

Human Health Adaptation to Heat wave due to Climate Change

October 2, 2014

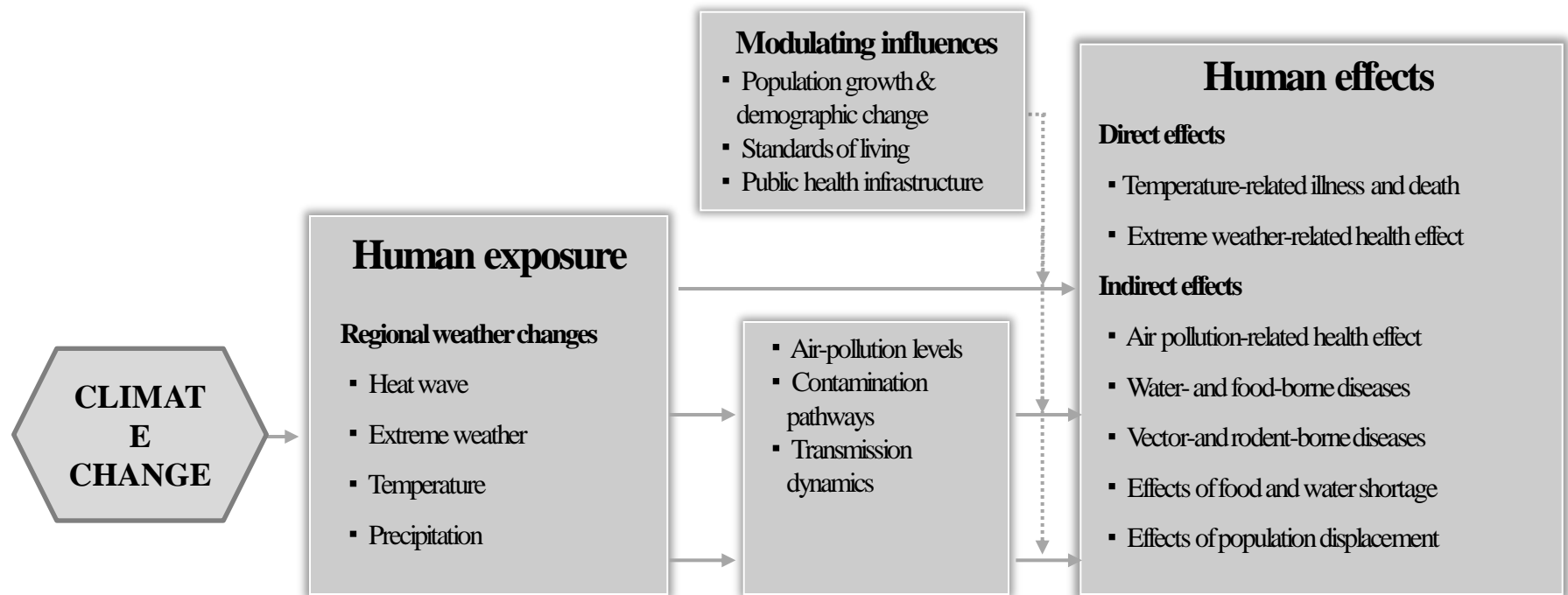
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Korea Environment Institute

- 1. Climate change impacts on health**
2. Adaptation plan & tools to tackle health impacts of heat wave
3. The mid- and long-term direction of adaptation plan

Potential health impacts of climate change

- **Climate change is the biggest global health threat in the 21st century**
(source: The UCL-Lancet commission, 2009)
- **Most expected health impacts of climate change will become adverse**
 - Mainly, changes in frequency or severity of familiar health risks



(Source: Based on Patz et al, 2000, EHP; IPCC, 2007; Haines et al, 2004, JAMA)

Why is heat wave a public health threat?

