Oral Session 5

Project HeatSafe: Physiological Strain and Heat Health Risks of Parcel Delivery Workers in South Korea

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Introduction

Parcel delivery workers in South Korea are legally classified as independent contractors with unregulated working hours and no access to employment healthcare coverages [1]. As their delivery tasks involve outdoor physical labor, the workers are exposed to varying environmental conditions including heat stress, which can induce heat-related injuries. Despite the increasing number of fatalities and injuries among these workers [1], few studies have investigated their health risks related to heat exposure during work. We aimed to quantify physiological strain of these delivery workers and investigate their work environment and experiences at work.

Methods

A total of forty male delivery drivers (age: 46 ± 7 years; height: 171 ± 6 cm; body mass: 71.7 ± 11.87 kg; BMI: 24.4 ± 3.6 kg/m^2) from two logistics work sites in South Korea (site A and site B) participated in this study in September and October 2022. Wet-bulb globe temperatures (WBGT) at each site were measured throughout their work shifts. Workers' body core temperature (T_c; gastrointestinal temperature) and heart rate (HR) were continuously recorded, while body mass was measured at four time points: pre-shift, mid-shift, post-shift, and the following morning. Urine specific gravity (USG) was collected pre-shift and the following morning. Work environment and past experiences of heat-related symptoms were assessed through in-depth interviews.

Results and Discussion

The workers' daily activities included truck loading at warehouses and outdoor delivery. The workers worked 11.7 hours per day on average, ranging from 9 to 16 hours depending on individuals. Mean WBGT was below 20°C (Site A: 19.4 [16.5 – 23.5]; Site B: 15.2 [10.7 – 23.4]) throughout the work shifts at both work sites. Despite the low environmental heat stress conditions, 32.5% of the workers' peak T_c exceeded 38°C, the upper limit of the Threshold Limit Values (TLV) for heat stress from the American Conference of Governmental Industrial Hygienists (ACGIH) guidelines [2]. Workers' mean peak T_c was 37.9 ± 0.2°C and 37.9 ± 0.3°C at sites A and B respectively (Figure 1a). Workers' mean peak HR was 136 ±14 bpm and 139 ±13 bpm at sites A and B respectively. 47.5% of the workers exceeded 80% of their age-predicted maximum HR (220-age) during their shift, and the breakdown of the data for each site is shown in Figure 1b. When comparing the incidence of peak T_c and peak HR between activities (i.e., truck loading and outdoor delivery) at each site, peak T_c was recorded during outdoor delivery in 95% of workers, and peak HR was recorded during outdoor delivery in 80% of workers. For body mass change, 50% of the workers lost more than 1.5% of their body mass after their shifts, which is the TLV for heat stress from the ACGIH guidelines [2]. Body mass significantly decreased across four time points of shifts at both sites, implying that there might be effects of each activity and shifts on body mass change (Table 1). 15% and 17.5% of workers were hypohydrated (USG ≤ 1.025) at the pre-shift and the following morning, respectively.

Analysis of the in-depth interviews revealed that the most common heat-related symptoms experienced by workers were irritableness (82.5%) followed by fatigue (80%), loss of appetite (65%), dizziness (50%), muscle cramps (37.5%), and headache (37.5%). All forty workers responded that the heat affected their work when working under hot conditions, implying that it could impact work productivity. 65% of the workers responded that they would find it beneficial to have health monitoring (e.g., T_c, HR, hydration status) wearable devices, suggesting a potential avenue for implementing real-time monitoring systems to enhance worker safety and reduce the risk of injuries and accidents.

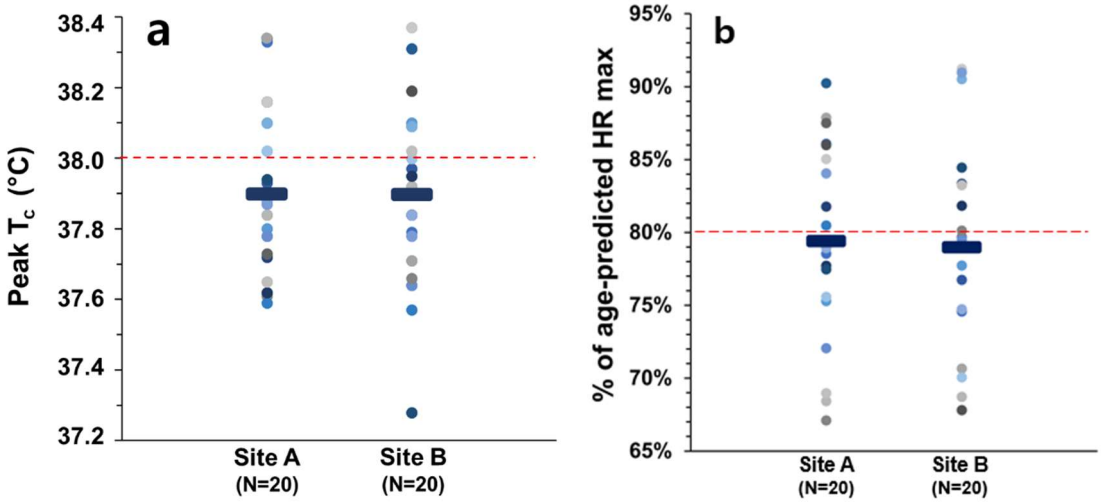

Figure 1. (a) Peak core temperature of each worker during shift and (b) percentage of peak heart rate (HR) to age-predicted HR max (220-age). The solid blue lines represent the mean value, while the circles represent individual data. Red dashed lines represent indicators for physiological strain.

Table 1. Mean and range of workers' body mass change over different time points (unit: kg). The column headers refer to the different measurement timepoints used to calculate body mass change (e.g., Mid-Pre refers to mid-shift body mass subtracted by pre-shift body mass). Pre: Pre-shift; Mid: Mid-shift; Post: Post-shift; Day 2: following morning.

	Mid-Pre	Post-Mid	Post-Pre	Day 2-Pre
Site A (N=20)	-0.63*** (-1.68 to 0.23)	-0.81*** (-2.28 to 0.65)	-1.38*** (-3.02 to 0.21)	-0.58** (-2.23 to 0.63)
Site B (N=20)	-0.33* (-1.18 to 0.52)	-0.70* (-2.14 to 2.05)	-1.03*** (-3.09 to 0.99)	-0.52*** (-1.92 to 0.11)

Repeated measures ANOVA with Tukey post-hoc test was conducted.
*P < 0.05, **P < 0.01, ***P < 0.001

Conclusions

Our profiling study revealed that delivery workers experience physiological strain despite the relatively low environmental heat stress during their shift. Workers also reported experiencing heat-related symptoms, suggesting a pressing need for interventions to manage heat-related health issues, given the unique challenges that delivery drivers face. Implementing technology-driven measures, such as cooling facilities or garments and health monitoring wearables, may promote workers' occupational safety and well-being.

References

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