Endometrial Cancer Incidence in Relation to Electric Blanket Use

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Endometrial cancer is associated with endogenous and exogenous estrogen excess. Some investigators have posited that electromagnetic fields may influence cancer risk through estrogenic hormonal mechanisms; however, there have been no studies reporting on electric blanket exposure in relation to endometrial cancer. The authors examined this possible association between endometrial cancer risk and electric blanket or mattress cover use as part of a population-based, case-control study. This analysis included incident endometrial cancer cases 40–79 years of age, interviewed during 1994 (n = 148; response rate, 87%) and identified from the Wisconsin tumor registry. Female controls of similar age were randomly selected from population lists (n = 659; response rate, 85%). Information regarding electric blanket and mattress cover use and endometrial cancer risk factors was obtained through structured telephone interviews approximately 1 year after diagnosis. After adjustment for age, body mass index, and postmenopausal hormone use, the risk of endometrial cancer was similar among ever users (odds ratio = 1.04, 95% confidence interval: 0.70, 1.55) and among current users (odds ratio = 0.87, 95% confidence interval: 0.49, 1.54) as compared with never users. Despite its small size and potential misclassification of exposure, this study provides evidence against an association between electric blanket or mattress cover use and endometrial cancer.


case-control studies; electromagnetic fields; endometrial neoplasms

Abbreviation: CI, confidence interval.

Exposure to electromagnetic fields has been suggested to increase the risk of hormone-dependent cancers such as breast, ovarian, testicular, prostatic, and endometrial (1–8). One suggested pathway includes deficient melatonin function (9). This pineal secretory product has antiestrogenic properties (2, 10–12), and melatonin secretion is significantly reduced in postmenopausal women (13), the group with the highest incidence of endometrial cancer (14, 15). Some studies have shown that melatonin secretion decreases in response to 50/60-Hz magnetic field exposure (16–20) such as produced by electric blankets—the greatest contributor to electromagnetic exposure of in-home appliances on a time- and body-average basis (21).

Although some investigators have suggested that electromagnetic field exposure may influence cancer risk through its effects on hormonal mechanisms, the failure to observe a clear association between electromagnetic field exposure from electric blanket or mattress cover use and risk of breast cancer (22–28) or prostatic cancer (8) argues against this. Because the relation between hormonal exposures is stronger for endometrial cancer than for breast cancer, an association between electric blanket use and endometrial cancer risk might be more readily detected (29–31). We present data on endometrial cancer risk in relation to the use of electric blankets or mattress covers from our population-based, case-control study.

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MATERIALS AND METHODS

All participants were female Wisconsin residents 40–79 years of age. Invasive endometrial cancer cases (diagnosed between 1991 and 1994) were identified by a mandatory statewide cancer registry. According to an institutionally approved protocol, the physician of record for each eligible case was contacted by mail to obtain permission to approach the subject. Eligibility was limited to cases with listed telephone numbers, driver’s licenses verified by self-report (if aged less than 65 years) and, if aged more than or equal to 65 years, a Medicare card (n = 856). A total of 745 cases (87.0 percent of eligible cases) participated in the study interview between June 1991 and June 1995. The reasons for nonparticipation included physician refusal (n = 6), subject refusal (n = 53), inability to locate the subject (n = 2), and death (n = 50). Of the interviewed cases, 98.0 percent had histologic confirmation of invasive endometrial carcinoma according to the tumor registry report.

Community controls were selected randomly from lists of licensed drivers (if aged less than 65 years) and Medicare beneficiary files compiled by the Health Care Financing Administration (if aged 65–79 years). The controls were selected at random to yield an age distribution similar to that of the cases in a parallel breast cancer study (22) and were those who met the eligibility criterion of having a listed telephone number. Controls were eligible for the study if they reported no previous diagnosis of uterine cancer. Of the 4,362 eligible controls, 521 refused, 35 could not be located, and 88 were deceased. A total of 3,718 (85.2 percent) completed the study interview. Exclusions after the interview included 1,304 controls who reported a history of hysterectomy and six cases for the models were chosen by forward stepwise regression. Conditional models were stratified according to age. Covariates included known or suspected risk factors for endometrial cancer: menopausal status, age at menopause, body mass index, parity, history of smoking, hormone replacement therapy use, education, and family history of endometrial cancer. After forward stepwise regression, the covariates remaining in the model were menopausal status (premenopausal or postmenopausal, defined as no menstruation for 12 months), body mass index (quartiles, self-reported reference weight (kg) divided by height (m) squared), and hormone replacement therapy use (never, former, current). The participants’ responses to questions about factors at the reference date are defined as current.

Subjects for analysis

The history of electric blanket or mattress cover use was included in the questionnaire from June 1994 to December 1994. Analysis was limited to women interviewed during this period (159 cases and 690 controls). We excluded 11 cases and 31 controls who could not provide complete information on electric blanket usage or other covariates. Therefore, 148 cases and 659 controls remained for this analysis.

