Reproductive History and Hot Flashes in Perimenopausal Women

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Abstract

Background: Hot flashes affect up to 75% of women undergoing the menopausal transition. They are among the most common health problems for perimenopausal women and are associated with a decrease in quality of life. The goal of this study was to examine the associations between reproductive history variables and midlife hot flashes.

Methods: Data were analyzed from 388 perimenopausal women who participated in the Midlife Health Study, a population-based, cross-sectional study of 639 women aged 45–54 years living in the Baltimore metropolitan region.

Results: The unadjusted analyses showed that none of the reproductive history variables analyzed, including age at menarche, number of live births, ever having been pregnant, age at first birth, age at last pregnancy, and history of oral contraceptive use, were associated with ever experiencing hot flashes. However, after adjusting for race, age group, marital status, education, employment, total family income, smoking and alcohol status, and body mass index (BMI), age at last pregnancy was significantly associated with moderate to severe hot flashes. Specifically, participants who were ≥ 36 years of age at last pregnancy were less likely to report moderate or severe hot flashes than those ≤ 35 years of age at last pregnancy (odds ratio 0.36, 95% confidence interval 0.16, 0.84).

Conclusions: In this study, in general, characteristics of reproductive history were not associated with midlife hot flashes. However, there are a number of potentially modifiable factors that are associated with the occurrence of hot flashes. Thus, alternatives may be available when hormone treatment is contraindicated.

Introduction

WORLDWIDE, HOT FLASHES ARE AMONG the most commonly reported symptoms among women transitioning through menopause,^{1–6} and in certain populations, hot flashes affect up to 75% of women undergoing this transition.¹ Both the perimenopausal and postmenopausal stages of the transition are characterized by hot flashes, with perimenopause lasting 5–10 years^{7,8} in some populations. With an anticipated 1.2 billion perimenopausal or postmenopausal women by 2030,⁹ there will be a large population of women affected by hot flashes. Ameliorating the effect of hot flashes on daily life is important because hot flashes are associated with a decrease in quality of life and are the most common reason for seeking medical intervention during the menopausal transition.^{1,7,10} To date, few risk factors for hot flashes

have been identified; those that have been identified include black race,^{11–13} obesity,^{13–17} cigarette smoking,^{3,4,12–19} and alcohol consumption.^{13,16,20,21}

The relationship between hot flashes and certain reproductive history variables, including age at menarche, age at first and last pregnancy, and parity, is less clear. Studies that have examined a woman's reproductive history and midlife hot flashes have reported inconsistent results.^{13,16,19,22,23} For example, Sabia et al.³ reported that among women aged 40–65 years enrolled in a large prospective study in France, multiparity was associated with a decreased risk of menopausal symptoms, including hot flashes. Similarly, a decreased risk of hot flashes associated with a higher number of live births was observed in a community-based prospective study of Japanese women.²⁴ In contrast, data from the Study of Women's Health Across the Nation (SWAN),¹² a multiethnic,

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cross-sectional study of women aged 42–52 years in the United States, and from a study of women in central North Carolina¹⁹ showed that hot flashes were not significantly associated with the number of live births. Conflicting results have also been reported for other reproductive history variables, such as age at menarche and age at first and last pregnancy.^{3,19,22,23} Inconsistency in the relationship between hot flashes and reproductive history factors may reflect differences in the ages of the study participants, cultural norms, lack of a consistent definition of hot flashes, and analyses of subjects undergoing natural and surgical menopause at different stages of the menopausal transition.

Identifying nonmodifiable risk factors for hot flashes, such as those pertaining to a woman's reproductive history, may alert women and their physicians to the potential positive effect of modifying risk factors for hot flashes sooner and more aggressively. Although prior studies have looked at a woman's reproductive history and hot flashes, to our knowledge, these studies did not specifically look at reproductive history in association with hot flash frequency, severity, and duration in women undergoing natural menopause. Thus, the aim of this cross-sectional study was to determine if certain reproductive history variables, including age at menarche, ever being pregnant, age at first birth, number of live births, and age at last pregnancy, were associated with the risk of any, more severe, or more frequent midlife hot flashes in perimenopausal women.

