



Meteorological Influence on Atrial Fibrillation, A Nationwide Observational Study



**Andrew Geunwon Kim¹, Nithi Tokavanich², Rand Sabanci¹,
Rebecca Freel², Victoria Hayes², Ranjan Thakur²**

¹ Internal Medicine, Sparrow Hospital, Michigan State University, East Lansing, USA

² Cardiac Electrophysiology, Sparrow Hospital, Michigan State University, East Lansing, USA

Korean Heart Rhythm Society

COI Disclosure

*Name of First Author:
Andrew Geunwon Kim*

The authors have no financial conflicts of interest
to disclose concerning the presentation



Disclosure

Relationships with commercial interests:

- Grants/Research Support: None
- Consulting Fees: None
- Other: None



Introduction



Introduction

- Atrial fibrillation
- Weather



Conflicting studies

- Temperature - Low²⁻¹¹ vs High¹⁶⁻²⁰ vs No effect²¹



Conflicting studies

- Temperature - Low²⁻¹¹ vs High¹⁶⁻²⁰ vs No effect²¹
 - Not high temperature - Heat shock protein^{13,14}
 - Confounding bias - Alcohol²⁰



Conflicting studies

- Temperature - Low²⁻¹¹ vs High¹⁶⁻²⁰ vs No effect²¹
 - Low temperature, Heat shock protein^{13,14}, Alcohol²⁰
- Humidity, precipitation - Low²⁰ vs High⁹ vs No effect^{11,22}

Poland

Vietnam



Conflicting studies

- Temperature - Low²⁻¹¹ vs High¹⁶⁻²⁰ vs No effect²¹
 - Low temperature, Heat shock protein^{13,14}, Alcohol²⁰
- Humidity, precipitation - Low²⁰ vs High⁹ vs No effect^{11,22}
- Wind speed - Low²⁴ vs High^{23,24} vs No effect



Conflicting studies

- Temperature - Low²⁻¹¹ vs High¹⁶⁻²⁰ vs No effect²¹
 - Low temperature, Heat shock protein^{13,14}, Alcohol²⁰
- Humidity, precipitation - Low²⁰ vs High⁹ vs No effect^{11,22}
- Wind speed - Low²⁴ vs High^{23,24} vs No effect
- O₃, CO, NO₂, SO₂ - Yes²⁵⁻²⁷ vs No²⁹
- PM_{2.5}, PM₁₀ - Yes²⁸⁻³⁰ vs No³¹



Methods



National health insurance data

- Healthcare Bigdata Hub
opendata.hira.or.kr



National climate data

- Korea Meteorological Administration
kma.go.kr



- Heat index, wind-chill index, apparent temperature



National air pollution data

- Korean Statistical Information Service
kosis.kr



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1		Total	Male	M 0-4yo	M 5-9yo	M 10-14yo	M 15-19yo	M 20-24yo	M 25-29yo	M 30-34yo	M 35-39yo	M 40-44yo	M 45-49yo	M 50-54yo	M 55-59yo	M 60-64yo	M 65-69yo	M 70-74yo	M 75-79yo	M 80yo-	Female	F 0-4yo
2	Jan-10	23666	14050	3	2	4	19	26	69	105	236	391	825	1383	1636	1992	2457	2400	1438	1070	9616	4
3	Feb-10	22843	13475	2	0	5	13	29	51	73	241	399	731	1341	1616	1915	2309	2336	1361	1059	9368	2
4	Mar-10	26816	15808	4	3	2	10	36	67	93	271	463	869	1572	1844	2242	2750	2717	1663	1213	11008	3
5	Apr-10	25669	15260	2	0	1	17	30	67	118	255	449	899	1482	1835	2112	2593	2572	1650	1184	10409	3
6	May-10	24909	14730	1	0	0	24	29	66	95	264	395	836	1386	1709	2005	2536	2560	1649	1183	10179	2
7	Jun-10	25770	15369	0	0	4	13	28	67	97	258	440	868	1493	1843	2136	2650	2579	1714	1186	10401	0
8	Jul-10	26366	15731	1	1	4	17	28	56	107	264	445	830	1533	1904	2220	2708	2683	1722	1217	10635	1
9	Aug-10	25961	15321	1	1	3	18	35	56	97	267	398	831	1458	1784	2151	2703	2624	1709	1194	10640	2
10	Sep-10	25310	15013	3	0	3	10	41	59	82	251	429	795	1539	1731	2087	2561	2569	1659	1202	10297	2
11	Oct-10	25546	15146	4	0	1	13	36	60	93	245	415	809	1526	1797	2141	2580	2560	1705	1164	10400	3
12	Nov-10	26626	15890	1	2	1	25	34	55	115	261	424	863	1563	1901	2246	2686	2653	1820	1248	10736	4
13	Dec-10	27029	16114	0	1	3	13	41	61	118	268	463	884	1618	1944	2262	2643	2728	1840	1233	10915	0
14	Jan-11	26219	15656	1	0	2	22	39	64	111	244	444	848	1571	1928	2234	2602	2647	1720	1192	10563	1
15	Feb-11	23571	13964	0	1	4	13	31	45	108	221	381	742	1369	1738	1976	2302	2362	1582	1093	9607	0
16	Mar-11	28536	16888	3	1	3	10	31	47	133	279	483	855	1665	2059	2410	2737	2878	1997	1304	11648	4
17	Apr-11	26874	16075	2	1	1	9	25	52	108	265	431	862	1612	2001	2252	2588	2763	1897	1213	10799	1
18	May-11	28003	16542	4	1	2	23	25	48	117	256	446	886	1631	2017	2318	2627	2866	1936	1343	11461	1
19	Jun-11	28192	16716	2	3	2	17	24	55	126	254	452	814	1636	2027	2381	2712	2905	2030	1284	11476	1
20	Jul-11	28208	16716	3	1	4	11	24	56	117	261	470	849	1640	2128	2341	2661	2848	1985	1323	11492	1
21	Aug-11	29861	17673	4	0	10	23	24	63	124	247	466	893	1723	2181	2473	2878	3079	2069	1432	12188	1
22	Sep-11	29864	17613	2	0	1	19	27	61	107	260	485	812	1657	2254	2521	2883	3050	2091	1390	12251	0
23	Oct-11	31844	18818	1	1	0	14	28	55	116	263	483	907	1856	2371	2674	3072	3274	2249	1459	13026	1
24	Nov-11	32898	19467	3	0	1	15	27	72	122	286	551	1009	1882	2413	2737	3100	3366	2367	1528	13431	0
25	Dec-11	34534	20372	3	1	2	15	26	59	108	286	534	1005	1899	2559	2871	3300	3604	2483	1637	14162	0
26	Jan-12	34160	20168	4	0	7	22	27	67	126	296	558	997	1867	2595	2903	3180	3428	2461	1655	13992	1
27	Feb-12	35377	20913	4	1	2	19	31	66	134	302	550	1001	1976	2633	2980	3415	3626	2537	1662	14464	0
28	Mar-12	36090	21430	5	1	2	11	27	55	108	294	589	995	1998	2692	3059	3395	3721	2672	1833	14660	2
29	Apr-12	36105	21390	4	1	1	13	19	66	119	305	592	1008	1940	2649	3016	3390	3774	2696	1814	14715	3
30	May-12	36875	21764	2	0	3	5	26	62	135	256	568	1060	1948	2732	3119	3402	3833	2755	1884	15111	2
31	Jun-12	36488	21698	3	0	6	10	27	62	108	272	572	1021	1976	2662	3067	3421	3823	2858	1834	14790	2
32	Jul-12	37704	22416	2	2	1	19	26	70	155	290	604	1040	2107	2790	3162	3461	3978	2867	1862	15288	2
33	Aug-12	36981	21907	0	1	3	15	24	65	149	282	584	1019	2037	2730	3049	3395	3882	2797	1900	15074	3



