Prolonged Heat Exposure in Florida's Construction Workforce and Its Impact on Cognitive Fatigue, Emotional Resilience, Family Strain, and Workplace Factors for Holistic Well-Being

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Abstract

Prolonged exposure to extreme heat poses significant challenges to construction workers' mental and physical well-being. While existing research has primarily focused on the physiological risks of heat stress, its psychological and social effects remain underexplored. This study examines how extreme heat influences workers' mood, fatigue levels, social interactions, and coping strategies, particularly in their home environments. A mixed-methods approach was used to gather insights from construction professionals, revealing that extreme heat contributes to severe exhaustion, irritability, and diminished motivation for routine tasks, including meal preparation and social engagement. Many workers report heightened stress and frustration, leading to strained personal relationships and reduced patience with family members.

Additionally, participants describe difficulty unwinding after work, often opting for isolation or disengagement from household responsibilities. While common coping strategies such as hydration, cold showers, and extended rest periods provide some relief, workers overwhelmingly support workplace modifications, including hydration stations, adjusted work schedules, and employer-led heat stress education programs. These findings provide valuable perspectives on the broader implications of heat stress beyond the workplace, suggesting that further exploration is warranted for a more comprehensive understanding of its long-term effects. Expanding the participant pool and incorporating deeper qualitative analysis would strengthen future research and aid in refining interventions that support worker well-being both on-site and at home. This study contributes to ongoing discussions on industry guidelines and workplace policies that can better safeguard construction workers in increasingly extreme climate conditions.

Impact Statement

Extreme heat significantly threatens construction workers' well-being, leading to fatigue, mood swings, and social withdrawal, which can hinder their personal lives. Employers and policymakers should prioritize hydration access, adjust schedules, and implement educational programs to promote a healthier, safer workforce in extreme climates.

1. Introduction

The construction industry faces growing challenges due to rising global temperatures, particularly in high-risk regions like Florida, where extreme heat and humidity significantly impact worker health. Outdoor labor in construction involves strenuous physical activity, increasing vulnerability to heat-related illnesses such as dehydration, heat exhaustion, and heat stroke. Climate change has intensified the frequency, intensity, and duration of heat waves, further exacerbating these occupational risks (Guirguis et al., 2021). By 2050, Florida is projected to experience a 50% increase in days exceeding 90°F, heightening concerns for outdoor workers (U.S. Global Change Research Program, 2017).

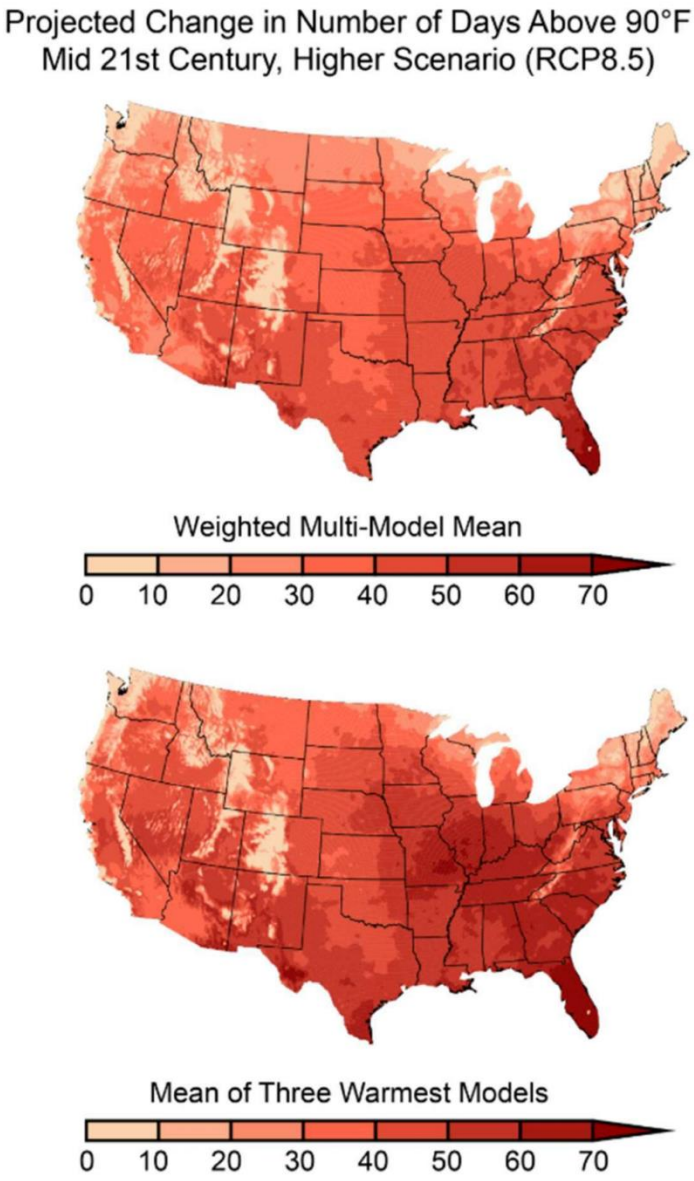

Figure 1. (U.S. Global Change Research Program, 2017) illustrates the projected increase in extreme heat days over the next several decades.

