0.001
Education	0.38	0.18	<0.05	0.06	0.20		0.06	0.20		0.06	0.20	
Black/African American ^b	0.60	0.72		0.84	0.75		0.68	0.75		0.69	0.75	
Latinx/Hispanic ^b	0.95	0.76		0.87	0.77		0.86	0.77		0.87	0.77	
Other race/ethnicity ^b	1.38	1.01		1.31	1.08		1.42	1.08		1.63	1.10	
Married ^c	0.58	0.49		-0.09	0.53		-0.06	0.53		-0.12	0.53	
Incarceration	-1.40	1.66		-0.57	1.58		-0.36	1.56		-0.20	1.56	
<i>Maternal Covariates (1995)</i>												
Smoker				-1.77	0.56	<0.001	-1.75	0.56	<0.01	-1.70	0.56	<0.01
Married ^c				0.61	0.64		0.51	0.64		0.54	0.64	
Self-reported Health				1.08	0.25	<0.001	1.10	0.25	<0.001	1.11	0.25	<0.001
Received welfare				-0.41	1.10		-0.19	1.06		-0.16	1.06	
Obesity				-0.45	0.56		-0.36	0.55		-0.31	0.55	
<i>Mother’s Child Covariate</i>												
Child’s Gender (female) ^d				-0.23	0.43		-0.02	0.43		0.11	0.46	
Constant	29.33	2.80	<0.001	28.25	3.16	<0.001	28.28	3.16	<0.001	28.49	3.19	<0.001
F test	8.97		<0.001	7.57		<0.001	6.63		<0.001	5.94		<0.001

β , unstandardized linear regression coefficient; Model 1 adds recent maternal covariates; Model 2 adds early maternal covariates; Model 3 adds child-reported victimization, gender; Model 4 adds adult child victimization.

Reference categories: ^aindicates frequency of abuse; ^bWhite; ^cnot married; ^dmale.

OLS, ordinary least squares.

Model 4 incorporates three additional types of the mother's child's life course violence exposure, including their current partner's IPV, experiencing physically forced sex, and more general violence exposure. The results in Model 4 further support the mid-life intergenerational weathering hypothesis since the mother's own physical abuse in childhood continues to have a negative association with maternal age of menopause ($b = -1.60, P < 0.05$), alongside a continuing negative association of her child's sexual abuse ($b = -1.39, P < 0.01$). This model also indicates specificity in children's violence exposure influences on maternal age of menopause, with the negative association of the mother's child's sexual abuse on maternal reproductive aging, but not the child's other violence exposures. Furthermore, established covariates of maternal smoking ($b = -1.70, P < 0.01$) and better self-reported health ($b = 1.11, P < 0.001$) are associated with maternal age of menopause in anticipated directions. Finally, also showing some specificity in the influences of violence on women's reproductive aging, another stressor of maternal incarceration is not associated with the timing of menopause ($b = -0.20, P > 0.05$).

Figure 2 shows the predicted maternal age of menopause from combinations of intergenerational violence exposures to further illustrate the mid-life intergenerational weathering hypothesis. Using the model results, menopause is predicted to occur at 48.26 years of age, controlling for all other factors, when mothers themselves experience no childhood physical abuse and their child does not experience any sexual abuse. However, again using model results, if mothers themselves experienced childhood physical abuse and their own child reported very frequent sexual abuse experiences, maternal age of menopause is instead predicted to occur at 39.48 years. This prediction is consequential as it falls below age 45, the known age of menopause that elevates women's risks of cardiovascular disease and mortality.¹⁴ Comparing the middle bars in Figure 1, higher levels of child sexual abuse (predicted to lower maternal age of menopause by 7.18 y) is more consequential than mother's own experience of childhood physical abuse (a predicted change of 1.6 y).