Reliability substudy

To assess the reliability of the questionnaire, we interviewed a sequential sample of controls again. After an average of 3.4 months (range, 2–6 months), 186 controls (83 percent) were successfully recontacted and reinterviewed. Cohen’s kappa with 95 percent lower confidence limits measured the reliability of the subject’s responses to the question about never/ever and never/former/current electric blanket or mattress cover use (32). The intraclass correlation coefficient measured the reproducibility of the reported duration of electric blanket or mattress cover use (32). The kappa for never/ever use was 0.82 (lower confidence limit, 0.74), and the kappa for never/former/current use was 0.83 (lower confidence limit, 0.75). The intraclass correlation coefficient for duration of electric blanket or mattress cover use was 0.77 (lower confidence limit, 0.72).

Analysis

Odds ratios and 95 percent confidence intervals from logistic regression models were used to estimate risk (33). Conditional models were stratified according to age. Covariates for the models were chosen by forward stepwise regression (p entry = 0.20, p removal = 0.30). Possible covariates included known or suspected risk factors for endometrial cancer: menopausal status, age at menopause, body mass index, parity, history of smoking, hormone replacement therapy use, education, and family history of endometrial cancer. After forward stepwise regression, the covariates remaining in the model were menopausal status (premenopausal or postmenopausal, defined as no menstruation for ≥6 months), body mass index (quartiles, self-reported reference weight (kg) divided by height (m) squared), and hormone replacement therapy use (never, former, current). The ordinal term representing never use and tertiles of duration of use into the regression models.

RESULTS

Compared with controls, women with endometrial cancer were more likely to have a heavier body mass, to be
nonsmokers, or (for postmenopausal women) to use hormone replacement therapy (table 1). The mean ages at the reference date were 63.1 years for cases and 65.0 years for controls.

After adjustment for age, women with endometrial cancer were slightly more likely than controls to have ever used an electric blanket or mattress cover (table 2). Of the endometrial cancer cases, 46 percent had ever used an electric blanket or mattress cover compared with 42 percent of the controls.

Among controls, ever users of an electric blanket or mattress cover were more likely than never users to have a history of hormone replacement use (21 percent vs. 15 percent, p value = 0.06). No other risk factor showed a statistically significant difference between never/ever electric blanket or mattress cover users in the control population.

Compared with women who had never used an electric blanket or mattress cover, the multivariable-adjusted odds ratio of endometrial cancer for women who had ever used an electric blanket or mattress cover was 1.04 (95 percent

**TABLE 1.** Characteristics of women with endometrial cancer and controls aged 40–79 years, Wisconsin, 1991–1994

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Cases (%) (n = 148)</th>
<th>Controls (%)* (n = 659)</th>
<th>Odds ratio†</th>
<th>95% confidence interval†</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body mass index (kg/m²)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;22.7</td>
<td>13</td>
<td>26</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>22.7–25.5</td>
<td>18</td>
<td>24</td>
<td>1.52</td>
<td>0.80, 2.88</td>
</tr>
<tr>
<td>25.6–29.0</td>
<td>20</td>
<td>22</td>
<td>1.6</td>
<td>0.84, 3.03</td>
</tr>
<tr>
<td>≥29.1</td>
<td>45</td>
<td>22</td>
<td>3.72</td>
<td>2.10, 6.57</td>
</tr>
<tr>
<td>Unknown</td>
<td>5</td>
<td>6</td>
<td>1.65</td>
<td>0.66, 4.10</td>
</tr>
<tr>
<td><strong>Parity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>14</td>
<td>10</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>8</td>
<td>0.81</td>
<td>0.34, 1.89</td>
</tr>
<tr>
<td>2</td>
<td>26</td>
<td>22</td>
<td>0.91</td>
<td>0.48, 1.73</td>
</tr>
<tr>
<td>≥3</td>
<td>53</td>
<td>60</td>
<td>0.68</td>
<td>0.38, 1.20</td>
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<tr>
<td><strong>Smoking history</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>66</td>
<td>55</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Former</td>
<td>24</td>
<td>29</td>
<td>0.74</td>
<td>0.48, 1.15</td>
</tr>
<tr>
<td>Current</td>
<td>10</td>
<td>16</td>
<td>0.53</td>
<td>0.30, 0.96</td>
</tr>
<tr>
<td><strong>Menopausal status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postmenopausal</td>
<td>83</td>
<td>84</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Premenopausal</td>
<td>17</td>
<td>16</td>
<td>2.19</td>
<td>0.96, 4.97</td>
</tr>
<tr>
<td><strong>Age at menopause (years)</strong>‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;45</td>
<td>9</td>
<td>12</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>45–49</td>
<td>21</td>
<td>21</td>
<td>1.43</td>
<td>0.64, 3.16</td>
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<tr>
<td>50–54</td>
<td>37</td>
<td>39</td>
<td>1.25</td>
<td>0.60, 2.60</td>
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<tr>
<td>≥55</td>
<td>20</td>
<td>17</td>
<td>1.61</td>
<td>0.71, 3.64</td>
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<tr>
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<td>13</td>
<td>11</td>
<td>1.72</td>
<td>0.71, 4.14</td>
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<tr>
<td><strong>Hormone replacement therapy‡</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>65</td>
<td>82</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Former</td>
<td>10</td>
<td>6</td>
<td>1.96</td>
<td>0.95, 4.02</td>
</tr>
<tr>
<td>Current</td>
<td>25</td>
<td>12</td>
<td>3.36</td>
<td>1.93, 5.85</td>
</tr>
</tbody>
</table>

