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President and General Counsel

October 27, 2025

Docket No. OSHA-2021-0009

Andrew Levinson, MPH
Director
Directorate of Standards and Guidance
Occupational Safety and Health Administration (OSHA)
U.S. Department of Labor
200 Constitution Ave NW
Washington, D.C. 20210

RE: Request for post-hearing comments on OSHA’s proposed standard on Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings (Docket No. OSHA-2021-0009)

Dear Director Levinson:

LatinoJustice PRLDEF (LJP)¹ and the NYU School of Law Climate Law Accelerator (CLX)² appreciate the opportunity to respond to OSHA’s questions following a hearing on the proposed rule, Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings (Docket No. OSHA-2021-0009). LJP and CLX submit this brief in strong support of OSHA’s proposed rule, which would take decisive action to mitigate the dangers posed by extreme heat.

As climate change worsens, extreme heat worldwide is expected to intensify. According to the IPCC, “it is virtually certain that hot extremes (including heatwaves) have become more frequent and more intense across most land regions since the 1950s,” with high confidence that this is driven by human-caused climate change.³ “By 2030, the U.S. will experience ‘extreme hot’ weather every other year,” with average temperatures increasing by more than six degrees

¹ LJP is a national civil rights organization that serves the Latinx community in all 50 states and all United States territories. Our headquarters is located in New York City and we have satellite offices in Orlando, Florida, and Austin, Texas. We have played a profound role in advancing equity and justice for Latinx communities through impact litigation, individual legal assistance, policy advocacy, and programming that fosters the next generation of Latinx leaders in the legal field and in our communities.

² The Climate Law Accelerator (CLX) is an initiative of the Earth Rights Research and Action (TERRA) Program at New York University School of Law. CLX is a global collaborative hub for research, advocacy, and strategic legal action on the climate emergency. As part of the TERRA Program, CLX collaborates with the TERRA Clinic at NYU School of Law to give law students hands-on experience with litigation, transnational advocacy campaigns, and strategic research and communications addressing critical threats to human rights and the environment.

³ Hoesung Lee et al., *Climate Change 2023 Synthesis Report*, Intergovernmental Panel on Climate Change, 46 (2023), https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_FullVolume.pdf.



Fahrenheit in some cities.⁴ Moreover, extreme heat events increase mortality and disease incidence.⁵ This is accompanied by socioeconomic impacts, including lower worker productivity.⁶ Importantly, these effects are most pronounced among outdoor workers, including those in the agriculture and construction sectors.⁷ Given that seventy-seven percent of farmworkers and over a third of construction workers in the U.S. are Latino, the health and socioeconomic impacts of extreme heat disproportionately affect this community.⁸ As the climate crisis continues to increase the incidence of extreme temperatures, this rulemaking takes on even greater importance.

In this brief, LJP and CLX rely on the best available science, existing state rules, and feedback from our community partners to respond to questions that OSHA posed during a hearing on the proposed rule. These responses address:

- I. The Costs and Benefits of Heat Prevention
- II. Prescriptive Standards over Performance-Based Standards for Rest Break Areas and Drinking Water Temperature
- III. Heat Prevention Training & Translation Services
- IV. Access to Air Conditioning for Bus Drivers in Puerto Rico
- V. Survey Data used in Testimony
- VI. Sedentary Work Exemption

We expand on each of these topics below.

I. The Costs and Benefits of Heat Prevention

The costs of extreme heat are myriad and significant, necessitating clear and robust adaptation measures. A 2021 study by the Atlantic Council found the U.S. may lose approximately \$100 billion in labor productivity losses caused by extreme heat.⁹ By 2050, those losses could cost a staggering \$500 billion per

⁴ Latino Justice, OSHA-2021-0009, *Comment on Proposed Rule on Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings*, 4 (Jan. 14, 2025), <https://clxtoolkit.com/wp-content/uploads/2025/02/OSHA-Public-Comments-LJP-and-TERRA-Clinic.pdf>.

⁵ Lee et al., *supra* note 3, at 50.

⁶ *Heat and health*, WORLD HEALTH ORGANIZATION (May 28, 2024), <https://www.who.int/news-room/fact-sheets/detail/climate-change-heat-and-health>.

⁷ Shouro Dasgupta et al., *Heat stress and the labour force*, 5 NATURE REVIEWS EARTH & ENVIRONMENT, 860, 864-865 (2024) (discussing the effects of extreme heat on labor output).

⁸ *Findings from the National Agricultural Workers Survey (NAWS) 2017-2018*, U.S. DEP'T OF LAB. (Aug. 1, 2021), <https://www.dol.gov/resource-library/findings-national-agricultural-workers-survey-naws-2017-2018-demographic-and>; Jorge González-Hermoso, *Latino Workers Power the Housing Sector but Remain Underrepresented in Leadership Roles*, URBAN INSTITUTE (Nov. 13, 2024), <https://www.urban.org/urban-wire/latino-workers-power-housing-sector-remain-underrepresented-leadership-roles>.

⁹ *Extreme Heat: The Economic and Social Consequences for the United States*, ATLANTIC COUNCIL, 2 (2021), <https://www.atlanticcouncil.org/wp-content/uploads/2021/08/Extreme-Heat-Report-2021.pdf>.



year.¹⁰ Importantly, these losses impact numerous sectors. While proportionally steepest in agriculture and construction, losses are greatest overall in the service sector, with productivity losses totaling \$600 million per year.¹¹ These realities emphasize that while heat protections are valuable in labor-intensive industries, they are also crucial in industries that may be perceived as less physically demanding, such as education and healthcare. In the Caribbean, where multiple U.S. territories are located, a temperature increase of one degree Celsius results in a three percent loss of productivity in industrial output.¹² In one study, temperatures greater than 98.6°F reduced the productivity of blueberry pickers by 12%.¹³ Extreme heat has, and will continue to have, pernicious effects on worker output, thereby increasing the importance of OSHA’s rulemaking.

OSHA’s proposed rule would not only help prevent these losses but also increase output.¹⁴ Cooler temperatures increase worker morale, thereby reducing turnover rates and improving an employer’s reputation and ability to recruit talent.¹⁵ In manufacturing, transportation, and construction, industries significantly impacted by extreme heat, occupational health and safety spending generates an average return of 1.24x to 2.14x per employee.¹⁶ OSHA’s proposed rule will yield significant benefits for employees and employers alike.

Importantly, OSHA’s rulemaking is poised to deliver benefits beyond the economics of workplace productivity. Uncontrolled extreme heat not only reduces worker productivity but also worsens and imposes significant costs across local, state, and federal health care systems. The Center for American Progress estimates that heat events are responsible for 235,000 emergency department visits and 56,000 hospital admissions annually, resulting in \$1 billion in healthcare costs across the U.S.¹⁷ In New York City, for example, thousands more workplace injuries occur on days 85°F or hotter.¹⁸ By making workplaces safer, employees are better protected from extreme heat and, by extension, are less likely to require emergency care and workers’ compensation. OSHA’s rule,

¹⁰ Adrienne Arsht-Rockefeller Foundation Resilience Center, *Extreme heat: The economic and social consequences for the United States*, ATLANTIC COUNCIL (Aug. 31, 2021), <https://www.atlanticcouncil.org/in-depth-research-reports/report/extreme-heat-the-economic-and-social-consequences-for-the-united-states/>.

¹¹ *Extreme Heat*, *supra* note 9, at 2.

¹² Dasgupta et al., *supra* note 7, at 859.

¹³ *Id.* at 865.

¹⁴ Keana Kaleikini et al., *Making the Most of OSHA’s Extreme Heat Rule*, FED’N OF AM. SCIENTISTS (July 31, 2024), <https://fas.org/publication/osha-extreme-heat-rule-investment/>.

¹⁵ *Id.*

¹⁶ Talia Varley, *The Hidden Costs of Climate Change on the Workforce*, HARVARD BUSINESS REVIEW (July 29, 2024), <https://hbr.org/2024/07/the-hidden-costs-of-climate-change-on-the-workforce>, citing Cameron A. Mustard & Basak Yanar, *Estimating the financial benefits of employers’ occupational health and safety measures*, 159 SAFETY SCIENCE (2023).

¹⁷ Steven Woolf et al., *The Health Care Costs of Extreme Heat*, CENTER FOR AM. PROGRESS (June 27, 2023), <https://www.americanprogress.org/article/the-health-care-costs-of-extreme-heat/>.

¹⁸ Samantha Maldonado and Suhail Bhat, *Extreme Heat Increases Workplace Injuries, But New York Lacks Safety Standards*, THE CITY REPORT (Aug. 31, 2023), <https://www.thecity.nyc/2023/08/31/extreme-heat-workplace-injury-safety-standards/>.



therefore, will not only improve workplace safety and productivity but also help alleviate the healthcare and workplace costs imposed by extreme heat.

Experts emphasize that, in the face of significant health and economic impacts due to extreme heat, adaptation measures are crucial.¹⁹ Moreover, ensuring employer support for adaptation measures ensures that health and economic losses are minimized.²⁰ Government intervention through OSHA’s proposed heat standard will promote active and robust adaptation.²¹ As noted by the Federation of American Scientists, “while some may express concerns about the costs and regulatory burden of these investments, [it is] crucial to consider the long-term benefits” to employee health and worker productivity.²²

To promote fiscal responsibility, a healthy workforce, and a strong economy, LJP and CLX urge OSHA to develop a robust and detailed heat standard for indoor and outdoor workers.

II. Prescriptive Standards over Performance-Based Standards for Rest Break Areas and Drinking Water Temperature

OSHA has requested feedback on whether any elements of the proposed rule should be prescriptive or semi-prescriptive. OSHA has also asked for feedback on when potentially vague terms, such as “suitably cool,” are warranted. LJP and CLX urge OSHA to avoid the use of vague terms and implement prescriptive standards for two requirements: drinking water temperature and rest break area access. Vaguely worded, non-prescriptive water temperature and break accessibility standards run counter to existing medical advice and common practice.

OSHA should require that break and hydration areas be located within a 0.25-mile distance from work zones. As LJP emphasized in its Comment, this requirement is already incorporated in protections for agricultural workers in two states: Washington and Colorado.²³ Both states have implemented a prescriptive requirement to ensure that rest breaks are actually utilized by workers.²⁴ If a rest break area is located too far from an employee’s work zone, she may feel disincentivized to use the rest break area, thereby defeating the purpose of the requirement.²⁵ Furthermore, this requirement for rest break zones mirrors OSHA’s requirements for sanitation access.²⁶ Designating rest break and

¹⁹ Dasgupta et al., *supra* note 7, at 867.

²⁰ *Id.* at 868.

²¹ Kaleikini, *supra* note 14.

²² *Id.*

²³ 9 COLO. CODE OF REGS. § 1103-15, Rule 3.2(D) (2024); WASH. ADMIN. CODE § 296-307-09740 (2024).

²⁴ Latino Justice, *supra* note 4, at 6.

²⁵ See Farmworker Ass’n of Fla., OSHA-2021-0009-6728, *Comment on Proposed Rule on Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings* (Aug. 13, 2024), <https://www.regulations.gov/comment/OSHA-2021-0009-6728>.