While the physical effects of heat exposure have been well-documented (Kjellstrom et al., 2009; Maloney & Forbes, 2011), less attention has been given to the psychological and social consequences of working in extreme heat. Prolonged exposure contributes to mental fatigue, irritability, emotional distress, and heightened stress levels, which can extend beyond the workplace and impact workers' personal lives (Acharya et al., 2018). Construction workers face additional burdens due to the physical demands of their jobs, unpredictable weather conditions, and the pressure to maintain productivity despite extreme environmental stressors. The effects of heat stress do not end when the workday does—many workers struggle with emotional exhaustion, reduced motivation for daily tasks, and strained social interactions at home. As climate change continues to intensify these conditions, the broader societal implications of heat exposure become more evident (Kotera et al., 2020). Understanding these challenges is critical to developing workplace interventions that address both the physical and psychological aspects of heat stress.

This study employs a mixed-methods approach to examine the impact of extreme heat on construction
workers' mental well-being, emotional resilience, and personal relationships. Surveys were distributed to workers in various roles, gathering quantitative data on fatigue levels, stress, and coping strategies, while open-ended responses provided deeper insight into how workers navigate heat-related challenges. Findings indicate that prolonged heat exposure leads to severe exhaustion, increased irritability, and reduced motivation for routine tasks such as meal preparation and social engagement.

Many workers report heightened stress, frustration, and difficulty unwinding after work, often opting for isolation or disengagement from household responsibilities. While common coping strategies such as hydration, cold showers, and rest breaks provide some relief, workers overwhelmingly support structured workplace interventions that include employer-mandated heat stress training, cooling stations, and more flexible scheduling policies.

As the construction industry continues to operate in increasingly extreme environmental conditions, it is essential to move beyond traditional heat mitigation strategies and adopt a holistic approach that prioritizes workers' well-being both on-site and at home. This study highlights the urgent need for data-driven interventions that address not only physical safety but also the mental and emotional toll of heat exposure in the workforce.

2. Method

This study utilized a mixed-methods approach to investigate how prolonged exposure to extreme heat impacts construction workers' mental well-being, emotional regulation, and recovery behaviors. Data was gathered through a series of anonymous surveys administered in phases to capture both quantitative metrics and qualitative insights. The methodology was designed to ensure validity, encourage participant honesty, and allow for direct comparison between worker experiences under extreme heat conditions and during fair weather. The following sections outline the procedures for participant recruitment, data collection, and analysis.

2.1 Participants and Recruitment

Participants were recruited from active construction sites managed by London Bay Homes in Southwest Florida, a region characterized by prolonged periods of high heat and humidity—the recruitment process aimed to obtain a diverse representation of workers exposed to extreme temperatures. Recruitment efforts were open to all construction workers performing physically demanding tasks in hot outdoor conditions, and selection was to all construction workers performing physically demanding

tasks in hot outdoor conditions, and selection was facilitated through company approval to ensure representation across multiple construction roles.

The first sample consisted of nine mid-level construction workers who responded to the study invitation. These roles included project managers and superintendents, whose duties involved outdoor site management and administrative tasks; electricians working in enclosed, poorly ventilated mechanical spaces; and stucco and framing workers operating in direct sunlight without access to climate control. Despite the small sample size, this diversity in job roles provided a broad perspective on occupational heat exposure.

Recruitment followed a structured process. Participants were invited to participate based on their exposure to extreme heat and recruitment occurred during the first four weeks of the study. Following this period, data collection was conducted biweekly over nine weeks. Surveys were distributed digitally via email, allowing convenient mobile access. All participation was voluntary, and anonymity was preserved through the exclusion of any personal identifiable information. Participants received a verbal briefing on the research objectives and methods, and verbal consent was obtained before survey distribution.

2.2 Data Collection

A three-part survey design was implemented to collect both quantitative and qualitative data related to workers' cognitive function, emotional stability, and coping behaviors. Surveys were delivered through Google Forms and optimized for mobile devices to accommodate workers' schedules. This design enabled broad participation while maintaining consistency in delivery and accessibility.

The primary survey instrument consisted of the following components:

Likert-Scale Assessments –

Participants rated experiences such as physical fatigue, appetite changes, mood fluctuations, irritability, social interaction, and recovery habits on a scale of 1 to 5. These questions produced measurable data to assess variations in stress levels and mental fatigue under high-heat conditions.

Multiple-Choice Questions –

This section captured data on hydration practices, shade availability, cooling options, and employer support. These categorical responses helped identify common adaptation strategies among participants.

Open-Ended Responses –

Participants provided detailed personal reflections on how working in extreme heat impacted their motivation, emotional state, and interactions with family and coworkers. These responses added critical context and depth to the numerical data.

