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Menopausal hot flashes, with varying degrees of severity, are a significant concern for women across the world. As many as 75% of menopausal women report hot flashes and 85% of these women will experience them for more than one year. These symptoms may continue to occur for 5 years or more (1). Episodes may last from 30 seconds to five minutes, generally averaging four minutes. Occurrence appears to be more common among African American women than Caucasian, Japanese, Hispanic, or Chinese women, while Mayan Indian women report no symptoms associated with menopause (2). Geographic variation in the frequency of this phenomenon may be related to the diet and lifestyle of the area (3). However, little research is available on the relationship of these factors to hot flashes.

While the exact cause and mechanism is not well understood, there is a prevailing theory. Studies have shown that as estrogen levels are decreased in women, due to surgery, chemicals, or age, the temperature regulation mechanism in the hypothalamus is affected. As a result the core body temperature is lowered, and the threshold between acceptable and unacceptable body heat levels is more easily crossed. This causes signals to be sent to the rest of the body to release heat, causing perspiration from the sweat.
glands, leading to the dramatic rise in skin temperature associated with menopausal hot flashes (2).

Several factors have been studied for their contributions to the severity and frequency of hot flashes in menopausal women. Among those are dietary intake, biological factors, and modifiable behaviors. With new data emerging regarding the association between these factors and characteristics of menopausal hot flashes, the need to more clearly define lifestyle recommendations for menopausal women has arisen.

**Problem Statement**

The purpose of this research study was to examine the effects of consumption of beverages (caffeinated and alcoholic) and physical activity on the frequency and severity of hot flashes in peri-menopausal, menopausal, and post-menopausal women by conducting an on-line survey of women over the age of 40 employed at a Midwestern University. The 26-itemized Women’s Health Survey (WHS) detailed usual caffeine intake, alcohol intake, physical activity level as well as characteristics of hot flashes.

The following research questions were answered in this study:

1. Was there a cumulative effect of beverages and physical activity frequency and severity of hot flashes?
2. Was there a significant relationship between physical activity level and the frequency and severity of hot flashes?
3. Was there a significant relationship between caffeinated beverage intake and the frequency and severity of hot flashes?
4. Was there a significant relationship between alcohol consumption and the frequency and severity of hot flashes?

**Rationale**

There are more than 40 million women in the United States over the age of 40, and 75% of women over the age of 50 will most likely experience hot flashes to some degree. It is estimated that approximately 46 million women in the United States will have reached menopause by the year 2020 (3). For some women, eight to ten flashes a day is not uncommon, interfering with their daily lives (4). Women with hot flashes are more likely to experience disturbed sleep, depressive symptoms and significant reductions in quality of life as compared to asymptomatic women (5). In recent years, limited studies have investigated the effects of alcohol, caffeinated beverages and physical activity on hot flashes.

Studies have also demonstrated a link between severity and frequency of physical activity and characteristics of hot flashes. Some have found that increased activity leads to increase in menopausal symptoms; while others show that a more active lifestyle may lead to a decrease in occurrence (6-10). According to current studies, women have reported consumption of alcohol (9-11) as precursors to hot flashes, with research both supporting and refuting this claim (2-5). Others report a link between caffeine ingestion and this menopausal symptom; however minimal research has been completed on this factor (7).

Several studies examining the frequency and severity of hot flashes have been completed (4-16). However, to date, to the best of this researcher’s knowledge, no
studies have been done specifically related to all three variables (caffeinated beverages, alcohol, and physical activity) and their effects on frequency and severity of hot flashes in pre-menopausal, peri-menopausal, menopausal, and post-menopausal women. Limited understanding of factors associated with vasomotor symptoms has slowed development of alternate methods for treating hot flashes. Therefore there is an emerging need for research directly related to these behaviors and their association with menopausal hot flashes.

The findings of this study will enable women to be better prepared to handle the challenges caused by hot flashes as well as become more knowledgeable on the topic. This research may allow menopausal women to use healthy alternative therapies rather than treatments that may precipitate detrimental side effects.

Definitions

For the purpose of this study the following definitions were used:

- **Hot flash, hot flush, vasomotor symptoms (VMS)** - a transient episode of flushing, sweating, and a sensation of heat, often accompanied by palpitations and a feeling of anxiety, and sometimes followed by chills (2)

- **Pre-Menopause** - regular menstrual cycle (1)

- **Peri-menopause** - last menstrual period within the last 3 months (1)

- **Menopause** - no menstrual periods for 12 consecutive months and no other biological or physiological cause can be identified (1)

- **Post-menopause** - last menstrual period more than 12 months ago (1)

- **Hot flash severity** - level or degree of hot flash (1)
- **Mildly severe hot flash**—a warm sensation without sweating or disruption of normal activity (2)
- **Very severe hot flash**—heat sensation with sweating that may have interrupted daily activities (2)
- **Frequency of hot flash**—number of times an event occurs (1)
- **Physical activity**—aerobic (running, walking, hiking, swimming, etc) or anaerobic strength (weight lifting, Pilates, etc) activity (2)
- **Mild intensity physical activity**—don’t break a sweat during activity
- **Moderate intensity physical activity**—break a light sweat, heart rate increased
- **Heavy intensity physical activity**—break a sweat, heart rate very increased

**Assumptions**

For this research study, the following assumptions were made:

- Participants were literate.
- Participants understood survey questions as intended.
- Participants answered survey questions honestly.

**Limitations**

For the purpose of this study, the following limitations existed:

- Self-reported severity and frequency of hot flashes may vary among participants.
- Sample selection was limited to female employees at Ball State University.
- Results may not be applicable to other populations.
Summary

Hot flashes are a significant concern among menopausal women. Many women between the ages of 40 and 65 years will experience the characteristics of menopause. While hot flashes are a part of the natural biologic process of menopause, their exact mechanism is not well understood. It is postulated that changes in the hypothalamus lead to characteristics such as dramatic rise in skin temperature, flushed appearance, rapid heartbeat, and perspiration.

Several lifestyle factors may contribute to the frequency and severity of hot flashes in menopausal women. Dietary intakes of caffeinated and alcoholic beverages as well as physical activity level have been studied in this regard. Results have not been definitive in the past. Therefore more research is needed to define nutrition and exercise recommendations for menopausal women.

This research examined the effects of beverages and physical activity on the characteristics of hot flashes in women over the age of 40. Methodology is discussed in chapter two. Results and data and data analysis can be found in chapter three, conclusions in chapter four. A complete review of the literature can be found in Appendix A.
CHAPTER II

METHODOLOGY

The purpose of this research study was to examine the effects of consumption of beverages (caffeinated and alcoholic) and physical activity on the frequency and severity of hot flashes in peri-menopausal, menopausal, and post-menopausal women over the age of 40 at a Midwestern university. These groups were selected since research has shown they are the most likely to experience menopausal hot flashes. This study was completed using a survey detailing demographic information, intake of beverages, physical activity, and characteristics of hot flashes.

Participants

Using a sample of convenience, a random sample of female college employees was recruited via email at a Mid-Western university to complete an on-line survey. According to the Executive Director of Academic Assessment at this university, as of the 2008 academic year, there were approximately 400 faculty members in the age range 40-60 plus. Based on this number, the ideal sample for the research is 207. This sample size was determined from a table of recommended sample sizes for populations with finite sizes (17). The inclusion criteria for participants were as follows: a) must be ≥ 40 years of age; b) must be peri-menopausal, menopausal, or post-menopausal as defined
previously in this study; c) must not be taking medications to treat menopausal symptoms; d) must be non-smokers; e) must be literate at the sixth grade level.

**Instrumentation**

The 26-itemized WHS included questions regarding demographic information, stage of menopause, whether participant has experienced hot flashes, average daily intake of caffeinated beverages, alcohol, and physical activity. To ensure the effect reported was due to the beverage in question; subjects were also required to record any intake of caffeinated pills, diet pills containing caffeine, and dark chocolate. The usual frequency of hot flashes per day was recorded. The usual severity of hot flashes was measured with a subjective ten-point rating scale of 1 for “very mild” to 10 for “extremely severe” (Appendix B).