More intense and frequent hot weather events are expected as a consequence of predicted climate change (source : IPCC, 2007)

Fig. 1. The changes of temperature distribution in the future from climate change (source: McMichael AJ et al, 2006, Lancet)

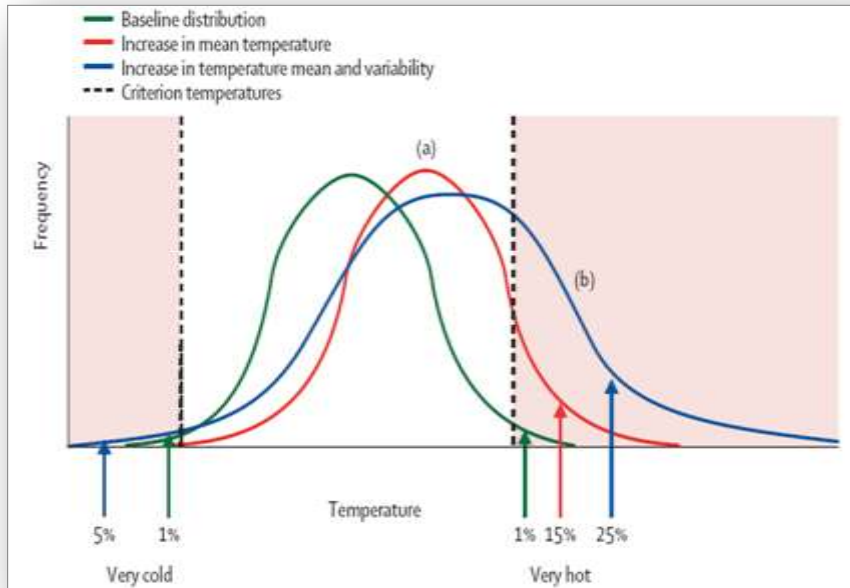
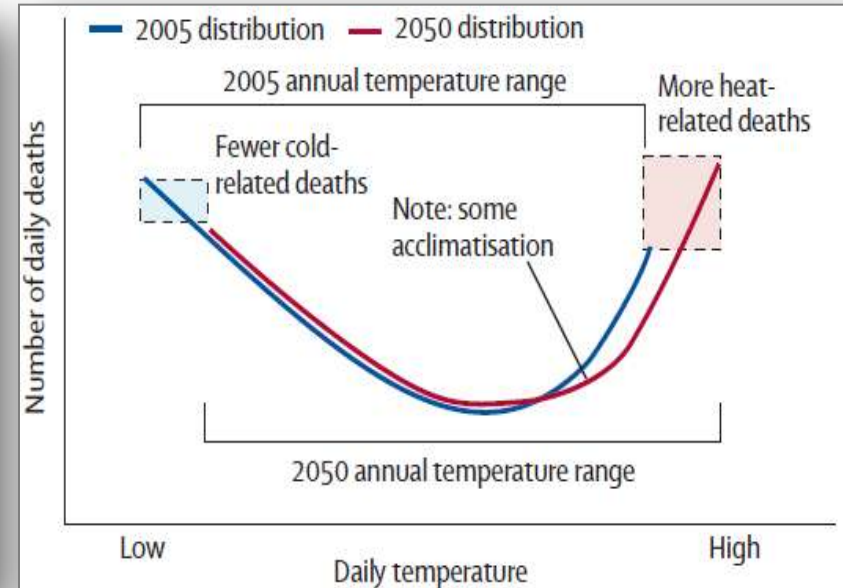


Fig. 2. Schematic representation of how high temperature from climate change would affect annual total of temperature-related deaths (source: McMichael AJ et al, 2006, Lancet)