Materials and Methods

Study design

The Midlife Health Study¹⁷ was a population-based, cross-sectional study of women aged 45–54 years conducted in the Baltimore metropolitan region between 2000 and 2004. The study examined the associations between hot flashes and participant demographics, medical and family history, and health behaviors (smoking, alcohol use, vitamin use, eating habits). Informed written consent was obtained from participants in compliance with procedures approved by the University of Maryland School of Medicine, University of Illinois, and The Johns Hopkins University Institutional Review Boards.

Participant recruitment

Names and addresses of women between 45 and 54 years of age residing in the Baltimore metropolitan region were obtained from AccuData America (Fort Myers, FL). AccuData compiles names and addresses using public sources, including data from the Department of Motor Vehicles and Voter Registration. Letters were sent to all identified women, inviting them to participate in a research study on the health of midlife women. The letters were initially sent to ZIP codes closest to the study site (located in a Baltimore suburb), with additional letters sent out in outward concentric circles from the site until the target sample size was met. Women interested in participating in the Midlife Health Study were asked to call the study site to obtain more information.

Participant eligibility and study sample

Participant eligibility was determined during the initial telephone call. Women were eligible if they were between 45

and 54 years of age, had an intact uterus and ovaries, and reported having at least three menstrual periods in the last 12 months. Women were excluded if they were pregnant, had a history of cancer of the reproductive organs, were taking hormone replacement therapy (HRT), or were on hormonal contraception. There were 2299 women who responded to the mailed invitations, of which 639 were determined to fulfill eligibility criteria for the Midlife Health Study. Although the 639 eligible participants included both premenopausal and perimenopausal women, only the 388 perimenopausal women were the focus of this study. Perimenopausal women were identified as those who reported experiencing their last menstrual period within the past year but not within the past 3 months or their last menstrual period within the past 3 months and experiencing 10 or fewer periods within the past year.

Data collection

During the telephone screening, after determining a subject was eligible, women were scheduled for an interview at a single study site where they were asked to complete a 26-page survey that took 45–60 minutes to complete. The survey was designed to obtain information on demographics, reproductive history and menstrual cycle characteristics, use of hormonal contraceptives, presence of menopausal symptoms, past use of HRT, medical and family history, and health behaviors, including smoking and alcohol use. Women were also asked to provide detailed characteristics of their hot flash history, including the severity, frequency, and duration of hot flashes. Each survey was reviewed by the clinic staff for completeness.

At the clinic visit, the staff also measured the participant's blood pressure and recorded data describing any medication taken by the subjects. Waist circumference was measured at the narrowest part of the waist. Hip circumference was measured at the fullest part of the hips. The participant was weighed without shoes in street clothing, rounding down to the nearest 0.5 lb. Height was measured without shoes, rounding down to the nearest 0.5 inch.

Variable definitions

Five outcome variables were examined: (1) ever experiencing hot flashes, (2) hot flashes experienced within the last 30 days, (3) frequency of hot flashes, (4) usual severity of hot flashes, and (5) duration of hot flashes. A participant's "Ever had hot flash" status was determined by her answer to the question: Have you ever had hot flashes? Participants could answer Yes, No, or Don't know. Frequency of hot flashes was determined by the participant's response to: Generally, how often do you experience hot flashes? Participant response choices ranged from every hour to less than a day per month. In our analyses, for those women reporting a history of hot flashes, frequency was dichotomized to >5 days per week and ≤5 days per week. Usual hot flash severity was indicated by the participant through her answer of mild (sensation of heat without sweating), moderate (sensation of heat with sweating), or severe (sensation of heat with sweating that disrupts your usual activity). For our analyses, hot flash severity was dichotomized to those experiencing either moderate or severe hot flashes or those reporting mild hot flashes. Duration of hot flashes was determined by the participant's

response to: Overall, how long have you had hot flashes? Possible responses ranged from <1 month to ≥ 5 years. Duration of hot flashes was dichotomized as >1 year and ≤ 1 year.

