

Supplementary Materials: *Effect of the COVID-19 pandemic on heatstroke-related ambulance dispatch in the 47 prefectures of Japan*

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Supplementary Figure 1

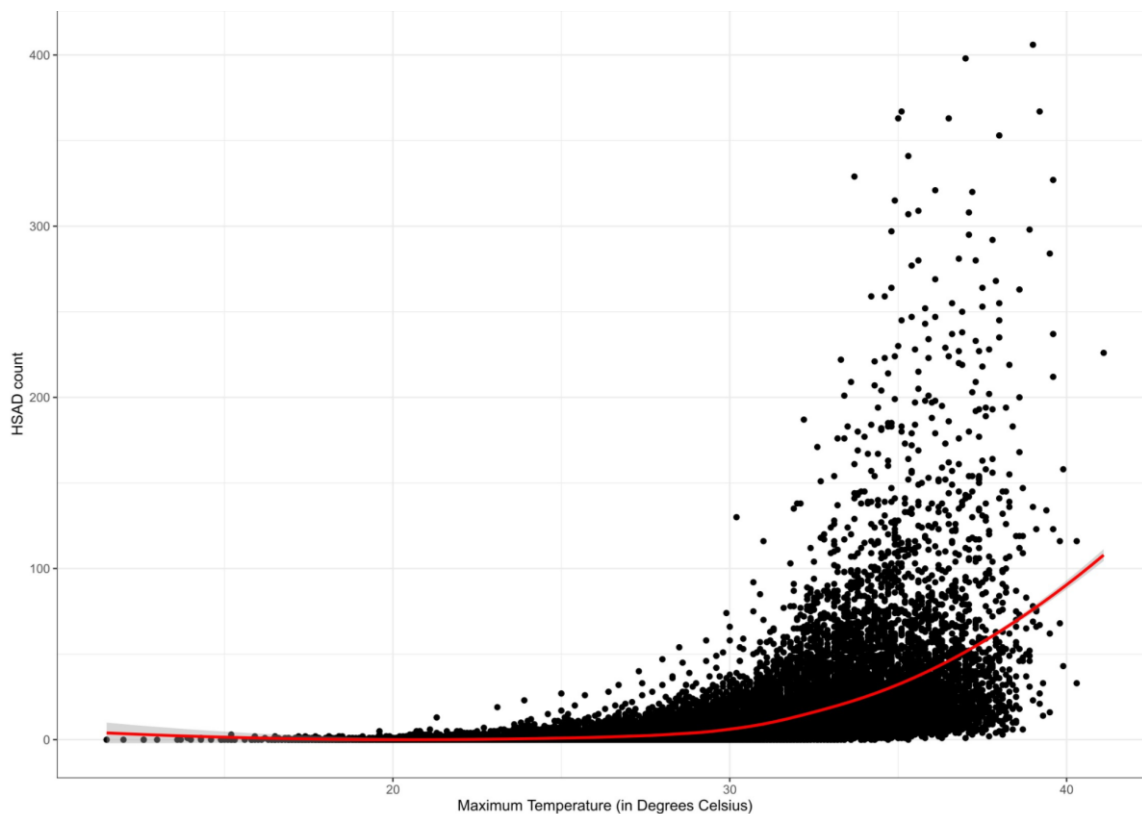


Figure S1. Simple linear regression (with loess fit; in red) of daily HSAD and maximum temperature

Daily HSAD data was fitted with daily maximum temperature with an apparent log-linear increase beyond the 80th temperature percentile, as depicted by the red solid line. Below the 80th temperature percentile, there was no apparent pattern, with nearly flatter fitted line.