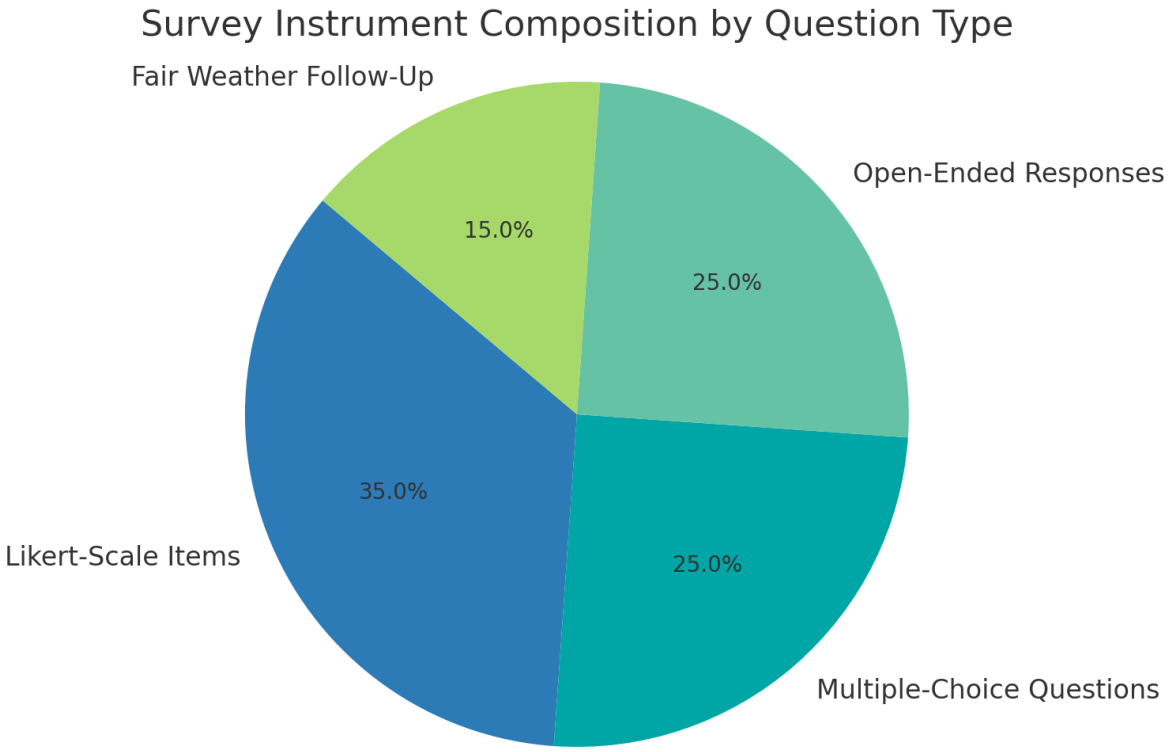

Figure 2. Distribution of question types across all surveys used in the study.

To minimize the additional time demands on participants and to uphold the confidentiality of their responses, open-ended qualitative questions were seamlessly integrated into the survey itself instead of being collected through separate interviews. This thoughtfully designed format enabled all participants to share their personal narratives and insights in a comfortable and accessible manner, allowing them to contribute meaningfully without the requirement of any further participation.

A third follow-up survey was added after the initial data collection period to improve the validity of the findings. This survey focused on participant experiences during mild or fair-weather conditions and was designed to serve as a comparative measure against the data collected under extreme heat. The structure mirrored the original survey but used a 1 to 5 Likert scale and contained similar categories, including emotional exhaustion, motivation, family engagement, and recovery. An open-ended prompt invited workers to reflecton whether extreme heat had significantly contributed to the symptoms they initially reported.

The inclusion of this third survey enhanced the robustness of the data by introducing a control condition—allowing direct comparison between high-heat and fair-weather responses. This comparative framework enabled the study to better isolate heat as a variable and verify whether the behavioral and emotional responses observed were primarily climate dependent.

2.3 Data Analysis

Quantitative data were analyzed using descriptive statistical techniques. For each Likert-scale item, mean and median values were calculated to summarize central tendencies, while standard deviation

was used to evaluate variability among responses. Frequency distributions were compiled for multiple-choice items to identify dominant patterns in coping strategies. The responses from the third (fair weather) survey were analyzed using the same statistical approach and then compared side-by-side with the high-heat data to identify meaningful shifts in behavior and well-being.

Qualitative data were analyzed through thematic coding. All open-ended responses were manually reviewed and categorized into recurring themes, such as mental fatigue, social withdrawal, emotional dysregulation, and heat-specific coping strategies. Thematic consistency across participant responses was used to identify key insights and trends, while individual narratives were preserved to illustrate real-world impacts.