²⁶ U.S. DEP’T OF LAB., *OSHA Field Sanitation for Agricultural Workers*, <https://www.dol.gov/agencies/whd/agriculture/field-sanitation/osha-field-sanitation-for-ag-workers> (last visited Sep. 16, 2025).



hydration areas to also be located within a 0.25-mile distance from work zones creates uniformity for sanitation, hydration, and other break facilities. This ultimately benefits both employers and employees, as consistency across OSHA regulations and state-level regulations facilitates uniform implementation by employers and, therefore, greater compliance with the proposed standards.

OSHA should also require that drinking water provided to workers in hot environments be maintained at 60°F or cooler. Workers across a broad range of fields, from outdoor plant nursery workers in Miami-Dade County to indoor public school teachers in Puerto Rico, continue to work in hot environments with insufficient access to cool drinking water.²⁷ This specific water temperature comports with several federal government agency guidelines and recommendations;²⁸ generates effective compliance by being consistent with state regulations;²⁹ and is necessary for preventing heat stroke and exhaustion.³⁰ While LJP and CLX understand the desire for employer flexibility in implementing measures, OSHA should not allow an employer to choose what temperature constitutes “suitably cool” water for the human body, when medical science has established that this temperature is 16°C (approximately 60°F) or cooler.³¹ Moreover, life-saving measures such as cool drinking water must be regulated in a standardized manner. If the proposed rule is to be effective, it must mandate requirements prescribed by the medical profession to prevent harm from heat

²⁷ *Planting Justice, WE COUNT!*, <https://www.we-count.org/plantingjustice> (describing a 2024 worker survey and finding that 1 in 3 surveyed workers were forced to work without access to water and that over 62% of those with access to water were often given dirty and non-sanitary water); Image posted by the Federación de Maestros (@fmrplucha), INSTAGRAM, #FMPRIInforma: 🍷🔥 *Ola de calor histórica en Puerto Rico* (Sep. 2, 2025) (noting on slide 6 that 72% of teachers surveyed in 2025 did not have access to cold or potable water).

<https://www.instagram.com/p/DOHFbVXj7kn/?igsh=MWRzc2Jyams5Y3U1>.

²⁸ Brenda Jacklitsch et al., *Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments*, NAT’L INST. FOR OCCUPATIONAL SAFETY AND HEALTH, 121 (2016); U.S. DEP’T OF DEFENSE, TECH. BULL. MED. 507/AFPAM 48-152, HEAT STRESS CONTROL AND HEAT CASUALTY MANAGEMENT (Mar. 7, 2023); U.S. DEP’T OF LAB., MINE SAFETY AND HEALTH ADMIN., HEAT STRESS: HAZARDS PREVENTION AND CONTROL, <https://www.msha.gov/sites/default/files/Alerts%20and%20Hazards/HealthAlert-HeatStress.pdf> (last visited Sep. 16, 2025); U.S. DEP’T OF LAB., *Protections for Agricultural Workers*, <https://www.dol.gov/agencies/whd/agriculture/field-sanitation/protections-for-agricultural-workers> (last visited Sep. 16, 2025); OCCUPATIONAL SAFETY & HEALTH ADMIN. & NAT’L INST. FOR OCCUPATIONAL SAFETY & HEALTH, OSHA-NIOSH HEAT ILLNESS INFO SHEET, <https://www.osha.gov/sites/default/files/publications/osha-niosh-heat-illness-infosheet.pdf> (last visited Sep. 16, 2025).

²⁹ *Heat stroke (hyperthermia)*, HARVARD MED. SCH. (March 24, 2023), https://www.health.harvard.edu/a_to_z/heat-stroke-hyperthermia-a-to-z#; OR. ADMIN. R. 437-002-0156 (2024).

³⁰ Terry Kelly, *Cool Off: Stay Safe in the Heat*, UNIV. OF N.M., <https://hsc.unm.edu/health/stories/cool-off.html> (last visited Sep. 16, 2025); William R. O’Donnell et al., *The Impact of Heat Stress on Performance in Competitive Athletes*, 9 J. INT’L SOC’Y SPORTS NUTRITION 44 (2012); A. A. Gagnon et al., *Heat Stress and Injury in Athletes: A Review of the Literature*, 49 INT’L J. ATHLETIC TRAINING 58-68 (2014).

³¹ Abdollah Hosseinlou et al., *The effect of water temperature and voluntary drinking on the post rehydration sweating*, 6 INT’L J. OF CLINICAL AND EXPERIMENTAL MEDICINE 8, 683-7 (2013).



exposure. LJP and CLX urge OSHA to fulfill the promise of this proposed rule by prescribing a specific water temperature requirement of 60°F or cooler.

In response to OSHA's question about employee preferences for warmer drinking water, LJP and CLX note that requiring employers to provide water at a specific temperature or cooler is not the same as requiring employees to drink water at a specific temperature. An employee who prefers warmer water maintains several options to meet that preference under the proposed rule, including the ability to warm her water by exposing it to ambient temperature and letting it heat up, or bringing non-cooled water to work herself. An employee whose personal preferences differ from the temperature suggested by the medical profession has more ability to warm her water than she does to cool it down. Given the necessity of providing cool water to a person experiencing heat stroke, employers must be required to provide their employees the option to drink water kept at 60°F or cooler.

LJP and CLX recommend that OSHA issue a prescriptive and precise rule by requiring drinking water to be provided at 60°F and rest break areas to be located within 0.25 miles of work zones. A vague or performance-based rule introduces unwarranted variability in two areas in which common practice and medical science have already developed clear guidance.

III. Heat Prevention Training & Translation Services

LJP and CLX encourage OSHA to provide detailed guidance to employers on the signs and symptoms of heat-related illness, as well as when and how an employer should provide breaks to employees. While the agency would presumably create its own guidance documents, helpful precedents exist from state agencies like Cal/OSHA.³² LJP and CLX emphasize the importance of making planning and training materials available in the predominant languages spoken by employees that would be covered under this rule. Disseminating such materials in a language that employees do not understand runs counter to the purpose of the rule.

In requiring employers to provide planning and training materials in multiple predominant languages, OSHA could suggest the use of low-cost tools such as Google Translate or DeepL. A study comparing Google Translate and DeepL found that both were highly accurate (86 and 89% respectively) at finding idiom equivalences between languages, indicating a high degree of sophistication.³³ Both of these translation services are available online for free and are therefore easily accessible to employers. Notably, DeepL is more accurate than Google Translate, and therefore may be a better choice in professional settings.³⁴ However, DeepL only offers commonly spoken languages; for languages like

³² See e.g., STATE OF CAL. DEP'T OF INDUS. RELATIONS, CAL/OSHA HEAT ILLNESS PREVENTION GUIDANCE AND RESOURCES (2024).

³³ Carlos Manuel Hidalgo-Tertero, *Google Translate vs. DeepL: Analysing Neural Machine Translation Performance Under the Challenge of Phraseological Variation*, 6 MONTI, 154, 173-174 (2020) (discussing the performance of Google Translate and DeepL).

³⁴ Roman Hresko, *Is DeepL Accurate? 2024 Research*, CENTUS (June 21, 2024), <https://centus.com/blog/is-deepl-accurate>.



Haitian Creole or Indigenous languages, Google Translate is preferred. Ultimately, making materials available in predominant languages is an important and achievable requirement that would ensure this rule and related guidance are understood by the employees who need them.

IV. Access to Air Conditioning for Bus Drivers in Puerto Rico

In its post-hearing questions, OSHA remarked that “in the absence of data on the percentage of vehicles with sufficiently cool vehicle cabs, OSHA’s preliminary economic analysis assumes that 50% of school bus drivers work in sufficiently cooled vehicles.” LJP and CLX have not been able to identify data from Puerto Rico, but suggest that OSHA consider data from states with similar climates in making its assumptions.

While comprehensive data for Puerto Rico is unavailable, a survey of U.S. states with comparable climates suggests that the rate of buses with air conditioning is less than 50%. Puerto Rico’s climate is described as Tropical Marine, due to the region’s high humidity and hot summer months.³⁵ In Alabama, a state with a comparable summer climate, temperatures in some areas can regularly reach 90°F or greater.³⁶ As of 2023, only 48% of public school buses in Alabama were air-conditioned, according to data provided by the state’s Department of Education.³⁷ In fact, multiple counties in Alabama had no buses with air conditioning (A/C), prompting legislative action.³⁸

In Louisiana, a state where the August heat index regularly exceeds 100 degrees, many public schools are not equipped with air-conditioned buses.³⁹ In Calcasieu Parish, for example, 95% of buses have no A/C, while just 28% of buses in East Baton Rouge Parish have A/C.⁴⁰ Education systems in Alabama and Louisiana are far better funded than those of Puerto Rico. While education comprises “the largest budget item” in Puerto Rico, it still “spends far less than any of the 50 states on each student: \$9,500 per student.”⁴¹ Meanwhile, Alabama and Louisiana

³⁵ *Weather and Climate of Puerto Rico*, WELCOME TO PUERTO RICO!, <https://welcome.topuertorico.org/reference/tempera.shtml> (last visited Sept. 13, 2025).

³⁶ Philip L. Chaney, *Alabama’s Climate*, ENCYCLOPEDIA OF ALABAMA, (last updated Sept. 8, 2025) <https://encyclopediaofalabama.org/article/climate/>.

³⁷ Jemma Stephenson, *Fewer than half of Alabama school buses have air conditioning*, ALABAMA REFLECTOR (Oct. 5, 2023), <https://alabamareflector.com/2023/10/05/less-than-half-of-alabama-school-buses-have-air-conditioning/>.

³⁸ *Id.*

³⁹ Julie O’Donoghue, *Mandatory air conditioning for Louisiana school buses hits dead end*, LOUISIANA ILLUMINATOR (May 22, 2024), <https://lailluminator.com/2024/05/22/mandatory-air-conditioning-for-louisiana-school-buses-hits-dead-end/>.

⁴⁰ *Id.*

⁴¹ *Public School Expenditures*, NATIONAL CENTER FOR EDUCATION STATISTICS, <https://nces.ed.gov/programs/coe/indicator/cmb/public-school-expenditure> (last updated May 2024); Kavitha Cardoza, *Schools in Puerto Rico are bracing for Trump cuts after gains made during the Biden years*, THE GUARDIAN (Mar. 28, 2025), <https://www.theguardian.com/us-news/2025/mar/28/puerto-rico-schools-education-cuts>.



spend \$13,461 and \$13,760, respectively.⁴² If states with similar climates to Puerto Rico and nearly 30% more funding cannot furnish 50% of their school buses with A/C, LJP and CLX do not think it reasonable to assume that 50% of public school buses in Puerto Rico have A/C. On the contrary, the true figure is likely much less than 50%.

V. Survey Data used in Testimony

OSHA has requested that LJP and CLX provide the survey data that was used in testimony. The depersonalized data from the survey conducted by the FMPR is included as Appendix A. LJP and CLX also provide information from a study commissioned by the Puerto Rican Department of Education, carried out by the engineering firm, M2A Group. While LJP and CLX cannot provide the underlying data for that study, OSHA can contact the Puerto Rican Department of Education directly for that information.