The independent variables for this analysis were age at menarche, ever been pregnant, number of live births, age at first birth, age at last pregnancy, and oral contraceptive use. With the exception of oral contraceptive use and ever been pregnant, the other four reproductive factors were initially recorded as continuous variables and subsequently categorized. Age at menarche was reported in years and categorized as ≤ 12 years and ≥ 13 years. Age at first birth was categorized to identify women with late first birth. The groups were defined as ≤ 29 years or ≥ 30 years. A woman's age at last pregnancy was categorized to identify women with late last pregnancies. The groups were defined as ≤ 35 years and ≥ 36 years.

Age was calculated using date of clinic visit and date of birth and categorized into two age groups: 45–49 years and 50–54 years. Race was originally classified as white, black, Hispanic/Latino, Asian/Indian, or other, but due to the small number of nonwhite participants, the variable was dichotomized as white or nonwhite. Marital status was categorized as married or living with a partner vs. single, divorced, widowed, or separated. Education level was classified into three groups: those who attained a college or higher degree, some college or the attainment of a technical degree, and those who had a high school education or less. Total family income was analyzed as <\$50,000 vs. $\geq$ \$50,000; employment status was categorized as not employed vs. employed (full-time or part-time). Body mass index (BMI) was calculated as a continuous variable and categorized into three groups: <24.9 kg/m², 25.0–29.9 kg/m², and ≥ 30 kg/m². Smoking was characterized as never or former vs. current, and current alcohol consumption (at least 12 drinks in the last year) was categorized as yes vs. no.

Statistical analyses

The unadjusted (crude) associations between each reproductive history factor and the measures of hot flash history, frequency, duration, and severity were tested using chi-square tests for categorical variables and Student's *t* tests for continuous variables. Multivariable logistic regression was conducted to adjust for potential confounders (Table 1). The participant age and BMI variables were examined as potential confounders in their continuous form. Variables were included as potential confounders in the regression model if they were associated with a history of hot flashes at $p < 0.10$ or if they were found to be related to reproductive history factors and the occurrence of hot flashes in the published literature. A two-tailed p value <0.05 was considered statistically significant.

Results

Of the 388 women in the analytic sample, the majority were white (84.3%), were married or living with a partner (66.2%), were employed full-time or part-time (82.2%), and reported a total family income of $\geq$ \$50,000 (68.8%) (Table 1). The average age was 49 years, with more than half of the participants between the ages of 45 and 49 years (56.7%); 55.2% indicated that they had achieved a college or graduate degree. The majority of the women reported that they had never smoked or were former smokers (89.9%); 64.7% reported that they had con-

TABLE 1. DEMOGRAPHIC AND LIFESTYLE CHARACTERISTICS OF PERIMENOPAUSAL WOMEN IN THE MIDLIFE HEALTH STUDY ($n = 388$)

Characteristics	n (%) ^a
Demographic characteristics	
Race	
White	327 (84.3)
Nonwhite	59 (15.2)
Age, years	
Mean $\pm$ SD	49.1 $\pm$ 2.4
Median	49
Age group	
45–49 years	220 (56.7)
50–54 years	168 (43.3)
Marital status	
Married or living with partner	257 (66.2)
Single, widowed, divorced, or separated	131 (33.8)
Highest year of schooling	
< College	64 (16.5)
Some college/technical school	110 (28.3)
Graduated college/technical school/graduate level	214 (55.2)
Current employment status	
Employed full-time or part-time	318 (82.2)
Not employed full-time or part-time	69 (17.8)
Total family income	
<\$50,000	116 (29.9)
$\geq$ \$50,000	267 (68.8)
Patient and lifestyle characteristics	
Smoking status	
Current smoker	38 (9.8)
Former smoker or never smoked	349 (89.9)
At least 12 drinks in the last year	
Yes	251 (64.7)
No	137 (35.3)
Obesity (kg/m ²)	
Mean $\pm$ SD	28.6 $\pm$ 7.0
Median	26.8
BMI ≥ 30	134 (34.5)
BMI 25–29.9	107 (27.6)
BMI ≤ 24.9	146 (37.6)

^aThe percent for each characteristic may not total 100% because of missing values.