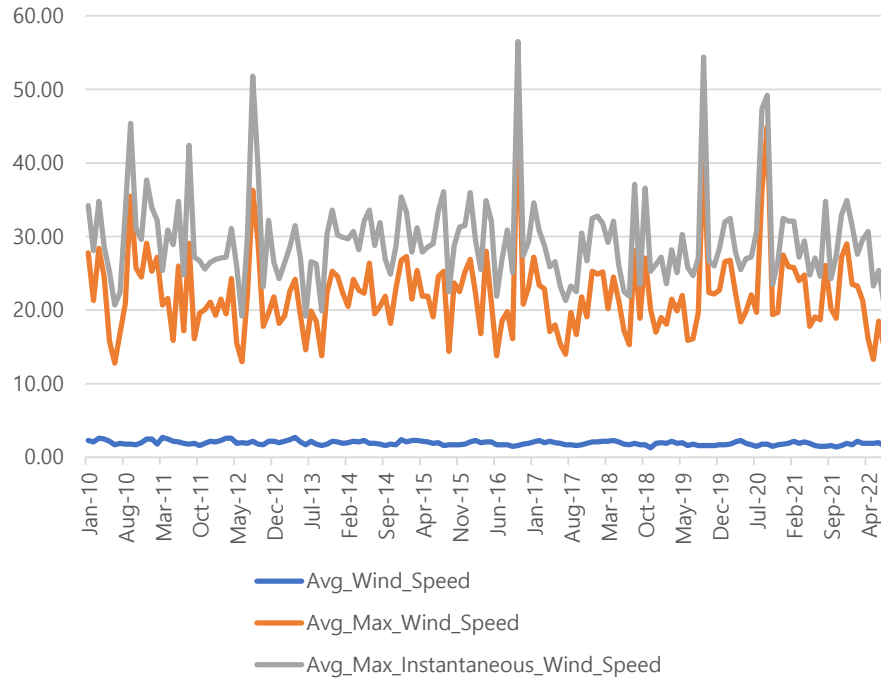
	temperature	max. temper	min. temper	temperature	precipitation	daily max. pr	hourly max. g	humidity (%)	min. humidit	wind speed (max. wind sp	max. instant	sunshine hou	solar energy	wind chill ind	heat index	max. heat ind	min. heat ind	atmospheric p
Jan-10	1.70	3.60	-6.60	10.20	31.20	61.10	22.00	62.00	6.00	2.30	27.80	34.20	179.50	270.53	1.96	-2.00	4.00	-7.00	1024.60
Feb-10	2.30	7.20	-2.00	9.20	83.50	157.50	36.00	65.00	6.00	2.10	21.30	28.10	138.20	278.72	2.77	2.00	6.00	-2.00	1021.10
Mar-10	5.50	9.90	1.10	8.80	91.90	183.90	38.00	65.00	10.00	2.60	28.40	34.80	125.30	350.78	5.83	4.00	9.00	1.00	1020.10
Apr-10	9.90	15.50	4.50	11.00	90.40	204.20	14.00	59.00	6.00	2.50	24.50	28.60	178.10	490.10	10.65	8.00	15.00	3.00	1017.80
May-10	17.10	23.00	11.50	11.50	126.60	251.90	24.50	65.00	9.00	2.20	15.80	25.20	205.70	588.17	18.54	17.00	23.00	10.00	1010.70
Jun-10	22.30	28.00	17.40	10.60	60.10	223.50	47.20	69.00	9.00	1.70	12.80	20.70	204.00	599.53	24.23	22.00	31.00	17.00	1009.30
Jul-10	25.40	29.60	22.20	7.40	258.00	580.60	93.00	79.00	16.00	1.90	16.90	22.40	131.30	486.88	27.47	26.00	36.00	23.00	1007.30
Aug-10	26.90	31.10	23.80	7.30	375.30	726.50	68.40	81.00	17.00	1.80	20.90	33.40	140.90	444.80	29.06	30.00	42.00	24.00	1010.00
Sep-10	21.80	26.90	18.00	8.90	268.30	671.50	96.00	77.00	14.00	1.80	35.50	45.40	159.30	418.03	23.67	22.00	29.00	18.00	1013.20
Oct-10	14.50	20.50	9.60	10.90	37.60	86.50	16.50	71.00	1.00	1.70	25.70	31.10	183.00	386.15	16.01	14.00	20.00	8.00	1019.00
Nov-10	7.10	13.60	1.30	12.30	12.80	31.20	15.60	59.00	1.00	2.00	24.50	29.60	202.50	306.96	7.97	5.00	13.00	1.00	1021.20
Dec-10	0.90	6.30	-4.10	10.40	28.80	57.10	14.00	61.00	7.00	2.50	29.10	37.70	170.60	242.23	0.93	1.00	5.00	-4.00	1018.00
Jan-11	-4.80	0.50	-9.80	10.30	5.00	27.10	10.50	54.00	4.00	2.50	25.30	33.90	214.60	317.86	-5.23	-5.00	1.00	-10.00	1027.30
Feb-11	1.90	7.90	-3.30	11.20	63.40	154.30	28.00	63.00	2.00	1.80	27.20	32.20	165.60	310.16	2.64	2.00	6.00	-3.00	1022.10
Mar-11	4.60	10.50	-0.80	11.30	23.80	56.00	27.50	51.00	6.00	2.70	20.70	25.40	248.30	530.79	4.79	2.00	9.00	-1.00	1021.40
Apr-11	11.20	17.40	5.20	12.20	115.30	196.50	35.00	58.00	4.00	2.50	21.60	30.90	213.20	532.33	12.06	10.00	17.00	3.00	1014.10
May-11	17.20	22.80	12.10	10.70	130.60	249.60	36.00	66.00	7.00	2.20	15.90	28.90	177.10	543.59	18.65	17.00	23.00	11.00	1010.70
Jun-11	21.90	27.10	17.60	9.50	285.30	498.20	54.00	72.00	11.00	2.10	26.00	34.80	173.90	540.10	23.71	22.00	29.00	17.00	1006.50
Jul-11	25.10	28.90	22.10	6.80	498.10	1131.00	76.50	82.00	23.00	1.90	17.20	24.80	114.20	428.27	27.15	26.00	36.00	23.00	1005.70
Aug-11	25.20	29.20	22.20	7.00	284.80	660.50	70.50	81.00	25.00	1.80	29.10	42.40	109.50	411.97	27.27	26.00	36.00	23.00	1008.30
Sep-11	21.10	26.40	16.80	9.60	77.30	320.90	55.00	72.00	11.00	1.90	16.10	27.20	180.00	453.39	22.90	21.00	28.00	16.00	1012.80
Oct-11	13.80	20.20	8.50	11.70	54.80	149.80	16.00	68.00	5.00	1.60	19.60	26.70	201.50	391.51	15.34	13.00	20.00	7.00	1020.30
Nov-11	11.00	15.90	6.80	9.10	103.60	230.60	44.50	69.00	8.00	1.90	20.10	25.60	128.40	226.39	12.19	10.00	15.00	5.00	1022.70
Dec-11	0.70	5.50	-3.60	9.10	16.00	105.00	11.50	58.00	5.00	2.20	21.10	26.50	172.60	242.19	0.97	1.00	4.00	-4.00	1027.60
Jan-12	-1.20	3.80	-5.70	9.50	16.70	74.20	15.50	57.00	3.00	2.10	19.30	26.90	176.90	270.33	-0.96	-1.00	4.00	-6.00	1026.10
Feb-12	-0.80	4.70	-5.70	10.40	9.50	48.70	9.00	53.00	5.00	2.30	21.50	27.10	185.60	345.41	-0.73	-1.00	3.00	-6.00	1024.00
Mar-12	5.70	10.70	1.00	9.70	87.60	201.10	34.00	60.00	1.00	2.60	19.50	27.20	179.80	414.87	6.05	4.00	9.00	1.00	1019.50
Apr-12	12.60	18.80	6.70	12.10	132.30	314.90	29.00	59.00	1.00	2.60	24.30	31.10	215.70	523.63	13.52	11.00	18.00	5.00	1013.00
May-12	18.30	24.50	13.00	11.50	38.10	77.40	18.00	62.00	4.00	1.90	15.50	25.90	232.50	621.57	19.93	18.00	25.00	12.00	1011.00
Jun-12	22.10	27.30	18.00	9.30	76.20	116.40	31.50	70.00	17.00	2.00	13.00	19.20	185.20	560.31	23.94	22.00	29.00	18.00	1007.00
Jul-12	25.50	29.70	22.00	7.70	298.80	572.30	80.50	80.00	24.00	1.90	22.10	30.00	164.00	487.26	27.57	27.00	37.00	22.00	1005.60
Aug-12	26.40	30.70	23.10	7.60	405.20	710.10	63.90	78.00	24.00	2.20	36.30	51.80	155.90	435.67	28.50	28.00	39.00	24.00	1008.20
Sep-12	20.20	25.20	16.20	9.00	250.10	478.60	59.00	78.00	20.00	1.80	29.30	39.40	180.60	408.24	21.98	20.00	26.00	16.00	1013.50



