



# Long-term Heatwave Exposure and the Risk of Kidney Stones per Year of Exposure

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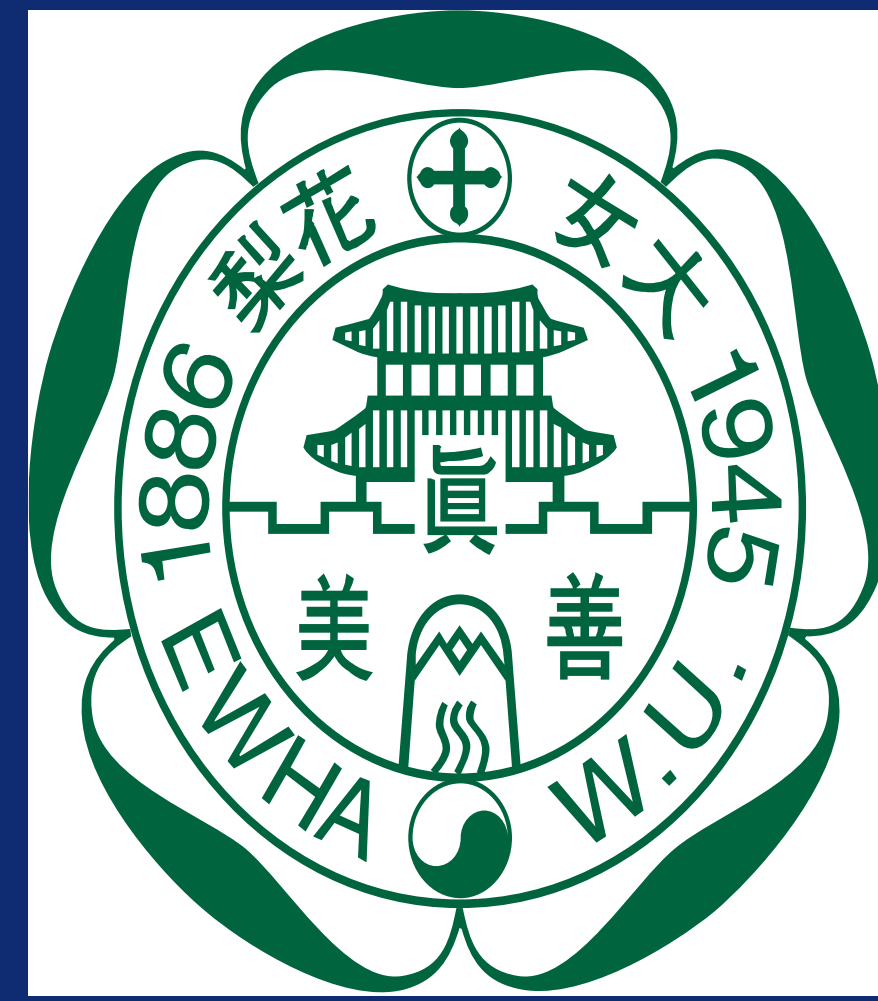
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## Introduction

High temperature exposure, one of the most important environmental risks to human health, resulted in 11.7 million DALYs worldwide in 2019 (IHME, 2019). Due to climate warming, the prevalence of temperature-related urinary stones in each country is expected to increase further. This study aims to analyze the relationship between heat wave exposure and the risk of kidney stone disease and to compare and analyze the risk of annual heat wave exposure and the risk of kidney stones based on the presence or absence of comorbidities.

## Methods

Data from the National Health Insurance Corporation, which contains information on domestic kidney stone patients, was used. From 2009 to 2011, a total of 487,853 people were eligible for the health checkup cohort. Among these, only residents of the seven major metropolitan cities (including those who moved between metropolitan cities) who received health checkups were included. Patients who moved to areas other than the seven major metropolitan cities during follow-up were excluded. Additionally, people diagnosed with kidney stones and those who died before September 30, 2011, were excluded. Ultimately, a total of 179,039 study subjects were included in the analysis. The model analyzed effects using the Cox proportional hazards model.

## Result

As a result, as the number of heat wave exposure days (h) increased each year, the risk of kidney stones during health examinations significantly increased (HR: 1.016, P: 0.027). When comparing the general population to people with comorbidities, the general population had a significantly higher risk of developing kidney stones when exposed to prolonged heat waves (HR-1 year: 1.044, P: 0.048 / HR-2 years: 1.025, P: 0.028 / HR-3 years: 1.024, P: 0.003).

