Electronic Supplementary Material (ESI) for Lab on a Chip.

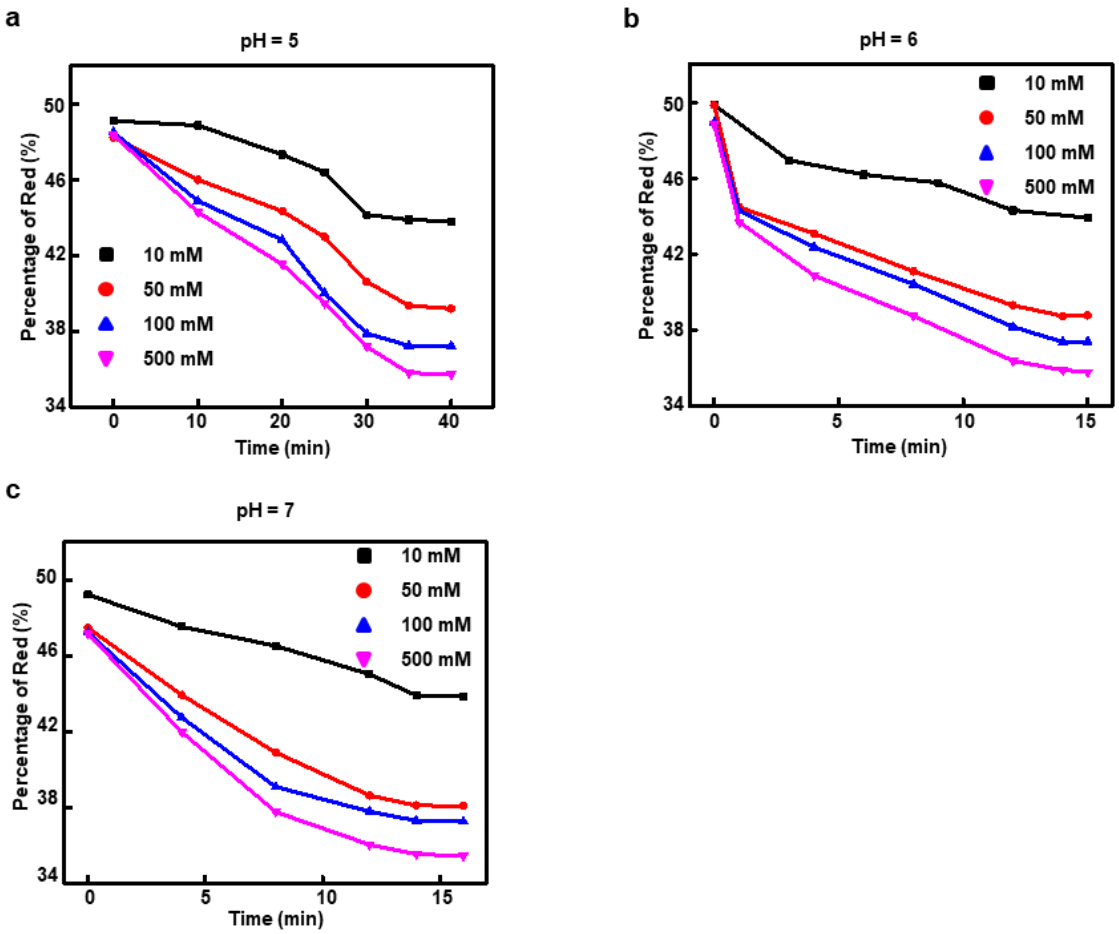

Figure S1. Urease-urea hydrolysis reaction dynamics at different pH conditions. (a-c) Color development and the corresponding normalized percentage of change in red levels with time at various sweat pH.