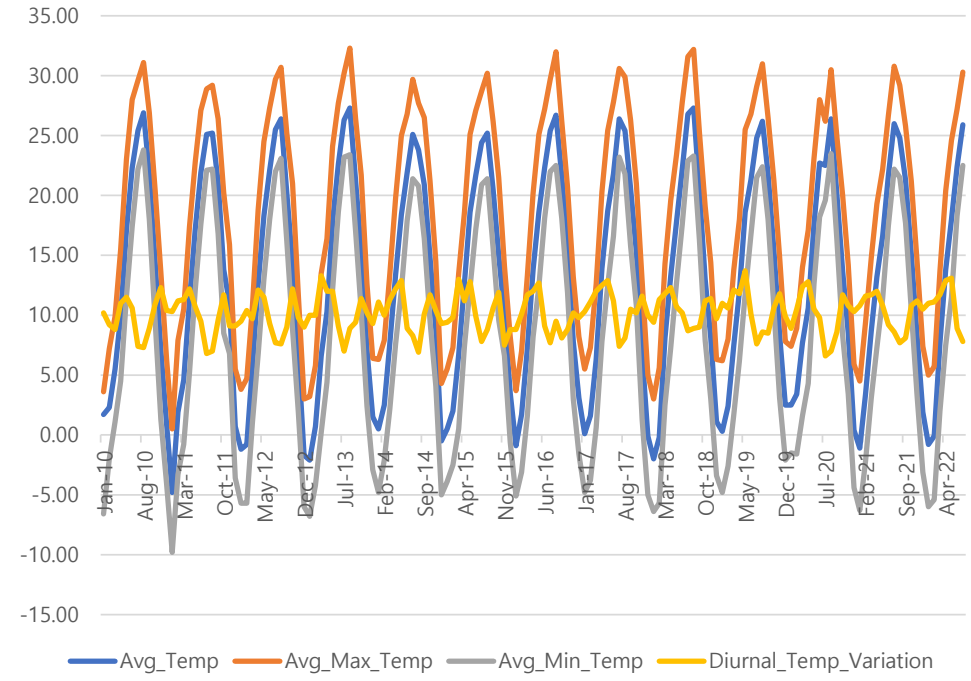
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1		SO2 (ppm)	O3 (ppm)	NO2 (ppm)	CO (ppm)	PM2.5 (µg/m³)	PM10 (µg/m³)	Pb (µg/m³)	Cd (µg/m³)	Cr (µg/m³)	Cu (µg/m³)	Mn (µg/m³)	Fe (µg/m³)	Ni (µg/m³)	As (µg/m³)	Be (µg/m³)	Al (µg/m³)	Ca (µg/m³)	Mg (µg/m³)
124	Mar-20	0.003	0.033	0.017	0.4	21	40	0.01833016	0.00080794	0.00310794	0.01551746	0.0280746	0.69326667	0.00245873	0.00408254	0	0.34473492	0.65958889	0.2208381
125	Apr-20	0.003	0.042	0.014	0.4	18	41	0.01821587	0.00071429	0.00366825	0.01390952	0.03486032	0.77832381	0.00274444	0.0063619	0	0.45565397	0.83429524	0.26099683
126	May-20	0.003	0.041	0.012	0.4	18	34	0.0160873	0.00076508	0.0039254	0.01379206	0.03778254	0.83055238	0.0032873	0.00309048	6.34921E-06	0.55419524	0.71716349	0.29314127
127	Jun-20	0.003	0.045	0.012	0.4	19	34	0.02258125	0.00079063	0.00338125	0.01589219	0.03307656	0.74787031	0.00382656	0.00547813	7.8125E-06	0.38292344	0.60370781	0.18073125
128	Jul-20	0.003	0.031	0.01	0.4	12	20	0.01770317	0.00097778	0.00257143	0.01332857	0.02161905	0.38948095	0.00321429	0.00611429	0	0.12912222	0.2867	0.07516508
129	Aug-20	0.003	0.023	0.009	0.3	14	24	0.01384407	0.00049661	0.00201017	0.01137627	0.01325424	0.24898136	0.00231695	0.00190847	0	0.108	0.20890339	0.12592712
130	Sep-20	0.003	0.032	0.011	0.4	12	22	0.017405	0.00078667	0.002995	0.01167333	0.02273667	0.36475667	0.00265167	0.00374333	6.66667E-06	0.12343667	0.27336667	0.101195
131	Oct-20	0.003	0.028	0.017	0.4	17	34	0.01895082	0.00045902	0.00244918	0.01364918	0.02342623	0.53340328	0.00335574	0.00810164	3.27869E-06	0.29879836	0.51643279	0.14862459
132	Nov-20	0.003	0.021	0.02	0.5	21	38	0.02510938	0.00077969	0.00365	0.02257031	0.03579375	0.76826406	0.00350625	0.00932969	0	0.340375	0.69965781	0.17358281
133	Dec-20	0.003	0.02	0.022	0.5	24	38	0.02497846	0.00060923	0.00353692	0.01789846	0.02895692	0.59422615	0.00266308	0.00450615	0	0.22388923	0.56195538	0.13537846
134	Jan-21	0.003	0.022	0.02	0.5	20	39	0.0256791	0.00086269	0.00388657	0.01771045	0.04966716	1.02725522	0.00338955	0.02497015	1.36364E-05	0.61418657	1.46629851	0.47987164
135	Feb-21	0.003	0.029	0.019	0.5	25	43	0.01985821	0.00064627	0.00231791	0.01308358	0.01978358	0.50463284	0.00197015	0.0033791	0	0.22787313	0.55710896	0.17369104
136	Mar-21	0.003	0.034	0.019	0.5	27	65	0.02799851	0.00085455	0.00303433	0.01941493	0.03835821	0.68372836	0.00420299	0.00650746	1.49254E-06	0.31018657	0.62325373	0.21198358
137	Apr-21	0.003	0.043	0.014	0.4	17	41	0.01759559	0.00052353	0.00259559	0.01554118	0.03034853	0.66196618	0.00607794	0.00508382	0	0.35131324	0.63811912	0.22491765
138	May-21	0.003	0.042	0.012	0.4	19	52	0.02354925	0.00096716	0.00290149	0.01760299	0.03563881	0.62893134	0.00242239	0.00704925	2.98507E-06	0.33147761	0.50588209	0.18295373
139	Jun-21	0.003	0.044	0.011	0.4	19	32	0.0198	0.00095455	0.00314848	0.01745606	0.03082121	0.59049697	0.00344091	0.00444848	4.54545E-06	0.26414242	0.46300152	0.1356303
140	Jul-21	0.003	0.033	0.01	0.3	12	22	0.01118507	0.00051194	0.00239701	0.01370896	0.01975821	0.32590896	0.00230299	0.00241791	0	0.09282239	0.21482985	0.0751194
141	Aug-21	0.003	0.032	0.009	0.4	11	21	0.00729118	0.00022794	0.00172206	0.00797206	0.01695588	0.28559118	0.00193676	0.00405735	1.47059E-06	0.11772647	0.25401765	0.10513235
142	Sep-21	0.003	0.032	0.009	0.4	8	17	0.00949855	0.00028696	0.00198116	0.00936522	0.01517101	0.27210145	0.00161449	0.00173623	0	0.0857942	0.20975652	0.08046667
143	Oct-21	0.003	0.027	0.014	0.4	14	27	0.00947	0.00020286	0.00217714	0.00796286	0.01835429	0.36862714	0.00169571	0.00328571	1.42857E-06	0.15741429	0.32638286	0.08496
144	Nov-21	0.003	0.024	0.02	0.5	23	40	0.00870286	0.00023571	0.00211714	0.00966714	0.01420143	0.34215857	0.00134857	0.00158429	0	0.13854143	0.30966857	0.10175286
145	Dec-21	0.003	0.02	0.021	0.5	22	36	0.02116	0.00056857	0.00437429	0.02159571	0.03397429	0.66398571	0.00379	0.00427143	0	0.23959286	0.54967429	0.12854429
146	Jan-22	0.003	0.022	0.022	0.5	26	39	0.01799178	0.00052466	0.0029589	0.01212466	0.02541644	0.53411644	0.00229315	0.00466164	1.36986E-06	0.23842877	0.51306164	0.13841644
147	Feb-22	0.003	0.033	0.017	0.4	23	37	0.0215831	0.00067887	0.00333944	0.0163169	0.03155211	0.68919155	0.00467746	0.00443803	0	0.28773803	0.63009155	0.13990704
148	Mar-22	0.003	0.035	0.017	0.4	22	42	0.01911268	0.00058732	0.00443099	0.01821831	0.03994507	0.90131831	0.00630282	0.00421549	0	0.49033521	0.93201127	0.26675634
149	Apr-22	0.003	0.044	0.013	0.4	19	39	0.01024306	0.00029861	0.00228056	0.00855	0.02949861	0.48085278	0.00278472	0.00222917	9.72222E-06	0.24417778	0.46634583	0.16568333
150	May-22	0.003	0.051	0.011	0.3	17	33	0.01747778	0.00051806	0.00274444	0.01282778	0.03158889	0.59910556	0.00347778	0.00598056	0	0.28251389	0.5101125	0.15377917
151	Jun-22	0.002	0.039	0.009	0.3	12	22	0.00946389	0.00040139	0.00185694	0.0093625	0.02089167	0.29917083	0.00242778	0.00145417	0	0.11491389	0.24386806	0.09462222
152	Jul-22	0.002	0.035	0.009	0.3	13	22	0.01434722	0.00064861	0.00179444	0.01014861	0.01891944	0.28603472	0.00254306	0.00360278	0	0.08283333	0.20804444	0.08905694