Three further analyses gauge the sensitivity of these OLS regression results to measurement issues. First, because the age of menopause variable included some very young ages, we alternately coded menopause at age 5 and below as missing. In parallel analyses to those in Table 2, the final model revealed similar associations of maternal childhood physical abuse ($b = -1.70, P < 0.05$) and child sexual abuse ($b = -1.08, P < 0.01$) with maternal age of menopause. However, the mother's child's physically forced sexual abuse became more significantly and negatively associated with age of menopause in this model ($b = -1.84, P < 0.05$). Next, in analyses with mothers reaching menopause between the ages of 35 and 64 ($n = 1,368$), we find the mother's child's sexual abuse has a robust negative association ($b = -0.70, P < 0.05$, Model 5) with maternal age of menopause (results provided in Table 3). Physically forced sex experienced by the child is negatively associated with maternal age of menopause

in this model and departs from the fuller sample analyses in attaining significance at conventional levels ($b = -1.69, P < 0.05$, Model 6). The mother's own physical abuse in childhood ($b = -1.42, P < 0.05$, Model 1) and physical IPV ($b = -1.40, P < 0.05$, Model 2) are both negatively associated with age of menopause. Maternal IPV reduces the association between her childhood abuse and age of menopause, and then in turn reduced by control variables (Model 3). Finally, using the full maternal age of menopause outcome variable (as per Table 2), we then tested the influence of categorical versions (ever vs never exposed) of the mother's child's sexual and other child abuse experiences. In that model, parallel to Model 4 in Table 2, the influence of mother's child's sexual abuse remained strong and was larger than in models presented in Table 2 ($b = -2.84, P < 0.05$). These sensitivity results indicate support for the mid-life intergenerational weathering hypothesis of maternal reproductive aging.

DISCUSSION

The results of this study suggest a mid-life intergenerational weathering hypothesis in finding that both maternal childhood physical abuse and her child's sexual abuse are associated with an earlier age of maternal menopause. This finding is new and suggests the studies of menopausal timing focused on women's direct violence exposure only *underestimate* the total influence of violence that mothers and their children experience. Our results also show an association of children's sexual abuse with an earlier age of maternal menopause. This finding builds on research indicating that associations between childhood abuse and early menarche may work through exposure to threatening experiences that are distinct from other stressful deprivations.¹⁰ Mothers may feel especially responsible for protecting their children from harm, given systemic societal gendered pressures.⁴⁰ Although maternal role strains may arise from any violence their children experience, they may be heightened for sexual abuse⁴¹ involving empathic threats.⁴² Based on our results then, future research on accelerated reproductive aging among women, associated with serious long-term health risks, should include indicators of women's children's sexually abusive experiences.

Although our study focuses on mothers and their children, the connection between children's violence exposure and parental reproductive aging should be investigated further with men. Accelerated reproductive aging experiences associated with violence are not necessarily gender-specific, but are only systematically tested to date with women. No studies specifically investigate violence associations with reproductive aging among men, although low testosterone levels are associated with men's myriad physical health problems.⁴³ Fathers may also be influenced by childhood sexual abuse among their children, again through empathic threats experienced as a parent.⁴² As well, the influence of men's own violence exposures over the life course should be tested in relation to their reproductive aging patterns, since with the

TABLE 3. OLS regression of maternal menopausal age (2015/17) (restricted to ages 35 and above), on her own physical violence exposure and her child's violence exposure net of covariates (multiple imputation, 20 data sets) ($n = 1,368$) [b , (sb)]