Supplementary Figure 2

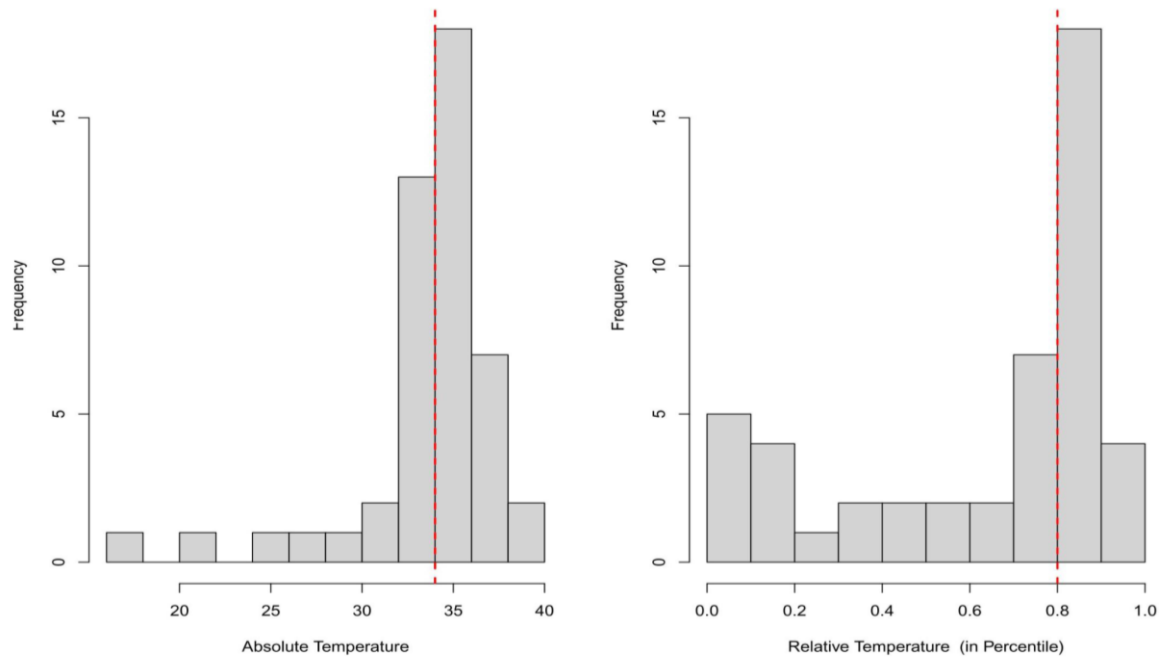


Figure S2. Absolute (left) and relative (right) temperature distribution of prefecture specific change point temperatures with respective median values (in vertical red dotted lines)

We first identified the prefecture-specific thresholds using the absolute temperature. After which, the absolute temperature thresholds were then transformed to relative temperature thresholds by locating the percentile location of the absolute temperature threshold in the prefecture-specific percentile distribution. We then plotted the distribution of the relative temperature thresholds across of the 47 prefectures. Owing to the skewed distribution, we utilized the median value as a threshold point; at 80th temperature percentile. We back calculated the absolute temperature threshold at the 80th temperature percentile per prefecture and proceeded with the prefecture-specific hockey stick model.

Supplementary Table 1

Table S1. Absolute and relative temperature (in percentile) estimated using segmented regression modeling

Prefecture	Absolute Temperature	Relative Temperature (percentile)
Hokkaido	25.49937515	0.863717671
Aomori	29.30000699	0.970491278
Iwate	17.20005141	0.877051469
Miyagi	33.10004441	0.890091218
Akita	32.5000052	0.843153283
Yamagata	36.48220178	0.78032788
Fukushima	20.79981204	0.863938731
Ibaraki	31.88936982	0.934426442
Tochigi	36.67876592	0.856906075
Gunma	36.60000896	0.888531694
Saitama	27.00020216	0.89205246
Chiba	34.70016828	0.121312276
Tokyo	35.09999639	0.799999513
Kanagawa	35.3994623	0.796722321
Niigata	32.89999986	0.521976092
Toyama	33.59001142	0.840908734
Ishikawa	33.49998045	0.767213413
Fukui	34.40432624	0.835301634
Yamanashi	37.40007273	0.815768973
Nagano	34.20606379	0.893305249
Gifu	39.00108607	0.859016258
Shizuoka	33.5994669	0.742621858
Aichi	36.7999329	0.875407941
Mie	33.40000694	0.957606189
Shiga	36.41828812	0.850097074
Kyoto	38.19986604	0.214788734
Osaka	34.86958007	0.0475398
Hyogo	32.99997708	0.136066277
Nara	34.50004213	0.049174448
Wakayama	31.98401028	0.597683718
Tottori	34.76247425	0.067178614
Shimane	34.22331681	0.079175636