**Data Collection**

The research proposal was submitted to Ball State University’s Institutional Review Board as an exempt approval. After approval, university employees were contacted via their Ball State account, informing them of the following parameters related to the study: their random selection, criteria for participating, purpose of research procedures, and approximate time needed to participate in the study. Employees were informed that by completing and submitting the WHS survey, they were giving their consent. Participants were given one month to complete the survey. Reminders were sent via email after a week of the study. Data was collected and analyzed at the conclusion of the study.
Reliability and Validity

The 26-itemized Women’s Health Survey was accepted for face validity by three experts (two dietitians, one physician). In order to begin to establish reliability, a small (n=20) sample of subjects took the survey twice, with two weeks between each administration. Test-retest results were observed from the same participants to assess similarity of answers for each test. The Kappa coefficients from the test-retest ranged from a low of .439 to 1.00, with a median coefficient of .768. Except for questions 21 and 22, where Kappa could not be calculated due to zero variance in responses, all coefficients were statistically significant.

Data Analysis

For the purpose of this research study, ordinary least squares (OLS) multiple regressions were run separately for hot flash frequency and severity. An overall level of self-reported activity, and average daily caffeine and alcohol intake were the predictors. Additionally, Spearman rank correlations were run separately for each beverage, eliminating those who never consumed the beverage in question. The test for significance was at the p < .05 level.
CHAPTER III

RESULTS AND DATA ANALYSIS

This research examined the effects of consumption of beverages (caffeinated and alcoholic) and physical activity on the frequency and severity of hot flashes in pre-menopausal, peri-menopausal, menopausal and post-menopausal women over the age of 40 at a Midwestern university. This study was completed using a 26-itemized survey detailing demographic information, intake of beverages, physical activity, and characteristics of hot flashes. It was intended to compare characteristics of hot flashes among participants in the different stages of menopause. However, due to relatively small sample size and uneven distribution among the reproductive stages this was unfeasible. It was hoped that data collected from this study regarding these variables would aid in more clearly defining lifestyle recommendations for women to minimize symptoms.

Demographics and Menopausal Characteristics

One-hundred and ninety-six women participated in this study, approaching the projected 207 needed for a 95% confidence level. Subjects were in the following age categories: 40-44 (n=21, 10.7%); 45-49 (n=37, 18.9%); 50-54 (n=54, 27.6%); 55-59 (n=50, 25.5%); 60 years or over (n=34, 17.3%), and the majority was Caucasian (n=187, 95.4%).
Table 1. Demographic information of subjects (n=196)

<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
<th>n*</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>40-44</td>
<td>21</td>
<td>10.7</td>
</tr>
<tr>
<td></td>
<td>45-49</td>
<td>37</td>
<td>18.9</td>
</tr>
<tr>
<td></td>
<td>50-54</td>
<td>54</td>
<td>27.6</td>
</tr>
<tr>
<td></td>
<td>55-59</td>
<td>50</td>
<td>25.5</td>
</tr>
<tr>
<td></td>
<td>60 +</td>
<td>34</td>
<td>17.3</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>White</td>
<td>187</td>
<td>95.4</td>
</tr>
<tr>
<td></td>
<td>African-American</td>
<td>6</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>Hispanic</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Asian/Pacific Islander</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

As seen in Table 2, most participants were in the naturally post-menopausal stage (n=81, 41.3%). Other stages represented included: pre-menopausal (n=32, 16.3%); peri-menopausal (n=28, 14.3%); menopausal (n=11, 5.6%); and post-menopausal due to surgery or chemotherapy/radiation (n=44, 22.4%). Most participants had experienced hot flashes (n=159, 81.1%), and were not taking medications or using alternative therapies to treat menopausal symptoms (n=182, 92.9%; n=179, 91.3%, respectively).
Table 2. Menopausal characteristics of participants (n=196)

<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
<th>n*</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage of Menopause?</td>
<td>Pre-menopausal</td>
<td>32</td>
<td>16.3</td>
</tr>
<tr>
<td></td>
<td>Peri-menopausal</td>
<td>28</td>
<td>14.3</td>
</tr>
<tr>
<td></td>
<td>Menopausal</td>
<td>11</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>Naturally postmenopausal</td>
<td>81</td>
<td>41.3</td>
</tr>
<tr>
<td></td>
<td>Post-menopausal due to surgery/chemo/radiation</td>
<td>44</td>
<td>22.4</td>
</tr>
<tr>
<td>Currently using alternative therapies?</td>
<td>Yes</td>
<td>15</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>179</td>
<td>91.3</td>
</tr>
<tr>
<td>Currently taking medications to treat menopausal symptoms?</td>
<td>Yes</td>
<td>13</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>182</td>
<td>92.9</td>
</tr>
<tr>
<td>Have ever experienced a menopausal hot flash?</td>
<td>Yes</td>
<td>159</td>
<td>81.1</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>36</td>
<td>18.4</td>
</tr>
</tbody>
</table>

* n is not always equal to 196 due to incomplete responses

As seen in Table 3, the majority of participants had experienced 0-3 hot flashes during the last week (n=143, 72.9%) while 13 subjects (6.6%) experienced more than 12 hot flashes. During this time period, subjects rated the usual severity of hot flashes, with 1 being very mild (a warm sensation without sweating or disruption of normal activity; and 10 being very severe (heat sensation with sweating that may have interrupted daily activities). Majority of women surveyed reported severity as very mild (n=118, 60.2%), while 32 (16.3%) rated hot flashes as severe to very severe.
Table 3. Characteristics of hot flashes in the last week (n=196)

<table>
<thead>
<tr>
<th>Frequency</th>
<th>n*</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>83</td>
<td>42.3</td>
</tr>
<tr>
<td>1-3</td>
<td>60</td>
<td>30.6</td>
</tr>
<tr>
<td>4-6</td>
<td>21</td>
<td>10.7</td>
</tr>
<tr>
<td>7-9</td>
<td>7</td>
<td>3.6</td>
</tr>
<tr>
<td>10-12</td>
<td>11</td>
<td>5.6</td>
</tr>
<tr>
<td>13+</td>
<td>13</td>
<td>6.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Severity</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3 (mild)</td>
<td>118</td>
<td>60.2</td>
</tr>
<tr>
<td>4-6</td>
<td>41</td>
<td>20.9</td>
</tr>
<tr>
<td>7-10 (severe)</td>
<td>32</td>
<td>16.3</td>
</tr>
</tbody>
</table>

* n is not always equal to 196 due to incomplete responses

Physical Activity and Beverages

The survey included questions regarding participation in physical activity. In response to the questions, “In the last week, how many times did you participate in 30 minutes of aerobic physical activity,” and “How intense would you rate you participation in aerobic activity,” majority of subjects reported participating 0-2 times per week at moderate intensity (n=110, 56.2%; n=89, 45.4%, respectively). When asked in reference to, “In the last week, how many times did you participate in 30 minutes of strength exercises,” and “How intense would you rate you participation in strength exercises,” majority of women reported participating 0-2 times at light to moderate intensity (not breaking a sweat or breaking a light sweat) (n=178, 60.2%; n=75, 38.3%, respectively) (Table 5).

Also included in the survey were several questions inquiring about consumption of caffeinated products. In response to the question, “In the last week, how many times did you consume caffeinated coffee (8 fluid ounce serving),” majority of women reported
consuming 0-3 servings (n=96, 49.0%). Sixty-one women reported drinking 4-9 servings (31.1%), while 39 (29.9%) drank 10 or more servings of coffee. Responding to the question, “In the last week, how many times did you consume energy drinks (12 fluid ounce serving),” 195 subjects (99.5%) stated they consumed 0-3 servings. When asked, “In the last week, how many times did you consume caffeinated hot tea (8 fluid ounce serving),” most participants reported having 0-3 servings (n=164, 86.2%), with 20 women (22.4%) consuming 4-9 servings of hot tea. In reference to, “In the last week, how many times did you consume caffeinated iced tea (8 fluid ounce serving),” 163 women (83.2%) answered 0-3 servings, while 28 subjects (14.3%) consumed 4-9 servings. When asked “In the last week, how many times did you consume caffeinated soda (12 fluid ounce serving),” most reported drinking 0-3 servings (n=131, 66.8%), while 44 women (22.4%) consumed 4-9 servings. When questioned “In the last week, how many times did you consume hot chocolate/cocoa (8 fluid ounce serving),” 192 women (98%) reported 0-3 servings. Responding to the question “In the last week, how many times did you consume dark chocolate (one ounce serving),” 82.7% reported 0-3 servings (n=162), while 31 (15.8%) reported consuming 4-9 servings of dark chocolate.

