



Short communication

Perimenstrual chocolate craving. What happens after menopause?

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ABSTRACT

About half of American women crave chocolate, and approximately half of the cravers crave it specifically around the onset of menstruation. This study examines whether the primary cause of this “perimenstrual” craving is a direct effect of hormonal changes around the perimenstrum, or rather if the craving is a general response in some individuals to stress or other notable events. Insofar as there is a direct hormonal effect, one would predict a substantial decrease of 38% in total chocolate craving in women post-menopause, corresponding to the proportion of women pre-menopause who report craving chocolate exclusively perimenstrually. Based on a survey of pre- and post-menopausal alumnae of the same University, we report a significant but small decrease in prevalence of chocolate cravings post-menopause. The decrease is only 13.4% and thereby much smaller than a 38% drop predicted by a purely hormonal explanation, suggesting that female reproductive hormones are not the principal cause of perimenstrual chocolate craving.

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Food cravings are a common phenomenon and occur in an estimated 94% of female and 75% of male undergraduate students in the United States (U.S.) (Zellner, Garriga-Trillo, Rohm, Centeno, & Parker, 1999). In a sample of U.S. women ages 20–37, 82% reported experiencing food cravings (Rodin, Mancuso, Granger, & Nelbach, 1991). Cravings are generally more prevalent in women than men and decrease somewhat with age, with 100% of young women and 70% of young men craving any food or drink, compared to 66% of older women and 62% of older men (Pelchat, 1997).

Chocolate is the most commonly and intensely craved food in North American countries (Weingarten & Elston, 1990). There are marked gender differences in the prevalence of chocolate craving, with approximately 90% of American women having craved chocolate at some point, compared to about 60% of men (Osman & Sobal, 2006), and 45% of American undergraduate women but only 17% of American undergraduate men craving chocolate regularly (Zellner et al., 1999). Gender differences prevail across generations with a survey of undergraduates and their parents finding 54% of daughters and 60% of mothers, but only 20% of sons and 24% of fathers craving chocolate (Rozin, Levine, & Stoess, 1991).

In American women, about half of cravings for chocolate occur perimenstrually (Bruinsma & Taren, 1999; Henderson, Rozin, Gale, & Freeman, in preparation; Hill & Heaton-Brown, 1994; Mercer &

Holder, 1997; Rozin et al., 1991; Zellner, Garriga-Trillo, Centeno, & Wadsworth, 2004), with a marked increase in craving beginning a few days before and extending into the first few days of menses. Since the incidence of chocolate craving in women is about twice that of men, and since about half of women crave chocolate perimenstrually, the striking gender difference in chocolate craving is attributable to the added presence of perimenstrual craving in women.

Hormonal factors may lead directly to an increase in the frequency and intensity of chocolate cravings specifically at the time of the perimenstrum. Women with regular menstrual periods undergo hormonal fluctuations such that there is an increase in levels of estrogen and progesterone during the periovulatory and midluteal phase, with estrogen levels peaking at the time of ovulation. This increase is followed by a drop in levels of both hormones during the luteal phase and lasting into menstruation. A natural hypothesis is that there is a direct link between hormonal changes and chocolate craving, such that a cyclic fall in the estrogen estradiol and/or progesterone induces perimenstrual chocolate cravings. An earlier study (Pelchat, 1997) found chocolate craving to be most prevalent in young (age 18–35) women, compared to prevalence rates in older (age 65+) women, and in young and elderly men, suggesting a role of ovarian hormones in influencing cravings. However, chocolate craving was not uniquely associated with the menstrual cycle, compared to a range of other sweet and savory foods (Pelchat, 1997). It has also been demonstrated that there is no significant link between levels of estradiol and the number, frequency, or types of cravings (Rodin et al., 1991), and exogenous administration of progesterone does

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not significantly reduce perimenstrual cravings (Michener, Rozin, Freeman, & Gale, 1999).

There is no doubt that chocolate contains many biologically active compounds, including the arousing substances caffeine, theobromine, tyramine and phenethylamine. It is interesting that unlike the case of coffee, where pharmacological effects are pronounced and often referred to by coffee users, the typical lay account for chocolate consumption is based on its sensory appeal, and not any of its pharmacological effects. Chocolate is extremely appealing in its unique sensory properties, including its melt-in-your-mouth texture, sweetness and fragrant aroma. For scientists, the undoubted pharmacological activity in chocolate is a strong temptation to account for its use in these terms. However, there is evidence that reduction of chocolate craving when chocolate is ingested results from the sensory experience of chocolate, and not its post-ingestive effects (Michener & Rozin, 1994). Of course, even if satisfaction of chocolate craving is sensory, it is possible that the initiation of the craving has a pharmacological origin. We believe that the preponderance of evidence favors a sensory account for the popularity of chocolate as a form of self-reward or indulgence, and/or as a means of coping with stress by inducing pleasure.