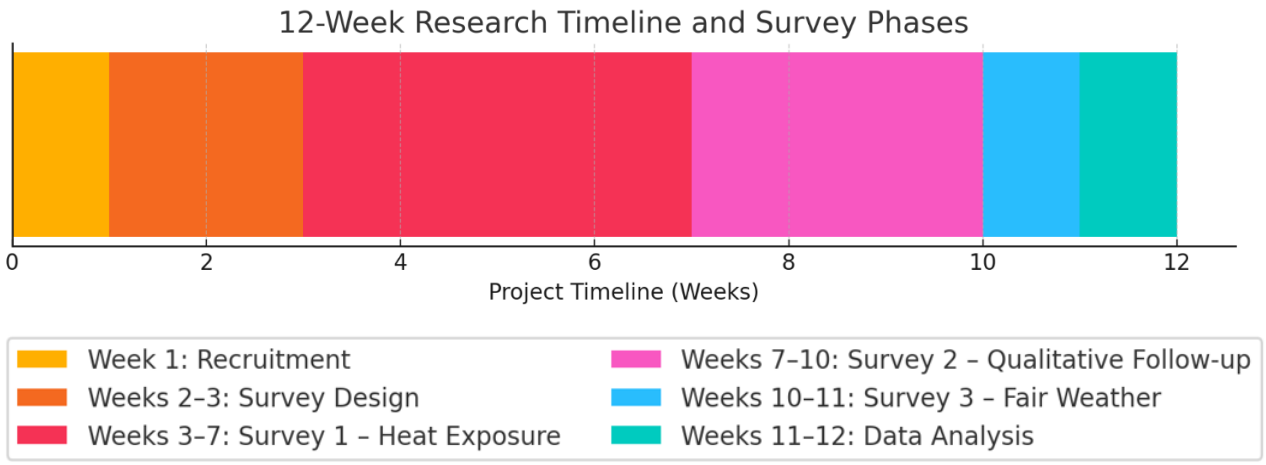

Figure 3. A 12-week timeline outlining the sequential phases of recruitment, survey deployment, and analysis leading to a comparative study of worker experiences.

This iterative coding process allowed for both pattern recognition and contextual interpretation.

The third survey was included in the thematic analysis to contrast participant narratives across environmental conditions. This side-by-side comparison enabled triangulation, strengthening the overall validity of the findings. Observing repeated mentions of improved mood, increased motivation, and greater family engagement in fair weather responses reinforced the conclusion that heat exposure was a significant factor in participant well-being.

2.4 Ethical Considerations

Although the study did not require Institutional Review Board (IRB) approval due to its academic scope and low risk nature, ethical standards were followed throughout the research process. All participation was voluntary, and no incentives were offered. Responses were collected anonymously to protect participant identity, and no personally identifiable information was gathered. The survey questions were carefully worded to avoid leading language or emotional discomfort. These measures ensured the ethical integrity and confidentiality of the data collection process.

3. Results

The results of this study reflect the mental, emotional, and behavioral impact of extreme heat exposure on construction workers operating in Southwest Florida. Data were gathered through three survey phases: two administered during periods of high heat, and a third distributed during fair

weather for comparative purposes. Quantitative data were drawn from Likert-scale responses evaluating variables such as fatigue, irritability, motivation, and recovery. Qualitative insights were extracted from open-ended responses and thematically coded to identify recurring psychological and behavioral patterns linked to environmental conditions.

3.1 Fatigue, Recovery, and Motivation

Fatigue was the most commonly reported issue during heat-exposed phases. During high-heat conditions, average fatigue was rated at 4.3 out of 5, compared to 2.1 under fair weather. Figure 1 shows individual participant fatigue scores reported during high heat conditions.

Higher scores reflect more significant levels of perceived fatigue, with 5 representing the most severe state of exhaustion.

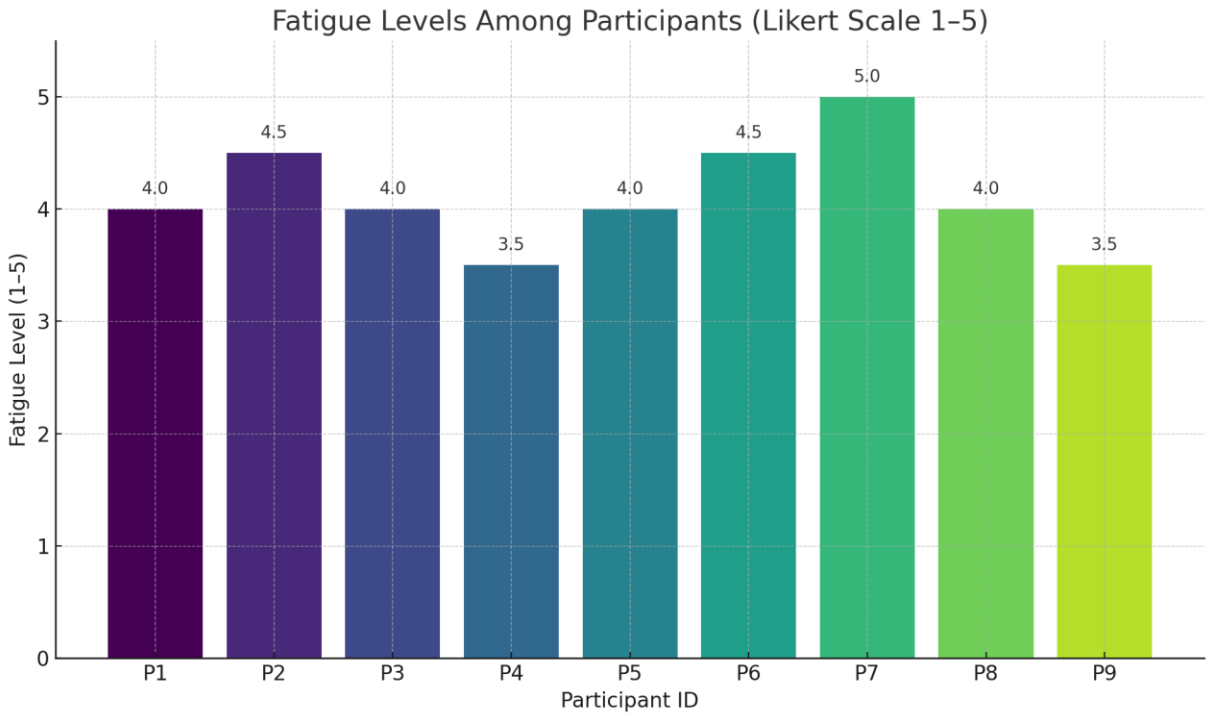

Figure 4. Fatigue Levels Among Participants (Likert Scale 1–5)