The FMPR survey, conducted in 2023, collected self-reported responses from 2,862 teachers from approximately 580 schools across Puerto Rico. The survey asked teachers to report on temperatures and various heat-related situations they have experienced. LJP and CLX's analysis of this survey concluded that (1) at least one teacher at approximately 171 schools reported having seen a student or staff be taken to the hospital; (2) at least one teacher at approximately 229 schools reported having witnessed fainting by students, staff, or community members; and (3) at least one teacher at approximately 168 schools reported experiencing classroom temperatures of 100°F or hotter. Given the many heatwaves and heat advisories that have occurred since this data was collected in 2023, these numbers are likely conservative.⁴³

In the words of one teacher who responded to this survey: “The heat is unbearable. I consider the conditions in which we are working to be abusive... It's sad to see the students crying with headaches from the unbearable heat and begging for water and cups so they can go to the fountain to get a drink.” Other teachers reported having witnessed students vomiting from heat, being unable to teach due to heat waves, and experiencing symptoms such as headaches, excessive sweating, and fatigue.

According to a recent study published in *The Journal for Climate Change and Health*, nearly 36% of schools were exposed to land surface temperatures

⁴² Melanie Hanson, *U.S. Public Education Spending Statistics*, EDUCATION DATA INITIATIVE (last updated Feb. 8, 2025), <https://educationdata.org/public-education-spending-statistics#pr>.

⁴³ See e.g., *Assessing the U.S. Climate in June 2024*, NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION (July 9, 2024), <https://www.ncei.noaa.gov/news/national-climate-202406> (noting heatwaves impacted Puerto Rico in June 2024, “breaking temperature records and creating life-threatening conditions.”); Jesse Daley, *National Weather Service Announces Heat Alerts Across USVI, Puerto Rico*, THE ST. THOMAS SOURCE (July 28, 2025), <https://stthomassource.com/content/2025/07/28/national-weather-service-announces-heat-alerts-across-usvi-puerto-rico/>.



exceeding 106.5°F in 2023 (see Appendix B).⁴⁴ Disparities in air conditioning compound such temperatures; survey results from the same study indicated significant disparities in air conditioning availability between private (17.28%) and public schools (2.93%).⁴⁵ This study also found that students and school employees in non-air-conditioned environments experienced significantly higher odds of experiencing heat-related symptoms, including fatigue, irrationality, lack of attention, and dizziness.⁴⁶

In April 2024, the Department of Education commissioned the M2A group to assess infrastructure and capacity at 425 schools across Puerto Rico. LJP and CLX found that of schools with A/C units, approximately 81% report that at least one unit does not work. 43% of surveyed schools report that at least half of their A/C units malfunction. On average, 41% of all classroom A/C units fail to turn on or cool down the room.

The Center of Investigative Journalism (CPI, its Spanish acronym) recently reported on the M2A Group's study.⁴⁷ For OSHA's convenience, this report is attached (see Appendix C). CPI found that from August 2023 to June 2024, in the educational region of Humacao alone, a School Nursing Program reported 135 cases requiring activation of the heat safety protocol for students affected by extreme temperatures.⁴⁸ According to the Department of Health's Syndromic Surveillance System, between 2023 and May 2025, there were 795 emergency room visits for heat-related illnesses, with 20% of these patients aged under 19.⁴⁹

Heat illness is a serious problem for schools across Puerto Rico, not only because of its rising temperatures and humidity, but also because of its energy crises. Puerto Rico's electricity system is unreliable due to hurricane damage, a decline in generation capacity, and surge demands in the summer.⁵⁰ Without emergency generators – which nearly 85% of schools in Humacao lack⁵¹ – schools cannot alleviate the unbearable heat for teachers required to stay and teach, even when students may be sent home.

LJP and CLX urge OSHA to pass the proposed rule to alleviate the suffering and harm imposed on teachers by increased heat and the lack of critical infrastructure. By requiring educational employers to provide preventative and mitigating solutions, the health and lives of teachers, as well as students, across the U.S., including its territories, are better protected.

⁴⁴ Pablo A. Méndez-Lázaro et al., *Assessing the Impacts Risks, and Vulnerabilities of Extreme Heat in Learning Environments of Puerto Rico in 2023*, THE JOURNAL OF CLIMATE CHANGE AND HEALTH, 7 (Aug. 27, 2025), <https://doi.org/10.1016/j.joclim.2025.100581>.

⁴⁵ *Id.* at 9.

⁴⁶ *Id.*

⁴⁷ Tatiana Díaz Ramos, *Puerto Rico Schools Struggle with Extreme Heat and Energy Crisis*, CENTRO DE PERIODISMO INVESTIGATIVO (Aug. 21, 2025), <https://periodismoinvestigativo.com/2025/08/energy-crisis-extreme-heat-classrooms/>.

⁴⁸ *Id.*

⁴⁹ *Id.*

⁵⁰ *Id.*

⁵¹ *Id.*



VI. Sedentary Work Exemption

The proposed rule states that employers are responsible for determining what work activities would be covered by the standard, and which would not. The proposed rule lists several exemption criteria, including “sedentary work activities at indoor work areas that only involve some combination of the following: sitting, occasional standing and walking for brief periods of time, and occasional lifting of objects weighing less than 10 pounds.” LJP and CLX reiterate their recommendation that OSHA limit the exemption for sedentary indoor work activities in paragraph (a)(2)(vi) to only activities performed below a heat threshold of 86°F. Scientific evidence from OSHA itself supports the claim that exposure to certain temperature thresholds –even while performing sedentary activities – can pose severe health risks.⁵² Limiting the sedentary indoor work exemption to only activities performed below a particular heat threshold would not only bring the OSHA standard in line with state rules, but also ensure that workers are properly protected now and in the future, given increasing temperatures.⁵³ Moreover, LJP and CLX would like OSHA to clarify that teachers cannot fall under this exception, because teaching is not considered an occupation with “sedentary” activity levels. Teaching is understood to surpass “sedentary” work exertion levels and should be assigned a “light” activity level or higher.

The proposed rule defines sedentary work as “[involving] less than or equal to one-third of the workday standing while only seldomly or occasionally lifting or carrying up to ten pounds.”⁵⁴ This definition is similar to that found in the Dictionary of Occupational Titles (DOT). DOT was created by the U.S. Department of Labor’s Employment and Training Administration and was last published in 1991. Although the DOT has been replaced by O*Net, DOT was still used by some agencies, such as the Social Security Administration in disability adjudications, as recently as April 2025.⁵⁵

In addition to definitions of activity levels, DOT provides lists of occupations and their corresponding strength categories. Almost all educational occupations, including shop teachers (DOT 091.221-010), high school teachers (DOT 091.227-010), elementary school teachers (DOT 092.227-010), kindergarten teachers (DOT 091.227-014), and preschool teachers (DOT 091.227-018), were assigned a strength factor of “L,” or “light.”⁵⁶ Light work is defined by DOT as:

⁵² Latino Justice, *supra* note 4, at 3-4.

⁵³ CAL. CODE REGS. tit. 8, § 3396 (2024); COLO. CODE OF REGS. § 1103-15, Rule 3.1.1(a) (2024); OR. ADMIN. R. 437-004-1131, 437-002-0156 (2024); Beusch et al., *Responsibility of major emitters for country-level warming and extreme hot years*, 3 COMM. EARTH & ENVIRON. (2022) (finding that U.S. will experience “extreme hot” weather every other year by 2030).

⁵⁴ Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings, 89 Fed. Reg. 169, 71069 (proposed Aug. 30, 2024) (to be codified at 29 CFR Pt. 1910, 1915, 1917, 1918, 1926, and 1928).

⁵⁵ OFFICE OF ADMIN. LAW JUDGES, U.S. DEP’T OF LAB., DICTIONARY OF OCCUPATIONAL TITLES (4th ed. 1991).

⁵⁶ OFFICE OF ADMIN. LAW JUDGES, U.S. DEP’T OF LAB., DICTIONARY OF OCCUPATIONAL TITLES – OCCUPATIONAL GROUP ARRANGEMENT (4th ed. 1991).



“Exerting up to 20 pounds of force occasionally, and/or up to 10 pounds of force frequently, and/or a negligible amount of force constantly (Constantly: activity or condition exists 2/3 or more of the time) to move objects. Physical demand requirements are in excess of those for Sedentary Work. Even though the weight lifted may be only a negligible amount, a job should be rated Light Work: (1) when it requires walking or standing to a significant degree; or (2) when it requires sitting most of the time but entails pushing and/or pulling of arm or leg controls; and/or (3) when the job requires working at a production rate pace entailing the constant pushing and/or pulling of materials even though the weight of those materials is negligible.”

Among educational occupations, only some managerial, non-teaching positions, such as director of educational programs (DOT 099.117-010), were assigned a strength factor of “S,” or “sedentary.”

The U.S. Bureau of Labor Statistics has also classified teachers as working with “light” activity levels. In the Bureau’s 2024 Occupational Requirements Survey (ORS), teaching positions were explicitly labeled as “[occupations] with a light strength level.”⁵⁷ In addition, teaching positions across the U.S. are advertised to candidates as positions with “light” exertion levels.⁵⁸ Finally, vocational experts (VEs) in cases against Social Security Commissioners have testified to courts in various jurisdictions that teachers and related employment are considered occupations with “light” activity levels.⁵⁹

Explicitly recognizing that teachers are not engaged in sedentary work, and therefore not subject to the exception, accords with the lived experience of teachers. As noted in hearing testimony from the Federation of Teachers of Puerto Rico (known by its acronym in Spanish, FMPR), school teachers are already severely impacted by indoor temperatures, given the non-sedentary nature of their work. FMPR agrees with the traditional and widely accepted classification of teaching as “light” work. Given the existing impacts already experienced by

⁵⁷ U.S. BUREAU OF LAB. STAT., OCCUPATIONAL REQUIREMENTS SURV. (2024), <https://www.bls.gov/ors/factsheet/strength.htm#>.

⁵⁸ *High School Associate Teacher POOL*, ZIPRECRUITER, <https://www.ziprecruiter.com/c/Suffolk-Public-Schools/Job/High-School-Associate-Teacher-POOL/-in-Suffolk,VA?jid=a44b8098fb0f9545> (last visited Sep. 13, 2025); *Teacher of the Visually Impaired (TVI) – Outreach Programs*, State of Colorado Job Opportunities, <https://www.governmentjobs.com/careers/colorado/jobs/4743704/teacher-of-the-visually-impaired-tvi-outreach-programs> (last visited Sep. 13, 2025).

⁵⁹ *Jasinski v. Barnhart*, 341 F.3d 182, 185 (2d Cir. 2003) (VE testifying that “Teacher’s aide is DOT number 249.367–074, and that’s light exertion, semi-skilled employment, and she described it being between sedentary to light. She indicated she may need to pick up a child, but that was on occasion. So I would ... put it in between the sedentary and light exertion [categories.]”); *Teresa D. v. Dudek*, No. 2:24-CV-48, 2025 WL 1742793, at *7 (E.D. Va. Apr. 28, 2025) (“The VE characterized Plaintiff’s prior work as a teacher (DOT 091.227-010), which is a skilled position with an SVP 7 and a light exertion level that is generally and actually performed at light. (R. 49). Although not past relevant work, the VE also identified Plaintiff’s work as a tutor (DOT 099.227-034), which is a skilled position with an SVP 7 and a light exertion level that is generally and actually performed at light.”).



teachers with rising indoor temperatures, LJP and CLX ask that OSHA clarify in its final ruling that teaching should not fall under the exception for sedentary work stipulated by the proposed rule.

VII. Conclusion

LJP and CLX appreciate OSHA's commitment to providing greater protection for workers facing extreme heat through this proposed rule. The proposed safeguards are critical considering climate change, which peer-reviewed scientific studies have shown will cause an ever-greater incidence of extreme heat events. They are also essential for protecting low-wage, immigrant, and outdoor workers, particularly in industries like agriculture, construction, and warehousing, who are disproportionately impacted by high heat.