A reasonable next step in exploring pharmacological/physiological versus sensory causes of chocolate craving is to evaluate the nature of chocolate cravings in women without a regular menstrual cycle. If hormonal changes associated with ovulation and menstruation are somehow directly and causally involved with perimenstrual chocolate craving, then the prevalence of chocolate cravings should drop markedly post-menopause.

Following irregular production of estrogen, progesterone and testosterone during peri-menopause, in menopause a woman's ovaries cease production of the estrogen hormones and progesterone altogether, resulting in the absence of cyclical hormonal fluctuations. Hormone replacement therapy, consisting of artificially boosting levels of estrogen, progesterone or progestin, in part to maintain the presence of a cyclic drop in progesterone (i.e. when progesterone pills are discontinued periodically), is sometimes prescribed to peri- and post-menopausal women experiencing adverse symptoms.

To our knowledge chocolate cravings have not been explored in women post-menopause to assess the presence, prevalence, temporal patterns, and perceived triggers of these cravings. Based on previous findings that suggest no direct link between perimenstrual hormone levels and chocolate craving in women pre-menopause it is hypothesized that women post-menopause continue to experience chocolate cravings even without menstruation. The link between menstruation and chocolate craving may result from the fact that for many women, menstruation is a stress, and that chocolate craving is stimulated by any form of stress. A link between craving and stress might also account for cyclically occurring cravings for sweets (Henderson et al., in preparation; Rozin et al., 1991; Weingarten & Elston, 1990), alcohol (Epstein et al., 2006) and cigarettes (Carpenter, Upadhyaya, LaRowe, Saladin, & Brady, 2006; Franklin et al., 2004). Furthermore, menstruation may be a socially sanctioned "excuse" to indulge in a highly calorically dense food, and thus comes to be used by women as a plausible and acceptable reason to consume chocolate.

Method

University of Pennsylvania alumnae, selected randomly from pre-specified graduating classes (1946/1947, 1962/1963 and 1984/1985) to include women pre- and post-menopause were sent an anonymous questionnaire. The return rate was 35.0%, yielding a total of 280 respondents (93.9% Caucasian), aged approximately 46 ($M = 45.81$, $S.D. = 0.93$; $n = 89$, 31.8% of sample), 63 ($M = 63.35$, $S.D. = 2.49$; $n = 154$, 55.0%) and 82 years ($M = 81.76$, $S.D. = 1.80$; $n = 37$, 13.2%). For convenience, because we targeted

groups of age 45, 65 and 80 (in terms of year of graduation), we refer to these three groups by these target age numbers.

Participants provided demographic information, including age and ethnicity, weight and height, ideal weight, and dieting habits ("Are you currently on a diet to lose weight?"), regularity of periods ("Do you have regular monthly periods?"), menopause status ("If you do not have regular monthly periods, are you (please circle one): In menopause, past menopause, or other?"), and use of hormonal birth control or hormone replacement therapy ("Are you currently using hormonal birth control, such as the pill or the patch?" and "If you are in menopause, are you on any form of hormone replacement therapy? If yes, which?"). None of the 65- and 80-year-old women and 82% ($n = 73$) of the 45-year-old respondents reported regular monthly periods, supporting the appropriateness of the sample selected. The 18.0% ($n = 16$) of the premenopausal women with absent or irregular periods, 14.1% ($n = 12$) of the premenopausal women currently on hormonal birth control (one woman received depo injections, four had hormonal intra-uterine devices, and the other seven used a variety of hormonal birth control pills), and 13.1% ($n = 25$) of the post-menopausal women currently using hormone replacement therapy were excluded from all analyses, leaving 62 women age 45 (27.2% of the total sample), 130 women age 65 (57.0%), and 36 women age 80 (15.8%) included in all comparisons.

Participants rated their liking for chocolate (on a 0–9 Likert scale, ranging from "0 = dislike extremely" to "9 = like extremely"), occurrence of food and drink cravings ("Do you crave any food or drink?" and "If so, what is your strongest craving for"), and frequency and intensity of chocolate cravings (rated on two separate Likert scales, ranging from "0 = never crave chocolate" to "5 = crave chocolate more than once a day," and from "0 = no cravings" to "4 = extreme cravings"). These rating scales have been used previously in our laboratory to identify chocolate cravers and to gauge overall severity of the craving experience.