Open-ended responses reinforced the quantitative findings related to cognitive and emotional strain during high-heat conditions. Several participants described post-shift exhaustion, low motivation, and diminished capacity to complete basic household tasks. For example:

- "Very tired."
- "No energy to prepare a meal unless it is dinner for two people."
- "I feel absolutely wiped and I feel like I can't do anything for the rest of the day."

Additionally, responses highlighted increased irritability and a tendency toward social withdrawal. One participant reported, “The heat makes me more aggressive and short fused,” while another noted, “Not much energy to socialize once I get home. I’m more quiet and prefer to be alone.” These qualitative insights are consistent with the self-reported decline in energy and motivation under

extreme heat. **Figure 5** presents a side-by-side comparison of participant scores for fatigue, recovery time, and motivation under heat and fair-weather conditions, illustrating significant improvements across all three categories when environmental stressors were reduced.

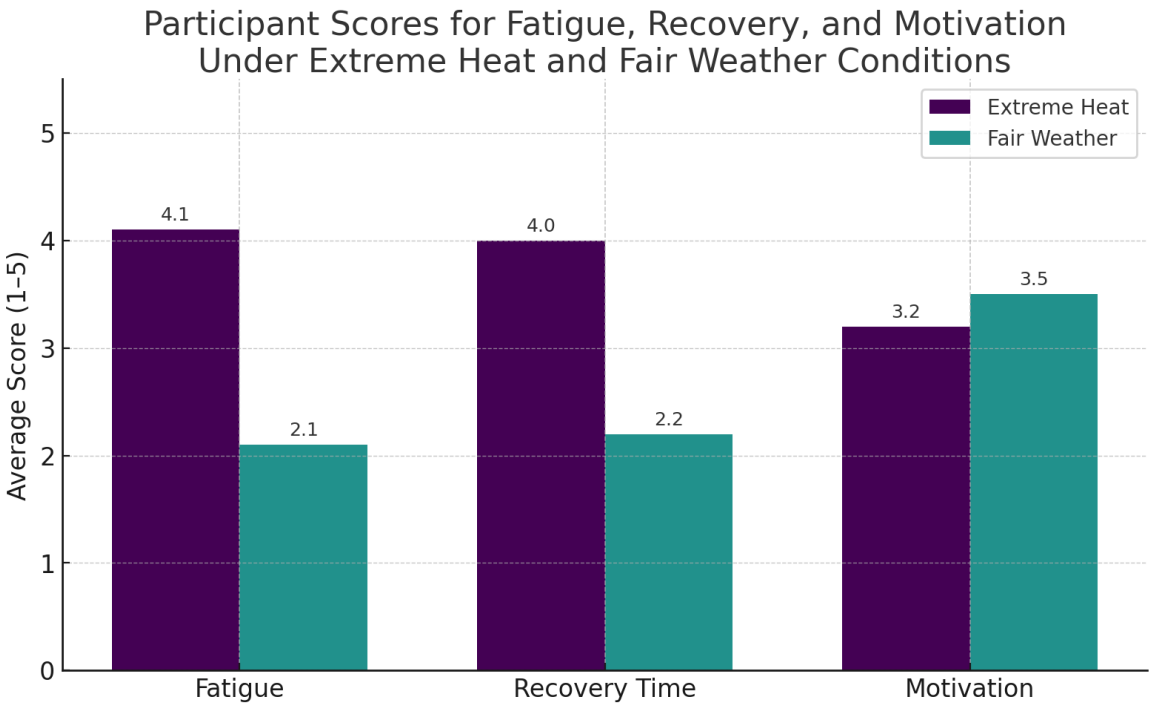

Figure 5. Comparison of participant well-being scores under heat and fair-weather conditions. Scores improved across all categories in cooler weather.

Under fair weather conditions, participants consistently reported enhanced energy levels and improved
capacity to engage in after-work activities. Motivation scores increased from an average of 3.2 to 3.5, while recovery time improved from 4.0 to 2.2. Fatigue levels showed the most dramatic shift, dropping from 4.1 to 2.1. These improvements were echoed in open-ended responses, with one participant noting they felt "more capable after work." The alignment between quantitative data and qualitative feedback reinforces the conclusion that extreme heat is a primary driver of emotional and physical depletion among construction workers.

3.2 Coping Strategies and Perceived Intervention Effectiveness

Participants reported engaging in passive recovery routines after working in extreme heat, with responses consistently referencing the need to physically and mentally decompress. These strategies were described as essential for managing exhaustion, emotional irritability, and social withdrawal. Although some reflections were captured in Survey 3, participants specifically framed their responses around coping behaviors used on particularly hot days.

Common coping methods included personal cooling, physical isolation, and avoidance of mentally taxing tasks. Participants described post-shift routines such as:

- "Chill in my pool."