As outlined in this comment, we strongly encourage OSHA to refine and strengthen the proposed rule in key areas, including requiring specific drinking water temperature and rest break area access, providing heat training in multiple predominant languages, and ensuring teaching positions are not exempt. By adopting LJP's and CLX's recommendations, OSHA can better safeguard workers facing extreme temperatures now and in the future.

Thank you for the opportunity to submit this post-hearing brief. We look forward to continued collaboration to protect workers and advance equity in workplace health and safety.

Sincerely,

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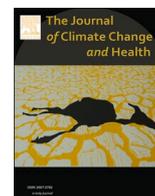
⁶⁰ Earth Rights Research & Action (TERRA) Clinic students Sara Blomquist and Michelle Howard contributed to this brief's drafting under supervision of counsel.

⁶¹ Efforts of NYU Clinics, Centers, or Programs do not purport to represent the institutional views of NYU School of Law, if any.

Appendix A

See Excel sheet uploaded separately

Appendix B



Research article

Assessing the impacts, risks, and vulnerabilities of extreme heat in learning environments of Puerto Rico in 2023



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ABSTRACT

Introduction: Puerto Rico is experiencing anomalous heat episodes. The year 2023 was marked by unprecedented extreme heat events with negative impacts in Puerto Rico's learning environments. This study aimed to understand the context, barriers, knowledge, risks, vulnerabilities, perceptions, employees' profiles, attitudes, and symptoms related to extreme heat in learning environments.

Materials and Methods: We employed a mixed-methods approach combining: (1) Earth Observation Data and geospatial analysis, (2) an online survey for teachers, administrative staff, and other school employees from diverse educational settings and levels and (3) a series of participatory activities with stakeholders, practitioners and decision makers that led to knowledge co-production and adaptation strategies.

Results: 36 % of schools were exposed to land surface temperatures exceeding 41.4 °C. The southern region showed the highest proportion (50.7 %) of schools in high or critical risk areas for heat and had insufficient A/C infrastructure. Survey results indicated significant disparities in A/C conditioning availability between private (17.28 %), public schools (2.93 %) and educational regions. Students and school employees in non-air-conditioned environments showed significantly higher odds of experiencing heat-related symptoms. Fatigue (OR=2.53), irrationality (OR=2.40), lack of attention (OR=2.14), dizziness (OR=2.62, 95 % CI: 1.91–3.65) were some of the most reported symptoms.

Conclusion: This assessment of extreme heat impacts in tropical learning environments reveals significant disparities in heat exposure and adaptation capacity across Puerto Rico's educational system. The findings highlight the urgent need for targeted interventions. This research contributes to the improvement of learning environments and serves as a model for adaptation efforts in educational settings in tropical islands.

1. Introduction

As global temperatures rise, extreme heat episodes are expected to become more intense, frequent, and longer-lasting [1,2]. The year 2024

was the warmest year on record [3,4]. The consequences of extreme heat are broad and include threats to human health, food and water insecurity, disruptions in ecosystems and energy systems, and adverse impacts on the education system at all levels [5]. The most vulnerable,

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communities tend to be disproportionately negatively affected. This highlights the need for equitable, transformational adaptation and mitigation strategies that address the cascading impacts of heat stress.

The Caribbean Region is experiencing elevated temperatures [5–8]. The combination of high heat and high humidity can be catastrophic, as high wet-bulb air temperatures trigger severe heat stress and illnesses by affecting core body temperature [9]. Increased mortality due to cerebrovascular and cardiovascular diseases in Puerto Rico is one of the consequences of elevated summer temperatures in San Juan, Puerto Rico [9,10].

Of particular concern is the impact of extreme heat on the education system and learning environments in tropical areas like the Caribbean Island States. An example is the Territory of Puerto Rico, which has consistently high temperatures and humidity levels. During the summer of 2023, Puerto Rico experienced an unprecedented surge in extreme heat [8]. While some schools across the island have facilities equipped with air conditioners (A/C), thousands of classrooms lack such infrastructure. This exacerbates the impact of heat on students and school employees.

The first half of the 2023/2024 academic year in Puerto Rico was marked by multiple extreme heat episodes following an already anomalous first half of 2023 (Supplementary Fig. 1). Marine heatwaves shattered records in 2023, with water temperatures above normal ($> 1.8^{\circ}\text{F}$), reaching some of the highest levels since the early 1980s in the Caribbean Region and marine waters surrounding Puerto Rico [11–13]. This heat significantly affected students, school employees, and the education infrastructure, from transportation to classrooms across the island. The situation led to employee strikes, parent and student demonstrations of dissatisfaction, and the cancellation of activities and services for many schools [14–16]. Moreover, schools and communities faced energy interruptions and power outages, further exacerbating the situation.

Energy is critical for cooling buildings and indoor environments in warm, humid tropical islands (e.g., hospitals, schools, homes, and many other buildings). Improper attention to maintenance, a series of financial and political crises, and delays in adopting climate adaptation plans have led the energy system of Puerto Rico to collapse. Energy interruptions are common on a weekly basis across the entire Territory of Puerto Rico, more pronounced since Hurricane Maria in 2017 [17]. This routinely leaves thousands of residents (many of whom are elderly and people with pre-existing health conditions and disabilities), schools, and businesses without electricity. Extreme heat pushes the electric system to new demands, with Puerto Rico often being unable to satisfy energy needs during these events, with major consequences.

The combined increase in average local air and sea temperatures, recurrent heat waves, humidity, and an unreliable electricity supply can exacerbate the school's vulnerability to extreme heat [18]. Extreme heat can adversely impact cognitive function, attention span, overall academic performance, and increase heat-related illnesses and discomfort among students and staff in educational settings [19,20]. Therefore, urgent, equitable actions and strategies are needed to prepare schools in Puerto Rico for a warmer climate.

This study aims to (1) understand the context, barriers, knowledge, risks, vulnerabilities, perceptions, school employees' profiles, attitudes, and symptoms related to extreme heat in learning environments, and (2) co-design equitable adaptation strategies with stakeholders to address these impacts. The results will help decision-makers, staff, family members, and students better prepare for future climate scenarios and warmer conditions in Puerto Rico. In a more regional context, the knowledge obtained in this study can be scalable and transferable to other Caribbean islands.

2. Methods

2.1. Human-Centered design approach

The study was conducted through the collaborations established in Puerto Rico by the Caribbean Collaborative Action Network (CCAN), a National Oceanic and Atmospheric Administration Climate Adaptation Partnerships/Regional Integrated Science Assessment Team. The CCAN multidisciplinary team of researchers and community members partner to evaluate needs, facilitate communication, build cross-regional connections, and build technical-scientific capacity in the US Caribbean Territories (Puerto Rico and the US Virgin Islands). In-person and virtual meetings are used with a human-centered design approach to develop and co-produce community climate adaptation capacities to match realistic, locally based scenarios.

In August 2023, the Teachers Federation of Puerto Rico (which represents around 32,000 members) worked with CCAN to understand heat impacts in their work environment. Multiple dialogue sessions and meetings were conducted among CCAN, the Teachers Federation of Puerto Rico, and the Puerto Rico Department of Education between August 2023 and June 2024. The study aimed to assess vulnerabilities and co-design actionable heat strategies; over ten capacity-building activities, dialogues, workshops, and working sessions were held with stakeholders to identify needs and collaboratively develop solutions. These efforts were integrated into a broader strategy of participatory heat adaptation planning tailored to learning environments in Puerto Rico.

Building on the human-centered design approach, researchers also piloted the one Vulnerability, Consequences, and Adaptation Planning Scenarios (VCAPS) process in January 2024. The VCAPS process is meant to facilitate “deliberative group learning” [21] as a method: “to support local vulnerability assessment and climate adaptation planning” [22]. Fifteen participants from various sectors (community organizations, non-profits, and emergency management) participated in a pilot session focused on extreme heat scenarios. Using color-coded post-it notes on a whiteboard, facilitators helped participants map causal pathways between heat events, vulnerabilities, impacts, and adaptation strategies.

2.2. Study area

The archipelago of Puerto Rico, located in the Caribbean region between latitudes $17^{\circ}55'\text{N}$ and $18^{\circ}31'\text{N}$ and longitudes $65^{\circ}37'\text{W}$ and $67^{\circ}17'\text{W}$, experiences a tropical maritime climate. Its weather is largely influenced by the Trade Winds, with maximum air temperatures ranging between $25\text{--}35^{\circ}\text{C}$ and minimum air temperatures oscillating between $20\text{--}25^{\circ}\text{C}$. The weather, on average, is warm and humid all year long, with little variation throughout the seasons.

2.3. Remote sensing technique and geospatial analysis

Based on previous research for San Juan, Puerto Rico [23], Land Surface Temperature (LST) images were generated from the Landsat 8 Operational Land Imager sensor using the Thermal Infrared Sensor (TIRS) Orthorectified Landsat 8 scenes (LANDSAT/LC08/C02/T1_L2) and were processed using the Google Earth Engine Applied Programming Interface [24,25]. TIRS bands have a spatial resolution of 100 m per pixel but were resampled at 30 m resolution to match the Landsat visible bands. TIRS data were used to map surface temperature across the island. This helped identify hot and cool spots. Of interest was to understand the location of schools relative to these patterns and identify schools in the warmest locations of Puerto Rico.

A complete geodatabase of 864 schools, obtained from the Puerto Rico Department of Education, was analyzed using the ArcGIS PRO-Spatial Analysis Tool. Given that the Caribbean tropical climate is not as strongly affected by the orbital tilt of the planet, average LST values

were extracted for each school in Puerto Rico using ArcGIS Spatial Analyst-Extract Values to Points based on Long-term Land Surface Temperature averages for Puerto Rico (2014–2023, Landsat LST in degrees Celsius). Schools were then categorized into five risk levels based on LST values: no risk (< 37.2 °C), low risk (37.3–39.6 °C), moderate risk (39.6–41.4 °C), high risk (41.4–42.8 °C), and critical risk (>42.8 °C), as shown in Table 1. Schools were also classified by seven Puerto Rico Department of Education educational regions [26] for comparative analysis.

2.4. Quantitative and qualitative data collection (Extreme heat survey in learning environments)

CCAN conducted an online survey to understand the context, barriers, knowledge, perspective, risks, and vulnerabilities of schools. The sample study included teachers, administrative staff, and other school employees from diverse educational settings and levels, spanning urban, suburban, and rural areas. A protocol was approved by the Institutional Review Board (IRB) at the University of Puerto Rico-Medical Sciences Campus-Human Research Subjects Protection Office (Protocol # 2304097058A001).

Respondents were recruited through direct communications at schools, social media (e.g., LinkedIn, Facebook, WhatsApp, Instagram), radio, and email groups. The research network-built alliances with key influencers, followed by the education sector and the Teacher’s Federation of Puerto Rico, to promote the survey, enhancing its reach and engagement and representing a wide range of learning institutions. While school names were entered as free-text fields, making exact counts of unique schools uncertain due to possible variations and duplicates, participants reported the educational level(s) offered at their institutions in a categorial field and most responses came from elementary and intermediate schools.

