Excessive Work Temperatures in the Garment Industry:

Regulatory Landscape, Health Effects,

and Strategies to Improve Conditions

Prepared for Worker Rights Consortium (WRC)

Kyle Peerless

PH 290 - Global Occupational Health

Professor Brown and Dr. Hammond

University of California, Berkeley

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Berkeley School of Public Health

WRC WORKER RIGHTS CONSORTIUM

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Introduction

Based on my correspondence with Tara Mathur and Scott Nova, I have been requested to develop a report for Workers Right Consortium (WRC) focusing on the hazard of excessive ambient temperature and humidity in the garment industry. I was asked to research and deliver the following information:

- Review the law with regard to ambient temperature (and humidity, where applicable) in garment factories in top garment-producing countries:
    - Bangladesh, Cambodia, China, Dominican Republic, El Salvador, Haiti, India, Indonesia, Lesotho, Pakistan, and Vietnam
- Review the same standard for the US (as a benchmark which may be cited by WRC in the absence of a law in the country where a factory is located)
- Review literature on ambient temperature at garment factories, resulting health issues (at what temperature/heat index do the workers in the factory begin to experience health issues), and strategies for managing the temperature.
- Provide a summary of the information and a list of sources

The following report contains this information, with a narrative and summary of how I found the information as well as full citations and an appendix which aggregates all the information I found for WRC's future reference. It is my hope this information will be useful in any future publication or campaign to pressure brands regarding excessive garment factory temperatures.

Existing Labor Law Regulating Workplace Temperature/Humidity in Relevant Garment-Producing Countries

After researching relevant labor law for each country, I have outlined the language I have found in each country's labor law that discusses workplace temperature, ventilation, and/or humidity. For Bangladesh, Dominican Republic, El Salvador, India, Pakistan, and Vietnam, I was able to directly locate official labor law in each of these countries which had relevant information to workplace temperature and I have cited those laws accordingly. For Cambodia, Haiti, and Indonesia, I was able to find relevant labor law language through condensed "Labor Law Guides" provided for each country as a part of the ILO/IFC (World Bank) *Better Work* initiative that has been carried out in each country. Lastly, for China, I was able to find relevant labor law explained via a document published by Cornell University and the international law firm Baker & McKenzie, which compiles this information generally with the intent of advising corporations and entrepreneurs that work in China on labor law considerations for their business. These aforementioned sources will be aggregated with full citation information and listed together in the appendix of the report. My findings for each country are as follows:

Bangladesh (1)

"52. Ventilation and temperature : (1) Effective and suitable provisions shall be made in every establishment for securing and maintaining in every work-room adequate ventilation by the circulation of fresh air; (2) such temperature as will secure to workers therein reasonable conditions of comfort and prevent injury to health. (3) the walls and roofs, as required by sub-section (2), shall be of such material and so designed that such temperature shall not be exceeded but kept as low as practicable; (4) where the nature of the work carried on in the establishment involves, or is likely to involve, the production of excessively high temperature, such adequate measures as are practicable, shall be taken to protect the workers there from by separating the process which produces such temperature from the work-room by insulation the hot parts or by other effective means. (5) If it appears to the government that in any establishment or class or description of establishments excessively high temperature can be

reduced by such methods as white-washing, spraying or insulating and screening outside walls or roofs or windows or by raising the level of the roof, or by insulating the roof either by an air space and double roof or by the use of insulating roof materials, or by other methods, it may prescribe such of those or those or other methods to be adopted in the establishment."

Cambodia (2)

" 8.7.2 Heat and Ventilation: Employers must ensure that the temperature in the workplace is reasonable for employees. There must be at least $10m^3$ of airspace in a factory or workshop for every employee. Employers must have thermometers in the workplace to monitor the temperature. 8.7.3 Work in areas with limited ventilation: If employees have to work in places with limited ventilation (such as caves, basements, or large cylinders), the employer must ensure that the employees have access to at least $30m^3$ of fresh air per person per hour."

China (3)

"Employers should conduct health checks (and bear the associated costs) for employees engaging in high-temperature work. Further, employers may not arrange for pregnant employees and minor employees to work... indoors where the temperature is above 33 degrees Celsius. For any suspension of work due to high temperature, employers cannot reduce employees' salary. Employers are also required to pay a high-temperature subsidy to employees who work ...when the indoor temperature reaches 33 degrees Celsius or above. However, the law is silent as to how the indoor temperature should be recorded or monitored and whether there is an acceptable minimum duration of such high temperature for the purposes of the subsidy. With respect to the subsidy amount, the High Temperature Regulations refer to local rules that are promulgated by the provincial labor authorities from time to time. With regard to penalties, if an employer violates relevant work safety provisions related to the health of employees, the employer may be ordered to rectify the non-compliance, suspend operations or face criminal liabilities in serious situations."