Okayama	36.70000243	0.940984778
Hiroshima	35.29951745	0.436067575
Yamaguchi	35.30100106	0.198353206
Tokushima	34.00002118	0.696712235
Kagawa	35.35892346	0.426253702
Ehime	34.45761273	0.813726026
Kochi	33.93166729	0.667211239
Fukuoka	34.6132924	0.838131612
Saga	34.0999966	0.365516082
Nagasaki	33.14702573	0.805200545
Kumamoto	33.79999228	0.708195388
Oita	34.69999996	0.162295099
Miyazaki	32.60000141	0.795081413
Kagoshima	35.29997643	0.07374183
Okinawa	32.09999905	0.326230412

Table S1 depicts the prefecture-absolute temperature thresholds and their corresponding temperature percentile location. The relative temperature percentile values were plotted to locate the central measure of the distribution, which was at the 80th percentile. The corresponding plot is shown in Figure S2, right panel.

Supplementary Table 2

Table S2. Sensitivity analyses regarding the adjustment and non-adjustment of PM2.5

Model	Specifications	¹ Pooled Estimates	p-value
I	Period Coverage: 2016-2020 Prefectures: All 47 prefectures PM2.5: Not adjusted	0.78 (0.75 – 0.82)	1.00
II	Period Coverage: 2016-2018 and 2020 (excluding 2019) Prefectures: All 47 prefectures PM2.5: Not adjusted	0.70 (0.64 – 0.76)	0.55
III	Period Coverage: 2016-2018 and 2020 (excluding 2019) Prefectures: All 47 prefectures PM2.5: Adjusted	0.79 (0.74 – 0.85)	0.79

¹ The pooled estimates are estimated via random effects meta-analysis through a restrictive maximum likelihood (REML) parameterization.

We initially started with Model I with full period coverage without adjusting for PM2.5. Since at the moment, the harmonized and publicly available PM2.5 data for all prefectures is not yet available for 2019, we proceeded with the utilizing the pre-pandemic period (2016 to 2018) together with the advanced reported (non-harmonized) 2020 data; as shown in Models II and III. We observe that the adjustment of PM2.5 (Model III) was not significantly different from the non-adjustment in Model II. Utilizing these results, we assumed that the non-adjustment of PM2.5 in the full model with the 47 prefectures for 2016 to 2020 would not be significantly different even with adjustment evident in the calculated p-value.

Supplementary Table 3

Table S3. Summary statistics by prefecture, comparing pre COVID-19 (2016-2019) and COVID-19 (2020)