The survey aimed to capture how extreme heat affects the health and well-being of school employees and students, focusing on the academic year spanning from August 2023 through May 2024 (2023/2024). The 42-question survey included closed and open-ended items, organized to collect data across several key domains aligned with the study’s objectives:

- Demographics and employee profiles: age, gender, education level, job category, type of institution (public/private), and region of employment.
- Contextual and infrastructure factors: availability and functioning of A/C, frequency of power and water outages, and perceived adequacy of school facilities.
- Barriers to adaptation: resource limitations, lack of institutional protocols, and infrastructure failures.
- Knowledge and perceptions: awareness of extreme heat impacts, perceived seasonal patterns of heat, and attitudes toward institutional preparedness.
- Risk and vulnerability factors: pre-existing health conditions, service to vulnerable student populations (e.g., special education).
- Observed and experienced symptoms: health effects reported in students (e.g., fatigue, dizziness, aggressiveness) and staff (e.g.,

fainting, hallucinations, muscle pain), including open-ended responses describing specific incidents and coping mechanisms.

Criteria for participation included aged 21 years and older, current school employees, and internet access. Data collection occurred from March to April 2024, and the survey was completely in Spanish.

Associations between variables were assessed using logistic regression and Chi-square tests. Odds Ratios (OR) [27] were calculated to analyze the likelihood of experiencing heat-related symptoms in environments with an without air conditioning. The symptoms analyzed in students included dizziness, irrationality, aggressiveness, nausea, fatigue, and lack of attention. For staff, responses analyzed included fainting, rapid heartbeats, hallucinations, confusion, dizziness, and muscle pain. All statistical analyses were performed using R statistical programming environment version 4.1.1 [28].

3. Results

3.1. Remote sensing technique and geospatial analysis

Generally, temperatures appeared hot and warm for the entire island (LST 25–40 °C). Coastal areas and lowlands were warmer than central mountain areas of Puerto Rico. Over 60 % of the infrastructure was built in lowlands, and most of the population lives in coastal municipalities of Puerto Rico (the biggest metropolitan area) [29]. LST maps suggest internal and external factors could play an important role in temperature distribution across the island (e.g., landscape, topography, elevation, and daily weather conditions). The warmest areas corresponded to urban areas (e.g., residential areas, shopping centers, roads), while cooler zones aligned with green infrastructure, highlands, forests, agricultural lands, water bodies, and associated ecosystems (Supplementary Fig. 2).

There were 864 schools evaluated. Results suggest 312 (36 %) of schools were routinely exposed to LST +41.4 °C on average (high risk areas and critical risk areas for heat). Among 565 primary schools providing services to children 12 years old and younger, 34 % are in areas identified as high risk and critical risk to heat. The Education Region of Ponce, in the central-southern coastal area of the island, is the region with the highest percentage of schools in “high risk areas” and “critical risk areas” (50.7 %), followed by the Region of Bayamón (45.2 %) and the Region of San Juan (42.2 %). The Region of Humacao, in the southeastern coastal plain and foothills of the island, had the lowest

Table 2 Number of schools per region exposed at different heat risk levels.

Regions	Total of School	No Risk n (%)	Low Risk n (%)	Moderate Risk n (%)	High Risk n (%)	Critical Risk n (%)
Arecibo	109	11 (10.09 %)	23 (21.10 %)	25 (22.94 %)	24 (22.02 %)	15 (13.76 %)
Bayamón	115	21 (18.26 %)	21 (18.26 %)	19 (16.52 %)	22 (19.13 %)	30 (26.09 %)
Caguas	122	33 (27.05 %)	23 (18.85 %)	18 (14.75 %)	24 (19.67 %)	15 (12.30 %)
Humacao	126	39 (30.95 %)	36 (28.57 %)	22 (17.46 %)	16 (12.70 %)	9 (7.14 %)
Mayagüez	117	15 (12.82 %)	13 (11.11 %)	15 (12.82 %)	12 (10.26 %)	17 (14.53 %)
Ponce	140	23 (16.43 %)	20 (14.29 %)	20 (14.29 %)	24 (17.14 %)	47 (33.57 %)
San Juan	135	14 (10.37 %)	19 (14.07 %)	38 (28.15 %)	34 (25.19 %)	23 (17.04 %)

Table 1 Average heat risk levels for schools in Puerto Rico based on average land surface temperature (LST).

Risk Level	Temperature Criteria [°Celsius]
No Risk	< 37.2
Low Risk	37.3–39.6
Moderate Risk	39.6–41.4
High Risk	41.4–42.8
Critical Risk	>42.8

percentage of schools in high risk or critical risk to heat (19.8 %) (Table 2 & Fig. 1–2).

3.2. Heat survey results

There were 1226 respondents from diverse Department of Education regions across Puerto Rico (Supplementary Table 1). The majority self-identified as female (88 %), with fewer males (10.6 %) or transgender persons (0.16 %). Participants were split into two age groups: 21–49 years (60 %) and 49 or more years (39 %). About half had a master’s degree (51 %). Most respondents were teachers/educators (79 %). Most respondents were employed in public institutions (92 %) and reported their schools provided special education services (95 %). The San Juan Region had the highest number of participants (17 %), while other regions had relatively equal participation among them (12 %–16 %). Participants also reported a variety of pre-existing health conditions, including mental health concerns (26 %), insomnia (24 %), asthma (21 %), respiratory conditions (17 %), high blood pressure (19 %), and obesity (13 %). Among participants 21–49 years, the most commonly reported conditions were migraines (25 %), hypertension (24 %), asthma (22 %), and mental health conditions (18 %). Among those 50 years or older, hypertension was substantially more prevalent (44 %), followed by respiratory conditions (22 %), diabetes (19 %), and asthma (22 %). Cancer, chronic obstructive pulmonary disease (COPD), and cardiovascular disease were more common in the older group but had lower overall prevalence. Findings suggest older school employees may face elevated health risks during extreme heat events due to higher rates of chronic illness.

Some schools in Puerto Rico have air conditioning (A/C), but not all A/C functions. The San Juan Region reported the highest percentage of functioning A/C (27.8 %), compared to only 8.6 % in the region of Ponce. These results suggest that schools in the San Juan Region are better equipped than those in the region of Ponce. There were also significant differences between private schools and public schools. Employees, students, and the community in general in private schools were more likely to report functional A/C (17.28 %) compared to public schools (2.93 %).

Several participants reported heat-related symptoms in non-A/C environments based on their own experiences and observations of their students (Table 3). The most reported symptoms most likely to be noticed in students in non-A/C environments were: fatigue (OR=2.53, 95 % CI: 1.95–3.27), irrationality (OR=2.40, 95 % CI: 1.78–3.28), and lack of attention (OR=2.14, 95 % IC: 1.66–2.77). For school employees, the most reported symptoms were dizziness (OR=2.62, 95 % CI:

1.91–3.65), hallucinations (OR=2.39, 95 % CI: 1.16–5.55), and muscle pain (OR=2.34, 95 % CI: 1.78–3.10).

Participants provided testimonials that illustrate these findings (Supplementary Table 2). Employees described severe impacts, including medical emergencies requiring hospitalization, disrupted learning environments, and inadequate cooling solutions like fans that “just blow hot air”.

3.3. Co-designing equitable adaptation actions or heat in learning environments of Puerto Rico

As described in Section 2.1, a series of capacity-building activities, workshops, dialogues and stakeholder working sessions were part of the study’s participatory co-design process. Most activities were in-person while some, (1st US Caribbean Extreme Heat Summit, included virtual transmission reaching 12,000 people from Mexico, Puerto Rico, Colombia, and the US).

Active participants included 26 institutions (federal agencies, state agencies, universities, community-based organizations, and non-government organizations). Participants included practitioners, stakeholders, first responders, scientists, decision-makers and school employees from over 60 institutions.

Discussions were driven by the following concerns:

- The impact of extreme heat on mental, physical, and emotional health, including the circadian rhythm of students and possible effects on childhood development.
- The impact of extreme heat on students’ abilities to concentrate due to loss of sleep caused by extreme heat in their homes, which affects their performance when returning to school.
- The number of students in classrooms aggravates the heat situation because the human body generates heat.
- The distractions caused by the use of fans and cooling equipment, interfering with student concentration, hearing, attention, and learning.
- The physical and mental well-being of teachers, which compromises their ability to teach and pedagogical effectiveness.
- The need for school employees and staff to learn to identify heat-related symptoms in students and colleagues.
- The development and implementation of school protocols for heat preparedness and response.
- The lack of data on students and employees with pre-existing health conditions and heat-related health conditions.

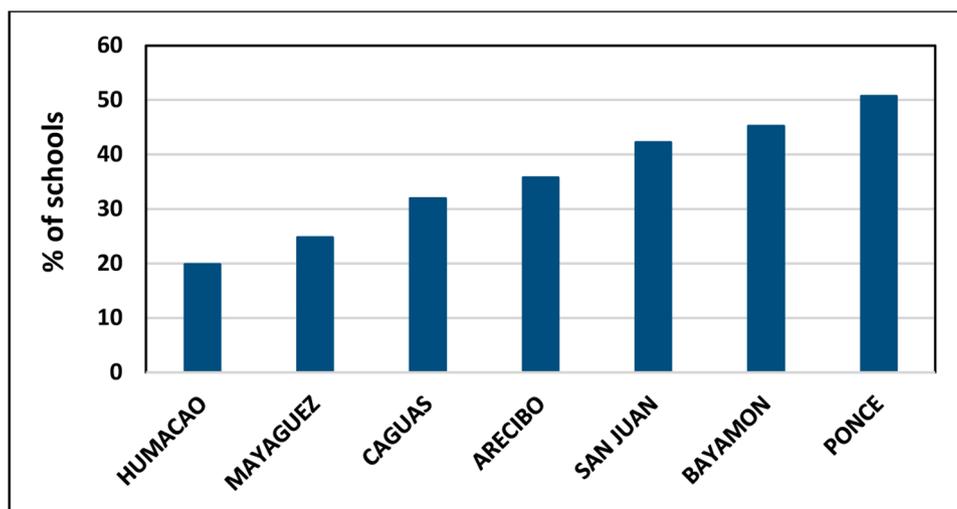


Fig. 1. Percentage of schools exposed to “High Risk Areas” and “Critical Risks Areas” for Heat per Education Region.

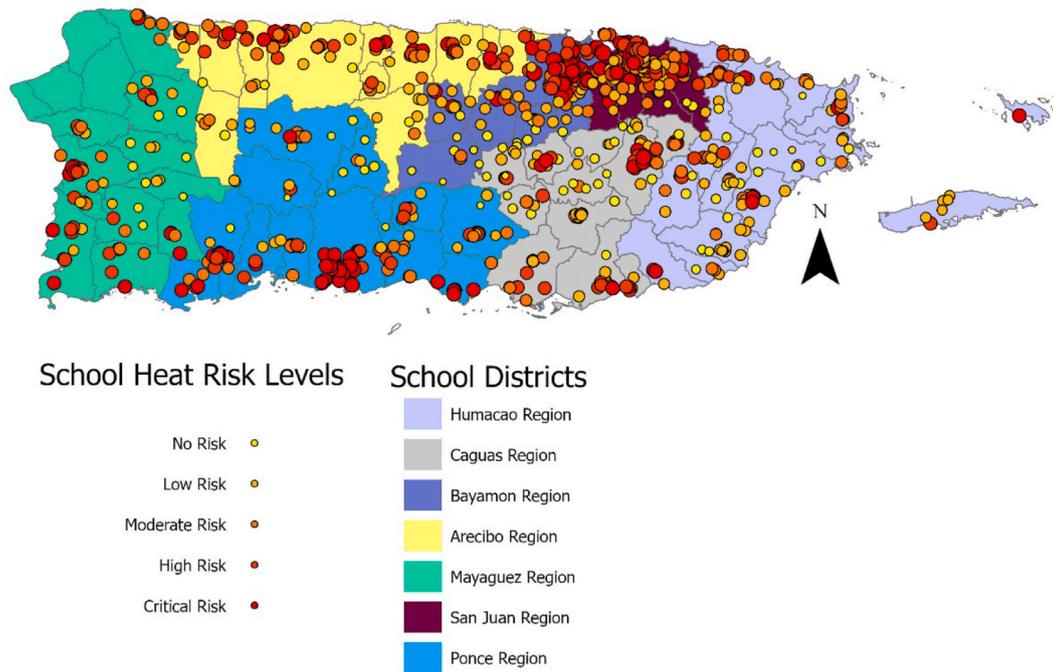


Fig. 2. Map showing the school’s spatial distribution per region/district exposed at different Heat Risk Levels. Darker red dots are schools at Critical Risk, while yellow dots are schools at No Risk.