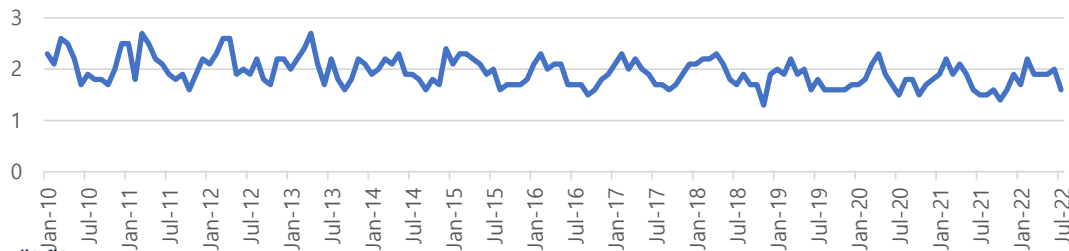
Wind speed



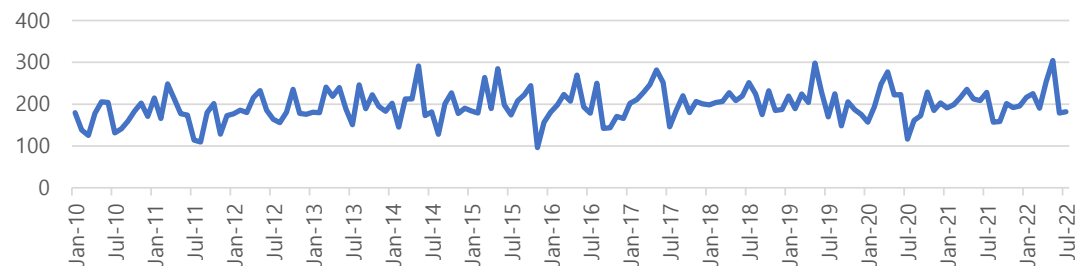
Temperature

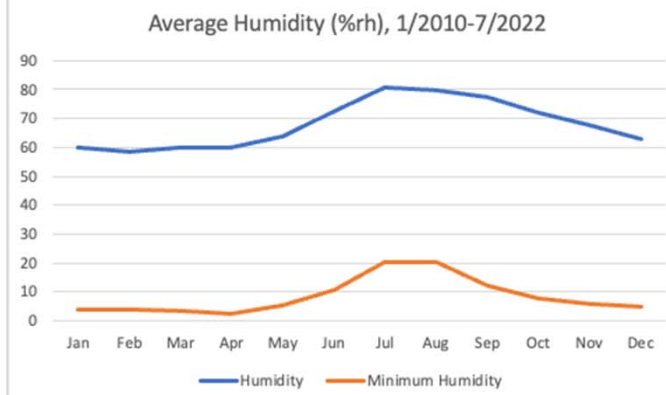
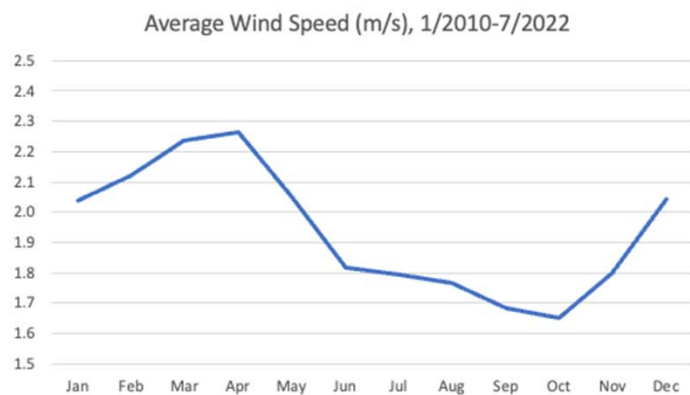
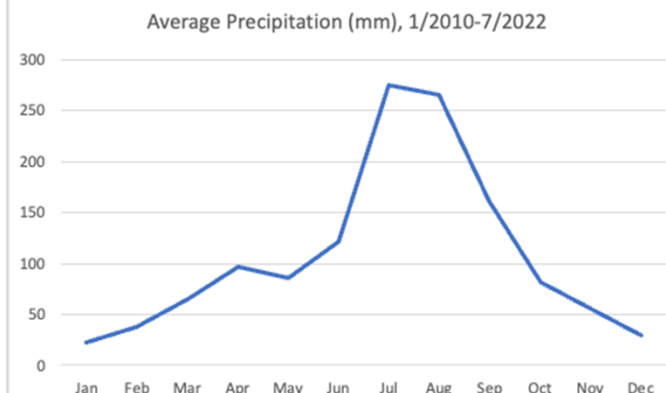
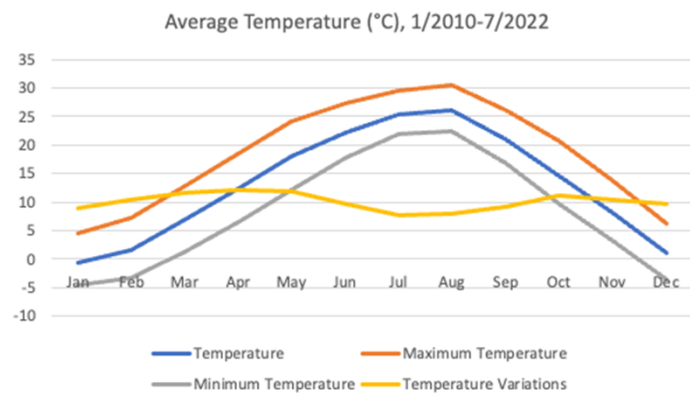
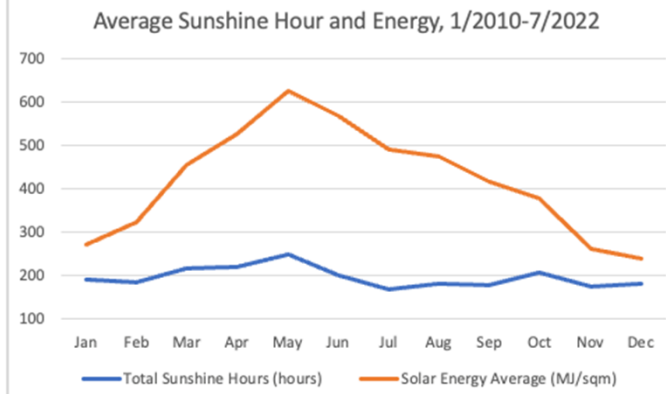
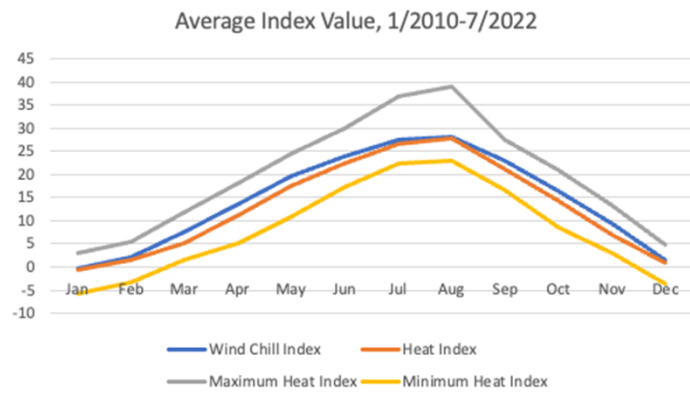