* Percentages are age adjusted to the distribution of cases.
† Logistic regression models conditional on age.
‡ Among postmenopausal women only.
confidence interval (CI): 0.70, 1.55) (table 2). The odds ratio of endometrial cancer associated with current use was 0.87 (95 percent CI: 0.49, 1.54). The odds ratio for former users was 1.12 (95 percent CI: 0.71, 1.76). An association between endometrial cancer and duration of electric blanket or mattress cover use was not observed (p trend = 0.97).

A modest interaction between ever use of an electric blanket or mattress cover and body mass index was suggested in relation to the risk of endometrial cancer; the positive association between increasing body mass and endometrial cancer risk was attenuated among users of electric blankets (p value = 0.03). However, no significant interactions were discerned between hormone replacement therapy or any other risk factor and ever use of an electric blanket or mattress cover.

**DISCUSSION**

In this population-based study, electric blanket or mattress cover use was not significantly associated with endometrial cancer risk. To our knowledge, this is the first study to assess the association between electric blanket or mattress cover use and endometrial cancer risk. Our confidence in these findings is strengthened by high participation rates (87 percent of eligible cases and 85 percent of eligible controls) and by our ability to control for many potentially confounding factors.

Some limitations should be considered in interpreting our results. Because all information in this study was based on reports from women themselves, some bias in reporting may have occurred. However, in our study population, the reliability of reported electric blanket or mattress cover use was reassuring for both ever/never use and currency of use. The small sample size constrained our analysis and limited the precision of our estimates. Thus, we cannot rule out the existence of a small increase (or decrease) in risk. Finally, our interviewers were blinded as to the case or control status for more than 80 percent of the participants, thereby minimizing differential interaction by the interviewer to the respondent.

Complete and accurate reporting of electromagnetic field exposure information is critical to any study of this type. Our history was brief, and a more complete exposure history might be possible. Some details are likely to be readily obtained, such as use patterns (throughout the night, seasonal, or bed warming only). However, other characteristics of exposure such as purchase date (engineering changes in wire configurations occurred in the 1980s) and style (various wiring configurations alter potential exposure levels) (21) would be difficult to collect. In addition, other sources of electromagnetic field exposure such as occupational history or other in-home exposures were not obtained.

Recent findings have suggested two distinct types of endometrial carcinoma: type I and type II. These carcinomas have fundamental differences in the hormonal milieu in which the tumors develop. Type I carcinoma is associated with the usual risk factors of hyperestrogenism, whereas type II seems largely unrelated to hormonal imbalance (34, 35). This study did not analyze the different histopathologic types separately. If electromagnetic field exposure is associated with only one type of endometrial cancer, then the authors’ findings might be attenuated.

Researchers have suggested several mechanisms for a possible oncostatic action of melatonin (36) such as scavenging radicals (37) enhancing immunity (38), stimulating gap-junction intercellular communication (39, 40), and/or downregulating circulating levels of neuroendocrine reproductive axis hormones (41). Experimental data with rodents of 50/60-Hz magnetic field exposure and melatonin secretion are inconclusive (42–45). One recent study...
reported that melatonin inhibited proliferation of a human endometrial cancer cell line (Ishikawa cells) in vitro (46). In a clinical study, women with endometrial cancer had significantly lower serum concentrations of melatonin than those of healthy controls (47). Human experimental studies that examined melatonin changes from magnetic field exposure have failed to observe consistent alterations (19, 20, 48–50). In contrast, a few epidemiologic studies have suggested that magnetic field exposure alters melatonin levels (17, 51–54). Some researchers suggest a possible cumulative effect of magnetic field exposure on the stability of individual melatonin measurement over time (43, 49). Chronic exposure conditions in humans have yet to be adequately explored; therefore, it is not possible to make a definite conclusion about the effect of magnetic field exposure on melatonin levels.

In conclusion, to the authors’ knowledge, this is the first report on the topic of endometrial cancer and exposure to electric blanket or mattress covers. Although the authors’ findings do not demonstrate an association, the study’s small size cannot rule out that an association exists. These findings, when considered with subsequent research, may provide further insight into the effects of electromagnetic field exposure on human health.

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