In response to the question, “In the last week how many times did you take caffeine pills,” 98.5% (n=193) reported never doing so. When asked, “In the last week, how many times did you take caffeinated diet pills,” 195 women (99.5%) reported never taking them.

Finally, the survey asked participants about their usual consumption of alcohol. In response to the question, “In the last week, how many times did you consume red wine (5 fluid ounce serving),” majority reported consuming 0-3 servings of red wine (n=178,
90.8%). Answering the question, “In the last week, how many times did you consume alcoholic beer products (12 fluid ounce serving),” 189 (96.4 %) reported 0-3 servings. Responding to the question, “In the last week, how many times did you consume white wine/champagne (5 fluid ounces),” majority reported 0-3 times (n=187, 95.4%). In response to the question, “In the last week, how many times did you consume mixed drinks (1.5-2.0 fluid ounce serving),” 191 women (97.5%) reported 0-3 servings (Table 7).

Table 4. Subjects participation in 30 minutes of aerobic physical activity per week (n=196)

<table>
<thead>
<tr>
<th>Variables</th>
<th>n*</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>46</td>
<td>23.5</td>
</tr>
<tr>
<td>1-2</td>
<td>64</td>
<td>32.7</td>
</tr>
<tr>
<td>3-4</td>
<td>48</td>
<td>24.5</td>
</tr>
<tr>
<td>5-6</td>
<td>23</td>
<td>11.7</td>
</tr>
<tr>
<td>7-8</td>
<td>11</td>
<td>5.6</td>
</tr>
<tr>
<td>&gt; 8</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><strong>Intensity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t participate</td>
<td>38</td>
<td>19.4</td>
</tr>
<tr>
<td>Light</td>
<td>47</td>
<td>24</td>
</tr>
<tr>
<td>Moderate</td>
<td>89</td>
<td>45.4</td>
</tr>
<tr>
<td>Heavy</td>
<td>21</td>
<td>10.7</td>
</tr>
</tbody>
</table>

* n is not always equal to 196 due to incomplete responses
Table 5. Subjects participation in 30 minutes of strength exercise per week (n=196)

<table>
<thead>
<tr>
<th>Variables</th>
<th>n*</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>118</td>
<td>60.2</td>
</tr>
<tr>
<td>1-2</td>
<td>60</td>
<td>30.6</td>
</tr>
<tr>
<td>3-4</td>
<td>14</td>
<td>7.1</td>
</tr>
<tr>
<td>5-6</td>
<td>4</td>
<td>2.0</td>
</tr>
<tr>
<td>Intensity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t participate</td>
<td>116</td>
<td>59.2</td>
</tr>
<tr>
<td>Light</td>
<td>39</td>
<td>19.9</td>
</tr>
<tr>
<td>Moderate</td>
<td>36</td>
<td>18.4</td>
</tr>
<tr>
<td>Heavy</td>
<td>2</td>
<td>1.0</td>
</tr>
</tbody>
</table>

* n is not always equal to 196 due to incomplete responses

Table 6. Subjects usual consumption of caffeinated beverages per week (n=196)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Beverage frequency</th>
<th>n*</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caffeinated Coffee (8 fluid ounce)</td>
<td>Never</td>
<td>79</td>
<td>40.3</td>
</tr>
<tr>
<td></td>
<td>1-3 times</td>
<td>17</td>
<td>8.7</td>
</tr>
<tr>
<td></td>
<td>4-6 times</td>
<td>17</td>
<td>8.7</td>
</tr>
<tr>
<td></td>
<td>7-9 times</td>
<td>44</td>
<td>22.4</td>
</tr>
<tr>
<td></td>
<td>≥ 10 times</td>
<td>39</td>
<td>19.9</td>
</tr>
<tr>
<td>Energy Drinks (12 fluid ounce)</td>
<td>Never</td>
<td>192</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>1-3 times</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>4-6 times</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>7-9 times</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>≥ 10 times</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hot Tea (8 fluid ounce)</td>
<td>Never</td>
<td>136</td>
<td>69.4</td>
</tr>
<tr>
<td></td>
<td>1-3 times</td>
<td>33</td>
<td>16.8</td>
</tr>
<tr>
<td></td>
<td>4-6 times</td>
<td>11</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>7-9 times</td>
<td>9</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td>≥ 10 times</td>
<td>7</td>
<td>3.5</td>
</tr>
<tr>
<td>Variables</td>
<td>Beverage frequency</td>
<td>n*</td>
<td>Percent</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------</td>
<td>----</td>
<td>---------</td>
</tr>
<tr>
<td>Iced tea (8 fluid ounce)</td>
<td>Never</td>
<td>116</td>
<td>59.2</td>
</tr>
<tr>
<td></td>
<td>1-3 times</td>
<td>47</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>4-6 times</td>
<td>20</td>
<td>10.2</td>
</tr>
<tr>
<td></td>
<td>7-9 times</td>
<td>8</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>≥ 10 times</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Soda (12 fluid ounce)</td>
<td>Never</td>
<td>70</td>
<td>35.7</td>
</tr>
<tr>
<td></td>
<td>1-3 times</td>
<td>61</td>
<td>31.1</td>
</tr>
<tr>
<td></td>
<td>4-6 times</td>
<td>23</td>
<td>11.7</td>
</tr>
<tr>
<td></td>
<td>7-9 times</td>
<td>21</td>
<td>10.7</td>
</tr>
<tr>
<td></td>
<td>≥ 10 times</td>
<td>19</td>
<td>9.7</td>
</tr>
<tr>
<td>Hot Chocolate (8 fluid ounce)</td>
<td>Never</td>
<td>175</td>
<td>89.3</td>
</tr>
<tr>
<td></td>
<td>1-3 times</td>
<td>17</td>
<td>8.7</td>
</tr>
<tr>
<td></td>
<td>4-6 times</td>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>7-9 times</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>≥ 10 times</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dark Chocolate (1 ounce-wt)</td>
<td>Never</td>
<td>95</td>
<td>48.5</td>
</tr>
<tr>
<td></td>
<td>1-3 times</td>
<td>67</td>
<td>34.2</td>
</tr>
<tr>
<td></td>
<td>4-6 times</td>
<td>18</td>
<td>9.2</td>
</tr>
<tr>
<td></td>
<td>7-9 times</td>
<td>13</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>≥ 10 times</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Caffeine Pills (200mg)</td>
<td>Never</td>
<td>193</td>
<td>98.5</td>
</tr>
<tr>
<td></td>
<td>1-3 times</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4-6 times</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>7-9 times</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>≥ 10 times</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Caffeinated Diet Pills</td>
<td>Never</td>
<td>195</td>
<td>99.5</td>
</tr>
<tr>
<td></td>
<td>1-3 times</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4-6 times</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>7-9 times</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>≥ 10 times</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* n is not always equal to 196 due to incomplete responses
Table 7. Subjects usual weekly consumption of alcohol (servings) (n=196)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Servings</th>
<th>n*</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Wine (5 fluid ounces)</td>
<td>0</td>
<td>144</td>
<td>73.5</td>
</tr>
<tr>
<td></td>
<td>1-3</td>
<td>34</td>
<td>17.3</td>
</tr>
<tr>
<td></td>
<td>4-6</td>
<td>16</td>
<td>8.2</td>
</tr>
<tr>
<td></td>
<td>7-9</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>10-12</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Beer (12 fluid ounces)</td>
<td>0</td>
<td>159</td>
<td>81.1</td>
</tr>
<tr>
<td></td>
<td>1-3</td>
<td>30</td>
<td>15.3</td>
</tr>
<tr>
<td></td>
<td>4-6</td>
<td>5</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>7-9</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>10-12</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>White wine/champagne (5 fluid ounces)</td>
<td>0</td>
<td>141</td>
<td>71.9</td>
</tr>
<tr>
<td></td>
<td>1-3</td>
<td>46</td>
<td>23.5</td>
</tr>
<tr>
<td></td>
<td>4-6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>7-9</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>10-12</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Mixed Drinks (1.5-2.0 fluid ounces)</td>
<td>0</td>
<td>164</td>
<td>83.7</td>
</tr>
<tr>
<td></td>
<td>1-3</td>
<td>27</td>
<td>13.8</td>
</tr>
<tr>
<td></td>
<td>4-6</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>7-9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>10-12</td>
<td>1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

