Committee on School Health

Heat Stress and School Closings

During the last decade, the practice of opening public school in early August has led to environmental stresses on students and teachers due to extremes of heat and humidity. In the South and Southwest, it is not unusual to have 15 to 20 days of 90°F (32.2°C) and relative humidity of 60% and higher during August. This puts a strain on teachers' and students' adaptability.

In surveying eight southern states, J. W. Trieschmann (unpublished data, 1983) found that the availability of air conditioning in public schools ranged from 15% in some states to 30% in others. The smaller, poorer, usually rural school districts had the least access to cooling equipment. Thus, a large school population is at the mercy of the elements. This is especially significant because the majority of this population has been acclimatized to air-conditioned homes and stores, and extremes of heat discomfort are not well tolerated.

Heat stress is defined as the overall effect of excessive heat on the human body. The important factors contributing to heat stress are air temperature, humidity, air movement, radiant heat, atmospheric pressure, physiologic factors (handicap or chronic disease), physical activity, and time exposure. Under normal conditions, temperature and humidity are the most important elements influencing comfort. The American Society of Heating, Refrigeration, Air Conditioning Engineers (ASHRAE) has published an index for determining heat stress based on human physiology, clothing, and standard room conditions. This index, called the "ET" or effective temperature (in Fahrenheit), is a measure of what hot weather feels like to the average person at different temperatures and humidities. The ET provides an excellent standard to be used by school superintendents in planning school hours during summer heat waves. The necessary information to calculate this is available from the National Oceanic and Atmospheric Administration (NOAA), which gives weather conditions on radio and broadcasts hourly temperature readings (in Fahrenheit) and relative humidity percentages. Using the nomogram in the Figure, the ET can easily be derived. For example: If the average temperature for the school hours 8 AM to 3 PM is 90°F and the relative humidity is 50%, then the ET would be 81°F.

The ET becomes important when it is subjected to clinical situations. Herrington, in 1951, found that errors increased from an average of 12 per hour to more than 90 per hour as the ET was increased from 79°F to 97°F. Similar findings by Peplar have confirmed that even slight increases in environmental temperature have an adverse effect on learning. Such data are convincing evidence of the undesirable effects of heat stress on school performance.

ASHRAE standards for air-conditioning systems strive to achieve 76°F with 50% relative humidity, or an ET of 70°F for all school environments. Classroom studies have shown maximal comfort for studying to be at an ET between 66°F and 75°F.

The type of clothing and the length of time of exposure to a given environmental condition greatly affect the comfort index. In classroom situations, all data point to the relationship between temperature, the kind of activity conducted therein, and

![Figure. Temperature-humidity index.](image-url)
the amount of concentration needed for the learning situation at hand.

An ET of 85°F for a sustained period of four to six hours is considered the maximum tolerable condition for sedentary educational activity. Fatigue and learning skills deteriorate rapidly beyond this point. At an ET between 93°F and 96°F, extreme caution is recommended. Such effective temperatures may result in heat cramps, heat stroke, and heat exhaustion.²

### TABLE. General Heat Stress Index*

<table>
<thead>
<tr>
<th>Category</th>
<th>Effective Temperature (ET) ('F)</th>
<th>Heat Stress Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danger</td>
<td>95</td>
<td>Heat stroke or sun stroke likely (no school)</td>
</tr>
<tr>
<td>Extreme caution</td>
<td>85–94</td>
<td>Heat stroke, heat cramps, heat exhaustion possible with long exposure (suggest 1/2 d-AM hours—or no school)</td>
</tr>
<tr>
<td>Caution</td>
<td>75–84</td>
<td>Learning skills decrease with long exposure; increased fatigue after 4–6 h (suggest 1/2 d AM hours)</td>
</tr>
<tr>
<td>Maximum comfort</td>
<td>65–74</td>
<td>Excellent learning skills; all day school (subject to activity and clothing)</td>
</tr>
</tbody>
</table>

*Data from ASHRAE.² Additional comfort during summer heat waves can be achieved by allowing students to wear shorts, “cut-offs,” or other light clothing. Liberal fluid intake and moderate physical activity (in shade) promote thermal adaptation. If high ET readings are consistent in the area year in and year out, a later school starting date should be considered. NOAA (weather radio) can provide the averages for the year for any region and locale.

Given the above data, the ET derived from the nomogram can be used to assist school authorities in determining when it is healthy and safe to hold school classes. The “Heat Stress Index” (Table) provides a guide based on ET readings.²

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**REFERENCES**

### Heat Stress and School Closings

*Pediatrics* 1984;74;313

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