BMI, body mass index; SD, standard deviation.

sumed at least 12 drinks in the last year. The average BMI was 28.6 kg/m², approximately one third had a BMI of ≥ 30 kg/m².

The average age at menarche was 12.5 years, with more than half of the women (54.1%) reporting experiencing menarche at age ≤ 12 years (Table 2). The majority (86.1%) of the study participants reported at least one pregnancy. More than three quarters of the women (77.8%) had one or more live births. The average age at first live birth was 26.8 $\pm$ 5.7 (mean $\pm$ standard deviation [SD]), with 52.6% of the participants experiencing their first live birth when they were ≤ 29 years of age. The average age at the time of last pregnancy was 31.7 $\pm$ 5.6 (mean $\pm$ SD); 59.3% were ≤ 35 years of age. The majority of the women (81.7%) had used oral contraceptives for ≥ 1 year.

Among the 388 women, 274 (70.6%) reported ever experiencing hot flashes. Almost half (49.0%) of these participants reported experiencing hot flashes within the last 30 days, and 63.1% reported that the majority of their hot flashes were either moderate or severe. Of the 274 women who reported they

TABLE 2. REPRODUCTIVE FACTORS AND HOT FLASH CHARACTERISTICS OF PERIMENOPAUSAL WOMEN IN THE MIDLIFE HEALTH STUDY ($n = 388$)

Factors	n (%)
Reproductive factors	
Age at menarche, years	
Mean $\pm$ SD	12.5 $\pm$ 1.7
Median	12
Age $\leq$ 12	210 (54.1)
Age $\geq$ 13	178 (45.9)
Ever been pregnant	
Yes	334 (86.1)
No	53 (13.7)
Number of live births	
Mean $\pm$ SD	1.6 $\pm$ 1.1
Median	2
None	86 (22.2)
One	76 (19.6)
Two	136 (35.0)
Three or more	90 (23.2)
Age at first birth, years	
Mean $\pm$ SD	26.8 $\pm$ 5.7
Median	27
No live births	86 (22.2)
Age $\leq$ 29	204 (52.6)
Age $\geq$ 30	98 (25.3)
Age at last pregnancy, years ^a	
Mean $\pm$ SD	31.7 $\pm$ 5.6
Median	32
No pregnancies	53 (4.9)
Age $\leq$ 35	230 (64.8)
Age $\geq$ 36	72 (20.3)
Oral contraceptive use, years ^b	
<1	58 (18.1)
1–4	104 (32.5)
5–10	91 (28.4)
>10	67 (20.8)
Measures of hot flashes	
Ever experiencing hot flashes	
Yes	274 (70.6)
No	114 (29.4)
Experienced hot flashes in the last 30 days	
Yes	190 (49.0)
No	196 (50.5)
Hot flash frequency, of those ever experiencing a hot flash	
$\geq$ 5 days/week	81 (29.6)
<5 days/week	177 (64.6)
Hot flash severity, of those ever experiencing a hot flash	
Moderate to severe	173 (63.1)
Mild	100 (36.5)
Hot flash duration, of those ever experiencing a hot flash	
$\geq$ 1 year	171 (62.4)
<1 year	95 (34.7)

^aDoes not include women with a pregnancy but no live birth ($n = 33$).

^bAmong those reporting oral contraceptive use.

The percent for each characteristic may not total 100% because of missing values.

had experienced hot flashes, 81 (29.6%) indicated having hot flashes on $\geq$ 5 days of a week. Additionally, 171 (62.4%) women reported they had experienced hot flashes for $\geq$ 1 year.