Table 3

Odds Ratios (OR) of heat-related symptoms in non-air-conditioned compared to air-conditioned environments: Observations of students and self-reported experiences.

Symptom	OR	CI 95 %	p-value
Heat-related symptoms that participants noticed in students^a			
Dizziness	2.09	1.61–2.71	<i>p</i> < 0.001
Irrationality	2.40	1.78–3.28	<i>p</i> < 0.001
Aggressiveness	1.86	1.43–2.42	<i>p</i> < 0.001
Nausea	1.87	1.40–2.51	<i>p</i> < 0.001
Fatigue	2.53	1.95–3.27	<i>p</i> < 0.001
Lack of attention	2.14	1.66–2.77	<i>p</i> < 0.001
Likelihood that participants experienced heat-related symptoms^b			
Fainting	1.52	0.94–2.55	<i>p</i> < 0.001
Rapid heartbeats	2.11	1.59–2.81	<i>p</i> < 0.001
Hallucinations	2.39	1.16–5.55	<i>p</i> < 0.001
Confusion	2.31	1.51–3.64	<i>p</i> < 0.001
Dizziness	2.62	1.91–3.65	<i>p</i> < 0.001
Muscle pain	2.34	1.78–3.10	<i>p</i> < 0.001

^a Symptoms observed by participants in students.

^b Symptoms experienced by the participants themselves.

- The need to address cognitive challenges that overlap with mental health issues, in the context of communication, social and economic conditions including poverty levels, all of which affect the educational environment.

Agreement on 45 comprehensive strategies occurred followed by grouping into the following categories.

1. Data collection and inventory: Gathering data and information to improve decision-making in the event of extreme heat episodes.
2. Training: Capacity building, risk communication, and training on extreme heat causes and impacts.
3. Community preparedness: Heat preparedness and response, including household members and communities in general.
4. Student well-being: Integration of student health and well-being.
5. School infrastructure (remodeling and adaptation):

- a. Adapting school’s electrical infrastructure for more frequent heat episodes.
- b. Adapting school’s buildings and architectural design, including implementation of nature-based solutions to mitigate extreme heat where appropriate.

Some of the workshop recommendations were immediately adopted by the Puerto Rico Department of Education in mid-2024 and are posted on their website (<https://de.pr.gov/ola-de-calor/>).

Furthermore, the VCAPS pilot revealed key findings about extreme heat in learning environments. Participants identified vulnerabilities (poor construction, inadequate ventilation, regulatory non-compliance) and impacts (school closures, teacher stress, student concentration issues). Proposed solutions included uniform modifications, creating cooling zones with water and shade access, and updating construction codes. Findings will guide future participatory exercises and adaptation planning in educational settings.

4. Discussion

This study analyzed the impact of extreme heat on Puerto Rico’s learning environments. Significant disparities were noted in heat preparedness and response capacity across educational regions and between public and private schools. Findings highlight critical areas for intervention and policy consideration in addressing heat adaptation in the education sector.

Geospatial analysis revealed 36 % of schools in Puerto Rico are at high or critical risk of heat-related impacts with some differences related to geographic setting. The Region of Ponce emerged as a priority for heat adaptation action because 51 % of its schools were in high or critical risk areas and had insufficient A/C. A question remains as to whether students and employees in public schools in the Region of Ponce are being more affected by heat episodes compared to other educational regions of the island.

Survey results revealed significant disparities in A/C operations across regions and between public and private schools. The five-fold higher availability of operational A/C reported in private schools than

in public schools highlights a critical area of inequity in Puerto Rico's education system. These results may imply an unjust heat adaptation in an existing struggling educational system. The public education system in Puerto Rico is currently under a transformation process affecting services, education quality, and teacher and student motivation [30,31]. The Department of Education closed 34 % of schools in 2017–2019, resulting in 58,606 students displaced [31,32]. In general, 70 % to 80 % of the Puerto Rican students in public schools live below the poverty line [32], but displaced students generally had a higher incidence of poverty. Most middle to high-income families in Puerto Rico tend to send their children to private schools. When access to education is dire, favorable socioeconomic backgrounds give students advantages in access and quality, and can exacerbate socioeconomic differences, as students in public schools may face a cascading increased risk of health impacts and diminished learning experiences [32].

It is important to note that our comparison of symptoms between environments with and without functioning A/C did not control for actual local temperature measurements at each school. While our geospatial analysis identified areas of higher heat risk, the survey focused on capturing real-world experiences as reported by staff, regardless of formal temperature measurements at the time of symptom occurrence. Additionally, while it's possible that some schools in naturally cooler areas (such as higher elevations) may not have A/C by design rather than due to resource limitations, data suggest that many schools without functioning A/C are in regions identified as high or critical heat risk zones, particularly in the Ponce region.

The reported heat-related symptoms in non-A/C environments, both for students and school employees, emphasize the potential for significant learning disruptions and occupational health. Our study revealed a higher likelihood of heat-related symptoms in schools without adequate cooling systems. The most frequently observed symptoms for students in non-A/C are directly related to cognitive function and learning capacity [33,34]. Children and school employees spend most of their waking hours in learning environments. This extended exposure compromises the teaching-learning process and the health of users [35–38]. A comprehensive study in the US analyzing data from 10 million students who retook the Preliminary Scholastic Aptitude Test (PSAT) demonstrated that hotter school days in the years preceding the test reduced scores, with extreme heat being particularly damaging [34]. Our findings suggest that students in schools without proper cooling systems are more likely to experience symptoms that could decrease academic performance and engagement.

School employees also reported heat-related symptoms that affected their well-being and their ability to teach effectively. Given the substantial time spent in these environments, this raises concerns about long-term impacts on student outcomes, as well as the staff's health, productivity, and well-being. Addressing these challenges requires a multifaceted approach, particularly in the Caribbean context, where extreme heat events are becoming more frequent [8]. Strategies and actions align well with recent research on heat resilience in educational and urban settings [39].

Adopting most of these strategies by the Puerto Rico Department of Education is an encouraging step towards improving the thermal comfort and learning conditions in schools across the island. However, implementing additional strategies faces several fiscal, economic, and institutional challenges, particularly in high-risk regions. These challenges often fall along socioeconomic lines, exacerbating existing inequalities [40]. Future research should evaluate the implementation and effectiveness of these strategies in reducing heat exposure and improving educational outcomes, focusing on equitable implementation across communities.

The co-design process used in this study demonstrates the value of human-centered design and engaging diverse stakeholders in developing risk reduction measures. This approach ensures solutions are both locally relevant and aligned with the best practices in heat resilience planning in learning environments. Ultimately, this contributes to the

immediate improvement of learning environments and serves as a model for mitigation efforts in educational settings worldwide.

While this study focused on Puerto Rico, findings are highly relevant to countries in the Caribbean and other Small Island Developing States (SIDS), which face similar natural hazards. Many Islands are experiencing record-breaking atmospheric and marine heat, unreliable energy infrastructure, and frequent power outages, which compound the risks of extreme heat in learning environments. The co-designed strategies outlined in this study, particularly those addressing school retrofitting, emergency protocols, and community-level preparedness, may serve as scalable models for improving thermal comfort and resilience in schools across the region.

5. Conclusion

To our knowledge, this manuscript is the first of its kind providing a comprehensive understanding of heat impacts on learning environments in Puerto Rico and the Caribbean Region. This assessment combined earth observation data, qualitative and quantitative instruments, and participatory processes. Our findings revealed substantial heat-related symptoms and shortcomings in infrastructure that could ameliorate heat stress in students and school staff. Through a co-design process, we identified practical, locally grounded strategies for heat adaptation and mitigation in learning environments of Puerto Rico.

Implementing some of these strategies by the Puerto Rico Department of Education underscores the urgency and feasibility of adaptation efforts in school settings. As extreme weather events continue to intensify across the Caribbean, urgent action is needed to safeguard those in learning environments' health, well-being, and academic performance. The findings from this study are valuable not only to schools and decision-makers but also to institutions such as the Puerto Rico Department of Education, public health officers, emergency preparedness personnel, and the National Weather Service-San Juan Office, as they help inform responses to heat-related illness risks in learning environments.

Future research should consider integrating clinical health data, environmental monitoring, and long-term academic outcomes to evaluate the effectiveness of adaptation interventions better and ensure their equitable implementation. Implementing the myriad transformative adaptation alternatives that have emerged from the co-design process will not only improve the learning environment in Puerto Rico but also lay the foundation for strengthening economic and social development for future generations. Addressing the challenges posed by extreme heat in schools is essential for improving learning environments in Puerto Rico. It could serve as a model for climate adaptation in educational settings in small island states and the Caribbean in general.

CRedit authorship contribution statement

Pablo A. Méndez-Lázaro: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation. **Laura T. Cabrera-Rivera:** Writing – review & editing, Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation. **Digna Rueda-Roa:** Writing – review & editing, Software, Formal analysis, Data curation. **Frank E. Muller-Karger:** Writing – review & editing, Visualization, Resources, Investigation, Formal analysis. **Manuel Heredia Morales:** Writing – review & editing, Investigation. **Mónica V. Sánchez-Sepúlveda:** Writing – review & editing, Methodology. **Ernesto Rodríguez:** Writing – review & editing, Investigation, Formal analysis. **Odalys Martínez:** Writing – review & editing, Investigation, Formal analysis, Conceptualization. **Ernesto Morales:** Writing – review & editing, Investigation, Formal analysis. **Patricia Chardón-Maldonado:** Writing – review & editing, Investigation. **Wanda I. Crespo-Acevedo:** Writing – review & editing, Investigation. **Sarah Molinari:** Writing –

review & editing, Methodology, Investigation. **Masoud Ghandehari:** Writing – review & editing, Investigation. **Jorge E. Gonzalez-Cruz:** Writing – review & editing, Methodology, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

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¡NUEVO ESTUDIO PUBLICADO!

Evaluación de los Impactos, Riesgos y Vulnerabilidades del Calor Extremo en los Entornos de Aprendizaje de Puerto Rico (2023)

Hasta la fecha, ningún estudio en Puerto Rico había documentado de forma integral los efectos del calor extremo en las escuelas. Este trabajo aborda esa brecha, combinando datos satelitales, encuestas y procesos participativos para informar estrategias de adaptación.