Average Wind Speed

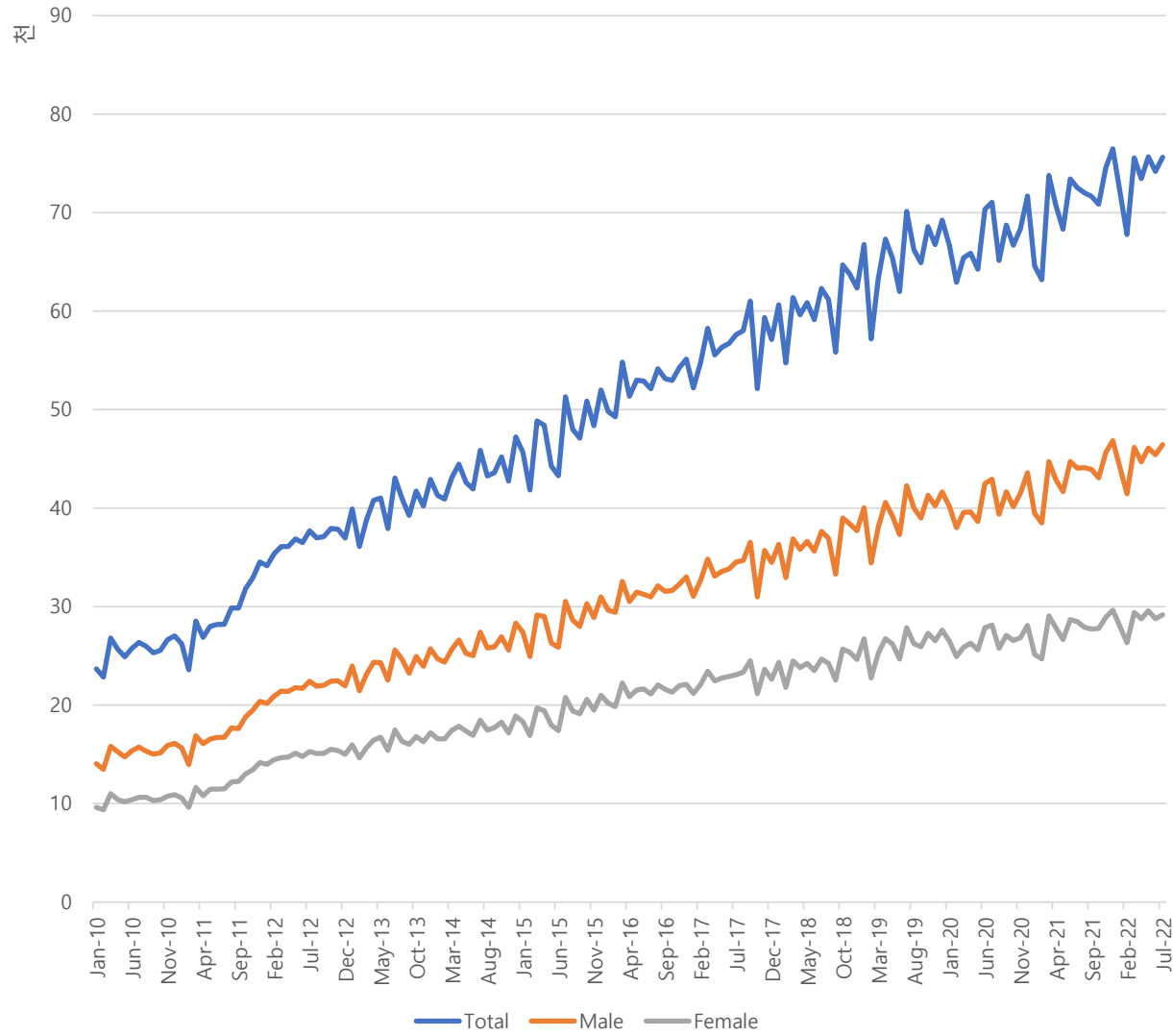


Total Sunshine Hours

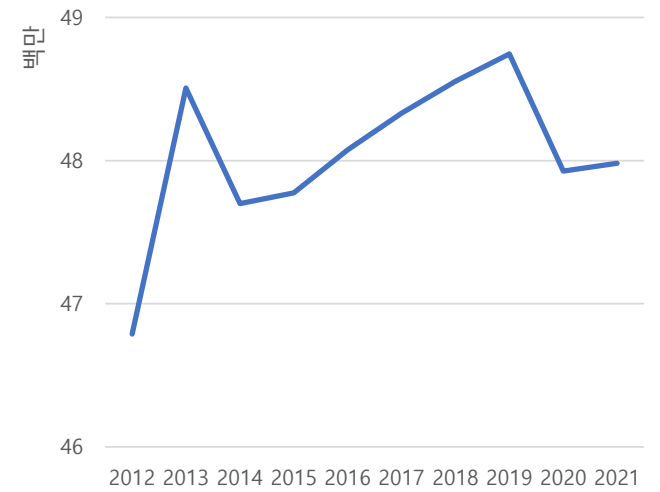




AF



Total



Statistical analysis

- SAS on demand for Academics
- Pearson correlation



Results



Simple Statistics						
Variable	N	Mean	Std Dev	Median	Minimum	Maximum
Avg_Temp	151	13.01457	9.27857	13.80000	-4.80000	27.30000
Avg_Max_Temp	151	18.43444	9.11362	20.20000	0.50000	32.30000
Regional_Max_Avg_Temp	151	28.71126	7.31128	30.00000	10.70000	41.00000
Avg_Min_Temp	151	8.33245	9.65939	7.90000	-9.80000	23.80000
Regional_Min_Avg_Temp	151	-5.26358	12.05896	-5.00000	-27.70000	26.80000
Avg_Precipitation	151	107.61722	99.93197	76.30000	2.60000	498.10000
Daily_Max_Precipitation_Avg	151	255.59868	218.93029	195.00000	14.50000	1131
Hourly_Max_Precipitation_Avg	151	40.53179	23.58510	36.00000	5.10000	102.70000
Avg_Wind_Speed	151	1.94371	0.28251	1.90000	1.30000	2.70000
Avg_Max_Wind_Speed	151	22.10132	5.54004	21.50000	12.80000	49.00000
Avg_Max_Instantaneous_Wind_Speed	151	29.50662	6.05481	28.60000	19.20000	56.50000
Avg_Humidity	151	67.72185	8.76901	67.00000	50.00000	86.00000
Avg_Min_Humidity	151	8.31788	7.07707	6.00000	0	25.00000
Sunshine_Hours	151	197.08940	37.68907	194.30000	96.20000	304.40000
Solar_Energy	151	421.17801	129.05152	426.81000	172.31000	754.45000
Wind_Chill_Index	151	14.26933	9.92950	15.11247	-5.23222	29.48760
Heat_Index	151	12.80132	9.89547	13.00000	-5.00000	30.00000
Max_Heat_Index	151	19.51656	11.95093	20.00000	-5.00000	44.00000
Min_Heat_Index	151	7.92715	9.82453	7.00000	-10.00000	24.00000
Diurnal_Temp_Variation	151	10.10199	1.94503	10.20000	-3.00000	13.70000



Pearson Correlation Coefficients
 Prob > |r| under H0: Rho=0
 Number of Observations