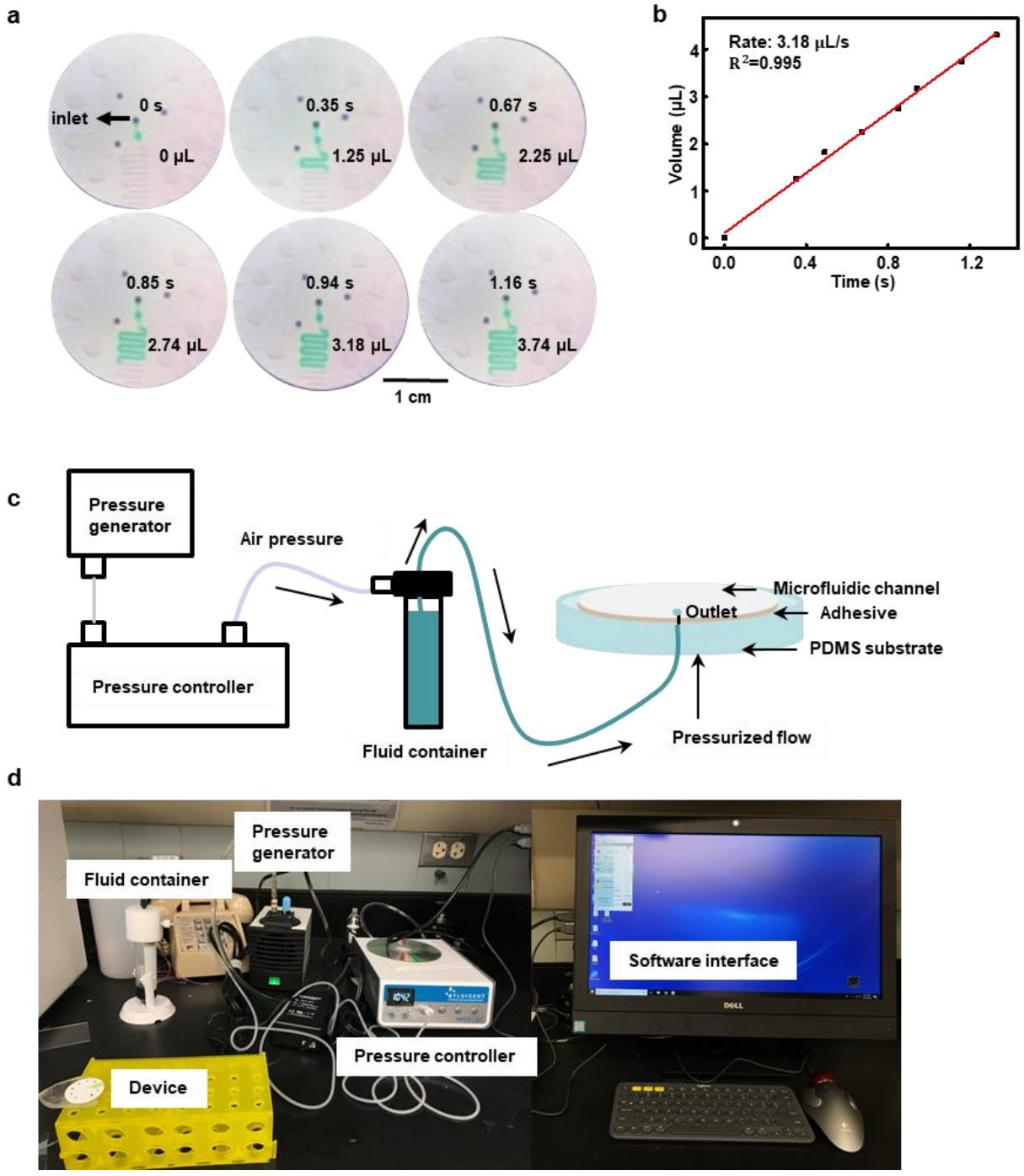

Figure S2. Demonstration of sweat rate measurements at inlet pressure of 2 kPa. (a) Optical images of devices during the measurements. (b) Calculated flow rate at a constant pressure of 2 kPa. (c) Schematic illustration of the setup for the demonstration of sweat rate under constant pressure. Experimental setup pressure: 2 kPa. (d) Optical image of the setup.