- "Enjoying a cold shower and then relaxing on the couch."

These practices highlight reliance on solitary and low-effort activities to recover from heat-induced fatigue. Notably, no participants indicated these coping mechanisms were part of their routine during cooler weather, supporting the conclusion that such adaptations are heat specific. Moreover, there were no mentions of proactive or workplace-supported strategies, suggesting that workers often bear the burden of recovery independently and after hours.

3.3 Communication and Emotional Support

When surveyed on fair-weather conditions, participants recalled a noticeable improvement in their emotional engagement with others. The absence of intense heat reduced emotional fatigue, enabling workers to be more present and communicative in their personal relationships. Open-ended responses indicated that emotional availability, patience, and willingness to express internal states were enhanced under more comfortable environmental conditions.

One participant shared, *"I've developed ways to talk about how work affects me with the people I'm close to,"* suggesting that cooler conditions created the mental space necessary for emotional reflection and communication. Another remarked, *"My family or friends understand how the heat impacts me and give me space when needed,"* highlighting a relational dynamic rooted in mutual understanding and emotional support.

These narratives underscore environmental stress's role in shaping social and emotional interactions. Heat-exposed participants often described isolation, irritability, and withdrawal, but the fair-weather reflections revealed an increased capacity for interpersonal connection and constructive dialogue. Emotional support was not only more accessible but also more reciprocated in these conditions.

Improving communication quality — not just frequency — was a key theme. Participants described conversations at home as more thoughtful, calm, and emotionally balanced when not physically depleted by heat. These findings suggest extreme environmental conditions may suppress essential relational behaviors, while fair weather restores the cognitive and emotional bandwidth needed for meaningful connection.

3.4 Thematic Analysis of Participant Reflections

All open-ended survey responses were subjected to thematic coding to gain deeper insight into the psychological and behavioral impact of environmental conditions. This qualitative analysis aimed to identify recurring emotional constructs, coping behaviors, and interpersonal patterns based on participants' self-reported experiences. Using an inductive approach, four primary themes emerged from the dataset: Post-Work Fatigue, Irritability or Emotional Withdrawal, Recovery Routines, and Support and Communication.

The coding process was guided by consistent keyword identification. Responses containing descriptors such as *"tired," "drained," "no energy,"* or *"wiped"* were grouped under Post-Work Fatigue. Mentions of *"quiet," "short answers," "irritable,"* or *"aggressive"* were categorized as Irritability or Emotional Withdrawal. Behavioral coping strategies like *"shower," "nap," "relax,"* or *"pool"* were included under Recovery Routines, while reflections involving *"support," "space," "talk,"* or *"understand"* fell into the Support and Communication theme.

As shown in Figure 6, Recovery Routines accounted for the highest number of coded responses (10

quotes), followed by Post-Work Fatigue (7), Irritability or Emotional Withdrawal (6), and Support and Communication (3). These results suggest that workers focus on individual recovery strategies to manage extreme heat's mental and physical toll. Emotional withdrawal and exhaustion were also frequently cited, reinforcing earlier findings about post-work disengagement and cognitive fatigue.