Evidences in South Korea

Health impacts from high temperature due to climate change

Researches in South Korea	
The current associations between high temperature and deaths	<p>Kim YM et al. 2011. Comparison of Temperature Indexes for the Impact Assessment of Heat Stress on Heat-Related Mortality. <i>Environmental Health and Toxicology</i> 26:e2011009</p> <p>Jongsik Ha, Ho Kim. Changes in the association between summer temperature and mortality in Seoul, South Korea. <i>International Journal Biometeorol.</i> 2012 DOI:10.1007/s00484-012-0580-4</p> <p>Jongsik Ha, YongSeong Shin, and Ho Kim. Distributed Lag Effects in the Relationship between Temperature and Mortality in Three Major Cities in South Korea. <i>Science of the Total Environment.</i> 2011;409:3274–3280.</p> <p>Jongsik Ha, Ho Kim, and Shakoor Hajat. Effect of Previous-Winter Mortality on the Association between Summer Temperature and Mortality in South Korea. <i>Environmental Health Perspectives.</i> 2011;119(4):542–546.</p> <p>Ho Kim, Jongsik Ha, and Jeongim Park. High Temperature, Heat Index, and Mortality in 6 Major Cities in South Korea. <i>Archives of Environmental & Occupational Health.</i> 2006;61:265–270.</p>
Current death burden of high temperature	<p>Jongsik Ha. The Changes in the Attributable Burden of High Temperature on Deaths. <i>Journal of Environmental Health Sciences.</i> 2012; 38(6):460-471.</p>
Future death burden of high temperature due to climate change	<p>Jihoon Yang, Jongsik Ha*. Estimation for future Death Burden of High Temperature from Climate Change. <i>Journal of Environmental Health Sciences.</i> 2013; 39(1):19-31.</p>

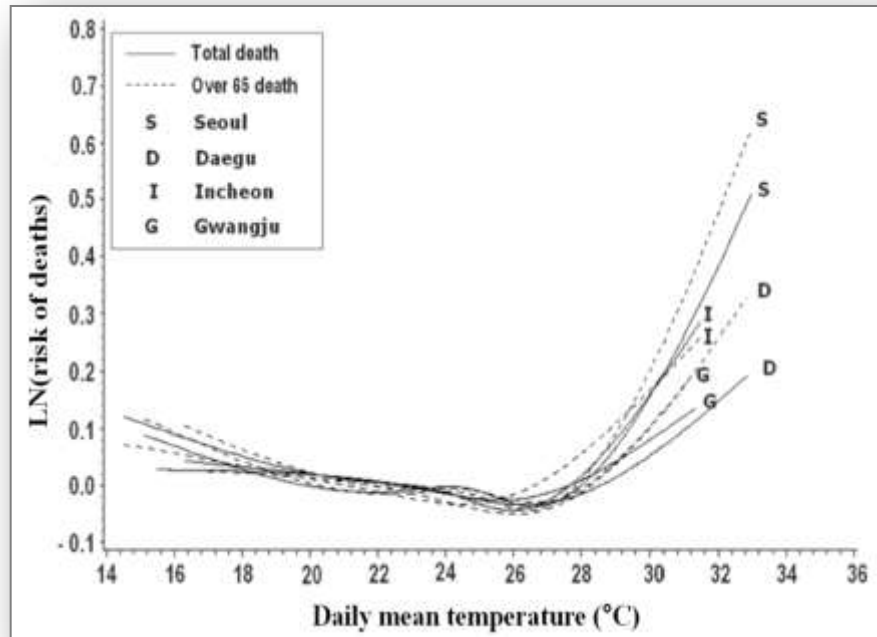
Evidences in South Korea

The current associations between high temperature and deaths

- **The goal :** The examination of the current associations between daily temperature and daily deaths in South Korea

- **Main results**

Fig. Temperature-mortality risk functions in South Korea
(source: Kim et al., 2006, STOTEN)



- **Implications**

- **High temperature is an important predictor of deaths in summer** (Kim et al., 2006, STOTEN)
- High temperature has an effect on mortality, not advancing the date of adverse events by a few days (Ha J et al, 2011, STOTEN)
- Health effects of high temperature is higher in low mortality of previous winter than in high mortality of previous winter (Ha J et al, 2011, EHP)
- Health effects of high temperature is decreasing in Seoul, particularly during late summer (Ha J et al, 2012, IJB)