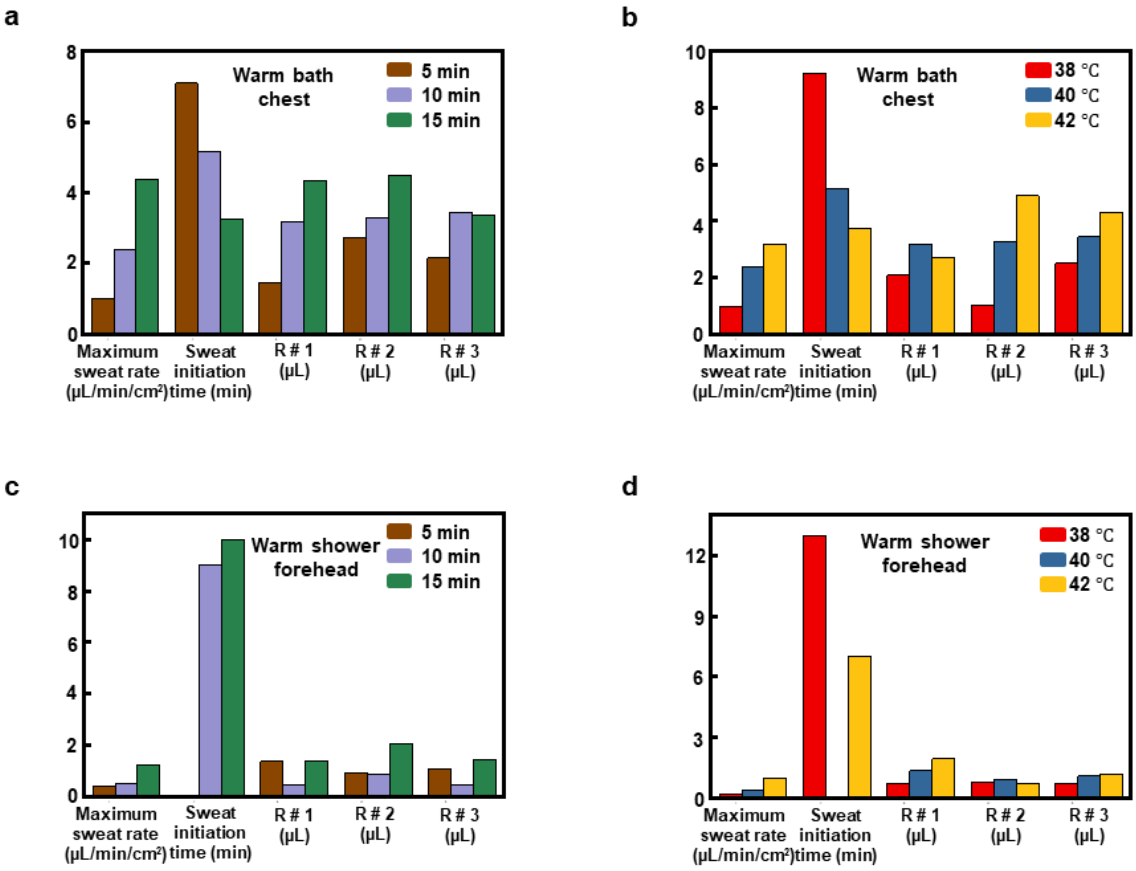

Figure S3. Sweat collection study for bathing with a device on the chest (top) and for showering with a device on the forehead (bottom). (a-d) Maximum sweat rate, sweat initiation time, and the collected sweat volumes in μ-reservoirs at various collection conditions including showering/bathing, duration, and water temperature.