Participants described any temporal patterns in their cravings, including whether or not they found their chocolate cravings to be (or to have been in the past) related to their menstrual cycle. Women who reported such a connection were asked to indicate times during the cycle at which cravings peaked, by checking off boxes corresponding to the days of the menstrual cycle, starting with "1 = first day of menstruation" to "28 = day before menstruation." If participants did not think there was any link but still craved chocolate they were asked to describe any other temporal patterns and triggers for their chocolate cravings in an open-ended question format ("If you experience any chocolate cravings, do you feel that they occur at any specific point in time, i.e. time of year, month, day, etc.?"). Responses were coded according to types of patterns and triggers identified (e.g. "time of day" or "mood states").

To establish the extent by which chocolate craving prevalence is expected to drop based on a hormonal account, the proportion of women pre-menopause who crave exclusively perimenstrually was determined. Of all women pre-menopause who reported any chocolate craving, 38.0% indicated craving exclusively perimenstrually, meaning only during the 4 days prior to and the first 4 days of menses and not at any other time of the cycle or in any other, non-cyclical fashion. In support of a hormonal account of cravings and with the absence of all previously perimenstrual cravers we would thus need to see an approximately 38% drop in craving prevalence post-menopause.

Results

Chocolate liking and craving

Respondents on average liked chocolate "very much" ($M = 8.08$, $S.D. = 1.08$, on a scale of "0 = dislike extremely" to "9 = like

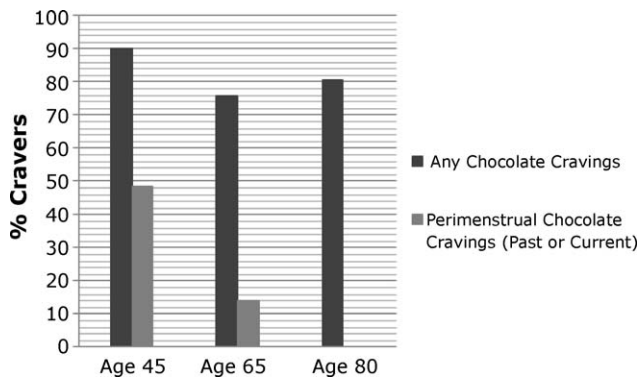


Fig. 1. Prevalence (%) of any chocolate cravings and perimenstrual chocolate cravings (past or current) in women age 45, 65, and 80.

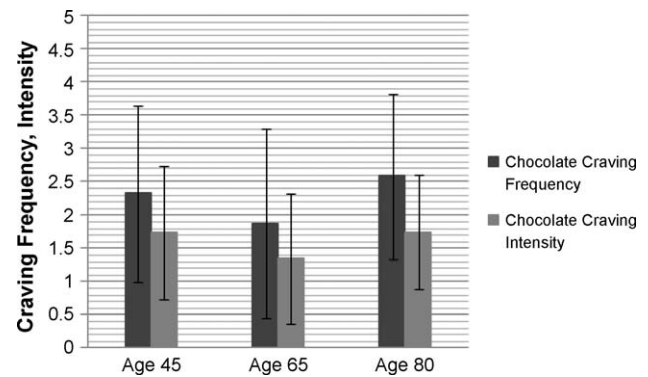


Fig. 2. Mean frequency (scales 1–5) and intensity (scales 1–4) of chocolate cravings in women age 45, 65, and 80 (S.D. error bars).

extremely”), with no significant differences or age-related trends in liking between women age 45 ($M = 8.23$, $S.D. = 1.12$), 65 ($M = 7.97$, $S.D. = 1.10$), and 80 [$M = 8.22$, $S.D. = 0.87$; $F(2,225) = 1.58$, $p = 0.21$, $\eta^2 = 0.01$]. There was a significant differences between women in the different age groups in the reported prevalence of *any* chocolate cravings ($\chi^2 = 5.43$, $p = 0.03$), with 90.2% of the 45-year-old women, 75.8% of women age 65, and 80.6% of the 80-year-olds reporting a craving frequency of at least “once a month” on the craving frequency scale (Fig. 1). Combining all post-menopausal women, 76.8% ($n = 126$) reported any chocolate craving, compared to 90.2% ($n = 55$) of premenopausal women ($\chi^2 = 5.03$, $p = 0.02$). Thus, a very modest reduction in cravings occurs following menopause, providing some evidence favoring a modest role for hormones in perimenstrual craving; however, post-menopausal craving prevalence remains much higher than what would be expected following the 38% drop predicted by an exclusive hormonal account.