* n is not always equal to 196 due to incomplete responses

Descriptive Statistics

As shown in Table 8, the mean number of hot flashes was 2.2 ± 1.5 per week, while the mean usual severity was 3.26 ± 2.58 on a scale of 1-10, with 1 being very mild (a warm sensation without sweating or disruption of normal activity); and 10 being very severe (heat sensation with sweating that may have interrupted daily activities). Mean participation in 30 minutes of aerobic physical activity was 2.48 ± 1.25 times per week, while mean participation in 30 minutes of strength exercises was 1.51 ± .724 times per week. Total estimated mean caffeine intake, based on reported intake of caffeinated
products, (18) was 1143.74 mg ± 1008.42 mg, while total estimated mean servings of alcohol was 2.52 ± 3.462 servings per week (one serving was defined as 5 fluid ounces wine or champagne, 12 fluid ounces beer, or 1.5-2.0 fluid ounces mixed drink). The median reported weekly intake of caffeine was approximately 1080 mg, while the median weekly intake of alcohol among participants was 1.2 servings.

Table 8.  Mean ± SD of subjects’ hot flash characteristics, physical activity level, and caffeine and alcohol consumption (n=191)

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean ± SD</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the last week, how many hot flashes have you had?</td>
<td>2.20 ± 1.50</td>
<td>191</td>
</tr>
<tr>
<td>In the last week, how would you rate the usual severity of hot flashes (1 being very mild, and 10 being very severe)?</td>
<td>3.26 ± 2.58</td>
<td>187</td>
</tr>
<tr>
<td>How many times in the last week did you participate in 30 minutes of aerobic physical activity?</td>
<td>2.48 ± 1.25</td>
<td>191</td>
</tr>
<tr>
<td>How intense would you rate your participation in aerobic activity?</td>
<td>2.47 ± .928</td>
<td>191</td>
</tr>
<tr>
<td>How many times in the last week did you participate in 30 minutes of strength exercises?</td>
<td>1.51 ± .724</td>
<td>191</td>
</tr>
<tr>
<td>How intense would you rate your participation in strength exercise?</td>
<td>1.61 ± .826</td>
<td>191</td>
</tr>
<tr>
<td>Total estimated caffeine for the week (mg)</td>
<td>1143.74 ± 1008.42</td>
<td>191</td>
</tr>
<tr>
<td>Total servings of alcohol for the week</td>
<td>2.52 ± 3.462</td>
<td>191</td>
</tr>
</tbody>
</table>

*n is not always equal to 191 due to incomplete responses
Ordinary Least Squares Regressions

Separate ordinary least squares (OLS) regressions were run for frequency and severity of hot flashes. OLS regression was used in order to determine the best fit for the data, and to ensure robustness. Level of self-reported physical activity, average daily caffeine, and alcohol intake were the predictors. The test for significance was established at $p < .05$.

Although 196 women participated in this research, due to insufficient information, only data for 188 were analyzed using OLS regression. Overall, the regression results revealed that the effects of self-reported physical activity, average daily caffeine, and alcohol intake were not significant in predicting the frequency of hot flashes ($R^2 = .043$, $F_{(6, 184)} = 1.39$, $p = .221$). However, after controlling for the other independent variables, the regression indicated that, relatively, more participation in aerobic physical activity increased frequency of hot flashes ($B = .241$, $\beta = .20$, $p = .031$); while higher intensity of aerobic physical activity had an inverse relationship ($B = -.423$, $\beta = -.261$, $p = .011$). All other variables remained statistically insignificant (Table 9).
Table 9. Ordinary least squares regression analysis of the influence of alcohol, caffeine, and physical activity on frequency of hot flashes (n=188)

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std.Error</td>
</tr>
<tr>
<td>Constant</td>
<td>2.406</td>
<td>.360</td>
</tr>
<tr>
<td>How many times in the last week did you participate in 30 minutes of aerobic physical activity?</td>
<td>.241</td>
<td>.111</td>
</tr>
<tr>
<td>How intense would you rate your participation in aerobic activity?</td>
<td>-.423</td>
<td>.165</td>
</tr>
<tr>
<td>How many times in the last week did you participate in 30 minutes of strength exercises?</td>
<td>-.259</td>
<td>.285</td>
</tr>
<tr>
<td>How intense would you rate your participation in strength exercise?</td>
<td>.339</td>
<td>.257</td>
</tr>
<tr>
<td>Total estimated caffeine for the week (mg)</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Total servings of alcohol for the week</td>
<td>.019</td>
<td>.035</td>
</tr>
</tbody>
</table>

Note: R²=.043, F(6, 184) = 1.39, p=.221; B= relationship between variables in the same units as variables, Beta= relationship between variables relative to each other in standardized units; Dependant variable: Q8 In the last week, how many hot flashes have you had?

Overall, regression analysis also revealed a small, but statistically significant effect of physical activity, caffeine, and alcohol on severity of hot flashes (R²=.068, F(6,180) = 2.195, p = .046). Interestingly, after controlling for all other independent variables, the regression indicated that relatively, higher intensity of strength exercise...
decreased severity of hot flashes ($B = -0.875, \beta = -0.315, p = 0.003$). All other variables remained insignificant (Table 10).

**Table 10.** Ordinary least squares regression analysis of the influence of alcohol, caffeine, and physical activity on severity of hot flashes (n=188)

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$B$</td>
<td>Std.Error</td>
</tr>
<tr>
<td>Constant</td>
<td>4.789</td>
<td>.611</td>
</tr>
<tr>
<td><strong>How many times in the last week did you participate in 30 minutes of aerobic physical activity?</strong></td>
<td>.188</td>
<td>.190</td>
</tr>
<tr>
<td><strong>How intense would you rate your participation in aerobic activity?</strong></td>
<td>-.875</td>
<td>.286</td>
</tr>
<tr>
<td><strong>How many times in the last week did you participate in 30 minutes of strength exercises?</strong></td>
<td>.004</td>
<td>.486</td>
</tr>
<tr>
<td><strong>How intense would you rate your participation in strength exercise?</strong></td>
<td>.260</td>
<td>.443</td>
</tr>
<tr>
<td><strong>Total estimated caffeine for the week (mg)</strong></td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td><strong>Total servings of alcohol for the week</strong></td>
<td>-.055</td>
<td>.060</td>
</tr>
</tbody>
</table>

Note: $R^2 = .068$, $F_{(6,180)} = 2.195$, $p = .046$, $B =$ relationship between variables in the same units as variables, $\beta =$ relationship between variables relative to each other in standardized units; Dependant variable: Q9 In the last week, how would you rate the usual severity of hot flashes?
Spearman Rank Correlations

Spearman rank correlations were run separately for hot flash frequency and severity. This analysis was performed in order to look at beverages individually after excluding those who never consumed the beverage in the last week. Spearman correlations were used since the level of consumption variable is ordinal. The calculated overall caffeine and alcohol consumption variables are close enough to interval/ratio scale variables that they can be treated as such.