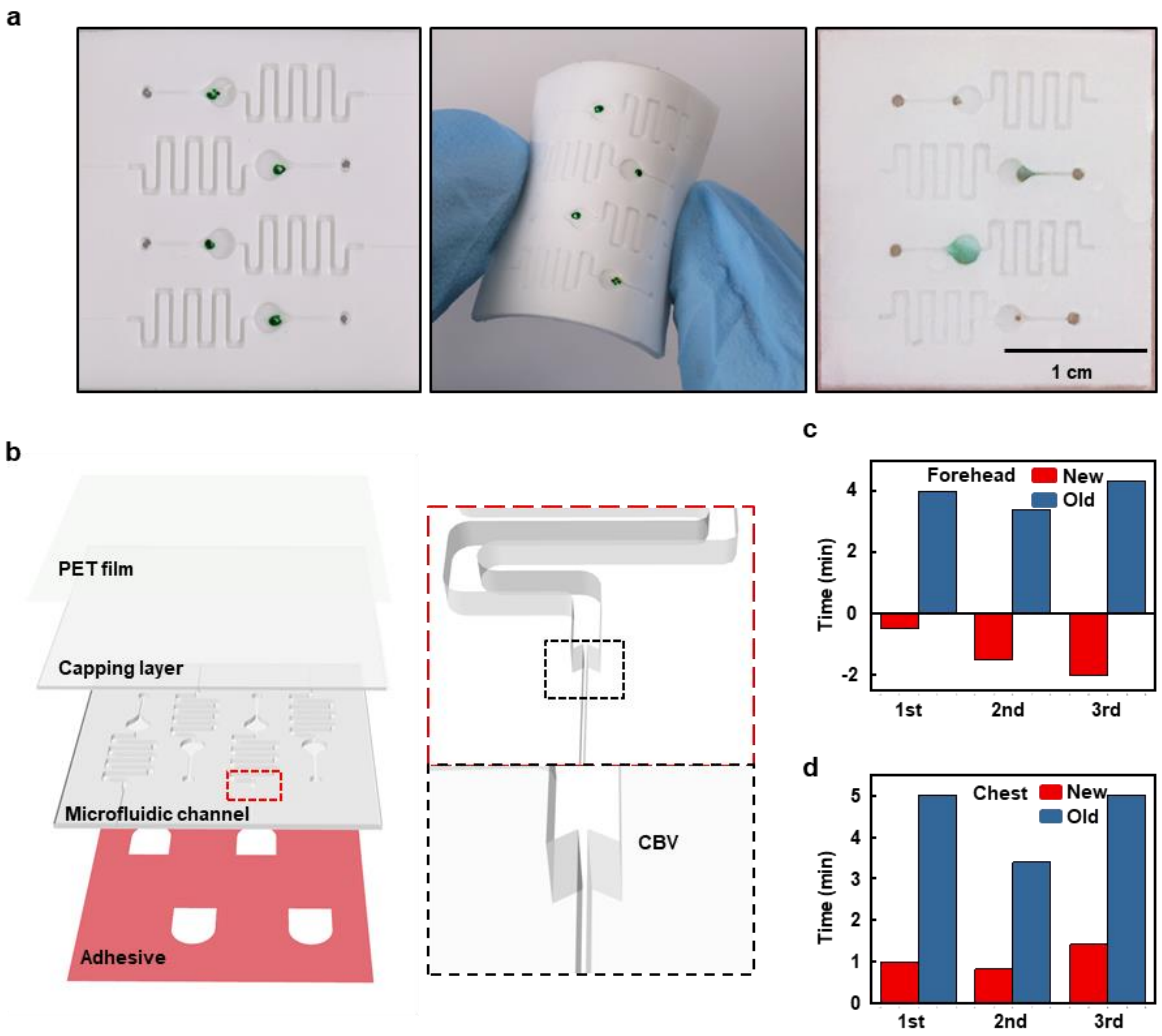

Figure S4. Alternative microfluidic design for sweat collection during showering/bathing. (a) Optical images of the device in a flat state before testing (left) during mechanical bending before testing (middle) and in a flat state after showering (warm water: 40℃, 10 min, on forehead). (b) Exploded view illustration of the device with a capillary burst valve (CBV) at the outlet to prohibit water from flowing into the system during showering or bathing. (c-d) Sweat initiation time on forehead (c) and on chest (d) where the end time for the shower is set to 0 min.