Evidences in South Korea

Current death burden of high temperature

- **The goal :** The estimation of the current death burden of high temperature, considering current climate, population, and incidence
- **Main results**
- **Implication**

Table. Yearly death burden of high temperature in Seoul and Daegu
(source: Ha J, 2012, JEHS)

City	Definition of study period	Yearly attributable death and burden of high temperature on deaths		
		Population	Attributable death counts (95% CI)	Attributable burden (95% CI) per 100,000
Seoul	1996-2010	10,066,343	60 (39 - 82)	0.60 (0.38 - 0.81)
	1996-2000	10,095,278	85 (48 - 121)	0.85 (0.48 - 1.20)
	2001-2005	10,041,178	72 (35 - 108)	0.72 (0.35 - 1.08)
	2006-2010	10,062,574	27 (-11 - 64)	0.27 (-0.11 - 0.63)
Daegu	1996-2010	2,503,126	28 (16 - 40)	1.13 (0.63 - 1.60)
	1996-2000	2,505,501	18 (-3 - 38)	0.73 (-0.10 - 1.51)
	2001-2005	2,526,268	42 (20 - 62)	1.66 (0.80 - 2.47)
	2006-2010	2,477,609	17 (-7 - 39)	0.68 (-0.29 - 1.59)

※ definitions of threshold : 80th percentile of daily mean temperature in summers of study period

- **Communities with higher death burden should be given higher priorities in adaptation strategies and policies**

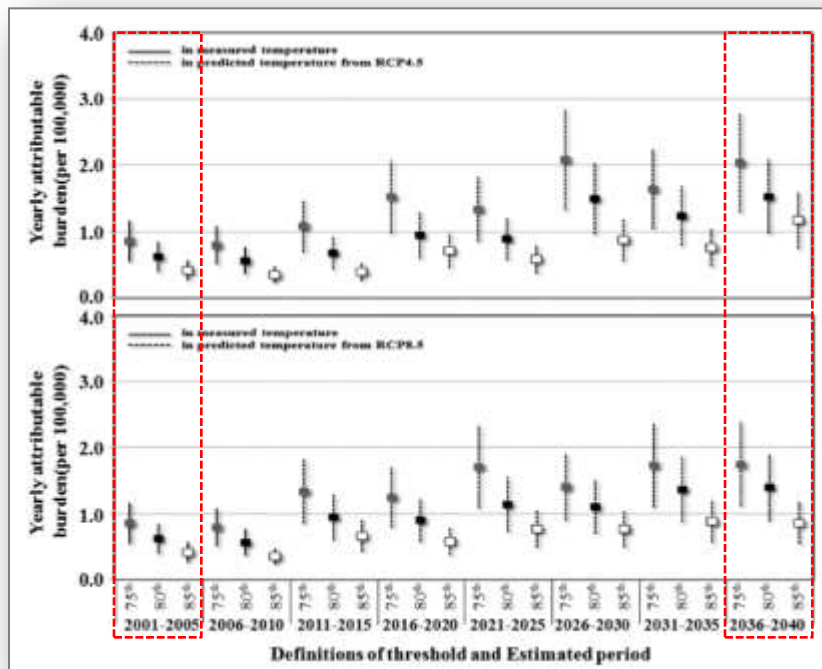
(source: Ha J, 2012, JEHS)

Evidences in South Korea

Future death burden of high temperature due to climate change

- **The goal :** The prediction of the future death burden of high temperature from climate change, considering future climate, population, incidence, and adaptation
- **Main results**
- **Implication**

Fig. Yearly death burden of high temperature in Seoul, based on the relationship in 1996-2010 (source: Yang J and Ha J*, 2013, JEHS)



- **In the future, high temperature would be a risk factor for deaths due to climate change**