Women age 80 reported the most frequent chocolate cravings ($M = 2.59$, $S.D. = 1.24$ on a 0–5 scale), compared to women age 65, who indicated the least frequent cravings ($M = 1.88$, $S.D. = 1.42$, post hoc $p = 0.03$). Women age 45 did not differ significantly from the two other age groups in reported craving frequency [$M = 2.32$, $S.D. = 1.32$; $F(2,208) = 4.36$, $p = 0.01$, $\eta^2 = 0.04$]. There were significant differences in reported craving intensity [$F(2,188) = 3.87$, $p = 0.02$, $\eta^2 = 0.04$], with women age 65 reporting significantly less intense cravings than women age 45 ($M = 1.34$, $S.D. = 0.97$ vs. $M = 1.73$, $S.D. = 1.00$, post hoc $p = 0.05$). Women age 80 did not differ significantly from the younger women in reported craving intensity ($M = 1.74$, $S.D. = 0.86$) (Fig. 2). Overall, women premenopause reported significantly more intense cravings than women post-menopause [Pre: $M = 1.73$, $S.D. = 1.00$ vs. Post: $M = 1.41$, $S.D. = 0.96$; $t(189) = 1.96$, $p = 0.05$], with no significant differences between the two groups in reported frequency of cravings [Pre: $M = 2.32$, $S.D. = 1.32$ vs. Post: $M = 2.03$, $S.D. = 1.41$; $t(209) = 1.36$, $p = 0.18$].

Prevalence of current or past perimenstrual chocolate cravings

There was a significant difference in the number of women in each age group who perceived their current or past (i.e. premenopausal) chocolate cravings as being related to their menstrual cycle ($\chi^2 = 41.53$, $p \leq 0.001$). Women age 45 were most likely to report a link between their chocolate cravings and their menstrual cycle (48.4%, $n = 30$); only 13.8% ($n = 18$) of 65-year-old women and none of the 80-year-old women saw their past chocolate cravings as having been related in some way to their menstrual cycle pre-menopause (Fig. 1).

Of all women who perceived a link between their chocolate cravings and the menstrual cycle either currently or in the past

(21.1%, $n = 48$), 81.3% ($n = 39$ of 48) reported that these cravings occur or occurred perimenstrually, i.e. several days before and several days into the onset of menses. The remaining 18.8% ($n = 9$) either perceived cravings to be strongest at some other time of the cycle (most notably around ovulation), or did not specify a particular time at which cravings increased. There was a significant difference in prevalence specifically of current or past (i.e. premenopausal) perimenstrual chocolate cravings, with women age 45 reporting a much higher incidence (41.9%, $n = 26$), compared to memories of women age 65 (10.0%, $n = 13$) and 80 (none) ($\chi^2 = 39.02$, $p \leq 0.001$; $\chi^2 = 37.03$, $p \leq 0.001$ when comparing 41.9%, $n = 26$ of pre-menopausal perimenstrual cravers to 7.8%, $n = 13$ remembered perimenstrual craving post-menopause). Note that the 45-year-olds are confirming the previously established incidence of perimenstrual craving (about 50% of adult American women chocolate cravers), and that the anomaly here comes from the *remembered* link for the older women.

Twenty-nine women (12.7% of the entire sample) reported craving triggers or temporal patterns unrelated to the menstrual cycle. Of the women age 45, 6.5% ($n = 4$) reported non-cyclical triggers, as did 16.2% ($n = 21$) of the 65 and 11.1% ($n = 4$) of the 80-year-old women ($\chi^2 = 3.66$, $p = 0.16$). Thus, marginally significantly more post-menopausal women reported past or current non-cyclical craving triggers (15.1%, $n = 25$), compared to the premenopausal respondents (6.5%, $n = 4$; $\chi^2 = 3.01$, $p = 0.06$). The temporal patterns and triggers unrelated to the menstrual cycle reported by women included craving during particular mood states (e.g. “when I’m stressed”) (39.3% of the 29 women who reported other triggers, $n = 11$), at specific times of day (e.g. “right before bedtime”) (21.4%, $n = 6$), other seasonal patterns (e.g. “I crave most during the winter”) (14.3%, $n = 4$), craving after a meal (10.7%, $n = 3$) or during holidays (7.1%, $n = 2$), and “other” factors (7.1%, $n = 2$).

Discussion

Pre-menopausal women reported a significantly higher prevalence of chocolate cravings, compared to their post-menopausal counterparts, though importantly not high enough to support anything like a complete “physiological” or exclusively hormonally based explanation for these cravings.