Dominican Republic (4)

"1.5 In all workplaces used by workers, the employer will take care of maintaining sufficient and adequate ventilation natural or artificial means that provide workplaces with fresh air or purified and that contributes to provide environmental conditions comfortable, not causing discomfort that harm the health of the worker. In addition, the employer must take appropriate measures with the purpose of avoiding the existence of temperatures in the workplace and extreme humidity, sudden changes in temperature, air currents annoying and unpleasant odors."

El Salvador (5)

Salvadorian Labor Law has an extremely extensive section on indoor workplace heat regulations which appear to (based on my marginal Spanish language competency) establish maximum temperatures, work/rest regimens, and also factor in the type of work and clothing being worn by workers. Since it is so long and thorough, I didn't find it worth summarizing here because it would take up too much space and will thus refer readers to the appendix to find the source directly.

Haiti (6)

"The company must insure that:...Suitable atmospheric conditions are ensured to avoid inadequate air supply and circulation, air pollution and, to the extent possible, excessive moisture, excessive heat or cold, and unpleasant odors."

India (7)

"13. Ventilation and temperature. (1) Effective and suitable provision shall be made in every factory for securing and maintaining in every workroom-- (a) adequate ventilation by the circulation of fresh air, and (b) such a temperature as will secure to workers therein reasonable conditions of comfort and prevent injury to health;- and in particular,- (i) walls and roofs shall be of such material and so designed that such temperature shall not be exceeded but kept as low as practicable; (ii) where the nature of the work carried on in the factory involves, or is likely to

involve, the production of excessively high temperatures, such adequate measures as are practicable shall be taken to protect the workers therefrom, by separating the process which produces such temperatures from the workroom, by insulating the hot parts or by other effective means. (2) The State Government may prescribe a standard of adequate ventilation and reasonable temperature for any factory or class or description of factories or parts thereof and direct that [proper measuring instruments, at such places and in such position as may be specified, shall be provided and such records, as may be prescribed, shall be maintained.] [(3) If it appears to the Chief Inspector that excessively high temperatures in any factory can be reduced by the adoption of suitable measures, he may, without prejudice to the rules made under sub-section (2), serve on the occupier, an order in writing specifying the measures which, in his opinion, should be adopted, and requiring them to be carried out before a specified date.]"

Indonesia (8)

"A. Requirements

1. Temperature and humidity: Temperature: 18 - 28.0 C, Humidity: 40% - 60%

2. Procedure for implementation: 1) Temperature and humidity: In order for office workspaces to meet health requirements efforts need to be made as follows: a) The ceiling height from the floor is at least 2.5 m. b) If the air temperature is> 28 0C needs to use a stylist air such as Air Conditioner (AC), fan, etc… d) If the humidity of the work space> 60% is necessary use a dehumidifier"

Lesotho (9)

No relevant indoor temperature regulations found (relevant Lesotho Labor Code listed in appendix)

Pakistan (10)

Note:** This legislation is almost identical to the legislation for India which I am guessing is linked to their colonial history under British India

“15. Ventilation and temperature.__ (1) Effective and suitable provisions shall be made in every factory for securing and maintaining in every work-room__ (a) adequate ventilation by the circulation of fresh air, and (b) such temperature as will secure to workers therein reasonable conditions of comfort and prevent injury to health, and in particular (i) the walls and roofs shall be of such material and so designed that such temperature shall not be exceeded but kept as low as practicable; (ii) where the nature of the work carried on in the factory involves, or is likely to involve, the production of excessively high temperature, such adequate measures as are practicable, shall be taken to protect the workers therefrom by separating the process which produces such temperature from the work-room by insulating the hot parts or by other effective means. (2) The Provincial Government may prescribe a standard of adequate ventilation and reasonable temperature for any factory or class or description of factories or parts thereof and direct that a thermometer shall be provided and maintained in such place and position as may be specified. (3) If it appears to the Provincial Government that in any factory or class or description of factories excessively high temperature can be reduced by such methods as whitewashing, spraying or insulating and screening outside walls or roofs or windows, or by raising the level of the roof, or by insulating the roof either by an air space and double roof or by the use of insulating roof materials, or by other methods, it may prescribe such of these or other methods to be adopted in the factory”

Vietnam (11,12)

Vietnamese Labor Law pertaining to ambient air temperature in the workplace is rather extensive compared to most countries. It sets up quantitative thresholds for temperature and humidity in the workplace and also sets maximum temperatures depending on severity and intensity of work (low, medium, high intensity, etc.). Since it is relatively long and thorough, I will not summarize it here and refer readers to the appendix.

