An Association between the Heat–Humidity Index and Preterm Labor and Delivery: A Preliminary Analysis

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ABSTRACT

Objectives. The goal of this study was to determine whether a relationship exists between heat–humidity indexes and rates of preterm labor and preterm delivery.

Methods. Preterm labor and delivery rates were compared during the 2 summer and 2 winter weeks with the highest and lowest heat–humidity indexes for each season.

Results. The rate of preterm labor increased consistently from 1.23% to 3.00% as the heat–humidity index rose. When preterm births were examined, the trend was similar but not statistically significant.

Conclusions. Given the public health import of preterm labor and the frequency with which pregnant women may be exposed to extremes of heat, studies designed to confirm or refute our preliminary observations are warranted. (*Am J Public Health.* 1997;87:1205–1207)

Introduction

Preterm labor and delivery are preeminent causes of perinatal morbidity. Many factors have been proposed as etiologies for preterm labor. There is laboratory evidence that heat stress may trigger labor; to our knowledge, however, no previous investigations have focused on the relationship between climatologic conditions and preterm labor.[1,2]

The overall effect of excessive heat on the body is known as heat stress. Research by Steadman[3] led to the development of a heat–humidity index, a measure of what the weather "feels like" at various temperatures and relative humidities. Since periods of extreme heat in parts of the United States over the last several years have exposed large numbers of pregnant women to heat stress, the impact of heat, if related to preterm labor, would be great. The purpose of this study was to determine whether extremely high heat–humidity indexes are associated with preterm labor.

Methods

A historic cohort study was conducted among patients receiving prenatal care at a municipal hospital in Brooklyn between March 21, 1993, and March 20, 1994. Local climatologic data reflecting conditions at an airport 16 km (10 miles) from the hospital were used in determining daily heat–humidity indexes. These data were obtained from the National Climatic Data Center (Asheville, NC). The heat–humidity index (HHI) was calculated as follows[4]:

$$HHI = td(f) - [(0.55 - 0.55 \times RH) \times td - 58],$$

where RH = relative humidity/100 and td = dry bulb temperature.

The average heat–humidity index for each 7-day period was calculated (Figure 1). Seven-day periods were chosen because the latency period between a given heat–humidity index and preterm labor is unknown. Therefore, even if an extreme heat–humidity index triggers labor, it might not result in an admission until the following day. Comparing single dates could therefore result in misclassification bias. One-week time frames would mitigate that effect. Four periods were selected: period A comprised the coldest 7 days of winter (January 15 through 21, 1994; heat–humidity index = 25), period B comprised the warmest 7 days of winter (March 4 through 10, 1994; heat–humidity index = 42.7), period C comprised the coolest 7 days of summer (September 15 through 21, 1993; heat–humidity index = 63.3), and period D comprised the hottest 7 days of summer (July 7 through 13, 1993; heat–humidity index = 79.5).

The heat–humidity index was the independent variable. Preterm labor and preterm delivery were dependent variables. We calculated the rate of preterm labor for each of the four periods by dividing the total number of preterm labor admissions during the period by the total number of patients at risk for premature birth during the period (those with gestational ages from 20 to 36 weeks inclusive, based on subsequent births within the institution). We calculated the incidence of premature delivery (the annual hospital rate is 11%) for each period in a similar fashion, the numerator being the total number of premature deliveries during the period. We excluded twins, patients with cerclage, and deliveries induced prematurely for obstetrical complications.