	Total	Male	M0to4yo	M5to9yo	M10to14yo	M15to19yo	M20to24yo	M25to29yo	M30to34yo	M35to39yo	M40to44yo	M45to49yo	M50to54yo	M55to59yo	M60to64yo	M65to69yo	M70to74yo	M75to79yo	M80yo_or_more
Avg_Temp	0.05327	0.05055	0.00108	-0.02602	-0.00348	0.01270	-0.09913	-0.04951	0.01106	0.00333	-0.01080	0.02003	0.03758	0.03639	0.03632	0.05126	0.05711	0.06536	0.05353
Avg_Max_Temp	0.5159	0.5377	0.9895	0.7512	0.9662	0.8770	0.2259	0.5461	0.8928	0.9677	0.8953	0.8072	0.6469	0.6573	0.6579	0.5319	0.4861	0.4253	0.5139
Avg_Min_Temp	0.06725	0.06422	0.00116	-0.03028	-0.02195	-0.00752	-0.10021	-0.04666	0.01328	0.01821	0.00177	0.03242	0.05054	0.05081	0.04912	0.06396	0.07098	0.08020	0.06653
Avg_Max_Avg_Temp	0.4120	0.4334	0.9887	0.7120	0.7890	0.9270	0.2208	0.5694	0.8714	0.8244	0.9828	0.6927	0.5377	0.5355	0.5492	0.4353	0.3865	0.3277	0.4170
Regional_Max_Avg_Temp	0.04245	0.03950	0.02189	-0.02110	-0.00296	-0.02779	-0.12947	-0.04999	-0.00381	-0.00354	-0.01759	0.00457	0.02320	0.02937	0.02404	0.03696	0.04674	0.05633	0.04382
Regional_Min_Avg_Temp	0.6048	0.6301	0.7897	0.9711	0.9712	0.7348	0.1131	0.5422	0.9629	0.9656	0.8303	0.9556	0.7774	0.7204	0.7695	0.6523	0.5687	0.4921	0.5931
Avg_Min_Temp	0.03178	0.02950	-0.00151	-0.01865	0.02090	0.03457	-0.09868	-0.05154	0.00312	-0.01895	-0.03299	0.00134	0.01488	0.01339	0.01655	0.03171	0.03522	0.04306	0.03432
Avg_Max_Temp	0.6985	0.7192	0.9853	0.8202	0.7989	0.6734	0.2280	0.5297	0.9697	0.8174	0.6876	0.9870	0.8561	0.8704	0.8402	0.6991	0.6677	0.5996	0.6757
Regional_Min_Avg_Temp	0.02603	0.02488	-0.00364	0.03488	0.01759	0.06813	-0.11573	-0.01470	-0.01089	-0.01566	-0.04776	-0.00318	-0.00173	-0.00486	0.01401	0.03004	0.02957	0.03488	0.03690
Regional_Max_Avg_Temp	0.7510	0.7617	0.9647	0.6707	0.8303	0.4059	0.1570	0.8579	0.8944	0.8487	0.5604	0.9691	0.9832	0.9528	0.8645	0.7142	0.7186	0.6707	0.6528
Avg_Precipitation	-0.03737	-0.03690	-0.07037	0.05466	0.08359	0.07701	-0.15366	-0.04856	-0.03196	-0.03383	-0.09876	-0.06080	-0.04822	-0.05538	-0.03946	-0.03471	-0.03817	-0.03062	-0.02453
Avg_Max_Precipitation	0.6487	0.6528	0.3906	0.5050	0.3075	0.3473	0.0596	0.5538	0.6969	0.6800	0.2276	0.4583	0.5566	0.4994	0.6305	0.6722	0.6417	0.7089	0.7650
Daily_Max_Precipitation_Avg	-0.02252	-0.02400	-0.01459	0.00294	0.07209	0.08138	-0.15554	-0.06666	-0.03687	-0.01072	-0.07122	-0.05044	-0.02990	-0.02442	-0.02958	-0.02549	-0.02719	-0.01113	-0.01970
Daily_Max_Precipitation_Avg	0.7837	0.7699	0.8589	0.9714	0.3790	0.3790	0.0565	0.4161	0.8531	0.8961	0.5865	0.8349	0.9366	0.7155	0.7660	0.7561	0.7403	0.8921	0.8102
Hourly_Max_Precipitation_Avg	0.09056	0.08970	0.00997	0.01914	0.05997	0.02491	-0.08365	-0.01440	0.05479	0.06852	0.02793	0.08021	0.06172	0.08893	0.08332	0.09210	0.07834	0.10036	0.09300
Hourly_Max_Precipitation_Avg	0.2688	0.2734	0.9033	0.8155	0.4645	0.7614	0.3072	0.8607	0.5040	0.4032	0.7335	0.3276	0.4515	0.2775	0.3091	0.2607	0.3390	0.2202	0.2560
Avg_Wind_Speed	-0.42535	-0.42417	0.16837	0.22757	0.10437	0.04729	-0.21542	-0.24015	-0.17727	-0.34289	-0.30341	-0.40713	-0.36479	-0.39326	-0.42423	-0.42392	-0.41828	-0.43048	-0.41952
Avg_Max_Wind_Speed	<0.0001	<0.0001	0.0388	0.0050	0.2022	0.5642	0.0079	0.0030	0.0294	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Avg_Min_Wind_Speed	-0.00180	0.00044	-0.14043	0.02139	-0.09544	-0.03207	0.04456	-0.00622	-0.03239	0.01311	-0.04284	-0.00201	-0.03327	-0.00545	0.00559	0.00135	-0.00107	-0.00184	0.00878
Avg_Max_Wind_Speed	0.9825	0.9957	0.0855	0.7944	0.2437	0.6959	0.5870	0.9396	0.6930	0.8730	0.6015	0.9805	0.6851	0.9470	0.9457	0.9868	0.9896	0.9821	0.9148
Avg_Max_Instantaneous_Wind_Speed	-0.05417	-0.05310	-0.13081	0.02093	-0.07694	0.02027	0.00287	-0.04778	-0.02779	-0.05357	-0.07497	-0.05588	-0.07068	-0.05181	-0.05080	-0.05253	-0.05493	-0.05358	-0.04556
Avg_Min_Instantaneous_Wind_Speed	0.5089	0.5173	0.1094	0.7986	0.3477	0.8049	0.9721	0.5602	0.7348	0.5136	0.3602	0.4955	0.3885	0.5276	0.5356	0.5218	0.5030	0.5135	0.5786
Avg_Humidity	0.09984	0.09933	-0.04704	-0.04599	0.01941	0.00576	0.02302	0.00493	0.08128	0.04004	0.04171	0.07689	0.09370	0.07864	0.09264	0.10282	0.10909	0.10604	0.09570
Avg_Min_Humidity	0.2226	0.2250	0.5663	0.5750	0.8130	0.9441	0.7791	0.9521	0.3212	0.6254	0.6111	0.3480	0.2525	0.3371	0.2579	0.2090	0.1824	0.1950	0.2425
Avg_Max_Humidity	-0.03030	-0.02976	-0.01777	-0.08394	0.15734	0.06432	-0.01897	-0.05324	-0.00322	-0.02524	-0.06429	-0.03347	-0.00242	-0.02625	-0.03596	-0.03378	-0.02431	-0.02427	-0.03218
Avg_Min_Humidity	0.7119	0.7168	0.8286	0.3055	0.0537	0.4327	0.8172	0.5162	0.9687	0.7584	0.4329	0.6833	0.9765	0.7490	0.6612	0.6805	0.7670	0.7674	0.6949
Sunshine_Hours	0.27233	0.26815	0.08258	-0.03389	-0.21071	-0.18362	0.05137	0.10377	0.12058	0.26730	0.26949	0.25787	0.27175	0.29152	0.25308	0.25582	0.27124	0.28020	0.24823
Sunshine_Hours	0.0007	0.0009	0.3134	0.6796	0.0094	0.0240	0.5310	0.2048	0.1403	0.0009	0.0008	0.0014	0.0007	0.0003	0.0017	0.0015	0.0008	0.0005	0.0021
Solar_Energy	0.14425	0.14311	-0.04578	0.02018	-0.03312	-0.06104	-0.10416	0.09548	-0.00273	0.10866	0.03327	0.08154	0.07405	0.08240	0.13193	0.15115	0.14870	0.14432	0.17388
Solar_Energy	0.0772	0.0796	0.5767	0.8058	0.6864	0.4566	0.2031	0.2436	0.9734	0.1841	0.6850	0.3196	0.3662	0.3145	0.1064	0.0639	0.0684	0.0771	0.0327
Wind_Chill_Index	0.06058	0.05784	-0.00175	-0.02916	-0.00622	0.01121	-0.09581	-0.04447	0.01418	0.00963	-0.00496	0.02727	0.04402	0.04329	0.04374	0.05847	0.06433	0.07265	0.06067
Wind_Chill_Index	0.4600	0.4805	0.9830	0.7223	0.9396	0.8913	0.2419	0.5877	0.8628	0.9066	0.9519	0.7396	0.5914	0.5977	0.5939	0.4758	0.4326	0.3753	0.4593
Heat_Index	0.05329	0.05065	0.00677	-0.04332	0.01311	0.01880	-0.08381	-0.05558	0.01582	0.00060	-0.00518	0.02173	0.04170	0.04199	0.03684	0.05057	0.05631	0.06547	0.05156
Heat_Index	0.5158	0.5368	0.9343	0.5974	0.8731	0.8188	0.3063	0.4979	0.8471	0.9942	0.9496	0.7911	0.6112	0.6087	0.6534	0.5375	0.4922	0.4244	0.5295
Max_Heat_Index	0.05222	0.04976	0.01052	-0.04152	0.00901	0.03597	-0.08721	-0.05168	0.03008	0.00937	-0.00104	0.02718	0.04808	0.04203	0.03572	0.04943	0.05323	0.06394	0.05046
Max_Heat_Index	0.5243	0.5440	0.8980	0.6127	0.9126	0.8610	0.2870	0.5285	0.7139	0.9091	0.9899	0.7404	0.5577	0.6083	0.6632	0.5467	0.5162	0.4354	0.5384
Min_Heat_Index	0.05442	0.05210	-0.00694	-0.03979	0.02327	0.02787	-0.08272	-0.04936	0.02450	0.00485	-0.00354	0.02482	0.04698	0.04113	0.03915	0.05248	0.05852	0.06538	0.05266
Min_Heat_Index	0.5069	0.5252	0.9326	0.6276	0.7767	0.7341	0.3126	0.5473	0.7652	0.9528	0.9656	0.7623	0.5667	0.6161	0.6332	0.5222	0.4754	0.4251	0.5207
Diurnal_Temp_Variation	0.15728	0.15443	0.01294	-0.04929	-0.20666	-0.20691	0.02053	0.03734	0.04676	0.17941	0.17213	0.14528	0.16292	0.17157	0.14796	0.14221	0.15768	0.16193	0.14128
Diurnal_Temp_Variation	0.0538	0.0583	0.8747	0.5478	0.0109	0.0108	0.8024	0.6489	0.5686	0.0275	0.0346	0.0751	0.0456	0.0352	0.0698	0.0815	0.0532	0.0470	0.0836
Avg_Atmospheric_Pressure	0.00887	0.01085	-0.02096	0.04369	-0.01890	-0.04303	0.12070	0.11711	0.00490	0.06393	0.07120	0.05236	0.02439	0.02186	0.02828	0.01235	-0.00190	-0.00158	-0.00070
Avg_Atmospheric_Pressure	0.9234	0.9064	0.8202	0.6357	0.8376	0.6407	0.1891	0.2027	0.9576	0.4879	0.4397	0.5700	0.7915	0.8127	0.7591	0.8935	0.9836	0.9863	0.9940