Bivariate analyses showed that nonwhite race (odds ratio [OR] 1.76, 95% confidence interval [CI] 1.00–3.10), older age

(OR 1.11, 95% CI 1.02–1.21), being married or living with a partner (OR 0.63, 95% CI 0.41–0.96), less education (OR 1.65, 95% CI 1.09–2.47), lower income (OR 2.28, 95% CI 1.45–3.58), having at least 12 drinks in the last year (OR 0.63, 95% CI 0.41–0.96), and a BMI of $\geq$ 30 kg/m² (OR 2.07, 95% CI 1.25–3.35) were significantly associated with experiencing hot flashes in the last 30 days. Other statistically significant associations included having at least 12 drinks in the last year and ever experiencing hot flashes (OR 0.59, 95% CI 0.36–0.96), older age and experiencing frequent hot flashes (OR 1.21, 95% CI 1.08–1.36), current cigarette smoking and more severe hot flashes (OR 3.18, 95% CI 1.17–8.58), and having a BMI of $\geq$ 30 kg/m² (OR 2.34, 95% CI 1.28–4.26) and experiencing hot flashes for $>$ 1 year.

Unadjusted analyses showed that none of the characteristics of reproductive history analyzed, including age at menarche, number of live births, ever having been pregnant, age at first birth, age at last pregnancy, and history of oral contraceptive use, were significantly associated with any of the hot flash outcome variables. However, after adjusting for race, age, marital status, education, employment, total family income, smoking and alcohol status, and BMI (Table 3), participants who reported that they were $\geq$ 36 years of age at the time of their last pregnancy were significantly less likely to report moderate or severe hot flashes compared to women aged $\leq$ 35 years at the time of their last pregnancy (OR 0.36, 95% CI 0.16–0.84). All other characteristics of reproductive history were not significantly associated with ever experiencing hot flashes, hot flashes experienced in the last 30 days, frequent hot flashes, moderate or severe hot flashes, or hot flashes experienced for $\geq$ 1 year after adjusting for potential confounders.

Additional analyses were performed that evaluated age at first birth as a continuous variable among participants who reported having given birth and the hot flashes outcomes. In the multivariate models that evaluated the associations between age at first birth and the five hot flashes outcomes, age at first birth was not significantly associated with any of the hot flashes variables. Additional analyses were also performed using age at last pregnancy as a continuous variable among participants who had reported a pregnancy. Age at last pregnancy was significantly associated with only one of the five hot flashes outcomes (ever experienced hot flashes: OR 0.93, 95% CI 0.88–0.98).

Discussion

In this study, women who reported that their age at last pregnancy was $\geq$ 36 years were less than half as likely to report moderate to severe hot flashes as those who experienced their last pregnancy at age $\leq$ 35 years of age. This statistically significant association is similar to findings of a decreased risk of midlife hot flashes associated with older age at last pregnancy reported by Staropoli et al.²³ and Schwingl et al.,¹⁹ although in both of these previously published studies, the risk estimate associated with older age at pregnancy was not statistically significant (34–46 years of age vs. 18–27 years of age at last pregnancy: OR 0.6, 95% CI 0.2–1.3²³; ($\geq$ 40 years of age vs. $<$ 40 years of age: OR 0.8¹⁹; $p = 0.05$). It is possible that women reporting an older age at last pregnancy also transition through menopause later, and, therefore, particularly in this study at the time of enrollment, these women may not have yet begun to experience hot flashes as frequently and