Prefecture	Pre-COVID-19 period (2016-2019)						COVID-19 period (2020)					
	HSAD		Maximum Temperature (°C)		Relative Humidity (%)		HSAD		Maximum Temperature (°C)		Relative Humidity (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Hokkaido	9.545081967	20.82699876	24.25819672	4.196250212	72.8852459	9.360844415	8.918033	12.76915	25.12295	3.935929	75.46721	7.971213
Aomori	3.206967213	6.096098377	25.58545082	3.92984858	78.07581967	8.443579468	3.508197	6.619837	26.21393	3.823618	79.55738	8.410982
Iwate	4.37704918	7.823597086	26.4557377	4.382376488	79.31557377	9.080000547	4.893443	6.771119	26.93689	3.93833	81.31148	9.264776
Miyagi	7.733606557	14.46438442	26.44651639	4.142996881	79.52459016	10.89502881	8.795082	14.65636	26.79918	4.282339	83.07377	9.690387
Akita	4.006147541	6.550229483	26.89651639	4.189559743	76.86680328	9.612442977	4.139344	6.018313	27.3623	3.628613	78.58197	9.532754
Yamagata	4.31147541	7.218880068	28.17889344	4.368106503	74.58811475	9.371218451	4.983607	6.917439	28.78443	4.236247	75.93443	10.07799
Fukushima	9.008196721	14.64234578	28.42745902	4.7467685	75.99590164	10.9488255	9.090164	12.85585	28.7623	4.691408	78.85246	10.49807
Ibaraki	12.37909836	19.18936579	28.04467213	4.042979096	80.09221311	8.329316673	12.95082	17.04435	28.17623	4.094161	82.15574	7.463432
Tochigi	7.653688525	12.69015313	28.76844262	4.219849939	78.85860656	9.99663638	7.565574	11.35744	28.89344	4.211902	82.36066	8.465843
Gunma	10.08606557	17.12799894	29.45881148	4.516831882	73.13114754	12.56258309	10.06557	13.38047	29.80164	4.533821	77.27869	11.79176
Saitama	30.79918033	47.78206686	29.97213115	4.645432497	74.08196721	11.96218557	33.01639	45.29809	30.08033	4.734446	80.0082	10.00371
Chiba	22.7807377	34.79595963	28.85245902	3.680376133	76.80327869	9.363426025	24.66393	34.08512	29.01885	3.770072	77.4918	7.999221
Tokyo	39.43237705	65.345799	29.07766393	4.101946885	80.0942623	10.56957626	47.85246	70.40106	29.37705	4.214434	82.52459	9.17976
Kanagawa	24.36065574	37.12420256	28.79754098	3.902107325	78.96311475	9.568228576	26.9918	39.30396	29.18607	3.945713	80.91803	8.229749
Niigata	10.24385246	14.82547211	27.94446721	4.010024672	76.90163934	8.68940192	9.696721	13.09463	28.38115	3.556145	79.14754	9.30269
Toyama	3.635245902	5.58103892	28.93831967	4.14977138	77.67418033	9.864918728	3.729508	5.489339	29.53525	4.065109	80.83607	9.722905
Ishikawa	4.903688525	7.15169648	28.98483607	3.899867788	71.53278689	9.139965201	5.344262	7.438753	29.35246	3.516577	73.28689	9.476792
Fukui	3.256147541	4.71769389	29.7647541	4.008833616	74.89139344	9.118796601	2.983607	3.863334	30.0959	3.79792	77.7377	9.481433
Yamanashi	3.608606557	5.889859007	30.82868852	4.129798152	68.31762295	10.59558705	3.827869	5.267541	30.90328	4.115239	76.58197	9.066185
Nagano	7.375	11.49451927	28.67991803	4.374643006	75.36885246	8.876705847	7.204918	9.035228	29.0377	4.152055	77.13934	9.387274
Gifu	10.56557377	17.70450479	30.95286885	3.951844625	69.20491803	11.91116228	9.491803	10.93652	31.19754	3.807571	71.39344	12.36601
Shizuoka	13.4897541	18.46089984	29.47786885	3.331900748	75.65778689	8.575052207	16.46721	26.21185	29.96148	3.326911	80.18033	8.329988
Aichi	33.99795082	52.7537964	30.80553279	3.886953659	69.70696721	11.63714723	33.61475	42.46018	31.11148	3.810559	74.7623	11.74597
Mie	9.446721311	15.34454499	29.33668033	3.639429695	69.65983607	10.64428902	10.09016	12.27037	29.51639	3.337846	71.07377	10.79345
Shiga	5.93647541	8.834205356	29.49139344	3.801956659	75.31147541	8.352925656	5.327869	7.207024	29.72459	3.634188	77.96721	8.541522
Kyoto	14.15778689	20.91936462	31.23893443	4.043551473	67.92213115	10.19069118	12.36885	15.20505	31.32213	4.034265	69.58197	11.42915
Osaka	38.71106557	54.2277928	31.03094262	3.745185209	69.70696721	9.738584779	39.90984	51.60947	31.1377	3.696108	71.01639	10.53054
Hyogo	26.05327869	35.05075858	29.82991803	3.366535151	71.95696721	10.04303842	24.90984	29.73631	29.84344	3.387214	73.54098	10.8202

