Health impact of climate change on occupational health and productivity in Thailand
Research Team

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Thailand is experiencing similar trend with an increase of about 1 degree Celsius over a 20 year period.

Source: Thai Meteorological Department, 2009
• Changes in temperature lead to increases in heat exposure which has ranges of health effects (mild heat rashes → deadly heat stroke).

• Heat exposure can also aggravate several chronic diseases (cardiovascular and respiratory disease).
Number of heat-related morbidity and mortality by gender and age group in Thailand, 2007-2009 (N = 232)

Source: National Health Security Office, Thailand, 2009
Number of heat-related morbidity and mortality by ICD-10 in Thailand, 2007-2009 (N = 232)

- Heatstroke and sunstroke
- Heat syncope
- Heat cramp
- Heat exhaustion, anhydrotic
- Heat exhaustion, unspecified
- Heat fatigue, transient
- Heat oedema
- Other effects of heat and light
- Effect of heat and light, unspecified

Source: National Health Security Office, Thailand, 2009
Heat Stroke in Thailand

1987: Athletes in marathon
1990: Soldiers become severely ill as exertional heat stroke
1992: 51 soldiers who received basic training
2009: 8 soldiers admitted to hospital and 3 died
Heat stroke in Thai Military, 1990-2009

Source: Army Medical Department, Royal Thai Army, 2009
Health Effects of Heat in Thailand

• Physiological differences in cardiovascular loading during work performances (Yoopat et al., 1998; Yoopat, 2002a; Yoopat, 2002b).

• Incremental heart rate was related to Wet Bulb Globe Temperature (WBGT) heat index (Makkonggaew, 2002).

• Exercise and heat stress induced higher heart rate and blood pressure (Nainate and Chaunchaiyakul, 2006).
To examine the relationship between climate condition and health status and productivity in two main categories of occupational setting where one setting involves heat generated from the industry and the other with heat in a natural setting.
Methodology

Selection of study location
- Two provinces
Annual mean temperature for Pathum Thani and Ayutthaya by year, 1999-2008

Source: Climate Information Services, Thai Meteorological Department, 2008
Information gathering and data collection

• Climate situation in Pathum Thani and Ayutthaya

• Measurements of WBGT and Relative Humidity (RH)

QuestTemp° 34
Area Heat Stress Monitor

5 consecutive days from 6.00 AM-6.00 PM
Information gathering and data collection (cont.)

- Individual worker’s data: questionnaire
  - type of work
  - working hour
  - heat stress
  - length of breaks
  - cooling actions
  - productivity of worker
Study population and sampling design

- Workers at 5 workplaces: industrial, agricultural and construction sectors
- Types of industry: pottery industry, power plant, and knife industry
Worksite 1: Sam Khok pottery industry
Worksite 2: Sam Khok vegetable field
Worksite 3: Ratchasuda construction building
Worksite 4: Wang Noi power plant
Worksite 5: Aranyik knife industry
Exposure Results
WBGT is found to be highest at 34.58 degree Celsius during 12.00-1.00 PM at agricultural site.
RH was very high or close to 100% in the early morning and decreased gradually after sunrise.
<table>
<thead>
<tr>
<th>Relative Humidity (%)</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60</th>
<th>65</th>
<th>70</th>
<th>75</th>
<th>80</th>
<th>85</th>
<th>90</th>
<th>95</th>
<th>100</th>
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<tbody>
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<td>110°F (47°C)</td>
<td>136 (58)</td>
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<td>124 (51)</td>
<td>130 (54)</td>
<td>137 (58)</td>
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<tr>
<td>104°F (40°C)</td>
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<td>124 (51)</td>
<td>131 (55)</td>
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<tr>
<td>102°F (39°C)</td>
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<td>119 (48)</td>
<td>124 (51)</td>
<td>130 (54)</td>
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<td>113 (45)</td>
<td>117 (47)</td>
<td>123 (51)</td>
<td>128 (53)</td>
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<td>100 (38)</td>
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<td>85 (29)</td>
<td>86 (30)</td>
<td>88 (31)</td>
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<td>96 (36)</td>
<td>98 (37)</td>
<td>100 (38)</td>
<td>103 (39)</td>
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<td>81 (27)</td>
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<td>83 (28)</td>
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<tr>
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<td>85 (29)</td>
<td>85 (29)</td>
<td>86 (30)</td>
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</tr>
</tbody>
</table>

**Heat Index °F (°C)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Possible heat disorders for people in high risk groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130°F or higher (54°C or higher)</td>
<td>Heat stroke or sunstroke likely.</td>
</tr>
<tr>
<td>Danger</td>
<td>105-129°F (41-54°C)</td>
<td>Sunstroke, muscle cramps, and/or heat exhaustion likely. Heat stroke possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90-105°F (32-41°C)</td>
<td>Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80-90°F (27-32°C)</td>
<td>Fatigue possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

Source: NOAA, US
### Heat Indices for the 5 workplaces

<table>
<thead>
<tr>
<th>Workplace</th>
<th>Temperature (Celsius)</th>
<th>Relative Humidity (%)</th>
<th>Heat Index (Celsius)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pottery industry</td>
<td>31</td>
<td>72</td>
<td>38.4</td>
</tr>
<tr>
<td>Vegetable field</td>
<td>31</td>
<td>65</td>
<td>36.6</td>
</tr>
<tr>
<td>Construction building</td>
<td>29</td>
<td>81</td>
<td>35.8</td>
</tr>
<tr>
<td>Power plant</td>
<td>33</td>
<td>63</td>
<td>40.9*</td>
</tr>
<tr>
<td>Knife industry</td>
<td>29</td>
<td>86</td>
<td>35.5</td>
</tr>
</tbody>
</table>