Statistical significance was assessed with an exact trend test to determine

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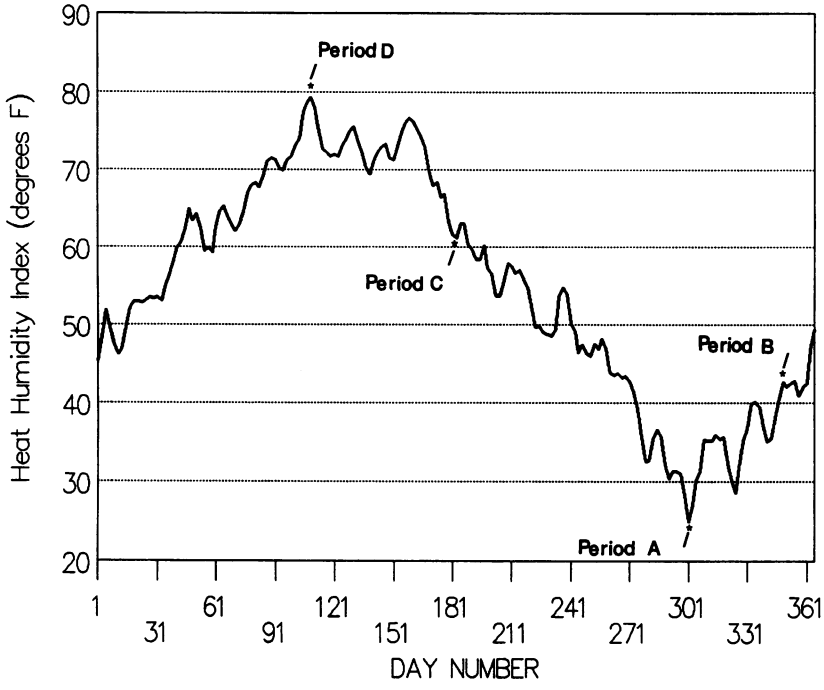

Note. See text for period definitions.

FIGURE 1—Heat–humidity index (HHI) for the period between March 21, 1993, and March 20, 1994: Brooklyn, NY.

TABLE 1—The Relationship of the Heat–Humidity Index to Rates of Preterm Labor and Delivery

	Heat–Humidity Index	Total No. at Risk[a]	Adjusted Preterm Labor Rate, % (No. Cases)	Adjusted Preterm Delivery Rate, % (No. Cases)
Period A	25.0	972	1.23 (12)	0.5 (5)
Period B	42.7	961	1.25 (12)	0.5 (5)
Period C	63.3	1031	2.00 (21)	0.7 (7)
Period D	79.5	1008	3.00 (30)	0.9 (9)

Note. Adjusted preterm labor rate was calculated by dividing the total number of preterm labor admissions during a period by the total number of patients who were between 20 and 36 weeks gestation during that time frame. Adjusted preterm delivery rate was calculated in a similar fashion, the numerator being the total number of premature deliveries during each period.

[a]Patients delivering at the study site who, during the period under study, were 20 to 36 weeks pregnant.

whether the increasing percentage of preterm events for the study periods could be explained by chance.[5]

Results

The preterm labor rate (the number of admissions for preterm labor during each time frame divided by the number of patients who were between 20 and 36 weeks' gestation [i.e., "at risk" for preterm labor] during that time) ranged from 1.23% to 3.0% (Table 1). The preterm delivery rate ranged from 0.5% to 0.9%. The heat–humidity index ranged from −4°C (25°F) to 26°C (79.5°F). Using the exact test for linear trend, we found a significant association between the heat–humidity index and the preterm labor rate ($P < .002$). When preterm births were examined, the trend was similar but not statistically significant ($P < .29$).

Discussion

We have noted, in a preliminary study, that extremes of heat are apparently associated with preterm labor. A similar trend seen in regard to preterm birth could have occurred by chance. Given the public health importance of preterm delivery and the frequency of exposure to extremes of heat, studies designed to confirm or refute our preliminary observations are warranted. If confirmed and extended, these data would reinforce the need for pregnant women to avoid extreme heat and maintain hydration.

Previous investigators have reported an association between thermal stress and labor. Dreiling et al. found that acute heat stress stimulated the release of antidiuretic hormone and oxytocin in pregnant ewes.[1] Vaha-Eskeli and Erkkola studied pregnant women exposed to heat stress for 20 minutes in a thermal chamber set at 70°C and 15% relative humidity and reported that moderate heat stress caused some uterine contractility.[2] Although the precise mechanism by which these effects were caused is unknown, it is possible that elevated heat–humidity indexes cause dehydration, which in turn releases antidiuretic hormone. Stimulation of the posterior pituitary could result in oxytocin release and uterine contractions.