¿Qué se estudió?



Se evaluó el impacto del calor extremo en las escuelas de Puerto Rico durante el año 2023. Se usaron imágenes satelitales (Landsat 8) para identificar las zonas escolares con mayor temperatura superficial.

- Se realizó una encuesta en línea con más de 1,200 empleados escolares (docentes, personal administrativo y de apoyo).
- Se desarrollaron talleres y diálogos participativos con el Departamento de Educación y la Federación de Maestros de Puerto Rico para co-diseñar estrategias de adaptación.

Hallazgos clave

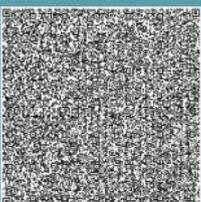
- 36 % de las escuelas se encuentran en áreas con temperaturas promedio superiores a 41.4 °C. La Región de Ponce presenta la mayor proporción de escuelas en zonas de riesgo alto o crítico (50.7 %).
- Existen grandes disparidades en el acceso a aire acondicionado: 17.3 % de las escuelas privadas vs 2.9 % de las públicas cuentan con A/C funcional.
- En salones de clases sin aire acondicionado, estudiantes y personal reportaron síntomas relacionados al calor: fatiga, mareo, falta de atención, irritabilidad y confusión.
- Se identificaron 45 estrategias de adaptación agrupadas en cinco áreas: recopilación de datos, capacitación, preparación comunitaria, bienestar estudiantil e infraestructura escolar.



¿Qué se puede hacer?

Para mejorar la resiliencia al calor en las escuelas de Puerto Rico, se recomienda:

- Implementar protocolos escolares de respuesta al calor.
- Mejorar la infraestructura eléctrica y ventilación natural.
- Adoptar soluciones basadas en la naturaleza (áreas verdes, sombra, techos fríos).
- Fortalecer la capacitación del personal educativo para reconocer y responder a síntomas de estrés térmico.
- Promover políticas de adaptación equitativas que prioricen las regiones y comunidades más vulnerables.



MANUSCRITO COMPLETO

Fuente de información:

Méndez-Lázaro, P.#, Cabrera-Rivera, L. T.#, Rueda-Roa, D., Muller-Karger, F., Heredia-Morales, M., Sánchez-Sepúlveda, M., Rodríguez, E., Martínez, O., Morales, E., Chardón-Maldonado, P., Crespo-Acevedo, W. I., Molinari, S., Ghandehari, M., González-Cruz, J. E. (2025). Assessing the Impacts, Risks, and Vulnerabilities of Extreme Heat in Learning Environments of Puerto Rico in 2023. *The Journal of Climate Change and Health*. <https://doi.org/10.1016/j.joclhm.2025.100584>

Appendix C

Puerto Rico Schools Struggle With Extreme Heat and Energy Crisis

Despite record heat in Puerto Rico as of August 2023, public schools remain unprepared for increasingly frequent hot days. School communities also grapple with ongoing power outages.

August 21, 2025



TATIANA DÍAZ RAMOS*y*

Lee en español

It's July, and the temperature registers 84 degrees Fahrenheit with 68% humidity at the summer camp at Culebra Ecological School, located on the island municipality just off Puerto Rico's eastern coast. Less than two hours later, as students line up for lunch, the temperature has climbed three degrees, while the humidity has decreased slightly. After lunch, the youngest go

out to the playground in front of the kindergarten and special education classrooms. Zedrik, wearing a long-sleeved cotton shirt, sits beside an areca palm that hasn't grown enough to provide shade, watching his classmates play.

"I'm going to third grade in August," he says. When asked if he'd like to wear a cap for sun protection, he replies, "If I bring a cap, I'll just forget it somewhere." Zaidliany joins the conversation, smiling with a bead of sweat trickling down her forehead to the tip of her nose. "I left my sunglasses at home, back on the main island of Puerto Rico," says the girl who will start first grade in August, when asked how she protects herself from the sun.



*Zedrik seeks shade from an areca palm at the Culebra Ecological School.
Photo by Brandon Cruz González | Centro de Periodismo Investigativo*

Although the school's heat safety protocol has not been activated, at least two teachers have suffered from heat exhaustion at the Culebra Ecological School since 2023. If afternoon temperatures get too high, Kenneth, a ninth-grader, retreats to the library, while Nayla, an eighth-grader, heads to the principal's office —both air-conditioned rooms, though neither cools fully. Students in summer programs simply make do with the classroom fans during the hottest hours of the day.

Designated as an emergency shelter, the school has generators and a solar panel system donated by the Red Cross, according to Rubén Vargas of the Public Buildings Authority (AEP, in Spanish). However, voltage fluctuations have damaged cafeteria equipment, the ceiling fans no longer run at full capacity, and there are only four water fountains for the entire school of [136](#) students and [22 teachers](#), school nurse Marlene Monell Rodríguez and cafeteria worker María Villanueva confirmed.



The school serves as an emergency shelter, and unlike many others, this one does have a generator.

Photo by Brandon Cruz González / Centro de Periodismo Investigativo

Each classroom has ceiling and pedestal fans, but the heat can become unbearable, especially in the secondary building, which lacks proper ventilation. Some teachers take turns using the library or community room, typically reserved for faculty meetings, to hold classes there because those spaces have air conditioning.

For three years, the school community has been waiting for the AEP to conduct an electrical capacity study so more air conditioners can be installed.

“My agency is a little slow. You can file reports, but it’s up to them to finish certain tasks. I’m a handyman and can check an air conditioner, but I can’t repair it —that has to be done by an electrician or refrigeration technician,” Vargas explained.



*Rubén Vargas, maintenance worker with the Public Buildings Authority.
Photo by Brandon Cruz González / Centro de Periodismo Investigativo*

In the Humacao educational region, which includes the Culebra Ecological School, the School Nursing Program reported 135 cases in 2023 requiring activation of the [heat safety protocol](#) for students affected by extreme temperatures. The following school year, the Humacao region, which includes schools on the East Coast, again had the highest number of cases, with 124 students requiring activation of the protocol.

Culebra's experience mirrors data from the National Oceanic and Atmospheric Administration (NOAA), showing that in 2024, heat indices exceeded 93 degrees Fahrenheit at stations such as Roosevelt Roads in Ceiba, which is part of the Humacao region. The Ponce station, on the island's southwest coast, recorded the highest index at 104 degrees. Carolina, in the north, matched Ceiba's 98-degree reading. The [heat index](#) measures how hot it feels once humidity is factored in.

*** A Flourish chart**

Additionally, a [recent study](#) by five University of Puerto Rico (UPR) academics, examining temperature changes at 12 monitoring stations across the island over half a century and their link to climate change, found a pattern of rising heat intensity in the northwest and southeast regions.

Since the Department of Education’s School Nursing Program began collecting data on these incidents in 2023, no other educational region has had more than 100 cases requiring the protocol. Of the 124 schools in Humacao, only 19 have an emergency generator, while 25 have solar panel systems, according to agency data from May.

Globally, the education of approximately 171 million students was disrupted by heatwaves in 2024, according to a United Nations Children’s Fund (UNICEF) [analysis](#). Children —especially younger ones— and athletes are among the most vulnerable to extreme heat, in part because [children sweat less](#) “and have a faster metabolism, meaning they heat up faster.” Spending more time outdoors increases their risk of heat exposure, and “when playing or exercising, children are less likely to rehydrate, which can be dangerous.”

How School Nurses Address Rising Temperatures

Before Hurricane María, not every school had a nurse. “Schools weren’t structured to include a nursing area,” explained Evelyn Rivera García, director of the [School Nursing Program](#), to the CPI. She assured that today “every school now has an appointed nurse,” totaling 888 professionals, according to the Department of Education’s website.



School nurse Marlene Monell in Culebra.

Photo by Brandon Cruz González | Centro de Periodismo Investigativo

Although the program lacks a fixed budget, Rivera García noted that “whenever we’ve requested funding, we’ve always been given enough to cover material or personnel needs.”

In her seven years working at Culebra Ecological School, Monell Rodríguez has never had to activate the heat protocol for students. “I’m constantly telling students, ‘Drink water,’” she said. She recalled treating math teacher José Quintana when he suffered heat exhaustion at the school in 2023.



José Quintana, a math teacher at Culebra Ecological School.

Photo by Brandon Cruz González | Centro de Periodismo Investigativo

The triathlete recounts, “I’d never felt anything like it. It started with a headache, then turned into chills — that’s when I got scared.”

When the heat safety protocol is activated, Monell Rodríguez explained, “the first step is to treat the symptoms: we apply cold compresses or place a cold water bottle on the neck to bring down the temperature and move the person to a cooler area.”

Monell Rodríguez took Quintana’s blood pressure, which “was sky-high,” and provided hydration and pain relievers. “I learned from the experience. Now I keep a small hotel-style mini-fridge in my classroom, stocked with water and other supplies. I was lucky — a colleague was buying a bigger fridge and gave me his old one,” said Quintana, who lives in Rincón, a municipality on Puerto Rico’s west coast.

According to the Department of Health’s Syndromic [Surveillance System](#), between [2023](#) and May [2025](#), there were 795 emergency room visits for heat-related illnesses. The municipalities in the Humacao educational region fall under the Metro, Fajardo, and Caguas health areas, where four out of 10 of these visits took place. Looking at the visits by age group, about 20% were patients under 19. Although this surveillance system exists, the agency still [lacks a plan](#) to address heatwaves.

[Academic research](#) confirms that exposure to extreme heat is linked to reduced cognitive performance in children, particularly among socioeconomically disadvantaged populations. [These studies](#) also show that without air conditioning, for every degree the temperature rises, learning outcomes decline by about 1% over the course of a school year.

“You’re also talking about exposure to other pollutants,” explained pediatrician Gredia Huerta. “When the temperature rises, air quality declines proportionally.”



*The indoor court at Culebra Ecological School is equipped with fans.
Photo by Brandon Cruz González | Centro de Periodismo Investigativo*

Coping with Heat While School Reconstruction Stalls

Education is one of the services most disrupted by climate change-related events, but in most countries, schools lack sufficient resources to effectively protect students and teachers from the impact of natural phenomena, UNICEF warns. Significant investments are also not being made to adapt educational environments to this reality. The CPI collaborates with

the Associated Press, CalMatters in California, Civil Beat in Honolulu, and Blue Ridge Public Radio in North Carolina to examine how school communities are recovering from natural disasters.

At Luis Muñoz Marín School in Yabucoa, in southeastern Puerto Rico, the school community improvised with raffles or by charging a fee for a “casual dress day” to acquire at least one pedestal fan for each classroom. Meanwhile, parents sent their children with portable fans to help them cope with the heat. Teachers also adjusted their routines, sometimes holding class outdoors or in the library, which has air conditioning, said history teacher Josian Casanova Rodríguez. The Department of Education provided only six fans for the entire school, which serves [150 students](#) and has [16 teachers](#).

The agency acknowledged Puerto Rico’s vulnerability to climate change in a [2023 guidance memo](#). In a more recent directive, it said it was “fully aware of the island’s energy crisis.”

Since the arrival of LUMA Energy, the private company that took over electricity distribution in 2021, customers have been without power for an average of 13 hours a year and have experienced an average of four outages annually. The electrical system is currently in a state of emergency — apart from the crisis caused by Hurricane María— because of a critical decline in generation capacity combined with surging demand during summer afternoons.