There was a small relationship between more consumption of caffeinated soda and both frequency \((r=.17, p=.06)\) and severity \((r=.19, p=.04)\) of hot flashes (Tables 11 and 12). The R squared of both of these would come out to less than .04 or 4% of the variation. No significant relationship between the other caffeinated or alcoholic beverages and hot flashes was revealed. Interestingly, for red wine, there was a correlation of \(r=.23\) between consumption and severity, but it was not statistically significant due to the low sample size (Table 14).
Table 11. Spearman correlations between caffeinated beverages and frequency of hot flashes

<table>
<thead>
<tr>
<th>Question</th>
<th>n</th>
<th>r</th>
<th>Approx. Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the last week how many times did you consume caffeinated coffee (8 fluid ounce serving)?</td>
<td>117</td>
<td>-.041</td>
<td>.660</td>
</tr>
<tr>
<td>In the last week how many times did you consume energy drinks (12 fluid ounce serving)?</td>
<td>2</td>
<td>NA*</td>
<td>NA*</td>
</tr>
<tr>
<td>In the last week how many times did you consume caffeinated hot tea (8 fluid ounce serving)?</td>
<td>60</td>
<td>-.005</td>
<td>.969</td>
</tr>
<tr>
<td>In the last week how many times did you consume caffeinated iced tea (8 fluid ounce serving)?</td>
<td>78</td>
<td>-.016</td>
<td>.887</td>
</tr>
<tr>
<td>In the last week how many times did you consume caffeinated soda (12 fluid ounce serving)?</td>
<td>123</td>
<td>.173</td>
<td>.055</td>
</tr>
<tr>
<td>In the last week how many times did you consume hot chocolate or cocoa (8 fluid ounce serving)</td>
<td>19</td>
<td>.214</td>
<td>.378</td>
</tr>
<tr>
<td>In the last week how many times did you consume dark chocolate (8 fluid ounce serving)?</td>
<td>99</td>
<td>.102</td>
<td>.314</td>
</tr>
</tbody>
</table>

*no statistics were computed due to insufficient information

Table 12. Spearman correlations between caffeinated beverages and severity of hot flashes

<table>
<thead>
<tr>
<th>Question</th>
<th>n</th>
<th>r</th>
<th>Approx. Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the last week how many times did you consume caffeinated coffee (8 fluid ounce serving)?</td>
<td>113</td>
<td>-.088</td>
<td>.355</td>
</tr>
<tr>
<td>In the last week how many times did you consume energy drinks (12 fluid ounce serving)?</td>
<td>2</td>
<td>NA*</td>
<td>NA*</td>
</tr>
<tr>
<td>In the last week how many times did you consume caffeinated hot tea (8 fluid ounce serving)?</td>
<td>60</td>
<td>.033</td>
<td>.804</td>
</tr>
<tr>
<td>In the last week how many times did you consume caffeinated iced tea (8 fluid ounce serving)?</td>
<td>77</td>
<td>-.087</td>
<td>.449</td>
</tr>
<tr>
<td>In the last week how many times did you consume caffeinated soda (12 fluid ounce serving)?</td>
<td>121</td>
<td>.189</td>
<td>.038</td>
</tr>
<tr>
<td>In the last week how many times did you consume hot chocolate or cocoa (8 fluid ounce serving)</td>
<td>20</td>
<td>-.010</td>
<td>.967</td>
</tr>
<tr>
<td>In the last week how many times did you consume dark chocolate (8 fluid ounce serving)?</td>
<td>97</td>
<td>.059</td>
<td>.563</td>
</tr>
</tbody>
</table>

*no statistics were computed due to insufficient information
Table 13. Spearman correlations between alcoholic beverages and frequency of hot flashes

<table>
<thead>
<tr>
<th>Question</th>
<th>n</th>
<th>r</th>
<th>Approx. Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the last week how many times did you consume red wine</td>
<td>51</td>
<td>.091</td>
<td>.527</td>
</tr>
<tr>
<td>(5 fluid ounce serving)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the last week how many times did you consume alcoholic</td>
<td>37</td>
<td>-.025</td>
<td>.881</td>
</tr>
<tr>
<td>beer products (12 fluid ounce serving)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the last week how many times did you consume white</td>
<td>55</td>
<td>.097</td>
<td>.481</td>
</tr>
<tr>
<td>wine or champagne (8 fluid ounce serving)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the last week how many times did you consume mixed</td>
<td>30</td>
<td>-.227</td>
<td>.227</td>
</tr>
<tr>
<td>drinks (1.5-2.0 fluid ounce serving)?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 14. Spearman correlations between alcoholic beverages and severity of hot flashes

<table>
<thead>
<tr>
<th>Question</th>
<th>n</th>
<th>r</th>
<th>Approx. Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the last week how many times did you consume red wine</td>
<td>49</td>
<td>.229</td>
<td>.114</td>
</tr>
<tr>
<td>(5 fluid ounce serving)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the last week how many times did you consume alcoholic</td>
<td>34</td>
<td>-.032</td>
<td>.858</td>
</tr>
<tr>
<td>beer products (12 fluid ounce serving)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the last week how many times did you consume white</td>
<td>53</td>
<td>-.015</td>
<td>.918</td>
</tr>
<tr>
<td>wine or champagne (8 fluid ounce serving)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the last week how many times did you consume mixed</td>
<td>28</td>
<td>-.149</td>
<td>.449</td>
</tr>
<tr>
<td>drinks (1.5-2.0 fluid ounce serving)?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In summary, the cumulative effect of physical activity, caffeine, and alcohol on the frequency of hot flashes was not significant. However, a small significant effect was found on severity of hot flashes. Controlling for other factors (beverage intake and strength exercise), frequency of hot flashes was significantly increased with greater participation in aerobic physical activity. Additionally, it was found that frequency and severity of hot flashes were significantly decreased with higher intensity of aerobic
activity. Spearman correlations revealed a small relationship between caffeinated soda and hot flash characteristics. Interestingly, there was a positive relationship between red wine and severity, but not statistically significant.
CHAPTER IV

DISCUSSION AND CONCLUSIONS

The purpose of this research study was to examine the effects of beverages and physical activity on the frequency and severity of hot flashes in pre-menopausal, peri-menopausal, menopausal and post menopausal women over the age of 40 at a Mid-Western University. This population was selected because they are representative of the population most likely to experience these menopausal characteristics. Although it was intended to compare three reproductive stage categories, this was not feasible due to the relatively small sample size and unbalanced representation in the various groups. When compared to the pre-menopausal and peri-menopausal categories, there were a higher number of participants in the post menopausal category. As such, data from all categories were compiled into one entity.

The exact cause and mechanism of menopausal hot flashes is not well understood, though there are theories. Studies have shown that as estrogen levels are decreased in women, due to surgery, chemicals, or age, the temperature regulation mechanism in the hypothalamus is affected. As a result the core body temperature is lowered, and the threshold between acceptable and unacceptable body heat levels is more easily crossed. This causes signals to be sent to the rest of the body to release heat, causing the noticeable rise in skin temperature associated with this menopausal characteristic (2).
Several studies have examined the effect of lifestyle factors on hot flashes, however, to date; no research had looked specifically at the effects of beverages and physical activity on the frequency and severity of hot flashes in women over the age of 40. It was hoped that results of this research would lead to a better understanding of menopausal characteristics and bring about more useful lifestyle recommendations for women dealing with hot flashes.

**Frequency and Severity of Hot Flashes**

The current research study found the effects of self-reported physical activity, average daily caffeine and alcohol intake were not significant in predicting the frequency of hot flashes ($R^2=.043$, $F_{(6, 184)} = 1.39$, $p=.221$). However, regression results did reveal a significant overall effect of the variables of interest on severity of hot flashes ($R^2=.068$, $F_{(6, 180)} = 2.195$, $p = .046$). Additionally, Spearman correlations revealed a small relationship between caffeinated soda intake and frequency and severity of hot flashes ($r=.17$, $p=.04$; $r=.19$, $p=.04$, respectively). The lack of more significant findings could be due to the somewhat skewed intake levels of both caffeinated and alcoholic beverages, as a majority of respondents drank little to none of the beverages studied. No previous research looked at these three variables together to assess an overall effect. However, several studies looked at the factors separately, which are discussed below.
Physical Activity Level

In the current study, a majority of subjects participated in 30 minutes of aerobic physical activity 1-2 times per week (n=64, 32.7%). Activity level was at moderate intensity (n=89, 45.4%). Majority of participants did not have at least 30 minutes of strength training (n=118, 60.2%). Mean participation in aerobic physical activity was $2.48 \pm 1.25$ times per week, while mean participation in strength exercises was $1.51 \pm .724$ times per week. Those who did strength exercises did so at light intensity (n=39, 19.9%). It was found that frequency of hot flashes significantly increased with more aerobic physical activity (p=.031). On the contrary, frequency and severity of hot flashes significantly decreased with higher intensity aerobic activities (p=.011, p=.003, respectively).