- Effects of heat exposure which consisted of 21 workers
- 4 out of 5 sites, have HI in the “extreme caution”
- *Power plant may fall into the category “danger”
## Demographical characteristics of workers

<table>
<thead>
<tr>
<th>Industry</th>
<th>Male [n (%)]</th>
<th>Range for age (yr)</th>
<th>Mean and range for work hours (hr)</th>
<th>Mean and range for break hours (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pottery industry (n = 5)</td>
<td>2 (40)</td>
<td>32-39</td>
<td>8, no range</td>
<td>8, 5-10</td>
</tr>
<tr>
<td>Vegetable field (n = 2)</td>
<td>1 (50)</td>
<td>49-58</td>
<td>6, no range</td>
<td>105, 90-120</td>
</tr>
<tr>
<td>Construction building (n = 5)</td>
<td>5 (100)</td>
<td>27-63</td>
<td>8.4, 8-9</td>
<td>43, 10-120</td>
</tr>
<tr>
<td>Power plant (n = 6)</td>
<td>6 (100)</td>
<td>33-58</td>
<td>7.2, 5-8</td>
<td>5.8, 0-20</td>
</tr>
<tr>
<td>Knife industry (n = 3)</td>
<td>1 (33.3)</td>
<td>43-76</td>
<td>3.3, 3-4</td>
<td>36.7, 20-60</td>
</tr>
</tbody>
</table>
Interventions

• Consume fluids, Bath
• Find a cool place to sit down
• Take breaks or rests
• Clothing, Electric or paper fans, air-conditioning
• Spend a short period
• Avoid working under strong sun radiation or hot areas
• Build small shelters
• Use PPEs
Construction and pottery industry workers assessed a loss of productivity ranged from 10 to 60%.
Conclusion and Suggestion

- Climate conditions in Thailand potentially affect both the health and productivity in occupational setting.
- Consider heat as a health hazard along with other industrial pollutants.
- Management of heat stress at the workplace requires efforts from all stakeholders (employees, employers, government agencies both at the local and central levels).
- Consider the impact of heat on workers health as a priority.
- Develop further more detailed research on this public health issue.
Presentation and Publication

Livelihood and Health Impacts of the Climate Change:
**Community Adaptation Strategies**

24-25 August, 2010
Pullman Raja Orchid Hotel
Khon Kaen, Thailand

Global Health Action
Situation and effects of climate change and heat exposure among workers in Thailand

2010-2013
Research Team

Faculty of Public Health and Faculty of Economics, Thammasat University

Nuntavarn Vichit-Vadakan, Dr.P.H.
Sasitorn Taptagaporn, Ph.D.
Uma Langkulsen, Ph.D.
Dow Mongkolsmai, Ph.D.
Objectives

- To describe climate situation: typical seasonal and daily variations in temperature and humidity conditions, wind speed, rainfall patterns and other factors of relevance to heat exposure;
- To describe the impact of climate change on heat exposure among workers;
- To characterize the type of occupations who have to work in hot outdoor or indoor environments, and the current practices to deal with heat;
- To determine exposures and measures taken to avoid overheating in workplace.
Conceptual Framework

Climate change

- Increased ambient temperature
- More hot days
- Higher average temperature

Heat stress

Develop guidance on preventing heat stress in the workplace

- Health impact assessment
- Productivity assessment
Export Proportion of Thailand, 2010

- Industrial products: 77%
- Agricultural products: 11%
- Agro-Industrial products: 7%
- Mineral products and Fuel: 5%
- Others: 0%

Source: Information and Communication Technology Centre, Office of the Permanent Secretary Ministry of Commerce With Cooperation of The Customs Department, 2010
Thailand’s Top Ten Exports, 2010

- Rice
- Chemicals
- Plastic resin
- Rubber products
- Refine fuels
- Rubber
- Electronic integrated circuits
- Gems and jewelry
- Motor vehicles and parts
- Computers, accessories and components

Source: Department of Export Promotion, Ministry of Commerce, Royal Thai Government, 2010
Temperature and Rainfall in Thailand

**Maximum temperature**
30-yr period: 1978-2007

**Mean annual rainfall**
30-yr period: 1971-2000

Source: Thai Meteorological Department, 2011
Study Sites

Kanchanaburi

Pathumthani
Research Methodology

- Questionnaire (provided by the Hothaps team): 30 workers and 10 key informants/site
- Worker’s diary (length of breaks, cooling actions, production output): 30 workers/site
- WBGT: 3 stations/site, 10 consecutive days, summer (April) and winter (November) seasons, 24-hour
- Heart rate (during shift): 3 workers/site, hourly
- Body temperature: 3 workers/site, hourly
Key Informants

1. Agricultural sector
   - District agricultural officer
   - Tambon agricultural officer
   - Tambon Administrative Organization (TAOs)
   - Primary care worker (PCWs)
   - Village leader
   - etc.

2. Industrial sector
   - Health and safety officer
   - Occupational health nurse
   - Occupational physician
   - Entrepreneur/owner
   - Human resource officer
   - Supervisor
   - etc.
## Project Timeline

**Starting date:** Oct 1, 2010

**Estimated duration:** 3 yrs

<table>
<thead>
<tr>
<th>Activity</th>
<th>Y1</th>
<th>Y2</th>
<th>Y3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
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<tr>
<td>• Collect and review existing documents</td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
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<tr>
<td>• Collect data by questionnaire, diary</td>
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<td><img src="image10" alt="Image" /></td>
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<tr>
<td>• Measure WBGT, heart rate, body temperature</td>
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<td>• Statistical analysis of data</td>
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<td><img src="image26" alt="Image" /></td>
<td><img src="image27" alt="Image" /></td>
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Thank you for your attention