“Last year, we had students with blood sugar issues, dizziness, and staff who had to leave because they couldn’t stand the heat.”

“This August is expected to be even hotter, and we don’t know how the Department will deal with it —or how we’ll respond,” said Casanova Rodríguez.

The Department of Education developed a [protocol](#) on extreme heat as part of each school’s Operational Emergency Plan, but progress has stalled in rebuilding the island’s school infrastructure, damaged by hurricanes and earthquakes eight years ago. Schools are not prepared or designed to withstand hotter and increasingly frequent days amid the energy crisis, according to interviews with staff, experts, climatological data, and information provided by the Department of Education.

“This year, they bought air conditioners and installed them, but we don’t have enough capacity to connect them. We’ve been waiting two years for the Public Buildings Authority to fix the school’s electrical substation and increase its capacity,” said the Yabucoa teacher.

✱ A Flourish heatmap

Extreme heat can act as a psychological stressor, alter mood, trigger anxiety, and reduce memory capacity, explained school clinical psychologist and University of Puerto Rico Río Piedras professor Nellie Zambrana.

“Both teachers’ and students’ moods are drastically affected. In the afternoon classes, I have to have different discipline codes than in the morning to capture students’ attention because otherwise, the class goes with ‘Mister, it’s so hot. It’s so hot.’ And it’s true, you see them with sweaty arms, notebooks wet with sweat,” detailed Quintana, the math teacher.

“Sometimes I’ve been wrong —I scolded a student and forgot why they were acting that way. You have to tone down the afternoon classes,” he added.

Casanova Rodríguez, for his part, admits that “it’s hard enough for teachers to stay focused in such heat, imagine the students trying to concentrate.”

Considering that Puerto Rico’s school infrastructure has been under reconstruction since Hurricane María in 2017, the Department of Education still hasn’t achieved what experts call “school resilience,” meaning campuses equipped with cisterns, generators, or photovoltaic systems. At Luis Muñoz Marín School, “if the power goes out, there are no options,” Casanova Rodríguez noted.

* A Flourish chart

Each school must know its environment and risk factors, environmental health specialist Gredia Huerta Montañez recommends. “Even if the Department of Education has guidelines related to climate change, each school must understand its reality, develop a written plan with clearly defined roles, and review that plan regularly with participation from the entire school community,” she urged.

The extreme heat protocol, included as an [annex](#) in the school’s Operational Emergency Plan, only contains general recommendations —such as staying hydrated or spending as much time as possible in ventilated or air-conditioned spaces. It does not include any specific initiatives to identify spaces for students affected by heatstroke or to reforest school campuses.

When compared with protocols from four U.S. school districts, the general recommendations on hydration and [limiting outdoor activities are the same](#). However, the U.S. protocols go further, with [detailed guidance](#) on when to suspend outdoor activities based on the heat index, how often [hydration breaks](#) should occur, and when to halt physical activity altogether.

“The reality is that depending on how well —or poorly— equipped a school is, the situation will only worsen for all students,” warned Zambrana.

Schools without cross ventilation, those with broken air conditioners, and windows covered by plastic screens are some of the examples Zambrana mentioned regarding schools’ lack of preparation to face heatwaves. “You can’t take students out to the basketball court if it doesn’t have a roof and say, ‘let’s take advantage of natural ventilation.’ All of this will affect students cognitively —and teachers too,” the psychologist elaborated.

The Energy Demand Challenge

As extreme heat becomes more common, the demand for cooling to keep schools at safe and comfortable temperatures continues to rise. A [Climate Central analysis](#), done by an organization of independent scientists and communicators researching climate change, estimated that over the past decade, back-to-school air conditioning demand in the U.S. has increased by 34%. Similarly, during the summer of 2023 in Puerto Rico, daily energy demand rose by up to 30 percent, according to research from the University at Albany and the City University of New York (CUNY).

“A colleague bought four portable air conditioning units. When he plugged them in, the system crashed. Then he unplugged one. The Public Buildings Authority worker came, reset the breakers, left three running, and the system failed again. He unplugged another, and it still failed. In the end, only one unit could stay on. That’s when we realized the school had a major electrical problem,” recounted Professor Quintana.

Both the Department of Education and the Office for the Improvement of Public Schools (OMEP) have invested more than \$15 million since 2021 in purchasing or renting and installing air conditioning systems in 12 schools. Three companies were contracted for this work: A.C.R. Systems, Jayvee Conditioning & General Contractors, and Alfredo Atkinson. The Public Buildings Authority has also rented air conditioning units for three schools since at least 2023, at a total cost of \$417,980.

At Culebra Ecological School, the only areas with air conditioning are the library, the community room, the principal’s office, and the special education and kindergarten classrooms. Although air conditioners provide some relief, Quintana argues that “it’s like shooting yourself in the foot —it creates a vicious circle, because who pays the electricity bill? We have to think about the school’s architectural design: high ceilings, open layouts, and consideration of sunrise, sunset, and wind currents.”

The main school building, which doubles as an emergency shelter, has the characteristics Quintana described. The secondary building, however, does not.

The adaptation of schools to extreme heat “has advanced very little on the Department’s part,” said José Javier Hernández Ayala, an associate professor of physical–spatial analysis at the University of Puerto Rico’s Graduate School of Planning. “Most of the effort has come from parents and teachers,” he added, noting that he and his father-in-law installed air conditioners at the public school where his wife teaches.

Huerta Montañez, for her part, emphasized that learning is affected not only by heat at school, “but also by what happens at home: power goes out every day or the unstable grid damages air conditioners. That child can’t study well, do homework, or sleep.”

While filling schools with air conditioners is not the only solution, Hernández Ayala proposes turning schools into energy- and climate-resilience hubs with photovoltaic systems, for example. He also suggests reforestation projects, better planning and design to create shade, and replacing outdated refrigeration and air-conditioning systems with energy-efficient equipment.

The obsolescence of equipment is not unique to Puerto Rico. Since [2020](#), the U.S. Government Accountability Office (GAO) has estimated that 41% of school districts need to update or replace their heating, ventilation, and air-conditioning systems.

Research from the University at Albany and CUNY highlights that rising energy demand strains existing infrastructure “which wasn’t designed to handle such heavy loads efficiently. The study calls for better insulation and windows to improve efficiency and reduce cooling costs, along with more advanced climate-control systems.”

At Culebra Ecological School, voltage fluctuations have damaged cafeteria equipment — including the ice machine, a refrigerator, and ceiling fans— said María Villanueva, who has worked there for five years. The three cafeteria employees cook without an exhaust hood. The food storage room has poor ventilation and lighting, so they have had to “discard food frequently,” when canned products spoil before their expiration date because of heat or humidity.



*The cafeteria's fans and some equipment at Culebra Ecological School are out of service.
Photo by Brandon Cruz González | Centro de Periodismo Investigativo*

In April 2024, the Department of Education contracted the engineering firm M2A Group for \$2,142,000 to conduct a first-phase assessment of electrical substations and overall capacity at 400 of Puerto Rico's 709 public schools.

The CPI requested the M2A Group report, but the Department provided only a partial version. The documents show that the company analyzed 425 schools across the San Juan, Bayamón, Mayagüez, Ponce, and Arecibo education regions. M2A found that 365 of those schools had air-conditioning systems that were not functioning.

The Department's [standards](#) for "energy efficiency" instruct principals and teachers to educate students about energy conservation and the climate impact of electricity use; to turn off equipment and lights at the end of each day; and to set air-conditioner temperatures between 70 and 72 degrees Fahrenheit.



Without a clear picture of schools' energy needs, reforestation emerges as a cost-effective way to mitigate heat. Last year, the Department of Education announced a [partnership](#) with the Department of Natural and Environmental Resources (DRNA, in Spanish) to plant trees on school campuses. Between April 2024 and May 2025, 39 trees were planted across eight campuses.

Schools in Puerto Rico celebrated Arbor Day annually starting in the late 19th century. Traditionally, students planted trees in schoolyards that day. The tradition faded over time —contributing to the lack of shade students face today.



*The primary-level building features high ceilings and cross-ventilation.
Photo by Brandon Cruz González / Centro de Periodismo Investigativo*

Trailer offices for school psychologists

The sequence of emergencies since 2017 has exposed Puerto Rico’s school-age population to anxiety, depression, and symptoms of post-traumatic stress due to disrupted routines and, in some cases, displacement. Additionally, the Environmental Protection Agency (EPA) reports that exposure to extreme heat raises the risk of anxiety and depression in children. Under these conditions, an increase in students seeking help from school psychologists is expected.

Zambrana notes that learning about climate change while seeing little policy progress fuels frustration among students and teachers alike.

“Public policy has to help and contribute. Can’t we at least fix ventilation? There’s no excuse — the Department of Education’s budget can cover that and more. We also need to think about how to maximize open spaces in our schools,” she said.

In 2000, Puerto Rico created school psychologist positions by law. Today, the Department reports 58 vacancies across 870 schools. Psychology professionals have denounced excessive administrative workloads, delayed pay, and the lack of private spaces suitable for confidential sessions.

Zambrana said that although the law is more than 20 years old, funding wasn't allocated in earnest until the pandemic.

“Only after the pandemic did they look for a budget. Paradoxically, with fewer students, we face more difficulties —those students' problems have grown and multiplied,” said Zambrana.

To address space constraints, in early May, Department of Education Secretary Eliezer Ramos Parés signed a contract worth nearly \$9 million with Salud para Todos Inc. to provide and install 11 office trailers for school psychologists on or before August 30. Each trailer costs \$80,136.99.

Meanwhile, one psychologist may be assigned to multiple schools. The Department confirmed to the CPI that five school psychologists currently serve two campuses each, in the Humacao and Ponce regions.

Emergency Response Impossible Without Data

Disasters of varying scale —from hurricanes to flooding from intense rains and even heatwaves— affect not only student and teacher performance but also schools' ability to operate.

The Associated Press reported that after [Hurricane Helene](#) in September 2024, schools in North Carolina could not resume classes for weeks due to power and water outages and impassable roads across the region. In Asheville, the largest city in western North Carolina, schools stayed closed for a month while district leaders debated how to reopen without potable water. Ultimately, the district arranged for FEMA to supply pallets of bottled water and water tanks for bathroom use.

In more remote areas, schools were closed for two months. In Yancey County — home to the highest mountain east of the Mississippi — Micaville Elementary students lost 39 school days and had to split enrollment between two district campuses. Returning to classrooms required a herculean effort, and some students had to say goodbye to their entire class. Emotional and psychological support took precedence; following the curriculum became secondary.

In Puerto Rico, teacher leaders, organizations, and academics estimate that 98 school days were lost after Hurricanes Irma and María in 2017. The Department of Education does not systematically record these disaster-related losses, according to statements the agency made in an information-access [lawsuit](#) filed by the climate justice organization El Puente.

“We can't keep responding to emergencies as isolated events — without planning and data. The only way to achieve the climate justice we seek is with accurate information that tells us what we're facing so we can draw up an effective plan,” said the organization's executive director, Federico Cintrón Moscoso.

Two weeks before the semester began, the Department of Education released two directives with [preventive strategies](#) for extreme heat. The first lists measures that school communities have already implemented, as documented by the CPI. The second announces the distribution of [water](#) to students in cartons at \$1.95 million.

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PARA HACER QUE INVESTIGACIONES COMO ESTA SIGAN SIENDO POSIBLES

DONA AHORA