	Model 1			Model 2			Model 3			Model 4			Model 5			Model 6		
	β	Std. error	P	β	Std. error	P	β	Std. error	P	β	Std. error	P	β	Std. error	P	β	Std. error	P
<i>Maternal Abuse</i>																		
Childhood Physical Abuse	-1.42	0.62	<0.05	-0.97	0.67		-0.94	0.70		-0.90	0.71		-0.90	0.70		-0.88	0.70	
Intimate Partner Physical Abuse				-1.40	0.56	<0.05	-0.64	0.59		-0.23	0.59		-0.23	0.59		-0.27	0.60	
<i>Child's Abuse</i>																		
Sexual Abuse <18 ^a													-0.70	0.35	<0.05	-0.73	0.36	<0.05
Emotional Abuse <18 ^a													0.02	0.12		0.04	0.12	
Physical Abuse <18 ^a													0.12	0.18		0.14	0.18	
Intimate Partner Violence																0.21	0.54	
Physically Forced Sex																-1.69	0.85	<0.05
Other Violence																-0.38	0.54	
<i>Maternal Covariates (2015-17)</i>																		
Age							0.15	0.03	<0.001	0.14	0.04	<0.001	0.14	0.04	<0.001	0.14	0.04	<0.001
Education							0.43	0.15	<0.01	0.29	0.16		0.29	0.16		0.29	0.16	
Black/ African American ^b							0.20	0.57		0.27	0.56		0.20	0.57		0.17	0.57	
Latinx/Hispanic ^b							0.03	0.70		-0.16	0.71		-0.16	0.71		-0.17	0.71	
Other race/ethnicity ^b							0.54	0.98		0.48	1.00		0.56	1.00		0.74	1.03	
Married ^c							0.52	0.39		0.18	0.43		0.20	0.43		0.16	0.44	
Incarceration							-1.11	1.43		-0.88	1.41		-0.82	1.40		-0.76	1.38	
<i>Maternal Covariates (1995)</i>																		
Smoker										-1.41	0.45	<0.01	-1.40	0.45	<0.01	-1.37	0.45	
Married ^c										0.51	0.50		0.46	0.50		0.46	0.50	
Self-reported Health										0.49	0.20	<0.05	0.50	0.20	<0.05	0.50	0.20	
Welfare Receipt										1.19	0.82		1.28	0.82		1.31	0.82	
Obesity										-0.20	0.45		-0.18	0.45		-0.14	0.45	
<i>Mother's Child's Covariate</i>																		
Child's Gender (female) ^d										-0.12	0.35		0.16	0.37		0.16	0.37	
Constant							38.18	2.25	<0.001	37.71	2.49	<0.001	37.64	2.49	<0.001	37.68	2.49	<0.000
F test							5.99		<0.001	5.16		<0.001	4.53		<0.001	4.19		<0.001

β , unstandardized linear regression coefficient; P, P value; Model 1 adds maternal physical abuse; Model 2 adds Maternal intimate partner abuse; Model 3 adds recent maternal covariates; Model 4 adds early maternal covariates; Model 5 adds child-reported victimization, gender; Model 6 adds adult child victimization.

Reference categories: ^aindicates frequency of abuse; ^bWhite; ^cnot married; ^dmale.

OLS, ordinary least squares.

important exception of sexual abuse, men, and boys are at higher risk of most forms of abuse than women and girls.⁴⁴

In terms of the clinical implications of our study, the findings support calls to screen for adverse childhood experiences (ACES) by primary care physicians, but in the context of reproductive aging, may be further needed in the context of care by obstetricians and gynecologists.^{45,46} Although both maternal incarceration and maternal childhood abuse are ACES, our results show it is violence exposure in particular that is associated with an earlier age of menopause. Therefore, a more finite and focused set of ACES screening on abuse specifically may be more efficient when providing reproductive health care to women over the life course to menopause. Our results also indicate that asking mothers about their children's ACES is warranted in this context, particularly on any sexual abuse experiences among them.

There are several limitations to this study. Women self-reported their age of menopause in this survey-based study, and research indicates self-reports are reasonable measures.⁴⁷ However, the question in the survey we analyzed asks women to identify the age they have gone through menopause or date of their last menstrual period. Menopause is not defined in the survey as "permanent cessation of menses after 12 months of amenorrhea," so it is uncertain if participants responded accurately. In addition, amenorrhea, especially in younger women, often is hypothalamic in origin and due to extreme stress, and this may cause 12 months of amenorrhea, but is not menopause. Furthermore, since the definition of menopause requires that 12 months have passed since the date of the last menstrual period, it is a limitation that this clarifying information was not provided to survey respondents. Another limitation with this measure concerns some respondents indicated an age of menopause before age 5, and others before age 35. We conducted sensitivity analysis removing these cases from the analytic sample and found similarities to the analyses with the full analytic sample. However, future research is needed on the reasons respondents had for reporting these very young ages, including if they misunderstood the question being asked.