## Conclusion

This study examines the long-term effects of heat wave exposure on the risk of kidney stones. It underscores the importance of monitoring total heat wave exposure in light of climate change. Additionally, it emphasizes the need for both the general public and individuals with comorbidities to manage their exposure to heat waves effectively.

## Acknowledgement

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Table 1. Characteristics of the study participants

Variable		Value
Total N		179039
Gender	male	98431(54.98)
	female	80608(45.02)
Age		59.89±8.63
	40-49	9878(5.52)
	50-59	91435(51.07)
	60-69	49444(27.62)
	70-79	23353(13.04)
Income	80-89	4929(2.75)
	Low	63707(35.58)
	High	115332(64.42)
Kidney stone patient	1	846(0.47)
Comorbidity		
co_HTN	1	61442(34.32)
co_HLD	1	40984(22.89)
co_DM	1	26241(14.66)
Follow-up period		7.92±2.23

Table 2. Risk of Kidney Stones per Year of Exposure (Univariate)

Variable	HR	95% CI	p
HeatDay1	1.024	0.985-1.065	0.227
HeatDay2	1.012	0.992-1.032	0.241
HeatDay3	1.013	0.999-1.027	0.071

Table 3. Risk of Kidney Stones per Year of Exposure (Multivariate)

Variable	exposure for 1 year			2 years of exposure			3 years of exposure		
	HR	95%CL	P	HR	95%CL	P	HR	95%CL	P
HeatDay	1.033	0.994-1.074	0.1	1.016	0.996-1.037	0.108	<b>1.016</b>	<b>1.002-1.030</b>	<b>0.027</b>
Age	0.982	0.979-0.985	<.001	0.982	0.979-0.985	<.001	0.982	0.978-0.985	<.001
Gender	0.671	0.635-0.708	<.001	0.671	0.635-0.708	<.001	0.671	0.635-0.708	<.001
Income	1.055	0.999-1.115	0.053	1.055	0.999-1.114	0.053	1.055	0.999-1.114	0.054
Co_HTN	<b>1.072</b>	<b>1.010-1.138</b>	<b>0.023</b>	<b>1.072</b>	<b>1.010-1.138</b>	<b>0.023</b>	<b>1.073</b>	<b>1.010-1.139</b>	<b>0.022</b>
Co_HLD	<b>1.243</b>	<b>1.168-1.323</b>	<.001	<b>1.243</b>	<b>1.168-1.323</b>	<.001	<b>1.243</b>	<b>1.168-1.323</b>	<.001
Co_DM	<b>1.084</b>	<b>1.010-1.163</b>	<b>0.026</b>	<b>1.084</b>	<b>1.010-1.163</b>	<b>0.026</b>	<b>1.084</b>	<b>1.010-1.163</b>	<b>0.026</b>

Table 4. Impact of Comorbidities on Kidney Stone Patients Due to Annual Heat Wave Exposure

Variable	exposure for 1 year			2 years of exposure			3 years of exposure		
	HR	95%CL	P	HR	95%CL	P	HR	95%CL	P
No comorbidities	<b>1.044</b>	<b>1.000-1.089</b>	<b>0.048</b>	<b>1.025</b>	<b>1.003-1.049</b>	<b>0.028</b>	<b>1.024</b>	<b>1.008-1.040</b>	<b>0.003</b>
Only HTN	1.036	0.984-1.092	0.179	1.021	0.991-1.051	0.168	1.018	0.997-1.039	0.099
Only DM	1.017	0.954-1.085	0.599	1.02	0.984-1.058	0.279	1.015	0.988-1.043	0.271
Only HLD	1.037	0.980-1.097	0.211	1.008	0.976-1.040	0.629	1.012	0.989-1.036	0.297
HTN+DM	1.01	0.946-1.079	0.765	1.016	0.978-1.055	0.424	1.009	0.981-1.037	0.529
HTN+HLD	1.029	0.976-1.086	0.289	1.003	0.974-1.034	0.838	1.006	0.985-1.028	0.576
DM+HLD	1.01	0.948-1.077	0.753	1.003	0.967-1.040	0.877	1.003	0.977-1.031	0.797
HTN+DM+HLD	1.003	0.949-1.061	0.912	0.998	0.967-1.030	0.909	0.997	0.975-1.020	0.824

HTN: Hypertension, DM; Diabetes Mellitus, HLD; Hyperlipidemia