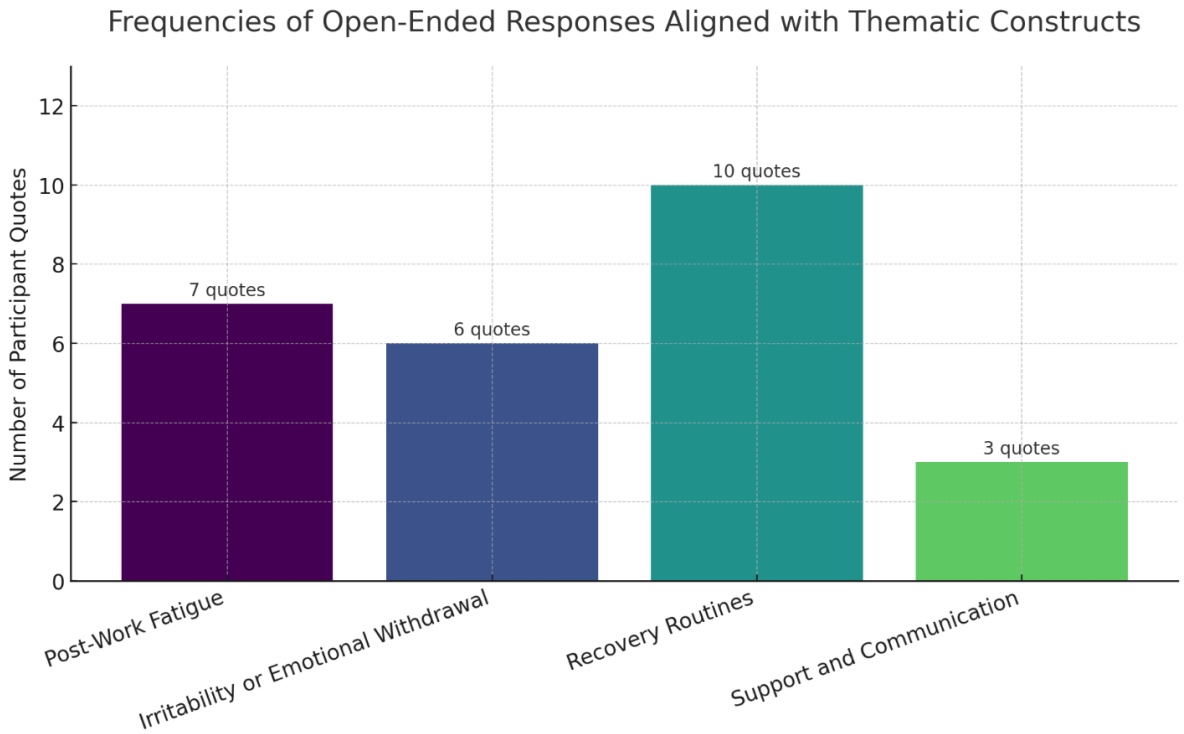

Figure 6. Distribution of Open-Ended Themes Reported by Participants

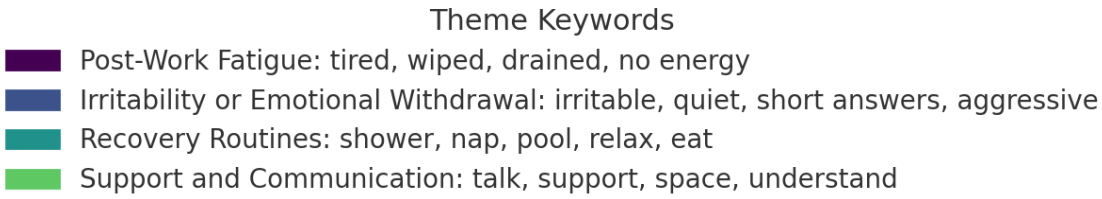

Figure 7. Color-Coded Keywords for Thematic Categories

Figure 7 provides a color-coded keyword legend that illustrates the coding logic used during analysis. This transparency ensures that thematic assignments are grounded in traceable linguistic markers, enhancing the validity and reproducibility of the qualitative coding process.

Together, these thematic categories reinforce the conclusion that heat-related stress manifests in predictable emotional and behavioral patterns. Moreover, the relatively lower frequency of quotes related to Support and Communication suggests that while interpersonal dialogue is valued, it may be less frequently initiated or articulated by participants, especially under physically taxing conditions.

3.5 Summary of Environmental Impact

The results across all survey phases strongly support the hypothesis that environmental temperature plays a central role in shaping construction workers' mental and emotional well-being. Participants reported markedly improved well-being under fair weather conditions, with quantitative and qualitative data indicating reductions in cognitive fatigue, emotional distress, and behavioral Withdrawal.

Comparative self-assessment scores revealed the following significant changes between heat-stressed and fair-weather conditions:

- **Fatigue** decreased from an average of **4.3** to **2.1**
- **Mood/Irritability** dropped from **4.1** to **2.0**
- **Social Withdrawal** decreased from **3.9** to **1.9**
- **Motivation** increased from **3.2** to **3.5**
- **Recovery Time** improved from **4.0** to **2.2**

These trends highlight the detrimental psychological toll of prolonged heat exposure and underscore the restorative impact of moderate environmental conditions. The consistency of improvement across all measured variables indicate that extreme heat is not just a contributing factor—but a primary determinant—of mental fatigue, Irritability, and disengagement among construction workers.