Pearson Correlation Coefficients																		
Prob > r under H0: Rho=0																		
Number of Observations																		
	Female	F0to4yo	F5to9yo	F10to14yo	F15to19yo	F20to24yo	F25to29yo	F30to34yo	F35to39yo	F40to44yo	F45to49yo	F50to54yo	F55to59yo	F60to64yo	F65to69yo	F70to74yo	F75to79yo	F80yo_or_more
Avg_Temp	0.05758	-0.02488	0.04721	0.04280	0.08447	0.21900	0.08926	0.03878	0.02226	0.11304	0.08346	0.05097	0.05570	0.04425	0.04453	0.06233	0.05929	0.05502
Avg_Max_Temp	0.4825	0.7617	0.5649	0.6018	0.3024	0.0069	0.2758	0.6364	0.7862	0.1670	0.3083	0.5343	0.4970	0.5896	0.5872	0.4471	0.4696	0.5022
Avg_Min_Temp	0.07203	-0.03090	0.02516	0.02191	0.08381	0.20479	0.08966	0.03669	0.01619	0.10649	0.09157	0.05630	0.06983	0.05891	0.05822	0.07709	0.07425	0.06865
Avg_Max_Precipitation	0.3795	0.7065	0.7591	0.7894	0.3063	0.0117	0.2736	0.6546	0.8436	0.1931	0.2634	0.4924	0.3942	0.4725	0.4777	0.3468	0.3649	0.4023
Regional_Max_Avg_Temp	0.04713	-0.02932	0.01301	0.06313	0.08471	0.20383	0.08674	0.03946	0.00989	0.08065	0.06295	0.04161	0.04846	0.03193	0.03054	0.04988	0.05252	0.04537
Regional_Min_Avg_Temp	0.5655	0.7208	0.8740	0.4412	0.3011	0.0121	0.2896	0.6305	0.9040	0.3249	0.4426	0.6120	0.5546	0.6972	0.7097	0.5430	0.5218	0.5802
Avg_Min_Precipitation	0.03540	-0.01085	0.08202	0.07492	0.08529	0.23668	0.08691	0.04231	0.02955	0.11848	0.06826	0.03735	0.03200	0.02178	0.02379	0.03815	0.03678	0.03463
Regional_Min_Precipitation	0.0661	0.8948	0.3167	0.3606	0.2978	0.0034	0.2887	0.6060	0.7188	0.1474	0.4049	0.6489	0.6965	0.7907	0.7718	0.6419	0.6539	0.6729
Avg_Max_Humidity	0.02784	0.04271	0.13600	0.13163	0.08259	0.21073	0.07873	0.03847	0.04319	0.09406	0.04122	0.01347	-0.00053	0.01523	0.01943	0.02355	0.02625	0.03331
Regional_Max_Humidity	0.7343	0.6025	0.0959	0.1072	0.3134	0.0094	0.3366	0.6391	0.5985	0.2506	0.6153	0.8696	0.9948	0.8528	0.8128	0.7741	0.7491	0.6847
Avg_Precipitation	-0.03808	0.00098	0.15760	0.10794	0.17421	0.22340	0.08055	-0.09229	0.14119	0.05216	-0.01371	0.00811	-0.05079	-0.04237	-0.04916	-0.05579	-0.03659	-0.02904
Avg_Max_Precipitation	0.6425	0.9905	0.0533	0.1871	0.0324	0.0058	0.3255	0.2597	0.0838	0.5247	0.8673	0.9213	0.5357	0.6055	0.5489	0.4962	0.6355	0.7234
Daily_Max_Precipitation_Avg	-0.02012	-0.02403	0.10766	0.03114	0.16261	0.19787	0.03653	-0.07673	0.11352	0.05154	0.01973	0.03327	-0.00363	-0.02791	-0.03239	-0.03267	-0.01045	-0.01964
Hourly_Max_Precipitation_Avg	0.8063	0.7696	0.1882	0.7043	0.0461	0.0149	0.6561	0.3491	0.1652	0.5297	0.8100	0.6851	0.9647	0.7337	0.6930	0.6905	0.8986	0.8108
Hourly_Max_Precipitation	0.09181	-0.04330	0.09136	0.07368	0.05537	0.20975	0.15114	-0.04553	0.14569	0.06265	0.12809	0.00553	0.08838	0.08155	0.09053	0.07510	0.09695	0.09079
Avg_Wind_Speed	0.2622	0.5975	0.2646	0.3686	0.4995	0.0097	0.0640	0.5788	0.14569	0.4447	0.1170	0.05553	0.08838	0.2805	0.2689	0.3594	0.2412	0.2676
Avg_Max_Wind_Speed	-0.42670	0.03230	0.03283	0.20473	0.05712	-0.14526	-0.18718	0.09247	0.11797	0.04207	-0.26460	-0.13647	-0.33751	-0.42368	-0.42166	-0.40671	-0.42077	-0.42494
Avg_Min_Wind_Speed	<0.0001	0.6937	0.6890	0.0117	0.4860	0.0751	0.0214	0.2588	0.1491	0.6080	0.0010	0.0947	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Avg_Max_Instantaneous_Wind_Speed	-0.00539	0.11303	0.02140	0.04305	0.00104	-0.01323	0.04994	-0.12347	-0.05922	-0.08069	-0.08208	-0.09609	-0.02574	-0.01318	0.00093	-0.01906	-0.00495	0.00500
Avg_Min_Instantaneous_Wind_Speed	0.9476	0.1670	0.7943	0.5997	0.9899	0.8719	0.5425	0.1309	0.4701	0.3247	0.3164	0.2405	0.7537	0.8724	0.9910	0.8164	0.9519	0.9514
Avg_Humidity	-0.05582	0.08092	0.06696	0.13185	0.01521	0.03788	-0.00444	-0.08794	0.01434	-0.05780	-0.07429	-0.10202	-0.05611	-0.06417	-0.04779	-0.06575	-0.05492	-0.04777
Avg_Min_Humidity	0.4960	0.3233	0.4140	0.1066	0.8529	0.6443	0.9569	0.2829	0.8613	0.4808	0.3647	0.2126	0.4938	0.4338	0.5601	0.4225	0.5030	0.5602
Avg_Precipitation	0.10053	0.01768	0.10388	-0.02286	0.06754	0.22193	0.11128	0.00417	-0.00940	0.11719	0.09027	0.10045	0.07123	0.09223	0.09432	0.10996	0.09657	0.09648
Regional_Precipitation	0.2194	0.8294	0.2043	0.7805	0.4099	0.0062	0.1737	0.9595	0.9088	0.1518	0.2704	0.2197	0.3848	0.2600	0.2493	0.1789	0.2382	0.2386
Avg_Max_Sunshine_Hours	-0.03114	-0.03636	0.17043	0.10320	0.07295	0.21648	0.09152	-0.01777	0.00668	0.13224	0.02593	0.09362	-0.01670	-0.03136	-0.04880	-0.03399	-0.02805	-0.03162
Regional_Max_Sunshine_Hours	0.7043	0.6576	0.0364	0.2073	0.3734	0.0076	0.2637	0.8286	0.9351	0.1055	0.7520	0.2529	0.8387	0.7022	0.5519	0.6786	0.7325	0.6999
Avg_Min_Sunshine_Hours	0.27869	-0.10645	-0.20447	-0.15636	-0.10998	-0.09765	0.01316	-0.01720	-0.18299	-0.05080	0.19194	0.11469	0.28721	0.27765	0.26699	0.28723	0.28793	0.26041
Regional_Min_Sunshine_Hours	0.0005	0.1933	0.0118	0.0552	0.1789	0.2329	0.8726	0.8340	0.0245	0.5356	0.0182	0.1609	0.0003	0.0006	0.0009	0.0003	0.0003	0.0012
Avg_Max_Solar_Energy	0.14591	-0.06950	-0.10364	0.07233	0.03282	0.07553	0.16131	-0.00203	-0.01320	-0.07024	0.03944	-0.03360	0.06388	0.13141	0.13072	0.12465	0.13337	0.16860
Regional_Max_Solar_Energy	0.0738	0.3965	0.2054	0.3775	0.6892	0.3567	0.0479	0.9803	0.8722	0.3915	0.6307	0.6821	0.4358	0.1077	0.1096	0.1273	0.1026	0.0385
Avg_Min_Solar_Energy	0.06490	-0.02522	0.04622	0.03803	0.08337	0.21931	0.09113	0.03696	0.02068	0.11072	0.08710	0.05364	0.06140	0.05160	0.05179	0.06936	0.06655	0.06227
Regional_Min_Solar_Energy	0.4285	0.7586	0.5731	0.6429	0.3088	0.0068	0.2658	0.6523	0.8010	0.1759	0.2876	0.5130	0.4539	0.5292	0.5277	0.3974	0.4169	0.4475
Avg_Max_Heat_Index	0.05746	-0.04171	0.05973	0.03949	0.07795	0.22196	0.08298	0.02964	0.01875	0.12547	0.09181	0.05802	0.06109	0.04477	0.04362	0.06183	0.06017	0.05385
Regional_Max_Heat_Index	0.4834	0.6111	0.4663	0.6302	0.3414	0.0062	0.3111	0.7179	0.8192	0.1248	0.2622	0.4792	0.4562	0.5851	0.5949	0.4507	0.4630	0.5114
Avg_Min_Heat_Index	0.05610	-0.03869	0.06583	0.05867	0.08443	0.24168	0.10040	0.04031	0.03905	0.14127	0.11734	0.06017	0.06349	0.04385	0.04410	0.05921	0.05796	0.05185
Regional_Min_Heat_Index	0.4939	0.6372	0.4219	0.4743	0.3027	0.0028	0.2200	0.6231	0.6341	0.0836	0.1513	0.4630	0.4387	0.5929	0.5908	0.4702	0.4796	0.5272
Avg_Max_Precipitation	0.05809	-0.02507	0.05876	0.04694	0.07542	0.23828	0.09870	0.03534	0.02378	0.12609	0.09357	0.06477	0.05910	0.04629	0.04516	0.06423	0.05933	0.05417
Regional_Max_Precipitation	0.4787	0.7599	0.4736	0.5671	0.3574	0.0032	0.2279	0.6666	0.7719	0.1229	0.2532	0.4294	0.4710	0.5725	0.5819	0.4333	0.4693	0.5089
Avg_Min_Precipitation	0.16167	-0.09089	-0.28942	-0.26939	-0.03086	-0.21584	-0.01147	-0.03818	-0.07088	-0.08941	0.09008	0.07827	0.16824	0.16785	0.15463	0.17178	0.16523	0.14969
Regional_Min_Precipitation	0.0473	0.2670	0.0003	0.0008	0.7068	0.0078	0.8888	0.6416	0.3871	0.2750	0.2714	0.3394	0.0389	0.0394	0.0580	0.0349	0.0426	0.0666
Avg_Atmospheric_Pressure	0.00581	0.01363	-0.08995	-0.06592	-0.13341	-0.22343	-0.08748	-0.02787	-0.07906	-0.07167	-0.03325	0.01935	0.00818	0.02226	0.02409	0.00308	0.00187	0.00263



Result

- General population, especially M >35yo, F >55yo
 - Average wind speed ($r=-0.42$, 95% CI -0.55 to -0.28, $p<0.001$)
 - Average sunshine duration ($r=0.27$, 95% CI 0.12 to 0.41, $p<0.001$)
- Intraday temperature variation (Inconsistent but statistically significant)
- Female population aged 20 to 24 years ($p<0.05$)
 - Average temperature, precipitation, humidity, atmospheric pressure

The interpretation requires caution.