Findings from the present study related to frequency of workouts and incidence and severity of hot flashes are congruent with results by previous researchers. Whitcomb et al., (6) looked at the relationship between physical activity prior to the time of the last menstrual period and hot flashes. This was a population based study using 512 peri-menopausal and post-menopausal women living in Baltimore, Maryland. Questionnaires assessed physical activity levels and frequency and severity of hot flashes. They reported that highly active women (reported exercising > 16 times per month) were significantly more likely to have moderate to severe hot flashes (OR = 1.70, $p = 0.01$) and daily hot flashes (OR = 1.79, $p < 0.01$) than less active women (report exercising 0-15 times per month). Similarly, Thurston et al., (7) looked at factors associated with frequency of hot flashes in 42 peri-menopausal or post-menopausal women recruited from Raleigh, Durham, and Chapel Hill North Carolina. They found a higher incidence of subjective
hot flashes after physical exertion (OR, 1.49; 95% CI, 0.99-2.25; p = .05), although regular aerobic exercisers had fewer hot flashes than sporadic exercisers.

The inverse relationship found between intensity of physical activity and severity of hot flashes supports the findings of a study by Sievert et al., (10). The researchers used a random sample of 293 women, aged 45-65, living in Massachusetts, and an oral interview/questionnaire. They found women who participated in heavy exercise (enough to speed up breathing and heart rate, at least two times per week) were significantly less likely to report both hot flashes and night sweats (p = 0.05) compared to those participating in minimal exercise (no exercise, or light exercise less than once per week).

In contrast, Sternfield et al. (8) looked at a case-control study of 82 peri-menopausal women in California to investigate the effects of regular exercise prior to the final menstrual period. The researchers found no association between habitual physical activity and menopausal hot flashes. The study also revealed regular physical activity did not significantly affect the frequency of menopausal symptoms such as hot flashes (p = 0.291). Similar findings were reported by Riley et al., (9). Researchers looked at the relationship between modifiable risk factors and hot flashes using a written survey of 755 peri-menopausal and post-menopausal women, age 40-65, in Massachusetts. Results indicated no significant relationship between habitual exercise and hot flash frequency or intensity (OR = 1.3; 95% CI = 0.78-2.16).
**Caffeine**

In the present study, total estimated mean caffeine intake per week was 1143.74 mg ± 1008.42 mg. The majority of participants reported consuming no caffeinated beverages in the last week, and no significant relationship on either frequency or severity was found in the regression analysis (B = .000, β = .026, p = .744; B = .000, β = -.047, p = .552, respectively). Due to the somewhat skewed distribution (most participants falling on the low end of caffeine consumption), the effect of a high intake of caffeine on hot flash characteristics was difficult to assess. However, after excluding those who never consumed the beverage, there was a relationship between consumption of caffeinated soda and frequency and severity of hot flashes ((r=.17, p=.04; r=.19, p=.04, respectively).

Few previous studies have looked at the effect of caffeine on hot flashes. However, Thurston et al., (7) found an increased likelihood of objective hot flashes (OR = 1.51; CI = 1.18-3.81; p = 0.003) after caffeine consumption.

**Alcohol**

In reference to beverage consumption, majority of participants reported never consuming alcoholic beverages. Total estimated mean intake of alcohol was 2.52 ± 3.462 servings per week (one serving was defined as 5 fluid ounces wine or champagne, 12 fluid ounces beer, or 1.5-2.0 fluid ounces mixed drink). Regression analysis revealed alcohol intake alone was not predictive of either frequency or severity of hot flashes (B = .019, β = 0.044, p = .583; B = -.055, β = -.074, p = .353, respectively). However, data cannot be generalized as unlike previous studies where associations were observed
between high alcohol intake and hot flashes, in the present study, this was not feasible as majority of participants had low intake of alcohol.

In contrast to the present study, earlier studies have shown significant relationships between alcohol intake and hot flash characteristics. Freeman et al., (11) looked at risk factors for hot flashes in a four-year cohort study of 375 participants in Philadelphia, Pennsylvania. They found alcohol use to be a significant predictor of hot flashes (OR 1.10, p = 0.002). Similar observations were also noted by Sievert et al., (10). Findings revealed daily alcohol consumption significantly increased the risk of hot flashes (p < 0.01). Like other researchers, Riley et al., (9) found a significant correlation between alcohol use of 1-5 drinks a day and reports of bothersome hot flashes in peri-menopausal women (OR = 0.52, CI = 0.31-0.86).

**Strengths**

This study had several unique characteristics. The current study focused on three definitive variables (caffeinated beverages, alcoholic beverages, and physical activity). Both their cumulative effects, as well as individual variables influence on hot flashes were analyzed. In contrast, other studies related to hot flashes have examined several factors in addition to these, such as BMI, incidence of smoking, and soy intake (7, 10, 11); focused on only one factor (such as physical activity) (6, 8); or focused on other unrelated variables, such as biological factors (12-16). The present study excluded current smokers from analysis, due to the relationship between smoking and an increased incidence of hot flashes found in previous studies (10, 11, 16). This self-reported survey examined usual dietary intake of beverages in the last month and normal physical activity
level (including both aerobic and strength exercises), and the effect of these variables on frequency and severity of hot flashes. Some previous studies looked at only “physical activity”, not necessarily specifying type (strength or aerobic) (6, 8), or did not assess usual intake of beverages in the last week or month, instead asking for a particular day’s intake (7). Many other studies overlooked severity or frequency of hot flashes, instead just focused on one of these variables (8, 10, 11, 14). Also, all females over the age of 40 were surveyed in this research, including subjects in all stages of menopause. In contrast, some previous studies only included one or two stages of menopause (6-9, 12, 16). Thus, overall this research has numerous strengths that would contribute to the body of knowledge as it relates to hot flashes during various stages of menopause.

Limitations

Like all studies, methodological limitations were present. The sample selection was limited to current faculty and staff at a Mid-Western University and research was based on self-reported subjective data as opposed to more objective data, such as laboratory measures. Participants relied on their memory of usual intake and activity in the last month, as opposed to reporting food intake and activity at the time of occurrence.

Another limiting factor was the relatively small sample. It is possible that a larger sample size may have allowed for a more diverse sample. Opening the survey to a larger population may have permitted comparison among subjects in the different reproductive stages as well as between different ethnicities and age groups. The sample in the current study was ethnically homogenous, since it was primarily comprised of Caucasians in a
Midwestern state. Also, majority of participants were in the post-menopausal reproductive stage.

**Future Research**

More research is needed specifically in the areas of caffeine and alcohol use in order to make a more definitive conclusion about the effect of beverage consumption on hot flashes. A larger population residing in various regions of the United States may be of use in the future. This will likely provide a better representation of diverse age groups, ethnicities, and reproductive stages of menopause.

Further studies comparing effects of recreational activity to various levels and types of aerobic activity would be useful to make more precise exercise duration and intensity recommendations to menopausal women. Another interesting factor to examine in the future is the effect of using complementary and alternative medicine to treat hot flashes. In addition, inclusion of objective studies in addition to subjective information will be useful in accurately measuring and assessing incidence and intensity of hot flashes. Other areas of focus would be to investigate the influence of nutrients (e.g. macronutrients, micronutrients, etc) and functional foods (e.g. soy) on menopausal symptoms. Lastly, relationships between risk factors for diseases (e.g. obesity, diabetes, and hypertension) and their contributory roles to characteristics of menopause need to be investigated.
Summary

Research has shown varying results on the impact of caffeine, alcohol, and physical activity on the frequency and severity of hot flashes in menopausal women. Hot flashes can reduce quality of life and lead to disruptions in daily activities, and therefore are of great concern. This study examined beverage intake and physical activity levels of college faculty and staff and the effect of these variables on frequency and severity of hot flashes. One-hundred and ninety-six women participated in this study, with 27.6% between the ages of 50-54 (n=54) and 41.3% naturally post-menopausal (n=81). One-hundred and fifty-nine (81.1%) women reported experiencing hot flashes in the past.

Although beverages and physical activity did not significantly predict frequency of hot flashes, it was found that they contributed to severity of hot flashes. Additionally, after elimination of those not consuming caffeinated soda, there was a positive correlation between more soda consumption and hot flash characteristics. Also, increasing intensity of aerobic activity significantly decreased frequency and intensity of hot flashes (p=.011, p=.003, respectively). Interestingly, increasing frequency of aerobic activity lead to increased (p=.031) frequency of hot flashes. These results suggest that it would be beneficial to women experiencing hot flashes to exercise at a high intensity, less frequently.