Notably, our results support and expand those from the Australian study, where IPV (ever) was associated with earlier menopause, also measured by women's self-report but with confirmation that 12 months have passed since the date of a woman's last period, and that the age given was that of natural menopause, not due to surgical intervention.¹⁷ Although maternal IPV was not associated with menopausal timing in our study (net of covariates), women's childhood physical abuse was. The measures of women's IPV also varied between these studies, and inconsistent associations between them may be sensitive to the measures used. However, both studies support the more general pattern of women's violence exposure being associated with their earlier menopausal timing. We suggest that multiple types of violence exposures should be measured in investigating this pattern when possible, including intergenerational exposure, which was extensively measured in Add Health. Another limitation is that we

do not have available a measure of maternal experiences of her own childhood sexual abuse, although we incorporate her physical IPV exposure and physical childhood abuse. It would also be an asset to measure maternal experiences of sexual and emotional IPV, which were not available in this study. Finally, the measure of childhood sexual abuse asked of mother's children is retrospective, which is a potential limitation. However, since it is self-reported by children themselves it is also an asset of this study since research shows that salient childhood events are retrospectively reported reliably.⁴⁸

Finally, all study findings are associations and it is unknown whether a personal history of abuse or abuse in a women's child's experiences causes an earlier age of menopause. Multiple factors that correlate with a history of abuse, including low SES, and prior bilateral tubal ligation might contribute to the observed association as confounders.

CONCLUSIONS

Our findings may have implications for intervention and prevention efforts since early menopause is a risk factor for women's health problems. There are many reasons to reduce childhood abuse and intergenerational violence, and impacting age of menopause may be an additional reason. Continued investments in child sexual abuse prevention programs are strongly advised.

Acknowledgments: Add Health is directed by Robert A. Hummer and funded by the National Institute on Aging cooperative agreements U01 AG071448 (Hummer) and U01 AG071450 (Aiello and Hummer) at the University of North Carolina at Chapel Hill. Waves I-V data are from the Add Health Program Project, grant P01 HD31921 (Harris) from Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), with cooperative funding from 23 other federal agencies and foundations. Add Health was designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill. Information on how to obtain the Add Health data files is available on the Add Health website (<http://www.cpc.unc.edu/addhealth>). No direct support was received from grant P01-HD31921 for this analysis. The Add Health Parent Study (AHPS) (2015-2017) data collection was funded by a grant from the National Institute on Aging (RO1AG042794) to Duke University, V. Joseph Hotz (PI) and the Carolina Population Center at the University of North Carolina at Chapel Hill, Kathleen Mullan Harris (PI).

REFERENCES

1. H.R. 1620: Violence against women act reauthorization Act of 2021. Available at: <https://www.govtrack.us/congress/bills/117/hr1620>. Accessed April 16, 2021.
2. Montgomery BEE. Human rights: the violence against women act reauthorization is due. *Am J Public Health* 2018;108:1490-1492.
3. Piquero AR, Jennings WJ, Jemison E, Kaukinen C, Knaul FM. Domestic violence during the COVID-19 pandemic- evidence from a systematic review and meta-analysis. *J Crim Justice* 2021;74:1-10.
4. Rodriguez CM, Lee SJ, Ward KP, Pu DF. The perfect storm: hidden risk of child maltreatment during the Covid19 pandemic. *Child Maltreat* 2021;26:139-151.
5. Molnar BE, Buka SL, Kessler RC. Child abuse and subsequent psychopathology: results from the national comorbidity survey. *Am J Public Health* 2001;91:753-760.