Discussion



Discussion & Limitations

- Nature of data (the number of insurance claims and encounters)
- Accuracy of data (initial impression, medical history)



Discussion & Limitations

- Nature of data (the number of insurance claims and encounters)
- Accuracy of data (initial impression, medical history)
- Multicollinearity of meteorological variables (eg, wind-PM2.5)
- Confounding bias (eg, aging (AF up) & renewable energy policy (Pollutants down))



Discussion & Limitations

- Nature of data (the number of insurance claims and encounters)
- Accuracy of data (initial impression, medical history)
- Multicollinearity of meteorological variables (eg, wind-PM2.5)
- Confounding bias (eg, aging (AF up) & renewable energy policy (Pollutants down))
- Causality (retrospective observational study)
- Scientific plausibility (wind-AF?, sunlight-AF?)



Conclusions



Conclusions

- There is correlation between atrial fibrillation and average wind speed (negative) and average sunshine duration (positive) in the general population, especially in males aged over 35 and females aged over 55.
- The correlation with intraday temperature variation is present but inconsistent among different age and sex groups.
- Among females aged 20 to 24 years, there is correlation with average temperature, precipitation, humidity, and atmospheric pressure.
- It is important to note that these correlations do not establish causality.



References

- [1] Zhao Q, Coelho MSZS, Li S, et al. Temperature variability and hospitalization for cardiac arrhythmia in Brazil: A nationwide case-crossover study during 2000–2015. *Environmental Pollution*. 2019;246:552–558.
- [2] Frost L, Paaske Johnsen S, Pedersen L, et al. Seasonal Variation in Hospital Discharge Diagnosis of Atrial Fibrillation: A Population-Based Study. *Epidemiology*. 2002;13:211–215. Rivera-Caravaca JM,
- [3] Roldán V, Vicente V, Lip GYH, Marín F. Particulate Matter and Temperature: Increased Risk of Adverse Clinical Outcomes in Patients With Atrial Fibrillation. *Mayo Clinic Proceedings*. 2020;95:2360–2369.
- [4] Comelli I, Ferro J, Lippi G, Comelli D, Sartori E, Cervellin G. Incidence of acute-onset atrial fibrillation correlates with air temperature. Results of a nine-year survey. *JEGH*. 2014;4:151.
- [5] Fustinoni O, Saposnik G, Esnaola y Rojas MM, Lakkis SG, Sposato LA. Higher Frequency of Atrial Fibrillation Linked to Colder Seasons and Air Temperature on the Day of Ischemic Stroke Onset. *Journal of Stroke and Cerebrovascular Diseases*. 2013;22:476–481.
- [6] Zhu X, Chen R, Zhang Y, et al. Low ambient temperature increases the risk and burden of atrial fibrillation episodes: A nationwide case-crossover study in 322 Chinese cities. *Science of The Total Environment*. 2023;880:163351.
- [7] Ahn J, Uhm T, Han J, et al. Meteorological Factors and Air Pollutants Contributing to Seasonal Variation of Acute Exacerbation of Atrial Fibrillation. *Journal of Occupational & Environmental Medicine*. 2018;60:1082–1086.
- [8] [4]
- [9] Nguyen JL, Link MS, Luttmann-Gibson H, et al. Drier Air, Lower Temperatures, and Triggering of Paroxysmal Atrial Fibrillation. *Epidemiology*. 2015;26:374–380
- [10] Vencloviene J, Babarskiene RM, Dobožinskas P, Dedele A, Lopatiene K, Ragaišyte N. The short-term associations of weather and air pollution with emergency ambulance calls for paroxysmal atrial fibrillation. *Environ Sci Pollut Res*. 2017;24:15031–15043.
- [11] [4]
- [12] Bhatnagar A. Environmental Determinants of Cardiovascular Disease. *Circ Res*. 2017;121:162–180.
- [13] Brundel BJJM, Shiroshita-Takeshita A, Qi X, et al. Induction of Heat Shock Response Protects the Heart Against Atrial Fibrillation. *Circulation Research*. 2006;99:1394–1402.
- [14] Liu D, Han X, Zhang Z, Tse G, Shao Q, Liu T. Role of Heat Shock Proteins in Atrial Fibrillation: From Molecular Mechanisms to Diagnostic and Therapeutic Opportunities. *Cells*. 2022;12:151.
- [15] Kupari M, Koskinen P. Seasonal variation in occurrence of acute atrial fibrillation and relation to air temperature and sale of alcohol. *The American Journal of Cardiology*. 1990;66:1519–1520.
- [16] Yarza S, Novack L, Sarov B, Novack V. Ability to adapt to seasonal temperature extremes among atrial fibrillation patients. A nation-wide study of hospitalizations in Israel. *Environmental Research*. 2023;216:114804.
- [17] Fujimoto R, Suzuki E, Kashima S, et al. Heat Exposure Following the Rainy Season Is Associated With an Increased Risk of Cardiovascular Emergency Among the Elderly in Japan. *JAHA*. 2023;12.
- [18] Paul A, Alex R, Jacob JR, Yadav B. Effects of heat stroke on surface ECG: a study on clinical outcomes. *Heart Asia*. 2019;11:e011221.
- [19] Zanobetti A, O'Neill MS, Gronlund CJ, Schwartz JD. Susceptibility to Mortality in Weather Extremes. *Epidemiology*. 2013;24:809–819.
- [20] Michałkiewicz D, Chwiałkowski J, Dziuk M, et al. Wpływ warunków atmosferycznych na występowanie napadowego migotania przedsionków [The influence of weather conditions on the occurrence of paroxysmal atrial fibrillation]. *Pol Merkur Lekarski*. 2006;20(117):265–269. PMID: 16780251
- [21] Sheehy S, Fonarow GC, Holmes DN, et al. Seasonal Variation of Atrial Fibrillation Admission and Quality of Care in the United States. *JAHA*. 2022;11.
- [22] Poletaev V, Antonelli D, Litskevich G, Turgeman Y. Monthly Variation in Emergency Department Admission for Acute Onset Atrial Fibrillation. *The Israel Medical Association Journal : IMAJ*. 2021 May;23(5):302–305. PMID: 34024047.
- [23] Vencloviene J, Babarskiene RM, Dobožinskas P, Dedele A, Lopatiene K, Ragaišyte N. The short-term associations of weather and air pollution with emergency ambulance calls for paroxysmal atrial fibrillation. *Environ Sci Pollut Res*. 2017;24:15031–15043.
- [24] Jones AM, Harrison RM, Baker J. The wind speed dependence of the concentrations of airborne particulate matter and NOx. *Atmospheric Environment*. 2010;44:1682–1690.
- [25] Rich DQ, Mittleman MA, Link MS, et al. Increased Risk of Paroxysmal Atrial Fibrillation Episodes Associated with Acute Increases in Ambient Air Pollution. *Environ Health Perspect*. 2006;114:120–123.
- [26] Yue C, Yang F, Li F, Chen Y. Association between air pollutants and atrial fibrillation in general population: A systematic review and meta-analysis. *Ecotoxicology and Environmental Safety*. 2021;208:111508.
- [27] Saifipour A, Azhari A, Pourmoghaddas A, et al. Association between ambient air pollution and hospitalization caused by atrial fibrillation. *ARYA Atherosclerosis*. 2019;15.
- [28] Link MS, Luttmann-Gibson H, Schwartz J, et al. Acute Exposure to Air Pollution Triggers Atrial Fibrillation. *Journal of the American College of Cardiology*. 2013;62:816–825.
- [29] Liu X, Kong D, Liu Y, et al. Effects of the short-term exposure to ambient air pollution on atrial fibrillation. *Pacing Clin Electrophysiol*. 2018;41:1441–1446.
- [30] BUNCH TJ, HORNE BD, ASIRVATHAM SJ, et al. Atrial Fibrillation Hospitalization Is Not Increased with Short-Term Elevations in Exposure to Fine Particulate Air Pollution. *Pacing and Clinical Electrophysiology*. 2011;34:1475–1479.
- [31] Čulić V. Triggering of Cardiac Arrhythmias. *Journal of the American College of Cardiology*. 2014;63:1226–1227.