United States

Federal Regulation (13)

At the federal level, the United States has no explicit and/or enforceable indoor ambient temperature or humidity standards for workplaces. It recommends workplaces be between 68-76°F (20-24°C) and says "employers are responsible for protecting workers from extreme heat". It provides guidance for employers to prevent heat-related illnesses and deaths, but there's no clear maximum permitted workplace temperature. This policy is articulated clearly in an internal memo from 2003 which is published on the Occupational Safety and Health Administration (OSHA) website (found in appendix).

California (14)

Given the lack of federal legislation, I performed research regarding state legislation and found that California is actually currently in the process of establishing statewide indoor heat regulations as of Fall 2018. The legislation is currently being drafted, amended, and presented before state government committees. I made contact with the director of Cal-OSHA's Heat Illness Prevention Program, David Hornung, who is one of the main representatives within Cal-OSHA who will be in charge of enforcing this law (he spoke in our class at UC Berkelez and is a former co-worker of Garrett Brown's). He told me the regulation should become law by Spring of 2019 so it would be worthwhile to follow up on this once it officially becomes law. The most recent draft of this regulation (dated October 24, 2018) is currently listed on Cal-OSHA's website. Given its length, I have not included the full text in this report but will include it in the Appendix. In brief summary, the regulation includes explicit quantitative thresholds at which the regulation and mandatory actions by the employer to reduce heat apply. The regulation also requires the employer to implement engineering (example would include installing air conditioning), administrative (example would include a mandatory work/rest regimen), or personal protective equipment (PPE) controls in certain contexts. The regulation also discusses workplaces having acclimatization or "cool-down" areas with mandatory access to

water for workers. Finally the regulation mandates employers having heat illness prevention plans and trainings for workers.

Effect of Heat Stress on Worker Health in Garment Industry

I was able to compile several key regulatory and technical sources which outline the health effects associated with heat stress at the workplace. The three foundational sources which are the most thorough and informative are the National Institute of Occupational Health and Safety (NIOSH) "Criteria for a Recommended Standard, Occupational Exposure to Heat and Hot Environments" (15), the 2018 American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) for Heat Stress (16), and OSHA's Online Technical Manual on Heat Stress (18,19). The NIOSH document is extremely thorough on explaining the biological effects of heat stress on workers, while the ACGIH document gives the reader analytical tools to understand heat stress levels workers will be exposed to given certain temperature, humidity, and clothing factors. The ACGIH document outlines the most up-to-date recommended work/rest regimens at certain temperature and work severity criteria. The ACGIH chapter also provides technical information about using Wet Bulb Globe Temperature (WBGT) measurements (and approximations using basic weather information because very few workplaces in the US, let alone the developing world have access to a WBGT thermometer) to determine when heat exposure hazards are present in the workplace. Lastly, the OSHA Technical Manual is very informed by information found in the NIOSH and ACGIH document, but it is also extremely valuable in that it provides an example/case study in which it demonstrates how one would investigate and use the analytical tools provided to demonstrate a heat stress violation took place in a workplace. **This model could be used during a WRC campaign to demonstrate workers are exposed to heat levels that would be considered unlawful in the United States and have caused worker fatalities in the past.** Here are summaries/examples of this information, which provide tables which can approximate human exertion in a work process, provide recommended work/rest regimens at certain temperatures, and also the heat stress Threshold Limit Value (TLV) graph which demonstrates when work stoppage should take place:

Source: ACGIH 2018 TLVs and BEIs" TABLE 3 (16)

Table 3. Metabolic Rate Categories and the Representative Metabolic Rate with Example Activities

Category	**Metabolic Rate (W)**	**Examples**
Rest	115	Sitting
Light	180	Sitting with light manual work with hands or hands and arms, and driving. Standing with some light arm work and occasional walking
Moderate	300	Sustained moderate hand and arm work, moderate arm and leg work, moderate arm and trunk work, or light pushing and pulling. Normal walking
Heavy	415	Intense arm and trunk work, carrying, shoveling, manual sawing, pushing and pulling heavy loads, and walking at a fast pace
Very Heavy	520	Very intense activity at fast to maximum pace