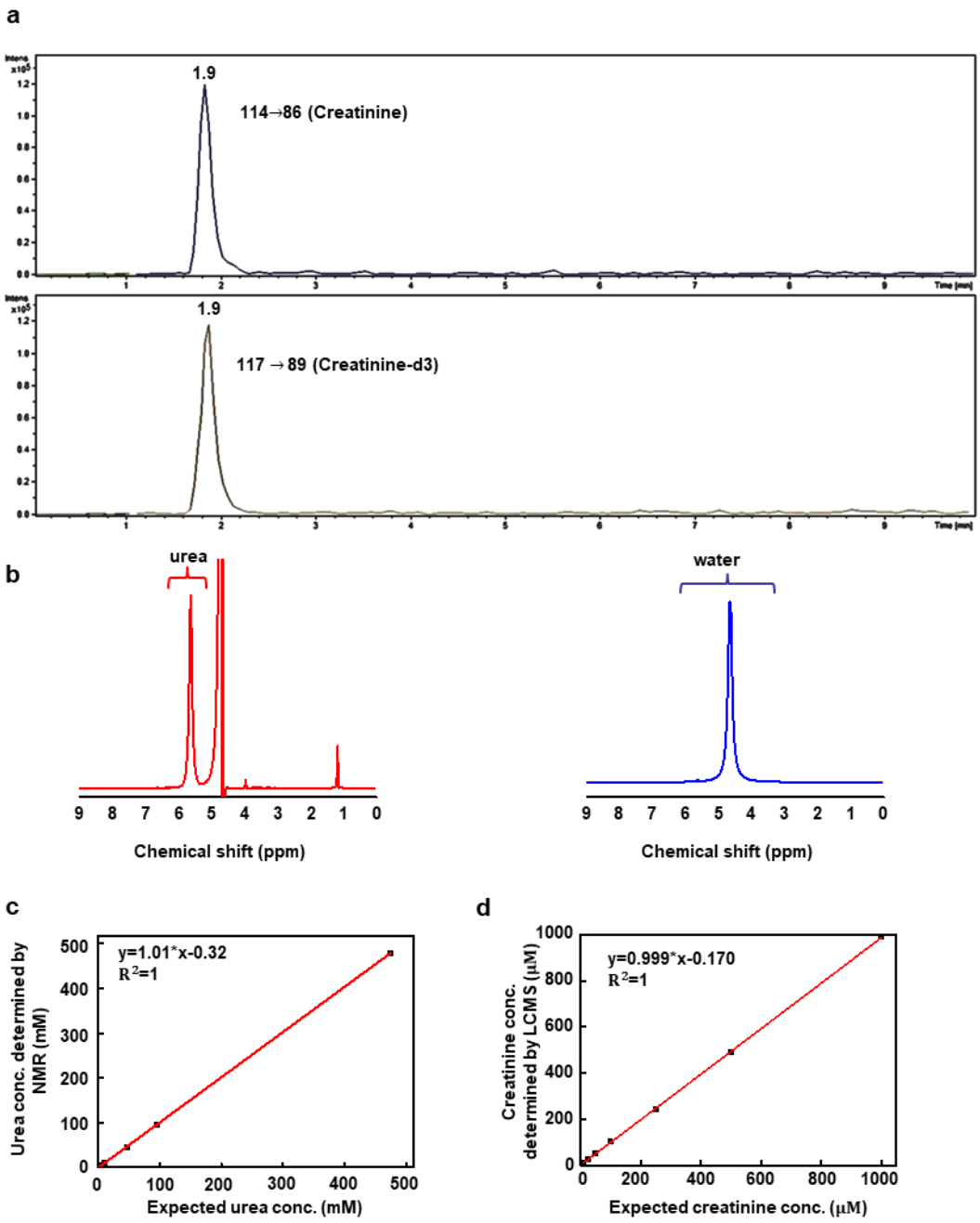

Figure S5. Traditional methods for urea and creatinine determination. (a) Extracted ion chromatogram of creatinine and its isotope, creatinine-d3, top: creatinine; bottom: creatinine-d3. (b) ^{1}H NMR spectrum of urea in human sweat, left: with water suppression; right: without water suppression. (c) Urea concentration determined by NMR in artificial sweat with various urea concentrations. (d) Creatinine concentration determined by LC-MS/MS with different concentrations.