A few flaws in this study should be acknowledged. Since this was a historic cohort, we were unable to use markers of hydration status. Also, all exposure data are subject to ecologic fallacy (i.e., exposure was not determined for each subject, and women could have been in modified environments). However, our low-income population had little access to air-conditioning, which would have reduced this bias. Confounding may also have been a factor, with differences in activity levels or vaginal infections linked to season. The possibility of misclassification bias exists, since clinical criteria for the diagnosis of preterm labor were used. However, admissions were based on standard hospital criteria, and information bias was obviated since clinicians were not aware of a putative association of climate with labor. In addition, although we increased the sensitivity of the analysis by studying the highest and lowest heat–humidity indexes, we cannot comment on a threshold at which this phenomenon might first be detected. In regard to the greater observed effect of heat–humidity index on labor rates than on delivery rates,

many intervening variables could influence the relationship between labor and delivery. Women admitted in preterm labor have intravenous therapy instituted, which might suffice to interrupt labor in individuals whose contractions are linked to dehydration. Also, medications are used to inhibit labor. Finally, a time series analysis with appropriate corrections for long-term trends such as seasonality and autocorrelation and for temperature alone would be necessary before one could definitively establish an independent effect for heat–humidity index by either day or week.

In summary, in a pilot study of prenatal patients in one geographic area, we found an association between high heat–humidity indexes and preterm labor. Given the preliminary, yet important, nature of the data, further prospective evaluation is warranted. □

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Vaginal Douching and Adverse Health Effects: A Meta-Analysis

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ABSTRACT

Objectives. The meta-analysis described here reviewed the current literature on adverse health effects of vaginal douching.

Methods. Papers published in English from 1965 through 1995 were potentially eligible.

Results. One third of White women and two thirds of Black women of reproductive age reported douching regularly. Analyses indicated that vaginal douching increases the overall risk of pelvic inflammatory disease by 73% and the risk of ectopic pregnancy by 76%. Frequent douching was shown to be highly associated with pelvic inflammatory disease and modestly associated with cervical cancer.

Conclusions. Current literature suggests that frequent douching increases the risk of pelvic inflammatory disease, ectopic pregnancy, and, possibly, cervical cancer. (*Am J Public Health.* 1997;87:1207–1211)

Introduction

Vaginal douching is an ancient practice. It is widely performed in the United States, yet the benefits, risks, and relevant biological mechanisms have been inadequately studied. Scientific data are not only limited but also inconsistent; thus, some physicians are unaware of reported potential risks related to douching, and others remain unconvinced. The public is often confused by inconsistent results from different studies. On the other hand, commercial douche products are actively marketed and readily available. Since the population that douches regularly is so large, even a small risk will bear an important public health implication. This review focuses on the epidemiology of vaginal douching; describes a meta-analysis of the associations of douching with pelvic inflammatory disease, ectopic pregnancy, and cervical cancer; and discusses unresolved issues for future research.

Methods

We started with a MEDLINE literature search using "douching" as the key word. All of the papers published in English from 1965 through July 1995 were eligible for this review. We also searched the potentially eligible studies by cross-checking all of the references included. We then restricted our topics to epidemiology of vaginal douching and associations with pelvic inflammatory disease, ectopic pregnancy, and carcinoma of the cervix. Other topics related to vaginal douching, such as vulvovaginitis, have an insufficient number of studies for the purpose of meta-analysis. Only papers that provided actual measurement of prevalence or an estimate of association were included. We extracted information of interest from each study and summarized the information in a table (available from the senior author). All of the researchers adjusted for potential confounders that were available and important to their studies, and all presented adjusted relative risks (RRs) and 95% confidence intervals (CIs). Our meta-

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