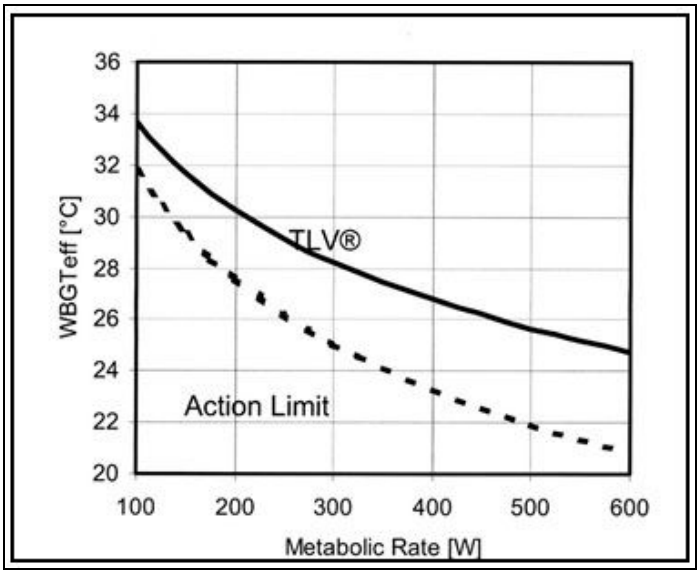
*The effect of body weight on the estimated metabolic rate can be accounted for by multiplying the estimated rate by the ratio of actual body weight divided by 70 kg (154lb)

Source: ACGIH 2018 TLVs and BEIs" TABLE 5 (16)

Table 5. Action Limits (WBGT values in Celsius)

% Allocation of Work in a Cycle of Work and Recovery	**Workload**			
	Light	**Moderate**	**Heavy***	**Very Heavy***
75 to 100%	28.0°C	25.0°C	N/A	N/A
50 to 75%	28.5°C	26.0°C	24.0°C	N/A
25 to 50%	29.5°C	27.0°C	25.5°C	24.5°C
0 to 25%	30.0°C	29.0°C	28.0°C	27.0°C

Source: ACGIH 2018 TLVs and BEIs" Figure 2, Graphical Reference of Action Limits and TLVs



Techniques to Manage Heat in Garment Industry

General Techniques Listed by OSHA/American Industrial Hygiene Community

The OSHA technical manuals (18,19) features key best practices to minimize heat-related illness and heat stress in the workplaces. The following are engineering controls that they list:

- Use air conditioning
- Increase general ventilation
- Provide cooling fans
- Run local exhaust ventilation where heat is produced (e.g., laundry vents)
- Use reflective shields to block radiant heat
- Insulate hot surfaces (e.g., furnace walls)
- Stop leaking steam
- Provide shade for outdoor work sites

They also list administrative controls that are possible:

- Acclimatize workers starting the first day working in the heat
- Re-acclimatize workers after extended absences
- Schedule work earlier or later in the day
- Use work/rest schedules
- Limit strenuous work (e.g., carrying heavy loads)
- Use relief workers when needed

Finally, they list relevant personal protective equipment:

- Loose fitting clothing
- Air-cooled garments
- Cooling vests
- Wetted over-garments

Further Techniques Listed in the Literature Focused on Garment Industry

In addition to general recommendations, I was asked to look through the literature to examine other cooling techniques such as evaporative cooling systems which can be cheaply implemented in the developing world. In the literature, there are several source which argue for more novel approaches such as evaporative cooling systems (20). This has been demonstrated to be successful in China but is somewhat limited in its effectiveness in more humid conditions. Additional sources also argue for certain considerations to be made in the construction of new garment factories in terms of plant layout (access to natural light, shade cover, etc.), but these are limited in that they can only be applied to new plants and don't necessarily confront the problems faced in existing plants (21). Probably the most promising recent technique I found in the literature (which has gained traction and support within the World Bank) is arguing for the implementation of LED lights in garment factories which release significantly less heat and have been demonstrated in academic papers to pay for themselves in terms of the increased productivity of workers due to working in slightly less hot conditions (22).