6. Thompson MP, Kingree JB, Desai S. Gender differences in long-term health consequences of physical abuse of children: data from a nationally representative survey. *Am J Public Health* 2004;94:599-604.
7. Sievert LL. Menopause as a measure of population health: an overview. *Am J Human Biol* 2001;13:429-433.
8. Sowers MR, La Pietra MT. Menopause: its epidemiology and potential association with chronic diseases. *Epidemiol Rev* 1995;17:287-302.
9. Muka T, Oliver-Williams C, Kunutsor S, et al. Association of age at onset of menopause and time since onset of menopause with cardiovascular outcomes, intermediate vascular traits, and all-cause mortality: a systematic review and meta-analysis. *JAMA Cardiol* 2016;1:767-776.
10. Colich NL, Rosen ML, Williams ES, McLaughlin KA. Biological aging in childhood and adolescence following experiences of threat and deprivation: a systematic review and meta-analysis. *Psychol Bull* 2020;146:721-764.
11. Forman MR, Mangini LD, Thelus-Jean R, Hayward MD. Life-course origins of the ages of menarche and menopause. *Adolesc Health Med Ther* 2013;4:1-21.
12. Wise LA, Palmer JR, Rothman EF, Rosenberg L. Childhood abuse and early menarche: findings from the black women's health study. *Am J Public Health* 2009;99 (Suppl 2):S460-S466.
13. Fleckman JM, Drury SS, Taylor CA, Theall KP. Role of direct and indirect violence exposure on externalizing behavior in children. *J Urban Health* 2016;93:479-492.
14. Thurston RC, Bromberger J, Joyce C, et al. Childhood abuse or neglect is associated with increased vasomotor symptom reporting among midlife women. *Menopause* 2008;15:16-22.
15. Gibson CJ, Huang AJ, McCaw B, Subak LL, Thom DH, Van Den Eeden SK. Associations of intimate partner violence, sexual assault, and post-traumatic stress disorder with menopause symptoms among midlife and older women. *JAMA Intern Med* 2019;179:80-87.
16. Carson MY, Thurston RC. Childhood abuse and vasomotor symptoms among midlife women. *Menopause* 2019;26:1093-1099.
17. Mishra GD, Chung HF, Gelaw YA, Loxton D. The role of smoking in the relationship between intimate partner violence and age at natural menopause: a mediation analysis. *Women's Midlife Health* 2018;4:1-10.
18. Allsworth JE, Zierler S, Lapane KL, Krieger N, Hogan JW, Harlow BL. Longitudinal study of the inception of perimenopause in relation to lifetime history of sexual or physical violence. *J Epidemiol Community Health* 2004;58:938-943.
19. Geronimus AT. The weathering hypothesis and health of African American women and infants: evidence and speculations. *Ethn Dis* 1992;2:207-221.
20. Geronimus AT. Understanding and eliminating racial inequalities in women's health in the United States: the role of the weathering conceptual framework. *J Am Med Womens Assoc* 2001;56:149-150.
21. McEwan BS. Stress, adaptation and disease: allostasis and allostatic load. *Ann N Y Acad Sci* 1998;840:33-44.
22. Bromberger JT, Kravits HM, Chang Y, Cyranowski JM, Brown C, Matthews KA. Major depression during and after the menopausal transition: study of women's health across the aation (SWAN). *Psychol Med* 2011;41:1879-1888.
23. Reynolds RF, Obermeyer CM. Age at natural menopause in Spain and the United States: results from the DAMES project. *Am J Hum Biol* 2005;17:331-340.
24. Sykes GM. *The Society of Captives: A Study of a Maximum Security Prison*. Princeton, NJ, USA: Princeton University Press; 1958.
25. Turney K, Wildeman C. Self-reported health among recently incarcerated mothers. *Am J Public Health* 2015;105:2014-2020.
26. Pollock JM. *Women, Prison & Crime*, 2nd ed Belmont, CA, USA: Wadsworth; 2002.