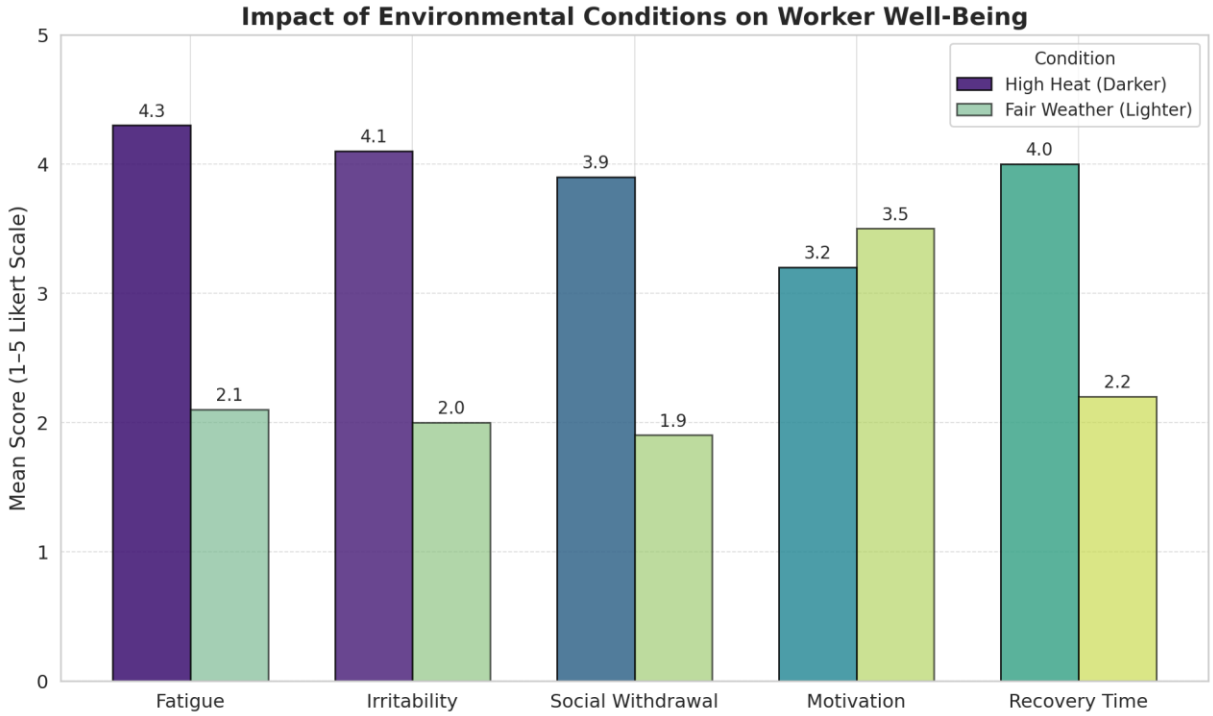

Figure 8. Illustrates that workers experienced less fatigue, better mood, and faster recovery in fair weather, confirming heat's negative impact on mental well-being.

Collectively, the data reinforces the need for adaptive workplace strategies that account for environmental stressors. Without appropriate interventions, elevated temperatures will continue to erode workers well-being, productivity, and overall quality of life on-site and at home.

4. Discussion

The data reveals a strong correlation between environmental temperature and multiple dimensions of
worker well-being. Participants consistently reported elevated fatigue, irritability, and emotional withdrawal during periods of extreme heat, paired with diminished motivation and prolonged recovery times. In contrast, fair weather conditions were associated with improved mood, quicker recovery, and greater capacity for interpersonal communication and emotional presence. These trends suggest that environmental heat is not merely a physical hazard but a potent contributor to psychological strain and diminished social functioning.

Thematic analysis further supports these conclusions. Under heat stress, participants described solitary, low-energy coping routines and a tendency to disengage emotionally both at work and at home. While these behaviors may be adaptive in the short term, they likely contribute to chronic stress and reduced relational satisfaction over time. Conversely, workers reflecting on fair-weather conditions emphasized emotional stability, improved communication, and a willingness to engage with others. These findings imply that psychological and social resilience are more accessible when physical discomfort is reduced.

The alignment between quantitative results and open-ended responses strengthens the validity of the
observed patterns. For instance, Likert scores for fatigue and irritability dropped by more than two full points under fair weather, while narrative responses indicated greater emotional availability and patience. The presence of both numerical and descriptive evidence across all three surveys reinforces the conclusion that temperature-related stress directly impacts mental health outcomes for construction workers.

Although this study relied on a relatively small sample, the consistency and richness of participant responses across multiple survey rounds enhance the credibility of the findings. Importantly, no participants reported structured or employer-led coping strategies, suggesting a significant gap in formal support systems and a potential avenue for future intervention. The absence of such strategies highlights the burden placed on individuals to self-manage environmental stress—often without sufficient tools or resources.

These results hold important implications for both occupational health policy and site-level management. Employers should consider heat as a risk factor for physical safety and emotional and relational stability. Simple interventions—such as shaded rest areas, staggered work schedules, and formal support for emotional recovery—may produce substantial gains in workforce resilience and overall productivity.

5. Conclusion

This study demonstrates that extreme heat has a measurable and multifaceted impact on construction workers' well-being, extending beyond physical fatigue to affect emotional regulation, social behavior, and recovery capacity. Self-reported data reveal that fair weather leads to significant improvements across all mental and behavioral indicators, while thematic analysis shows that workers under cooler conditions are more communicative, emotionally stable, and socially engaged.

These findings underscore the urgency of addressing environmental stress through preventive and

supportive workplace policies. As climate patterns continue to intensify, construction employers and industry leaders must adapt working conditions to prioritize holistic worker well-being. Future studies should expand the sample size and investigate the long-term consequences of sustained heat exposure, and the effectiveness of employer led interventions designed to mitigate its psychological effects.

Data Availability Statement

Data and codes that support this study are accessible from: https://github.com/TASDEMIR921/hot

Funding Statement

No

Competing Interest

None

AI assistance statement

Data analysis and visualization were conducted using standard Python packages, including pandas and matplotlib, with AI assistance from GPT-4o to refine statistical interpretations and generate structured code for automating survey response analysis. AI assistance was also utilized for text refinement, improving clarity and conciseness, restructuring paragraphs for logical coherence, and providing suggestions for semantic analysis of qualitative responses.

All AI-generated content was verified for accuracy and relevance to ensure alignment with the study's objectives. AI tools were used as a complementary aid, and all final interpretations, data handling, and methodological decisions were made independently by the researcher.

Ethical Standards

This research adheres to ethical guidelines ensuring participant privacy and data security. Institutional Review Board (IRB) approval was not sought, as this study remains an internal academic
project with no external publication or public dissemination. An email inquiry was sent to the IRB office regarding review requirements, but no response was received. Despite this, strict confidentiality measures have been upheld, including anonymized data collection, secure data storage, and compliance with ethical research practices.

Author Contributions

Conceptualization: C.J. Methodology: C.J. Data Collection: C.J. Data Curation: C.J. Data Visualization: C.J.
Writing Original Draft: C.J. Writing Review & Editing: C.J. Final Approval: C.J.

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