This connects into my last recommendation, in that there are several prominent economists at universities in the United States such as MIT doing research about the productivity losses associated with excess heat, climate change, and pollution in developing countries such as India. Many of these papers attempt to link worker absenteeism and productivity to increased temperature, and clearly demonstrate economic losses associated with high temperature/humidity, which of course they predict this will only get worse as the effects of climate change intensify (23, 24, 25). I think translating some of the economic arguments from these papers might potentially bear fruit in terms of getting brands/factories to invest in more adequate cooling systems because of the potential increase in productivity they could see from doing so.

Appendix

All of these sources will be made available via DropBox and/or Google Drive

Sources for Labor Law

1. Bangladesh Labor Act, 2006, Chapter 5, Section 52
2. "Guide to the Cambodian Labour Law for the Garment Industry." *Better Factories Cambodia*. International Labor Organization, revised 2013.
3. "China Employment Law Update - August 2012" (2012), Baker & McKenzie, via Cornell University School of Industrial and Labor Relations Digital Commons
4. Dominican Republic (translated from Spanish): "Safety and Health at Work Regulations, Decree Number 522-06 of October 17, 2006" (2006) Section 1.5
5. El Salvador (translated from Spanish): "Decree no. 89 of April 27, 2012 approving the General Regulation for the Prevention of Risks in Workplaces (§§ 137-148)" (2012), Article 137-148
6. "Practical Guide, Haitian Labor Code." *Better Work Haiti*. International Labour Organization. March 2017
7. India Factories Act (1948), Chapter 3, Section 13
8. "Labor Law Guidelines" (translated from Indonesian), Section 7.4, *Better Work Indonesia*: International Labor Organization and International Finance Corporation
9. Lesotho: Labour Code Order, 1992
10. Pakistan Factories Act (1934), Chapter 3, Section 15
11. "Guide to Vietnamese Labor Law for the Garment Industry, 6th Edition." *Better Work Vietnam*. International Labor Organization. 2018.
12. Vietnam : "Technical Regulation on Microclimate - Permissible Value of Microclimate in the Workplace" (2016); Vietnamese Health Ministry

Sources for Health Effects and Analytical Tools to Determine Presence of Heat Stress

13. "Reiteration of OSHA Policy on Indoor Air Quality" (2003) https://www.osha.gov/laws-regs/standardinterpretations/2003-02-24
14. "Heat Illness Prevention Draft Text-draft revisions 10/24/18 compared to 5/6/18" CalOSHA, California Deparment of Industrial Relations, 2018.
15. "NIOSH criteria for a recommended standard: occupational exposure to heat and hot environments." By Jacklitsch B, Williams WJ, Musolin K, Coca A, Kim J-H, Turner N. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 2016-106.
16. 2018 ACGIH TLVs and BEIs, American Conference of Governmental Industrial Hygienists
17. "Heat Stress--The Forgotten Fundamental." by Giles, C. *Giles Occupational Safety & Health (GOSH) LLC*. 2018 American Industrial Hygiene Conference and Exposition Presentation.
18. OSHA Technical Manual, Section III: Chapter 4: Heat Stress. United States Department of Labor. Updated September 15, 2017
19. OSHA Technical Manual, Section III: Chapter 2: Indoor Air Quality Investigation. United States Department of Labor. Updated September 15, 2017

Sources for Techniques to Mitigate Heat/Economic Arguments for Lost Productivity

20. Peng, J., Li, L., Liu, F., & Chen, S. (2015). Application on Evaporative Cool Technique in Garment Workshop in Hot-humid Area. *Procedia Engineering, 121*, 2029-2036. doi:10.1016/j.proeng.2015.09.203
21. Naz, Farah (2008). "Energy Efficient garment factories in Bangladesh." PLEA 2008 Conference on Passive and Low Energy Architecture, Dublin, Ireland.
22. Adhvaryu, A., Kala, N., & Nyshadham, A. (2018). The Light and the Heat: Productivity Co-benefits of Energy-saving Technology. doi:10.3386/w24314

23. Kjellstrom, T., Holmer, I., & Lemke, B. (2009). Workplace heat stress, health and productivity - an increasing challenge for low and middle-income countries during climate change. *Global health action*, *2*, 10.3402/gha.v2i0.2047. doi:10.3402/gha.v2i0.2047
24. A Adhvaryu, N Kala, A Nyshadham. "Management and shocks to worker productivity: evidence from air pollution exposure in an Indian garment factory" University of Michigan, 2014
25. Somanathan, E. Sudarshan, A, et al. *The impact of temperature on productivity and labor supply: Evidence from Indian manufacturing*. No. 15-03. Indian Statistical Institute, New Delhi, India, 2015.