The sizeable proportion of women in all age groups who report chocolate and other cravings indicates that the notion of “craving” is not generation-specific, but rather an experience that is familiar to women at any age. There were no significant differences by age in liking for chocolate which rules out a marked impact of generational factors, such as limited access to chocolate or experiences with chocolate of lower quality in older women who grew up in the depression and post-war eras.

The most notable differences by age were in the self-reported patterns of and triggers for chocolate craving identified by women. The prevalence of self-reported perimenstrual craving (current in premenopausal women and past in post-menopausal women) was highest and in the expected range (based on previous studies) in the 45-year-old women. In women post-menopause on the other hand, there were very few reports of prior, pre-menopause chocolate cravings that were thought to be related to the menstrual cycle. This could be due either to an actual absence or to a lack of recall of any perimenstrual cravings premenopausally. The latter assumption is supported by the fact that reports of past perimenstrual cravings are low in the 65-year-old women but absent entirely in the 80-year-old women.

Regardless of which explanation is accurate it is important to note that even though the perceived triggers for cravings changed as a function of menopause status, the anticipated almost 38% of exclusively perimenstrual chocolate cravings pre-menopause that would be expected to disappear at menopause, if primarily hormonally caused, did not materialize. Craving prevalence did not decrease simply by the approximate proportion of premenopausal perimenstrual cravers (i.e. leaving only the women who craved non-perimenstrually prior to menopause). Instead, the drop in prevalence from pre- to post-menopause reported here was a mere 13.4%, and most of the women post-menopause (76.8%) continued to crave chocolate and attributed these cravings to a variety of triggers, including negative mood states and seasonal factors.

Along with the prior literature cited in the introduction, our results suggest that the *principal* cause of perimenstrual chocolate craving is not hormonal state *per se*. Rather, a major effect of low perimenstrual hormone levels may be to produce mood changes or dysphoria, which may prompt chocolate consumption as a reward or a means of coping. That the perimenstrum induces craving as a function of the accompanying dysphoria or stress, is supported by the fact that perimenstrual chocolate craving occurs in a higher incidence of women with pre-menstrual syndrome (Henderson et al., in preparation) than in other premenopausal women who do not suffer from this disorder. If the perimenstrum functions primarily as a salient source of stress or dysphoria, then it should be true that perimenstrual cravers should be able to identify other stresses or mood changes that also induce chocolate craving. Very few (6.5%) of such accounts were given by 45-year-old perimenstrual (or non-perimenstrual) cravers. Such accounts were more common in the post-menopausal women, who, at the same time, rarely remembered craving perimenstrually. So it is possible that if individuals report a craving trigger, they typically report only the most salient recent cause.

It is also possible that the non-perimenstrual cravers are manifesting a different type of craving from the perimenstrual cravers. The non-perimenstrual cravers, and craving men for that matter, may just love chocolate. The perimenstrual cravers may on the other hand use chocolate as a coping mechanism (see Hormes and Timko, in preparation, for evidence for this distinction between two types of chocolate cravers). If most of the perimenstrual cravers are craving because of perimenstrual stress or dysphoria, then we would expect that post-menopausal women who were perimenstrual cravers, and only those women, would report mood or stress triggers for their chocolate cravings. Of course, it is also a very reasonable view that some chocolate craving is induced by hunger or by expectations after completing the savory portion of a meal. This may be primarily true in the non-perimenstrual cravers, and may escape mention, because it is natural to crave food more when hungry.

Post-menopausal women show only a very modest decrease in chocolate craving. This modest decrease, in the face of no drop in

the liking for chocolate, may be due in some small part to the absence of a direct effect of female hormone changes in these women. But our results suggest that the perimenstrum is linked to chocolate craving because for some women, chocolate is a way to deal with the stress or dysphoria associated with menstruation. Use of chocolate to cope with or compensate for such experiences is a culturally supported response in North America. In North America, where chocolate has the property of being a “forbidden food” for many women, discomfort may license its consumption.

If our hypothesis of stress/dysphoria as a major stimulus for chocolate craving in a subset of North American women is correct, then it should be possible to document that other stresses or mood changes cause chocolate craving in these women, and that the more stressful the perimenstrum, the more likely chocolate craving will accompany it (note some evidence that this is the case, cited above). It is often the case that what we study is multiply caused, and that what we originally take as a natural single class of phenomena (e.g. chocolate craving) turns out to be multiple phenomena.

Conflict of interest

The authors declare no competing financial interests.

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Contributions: JMH and PR designed the study and wrote the paper. JMH conducted the data collection and statistical analyses.

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