27. Buka SL, Stichick TL, Birdthistle I, Earls FJ. Youth exposure to violence: prevalence, risks, and consequences. *Am J Orthopsychiatry* 2001;71:298-310.
28. Foster H, Brooks-Gunn J. Toward a stress process model of children's exposure to physical family and community violence. *Clin Child Fam Psychol Rev* 2009;12:71-94.
29. Harris L, Mullan K. *The National Longitudinal Study of Adolescent to Adult Health (Add Health), Waves I & II, 1994-1996; Wave III, 2001-2002; Wave V, 2016-2018; Wave IV, 2007-2009 [machine-readable data file and documentation]*. Chapel Hill, NC: Carolina Population Center, University of North Carolina at Chapel Hill; 2018.
30. Harris KM, Halpern CT, Whitset E, et al. Cohort profile: The National Longitudinal Study of Adolescent to Adult Health (Add Health). *Int J Epidemiol* 2019;48:1415-1415k.
31. Eischen FF, Monath A, Hotz VJ, Harris KM. *Parents Phase 2 (2015-2017) Data Documentation*. Chapel Hill, NC, USA: Carolina Population Center, University of North Carolina Chapel Hill; 2019.
32. Hotz VJ. Add Health Parent Study: Sampling Plan, Survey Content and Comparison with Other Surveys. Oral presentation at: AHPS User Workshop; August 14, 2019; Duke University.
33. Harris KM. *The Add Health Study: Design and Accomplishments*. Chapel Hill: University of North Carolina; 2013.
34. Straus MA, Hamby SL, Boney-McCoy S, Sugarman DB. The revised conflict tactics scales (CTS2): development and preliminary psychometric data. *J Fam Issues* 1996;17:283-316.
35. Macmillan R, Gartner R. When she Brings home the bacon: labor-force participation and the risk of spousal violence against women. *J Marriage Fam* 1999;61:947-958.
36. Kuha J. AIC and BIC: comparisons of assumptions and performance. *Sociol Methods Res* 2004;33:188-229.
37. StataCorp. *Statistical Software: Release 16*. College Station, TX: Stata-Corp LLC; 2019.
38. Allison PD. *Missing Data*. Thousand Oaks, CA, USA: Sage; 2002.
39. Hotz VJ. Add Health Parent Study: Sampling Weights for AHPS Analyses. Oral presentation at: AHPS User Workshop; August 15, 2019; Duke University.
40. Jackson D, Mannix J. Giving voice to the burden of blame: a feminist study of mother's experiences of mother blaming. *Int J Nurs Pract* 2004;10:150-158.
41. Carvalho QCM, Galvao MTG, Cardoso MVLML. Child sexual abuse: the perceptions of mothers concerning their daughters' sexual abuse. *Rev Latino-am Enfermagem* 2009;17:501-506.
42. Westman M. Crossover of stress and strain in the work-family context. In: Jones F, Burke RJ, Westman M, editors. *Work-Life Balance: A Psychological Perspective*. New York, NY: Psychology Press; 2006. pp. 163-184.
43. Basaria S. Reproductive aging in men. *Endocrinol Metab Clin N Am* 2013;42:255-270.
44. Foster H. Adolescent crime and victimization: sex and gender differences, similarities and emerging intersections. In: Gartner R, McCarthy B, editors. *The Oxford Handbook on Gender, Sex and Crime*. Oxford, U.K.: Oxford University Press; 2014. pp. 319-342.
45. Jones CM. Identifying and preventing adverse childhood experiences: implications for clinical practice. *JAMA* 2020;323:25-26.
46. Campbell TL. Screening for adverse childhood experiences (ACEs) in primary care: a cautionary note. *JAMA* 2020;323:2379-2380.
47. Schmidt-Pokrzywniak A, Kluttig A, Trocchi P, Zinkhan M, Stang A. Reliability of self-reported weight, age at menarche and menopause, and reason for absence of menses: a cohort study. *J Womens Health, Issues Care* 2016;5:4.
48. Brewin CR, Andrews B, Gotlib IH. Psychopathology and early experience: a reappraisal of retrospective reports. *Psychol Bull* 1993;113:82-98.