TABLE 3. ASSOCIATION BETWEEN REPRODUCTIVE FACTORS AND HOT FLASH CHARACTERISTICS

Reproductive factors	Hot flash characteristics ^a				
	Ever experienced (n = 388)	Recent ^b (n = 386)	Frequency ^c (n = 258) ^d	Intensity ^e (n = 273) ^d	Duration ^f (n = 266) ^d
Age at menarche, years	0.98 (0.85-1.12)	1.05 (0.93-1.20)	1.08 (0.91-1.28)	0.95 (0.81-1.12)	1.12 (0.95-1.31)
Number of live births					
None	Reference	Reference	Reference	Reference	Reference
One	1.02 (0.49-2.15)	0.90 (0.46-1.75)	0.90 (0.39-2.09)	0.68 (0.31-1.53)	0.69 (0.31-1.55)
Two	0.78 (0.42-1.47)	0.91 (0.50-1.63)	0.54 (0.25-1.17)	0.83 (0.41-1.70)	0.67 (0.33-1.38)
Three or more	0.73 (0.37-1.46)	0.69 (0.36-1.32)	0.79 (0.33-1.89)	0.60 (0.27-1.37)	1.10 (0.50-2.41)
Ever been pregnant					
Yes	Reference	Reference	Reference	Reference	Reference
No	1.24 (0.64-2.38)	1.27 (0.67-2.39)	0.69 (0.30-1.58)	0.69 (0.32-1.49)	0.99 (0.44-2.24)
Age at first birth, years					
≤ 29	Reference	Reference	Reference	Reference	Reference
≥ 30	0.78 (0.43-1.41)	0.79 (0.46-1.38)	0.65 (0.32-1.34)	0.80 (0.41-1.56)	0.88 (0.45-1.70)
No live births	0.92 (0.46-1.82)	0.93 (0.50-1.75)	0.78 (0.34-1.75)	0.59 (0.27-1.28)	0.59 (0.27-1.30)
Age at last pregnancy, years					
≤ 35	Reference	Reference	Reference	Reference	Reference
≤ 36	0.59 (0.33-1.04)	1.01 (0.57-1.78)	1.41 (0.66-2.99)	0.36 (0.16-0.84)	0.86 (0.40-1.84)
No pregnancies	1.07 (0.59-1.93)	1.20 (0.70-2.05)	1.56 (0.78-3.12)	1.16 (0.61-2.21)	1.25 (0.66-2.37)
Oral contraceptive use, years					
< 1	Reference	Reference	Reference	Reference	Reference
1-4	1.32 (0.62-2.80)	1.38 (0.67-2.85)	1.07 (0.38-2.98)	0.78 (0.33-1.89)	0.88 (0.35-2.17)
5-10	1.23 (0.57-2.65)	1.19 (0.57-2.46)	2.19 (0.81-5.94)	1.03 (0.42-2.50)	1.16 (0.46-2.88)
> 10	1.17 (0.52-2.65)	1.02 (0.47-2.20)	1.48 (0.53-4.12)	0.76 (0.30-1.96)	0.83 (0.32-2.19)

^aOdds ratios and 95% confidence intervals adjusted for race, age, marital status, employment status, income, education, smoking status, alcohol consumption, and BMI.

^bRecent: hot flashes reported in the last 30 days.

^cFrequency: hot flashes occurring ≥ 5 days per week.

^dIn participants who ever reported having a hot flash.

^eIntensity: hot flash described as moderate to severe in intensity.

^fDuration: hot flashes occurring for ≥ 1 year.

as severely as participants of a similar age who had their last pregnancy at an earlier age (≤ 35 years). Women reporting an older age at last pregnancy and who experience normal ovulation cycle lengths may also have slower oocyte atresia.²⁵ Slower oocyte atresia or the continuance of normal cycling of estrogen levels could potentially delay or prevent the onset of fluctuating estrogen levels associated with the menopause transition and the resulting thermoregulatory dysfunction that manifests as hot flashes and night sweats.²⁶

All other characteristics of reproductive history examined in this study were not significantly associated with hot flashes in our sample of midlife perimenopausal women. These results are consistent with prior cross-sectional studies, but not longitudinal studies, that found no association between some or all of the same characteristics of reproductive history examined in the current study and ever having hot flashes.^{19,22,23} For example, Schwingl et al.¹⁹ found no association between hot flashes and both age at menarche and number of live births. The women included in the Schwingl et al. study were population-based controls for a central North Carolina breast and endometrial cancer case-control study; these women were premenopausal, perimenopausal, and postmenopausal women aged 41–75 years, with a mean age of 58.4 years. Despite the older ages of the participants and inclusion of postmenopausal women, the associations between hot flashes and both age at menarche and number of live

births were not statistically significant, as were the associations reported in our study.