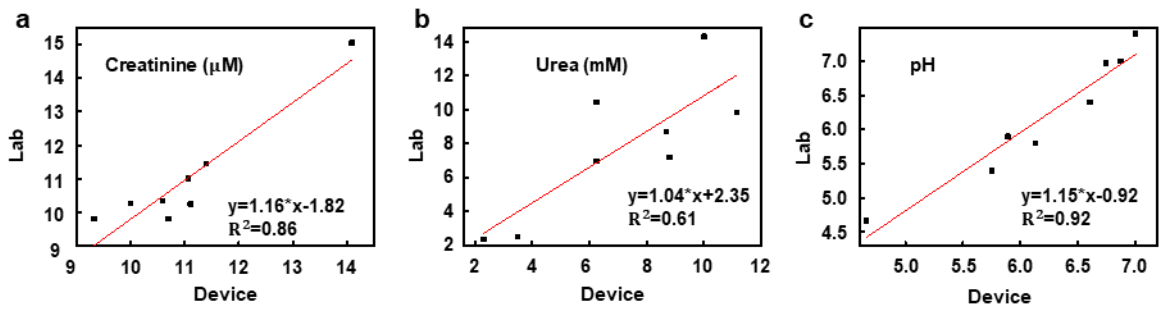

Figure S6. Statistical analysis of the concentration of biomarkers obtained from device and laboratory measurements. Linear fitting of biomarker concentration (a) creatinine, (b) urea, and (c) sweat pH measured by device and traditional methods in the same test.

Table S1. Statistical analysis of different sweat induction methods as shown in Figure 3c.

Two-tail pair test ($* P < 0.1$)	Urea	Creatinine	pH
Exercise/Shower 1	0.96	0.69	0.80
Exercise/Shower 2	0.84	0.99	0.74

Null hypothesis: $mean_{exercise}$-$mean_{shower}$=0, alternate hypothesis: $mean_{exercise}$-$mean_{shower}$<0 or $mean_{exercise}$-$mean_{shower}$>0. $P > 0.1$ indicates $mean_{exercise}$ is not significantly different from $mean_{shower}$.

Table S2. Statistical analysis of different shower/bath conditions as shown in Figure 3d-g

Two-tail pair test ($* P < 0.1$)		Maximum sweat rate	Sweat initiation time	R#1	R#2	R#3
Warm bath/forehead	5/10 min	0.050	0.327	0.095	0.126	0.209
	10/15 min	0.315	0.058	0.782	0.475	0.573
	38/40 ℃	0.048	0.220	0.035	0.034	0.145
	40/42 ℃	0.144	0.014	0.5	0.754	0.347
Warm shower/chest	5/10 min	0.087	0.5	0.789	0.755	0.789
	10/15 min	0.556	0.212	0.789	0.349	0.445
	38/40 ℃	0.181	0.296	0.162	0.090	0.036
	40/42 ℃	0.280	0.5	0.854	0.755	0.250

For Table S2, the hypothesis is different from that of equal variance hypothesis for other statistical analysis in this work, since the results are expected to have significant dependence on sweat induction conditions. For maximum sweat rate and R#1-3, null hypothesis: $mean_1$-$mean_2$>=0, alternate hypothesis: $mean_1$-$mean_2$<0. $P > 0.1$ indicates $mean_1$ is not significantly less than $mean_2$ while. $P < 0.1$ indicates $mean_1$ is significantly less than $mean_2$. For sweat initiation time, null hypothesis: $mean_1$-$mean_2$<=0, alternate hypothesis: $mean_1$-$mean_2$>0. $P > 0.1$ indicates $mean_1$ is not significantly greater than $mean_2$ while. $P < 0.1$ indicates $mean_1$ is significantly greater than $mean_2$. Note: Since the sample size is relatively small, it's hard to get 0.05 significance level. Therefore, the results are represented at 0.1 significance level.