Nara	7.805327869	11.13041102	30.6647541	3.910895057	74.30942623	9.668666622	6.909836	8.193935	31.07131	3.932162	74.31148	9.942049
Wakayama	5.493852459	6.631698745	30.30983607	3.345060653	73.1352459	9.145085839	5.434426	6.78597	30.37623	3.415958	74.36885	8.816027
Tottori	3.450819672	5.094753043	30.11086066	4.208252487	76.10655738	9.012705954	3.401639	3.531815	30.2459	4.100537	76.94262	9.503631
Shimane	3.540983607	4.942208172	29.13627049	4.003927233	79.10860656	8.421791897	3.360656	3.865648	29.14672	4.060212	79.47541	9.452109
Okayama	12.62909836	16.73932691	30.66598361	3.809044496	73.96106557	9.745030877	10.7377	11.82993	30.92705	3.942836	75.32787	10.49789
Hiroshima	14.19262295	18.39716373	30.22090164	3.696645575	66.37295082	10.33267211	12.38525	13.85488	30.12787	3.622594	66.38525	10.29117
Yamaguchi	5.989754098	8.068616003	30.74979508	3.941033537	77.70081967	9.63186017	5.008197	6.997633	30.34508	3.95577	79.29508	9.41222
Tokushima	3.774590164	4.981527461	29.92520492	3.477932775	76.76229508	10.38938273	4.090164	4.882088	30.19262	3.564614	77.12295	10.1057
Kagawa	5.135245902	6.973560183	30.59631148	3.768167045	72.37295082	10.21776475	5.393443	5.781929	30.91721	3.852501	73.18033	10.55174
Ehime	7.395491803	9.311258126	30.38278689	3.567384599	73.2397541	10.12396964	7.180328	7.639627	30.53197	3.405083	74.12295	8.991803
Kochi	4.282786885	5.811016835	30.21536885	3.064486496	78.67622951	9.7907097	3.877049	4.520985	30.15656	3.252335	80.54098	9.331496
Fukuoka	21.88319672	27.12940857	30.55245902	3.651614098	75.55737705	8.954183339	20.51639	24.33419	30.25574	3.516503	75.45902	8.90366
Saga	4.965163934	6.244242981	31.02192623	3.830161128	74.44467213	10.68366368	4.245902	5.371045	30.6123	3.486185	76.9918	10.67591
Nagasaki	7.18442623	8.888702845	29.83258197	3.333660063	80.43237705	9.744557628	6.467213	8.356899	29.22541	2.845514	83.66393	8.68228
Kumamoto	11.6454918	13.77523222	31.16659836	3.762051287	75.41803279	10.85187947	10.7459	11.98729	30.9582	3.535063	77.61475	10.22187
Oita	6.399590164	7.576181188	29.86331967	3.791542902	77.59221311	10.50919715	6.032787	6.701344	29.91639	3.494301	78.64754	9.384286
Miyazaki	6.375	7.746016397	29.77479508	3.135869181	82.63319672	8.21319395	6.040984	7.474914	30.15492	3.471992	82.06557	7.256502
Kagoshima	11.2192623	11.45543449	31.0522541	3.077886125	78.28893443	8.023868429	10.89344	12.93519	30.58934	3.343399	80.17213	7.57518
Okinawa	7.776639344	6.262343653	31.32971311	1.912113745	79.99180328	6.969273604	6.590164	5.29268	31.37951	1.703663	83.53279	5.027502

* SD=standard deviation; degrees Celsius (°C); percentage (%)

Table S3 shows the prefecture-specific summary statistics HSAD, maximum temperature and relative humidity in Pre-COVID-19 and COVID-19 period. Specifically, central measure (mean) is shown alongside the spread (standard deviation) for each combination of prefecture and variable of interest.