In contrast to findings from our study, results from longitudinal studies^{15,16,27} with sample sizes ranging from 660 to 812 women showed statistically significant associations between increasing number of live births and reports of experiencing or being bothered by hot flashes. Our nonsignificant finding occurred despite our sample being similar to earlier longitudinal study populations with regard to age, menopausal transition stage, and education level; the different study outcomes may reflect the difference in study design (longitudinal vs. cross-sectional). Other important predictors of hot flashes found in previous studies include premenstrual symptoms, race/ethnicity, and country of origin.^{11–13,28,29} Studies of women from countries other than the United States found an inverse association between having a least one live birth and hot flashes.^{3,24} It is not clear if the current study, which was done primarily among white women in the Baltimore metropolitan region, is comparable to studies of these populations outside the United States. Although our study did not assess the relationship between premenstrual symptoms and hot flashes, results of prior studies that have specifically assessed this relationship are inconsistent and may reflect the different aims of the studies.^{11,12}

Although our study indicated that age at last pregnancy is associated with moderate to severe hot flashes, this aspect of a woman's reproductive history is not modifiable. However, it

could be used in conjunction with other modifiable risk factors, such as cigarette smoking or having a BMI of ≥ 30 kg/m², to identify women who may be more likely to experience moderate or severe hot flashes. Therefore, identification of lifestyle characteristics that can be changed or modified and have been shown to be associated with hot flashes would provide broader treatment options for women and healthcare providers.

Limitations and strengths

There are several limitations of this study. First, focusing on perimenopausal women limits the results to women undergoing the menopause transition. This is important because hot flashes can begin during premenopausal stages and peak in early postmenopause.²⁹ There is the potential that women who reported not having hot flashes in the current study may go on to have hot flashes and, thereby, be misclassified in this analysis. Second, the study sample was relatively small; therefore, we may have had limited power to detect certain small but important associations. Third, the majority of the study sample was white and of relatively high socioeconomic and education status; hence, the results are not generalizable to the population of all midlife women. A lack of generalizability of our findings to other races/ethnicities is especially important because studies have shown nonwhite women to have a higher frequency of reporting hot flashes in comparison to white women.^{11,29} Volunteer bias is also possible, as participation required women to respond to a mailed invitation by telephoning the clinic. Those who responded to the invitation may be different (i.e., already experiencing hot flashes) than nonvolunteers. They could also have different risk factors and be more motivated and concerned about their health.

Despite these limitations, this study had a number of strengths. A notable strength is that this study characterized hot flashes by frequency, severity, and duration and analyzed the association between each characteristic of reproductive health history and these outcomes. To our knowledge, the analysis of reproductive history characteristics with the more detailed hot flashes outcomes has not been conducted in previous studies.

Conclusions

In this study, only age at last pregnancy was associated with moderate to severe hot flashes; this finding is consistent with the results of earlier published studies. Although older age at last pregnancy was associated with a lower likelihood of reporting moderate to severe hot flashes, it is a nonmodifiable risk factor. Thus, in women for whom hormone treatment is contraindicated, having a heightened awareness of age at last pregnancy in conjunction with early aggressive lifestyle changes (e.g., weight loss and smoking cessation) would provide alternative treatment plans and options for hot flash amelioration. Additional studies are needed to confirm these findings in broader populations of midlife women. Such research will increase the understanding of the etiology of hot flashes and may lead to better treatments for menopausal symptoms.

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Disclosure Statement

The authors have no conflicts of interest to report.

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