As researchers continue to examine the causes and contributing factors associated with menopausal hot flashes, it is important to consider lifestyle factors such as those in the present study. These findings show a possible link between beverage consumption and physical activity level and the severity of hot flashes. Dietitians and other medical professionals must work to find a connection to other modifiable behaviors in order to
decrease the impact hot flashes have on menopausal women. In doing so, a better understanding of this life process can be gained, as well as improving quality of life for those affected.
References


LITERATURE REVIEW

The purpose of this research was to examine the effects of consumption of beverages (caffeinated and alcoholic) and physical activity on the frequency and severity of hot flashes in pre-menopausal, peri-menopausal, menopausal, and post-menopausal women by conducting a survey of women who are employed at a Midwestern University. This review of the literature discusses current and past research on the variables of interest: caffeine, alcohol, and physical activity, biological factors associated with hot flashes, and previous studies on frequency and severity of hot flashes in women.

Physical Activity level

Several studies on the effects of physical activity on menopausal hot flashes have been done in recent years. Whitcomb et al., (6) looked at the relationship between physical activity prior to the time of the last menstrual period and hot flashes. This was a population based study using 512 perimenopausal and post-menopausal women living in Baltimore, Maryland. Questionnaires were utilized to assess physical activity levels at different ages along with the frequency and severity of hot flashes. Their results found that highly active women (reported exercising > 16 times per month) were significantly more likely to have moderate to severe hot flashes (OR = 1.70, p = 0.01) and daily hot flashes (OR = 1.79, p < 0.01) than less active women (report
exercising 0-15 times per month). Similarly, Thurston et al., (7) looked at factors associated with frequency of hot flashes. Researchers used both objective (ambulatory sternal skin conductance) and subjective (self-reported) measures of hot flashes in 42 perimenopausal or post-menopausal women recruited from Raleigh, Durham, and Chapel Hill North Carolina. They found a higher incidence of subjective hot flashes after physical exertion (OR, 1.49; 95% CI, 0.99-2.25; p = .05), although regular aerobic exercisers had fewer hot flashes than sporadic exercisers. Sternfield et al., (8) looked at habitual physical activity and menopausal hot flashes. This case-control study of 82 perimenopausal women in California looked at whether the effects of regular exercise prior to the final menstrual period resulted in a reduced risk of hot flashes. They found no association between the two, as regular physical activity did not significantly reduce the frequency of menopausal symptoms such as hot flashes (p = 0.291). Similar findings were reported by Riley et al., (9). Researchers looked at the association of modifiable risk factors and hot flashes using a written survey of 755 peri-menopausal and post-menopausal women, age 40-65, in Massachusetts. Results indicated no significant relationship between habitual exercise and hot flash frequency or intensity (OR = 1.3; 95% CI = 0.78-2.16).

One study found a significant benefit to regular exercise. Sievert et al., (10) used a random sample of 293 women, aged 45-65, living in Massachusetts, and an oral interview/questionnaire. They found women who participated in heavy exercise (enough to speed up breathing and heart rate, at least two times per week) were significantly less likely to report both hot flashes and night sweats (p = 0.05) compared to those
participating in minimal exercise (no exercise, or light exercise less than once per week). There was no other significant difference based on activity level.

**Caffeine**

Limited research is available on the association of caffeine and hot flashes in menopausal women. As mentioned above, Thurston et al., (7) looked at several factors associated with hot flash frequency. Researchers used both objective and subjective measures of hot flashes in 42 perimenopausal or post-menopausal women recruited from North Carolina. Investigators found an increased likelihood of objective hot flashes (OR = 1.51; CI = 1.18-3.81; \( p = 0.003 \)) after caffeine use for both perimenopausal and post-menopausal women.

**Alcohol**

Several studies examining the effect of alcohol consumption on hot flashes have been done. A study by Freeman et al., (11) looked at risk factors for hot flashes in a four-year cohort study of 375 participants in Philadelphia, Pennsylvania. They found alcohol use to be a significant predictor of hot flashes (OR 1.10, \( p = 0.002 \)). Similarly, the previously mentioned study by Sievert et al., (10) used a random sample of 293 women, aged 45-65, living in Massachusetts, and an oral interview/questionnaire. Researchers reported daily alcohol consumption significantly increased the risk of having hot flashes (\( p < 0.01 \)). Riley et al., (9) surveyed peri-menopausal and post-menopausal women (n=755), aged 40-65, living in Massachusetts. Results showed a significant correlation between alcohol use of 1-5 drinks a day and reports of bothersome hot flashes in
perimenopausal women (OR = 0.52, CI = 0.31-0.86), but no significant effect in post-menopausal women.

**Biological Factors**

A number of studies looking at biological factors associated with the occurrence of hot flashes have been completed in recent years. Schilling et al., (12) investigated whether sex steroid hormone levels and genetic polymorphisms in hormone biosynthesis and degradation enzymes are associated with the risk of hot flashes. Participants, between 45-54 years (n = 639) in this cross-sectional study in Baltimore, Maryland, completed a questionnaire and provided a blood sample. Results indicated that when compared to women who had never had hot flashes, progesterone levels were significantly lower in those with hot flashes in the past 30 days (p = 0.001), moderate or severe hot flashes (p = 0.003), hot flashes that occur at least weekly (p = 0.001), and hot flashes that occurred for less than one year (p = 0.002). Researchers also found women who carried a polymorphism in both genes related to hot flashes (3βHSD and CYP1B1) had a higher risk of hot flashes for one year or more than those who carried neither of the polymorphisms (RR: 1.33, 95% CI: 0.99, 7.80). Similarly, Randolph et al., (13) looked at the relationship of reproductive hormones and vasomotor symptoms in 3302 women participating in the Study of Women’s Health Across Nations (SWAN), taking place in several cities across the United States. Greater hot flash prevalence was significantly associated with higher levels of FSH and E2 sex hormones (OR: 6.06; 95% CI: 5.28, 6.96 and OR: 5.75; 95%CI: 5.04, 6.57). In a related study, Schneider et al., (14) examined the association of polymorphisms of angiogenesis genes with hot flashes. Participants in
Indianapolis, IN. (n=1244) completed a questionnaire and provided a blood sample. For pre-menopausal women, the eNOS-786 CT and TT genotypes were significantly associated with higher risk of current hot flashes than other genotypes ($p = 0.03$), however following adjustments for clinical variables, results were not significant ($p = 0.08$). For post-menopausal women, the HIF1α 1744 CT and TT genotypes were associated with experiencing significantly more hot flashes ($p = 0.05$) and were still significant after adjustments ($p = 0.04$).

**Frequency and Severity of Hot Flashes**

Various studies examining the frequency and severity of hot flashes have been completed of late. In addition to previously discussed research, (6-14) other studies have looked at this topic. Whiteman et al., (15) assessed whether lifestyle factors were associated with frequency and severity of hot flashes in a cross-sectional study of 1087 women 40-60 years old, living in Baltimore, MD. They found women who smoked (OR = 1.9, CI = 1.3, 2.9) and those had a BMI of at least 30 kg/m$^2$ (OR = 2.1, CI = 1.5, 3.0) had significantly more moderate to severe hot flashes (having interrupted usual activity). Smokers (OR = 2.2; CI = 1.4, 3.7) also had a significantly greater risk of having daily hot flashes. Gallicchio et al., (16) examined the relationship between smoking and the occurrence, frequency, and severity of hot flashes. This was a case-control study of menopausal women residing in Baltimore, Maryland, 45-54 years of age, using a telephone questionnaire. Results indicated that past and current smokers had a significantly higher risk of experiencing more perceived frequent and severe hot flashes compared to those that had never smoked ($p < 0.01$).
Summary

This review of the literature discussed current and past research on the variables of interest. Overall, there is a lack of consensus on which factors are associated with the frequency and severity of hot flashes in menopausal women. Though some studies found correlations between specific factors and these menopausal symptoms, there was much variation in the sample, design, and methods used. There is a need for more research into these associations and to define recommendations for menopausal women experiencing hot flashes.
APPENDIX B
Women’s Health Survey (WHS)

1. Age (years)
   a. 40-44
   b. 45-49
   c. 50-54
   d. 55-59
   e. 60 or over

2. Ethnicity
   a. White
   b. African-American
   c. Hispanic
   d. Asian/Pacific Islander
   e. Other

Please answer the following questions regarding your usual behavior in the last month.

3. Are you a smoker?
   a. Yes
   b. No

4. Do you currently take any medications to treat menopausal symptoms?
   a. Yes
   b. No

5. Are you currently using any alternative therapies to treat menopausal symptoms (e.g. black cohosh, dong quai root, ginseng, kava, red clover, soy)?
   a. Yes
   b. No

6. What is your current reproductive stage?
   a. Pre-menopausal (regular menstrual cycle)
   b. Peri-menopausal (last menstrual period within the last 3 months)
   c. Menopausal (last menstrual period within the last year)
   d. Naturally Post-menopausal (last menstrual period more than 12 months ago)
   e. Post-menopausal due to surgery or chemotherapy/radiation

7. Have you ever had a menopausal hot flash? (An episode of flushing, sweating, and a sensation of heat, often accompanied by palpitations and a feeling of anxiety, and sometimes followed by chills)
   a. Yes
   b. No
8. In the last week, how many hot flashes have you had?
   a. 0
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. More than 12

9. In the last week, how would you rate the usual severity of the hot flashes? 1 being **very mild** (a warm sensation without sweating or disruption of normal activity) and 10 being **very severe** (heat sensation with sweating that may have interrupted daily activities)?
   a. Did not experience hot flashes
   b. 1
   c. 2
   d. 3
   e. 4
   f. 5
   g. 6
   h. 7
   i. 8
   j. 9
   k. 10

10. In the last week, how many times did you participate in **30 minutes** of aerobic physical activity (running, swimming, hiking, walking, etc.)?
    a. 0
    b. 1-2
    c. 3-4
    d. 5-6
    e. 7-8
    f. More than 8

11. How intense would you rate your participation in aerobic activity?
    a. Don’t participate
    b. Light (don’t break a sweat)
    c. Moderate (break a light sweat, heart rate increased)
    d. Heavy (break a sweat, heart rate very increased)
12. How many times per week do you participate in **30 minutes** of strength exercises (weight lifting, Pilates)?
   a. 0
   b. 1-2
   c. 3-4
   d. 5-6
   e. 7-8
   f. More than 8

13. How intense would you rate your participation in strength exercises?
   a. Don’t participate
   b. Light (don’t break a sweat)
   c. Moderate (break a light sweat, heart rate increased)
   d. Heavy (break a sweat, heart rate very increased)

14. In the last week, how many times did you consume caffeinated **coffee** (8 fluid ounce serving)?
   a. Never
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. 13-15
   g. 16-18
   h. More than 18 per week

15. In the last week, how many times did you consume **energy drinks** (e.g. Red Bull, Sobe; 12 fluid ounce serving)?
   a. Never
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. 13-15
   g. 16-18
   h. More than 18 per week
16. In the last week, how many times did you consume **cafeinated hot tea** (8 fluid ounce serving)?
   a. Never
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. 13-15
   g. 16-18
   h. More than 18 per week

17. In the last week, how many times did you consume **iced tea** (8 fluid ounce serving)?
   a. Never
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. 13-15
   g. 16-18

18. In the last week, how many times did you consume **caffeinated soda** (e.g. Coke, Pepsi, etc, 12 fluid ounce serving)?
   a. Never
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. 13-15
   g. 16-18
   h. More than 18 per week

19. In the last week, how many times did you consume **hot chocolate** or **cocoa** (8 fluid ounce serving)?
   a. Never
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. 13-15
   g. 16-18
   h. More than 18 per week
20. In the last week, how many times did you consume **dark chocolate** (at least 1 ounce serving)?
   a. Never
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. 13-15
   g. 16-18
   h. More than 18 per week

21. In the last week, how many times did you take **caffeine pills** (e.g. no-doz, vivarin, 1-200 mg pill)?
   a. Never
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. More than 12

22. In the last week, how many times did you take **caffeinated diet pills**?
   a. Never
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. More than 12

23. In the last week, how many times did you consume **red wine** (1 serving, 5 ounce glass)?
   a. Never
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. More than 12

24. How many times per week do you consume **alcoholic beer products** (12 ounce serving)?
   a. Never
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. More than 12
25. How many times per week do you consume **wine** (not red; 5 ounce serving)?
   a. Never
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. More than 12

26. How many times per week do you consume **mixed drinks** (1.5-2 ounce serving)?
   a. Never
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10-12
   f. More than 12
APPENDIX C
I am a dietetic graduate student at Ball State, conducting a research study as part of my Masters Degree. You may have been selected to participate in this study to examine the effects of beverages and physical activity on hot flashes in menopausal women if you meet the following criteria:

- Female, ≥ 40 years of age
- Must be one of the following:
  - peri-menopausal (last menstrual period within the last 3 months)
  - menopausal (last menstrual period within the last year)
  - post-menopausal (last menstrual period more than 12 months ago)
- Non-smoker
- Not taking any medications to treat symptoms of menopause

If you do not meet these criteria, you can delete this email now.

The amount of time required for this study is only 10 minutes to complete the survey. This survey will be accessible from April 2nd to May 3rd by visiting:

http://inquisitor.bsu.edu/inqsit/inqsit.cgi/ucsresearch?WomHlth

Your participation is voluntary, and you may withdraw from the study at any time and for any reason. There is no penalty for not participating or withdrawing. There are no costs to you or any other party. By having you complete and submit the survey, your consent will be assumed. I plan to disclose only the results of grouped data, and not identifiable individual response for publication purposes so that the information obtained may contribute to women’ health and nutrition and may be put into practical use. The findings of this study will enable women to be better prepared to handle the challenges caused by hot flashes and will allow them to use alternative therapies rather than treatments with possible detrimental side effects.

If you have any questions or concerns, please do not hesitate to contact me or my research advisor. For questions about your rights as a research subject, please contact Coordinator of Research Compliance, Office of Academic Research and Sponsored Programs, (765) 285-5070.

This project has been reviewed according to Ball State’s procedures governing your participation in this research.

Thank you!

Sincerely,
Valerie Amend
Dietetics Graduate Student
(317) 840-2756

Dr. Jay Kandiah
Professor of Nutrition
(765) 285-5922
Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that Valerie Amend successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 09/09/2008

Certification Number: 87674
Institutional Review Board

DATE: February 11, 2009
TO: Valerie Amend, BS
FROM: Ball State University IRB
RE: IRB protocol # 101945-1
TITLE: Implications of Beverage Consumption and Physical Activity on Hot Flashes in Menopausal Women
SUBMISSION TYPE: New Project

ACTION: DETERMINATION OF EXEMPT STATUS
DECISION DATE: February 11, 2009

The Institutional Review Board reviewed your protocol on February 11, 2009 and has determined the procedures you have proposed are appropriate for exemption under the federal regulations. As such, there will be no further review of your protocol, and you are cleared to proceed with the procedures outlined in your protocol. As an exempt study, there is no requirement for continuing review. Your protocol will remain on file with the IRB as a matter of record.

Editorial notes:

1. In your narrative you state that, "Weekly reminders will be sent via email to ensure a greater response." The IRB is under the assumption that the email reminder will be sent to everyone (whether having participated or not) instead of individual reminders to just those who have not participated. If you intend to send individual reminders, you will need to submit a modification stating this within your narrative to the IRB (please use the following instructions listed on Pages 1-2 to submit your modification: http://www.bsu.edu/irb/media/pdf/modification.pdf).

2. Please state how the thumb drive will be secured (i.e. locked in a cabinet, etc.).

While your project does not require continuing review, it is the responsibility of the P.I. (and, if applicable, faculty supervisor) to inform the IRB if the procedures presented in this protocol are to be modified or if problems related to human research participants arise in connection with this project. Any procedural modifications must be evaluated by the IRB before being implemented, as some modifications may change the review status of this project. Please contact please contact Amy Boos at (765) 285-5034 or akboos@bsu.edu if you are unsure whether your proposed modification requires review or have any questions. Proposed modifications should be addressed in writing and submitted electronically to the IRB (http://www.bsu.edu/irb) for review. Please reference the above IRB protocol number in any communication to the IRB regarding this project.

Reminder: Even though your study is exempt from the relevant federal regulations of the Common Rule (45 CFR 46, subpart A), you and your research team are not exempt from ethical research practices and should therefore employ all protections for your participants and their data which are appropriate to your project.