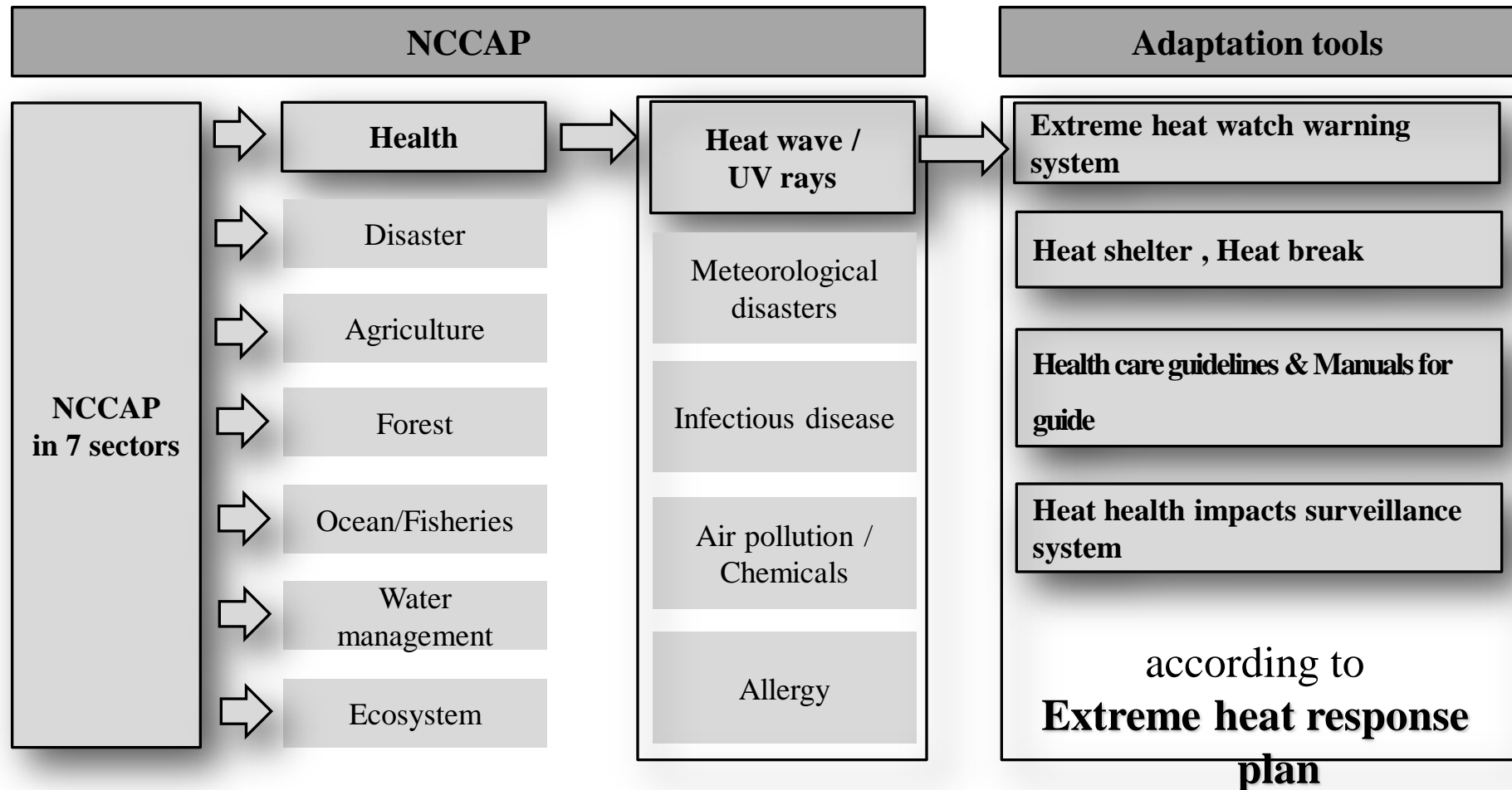
(source: Yang J and Ha J*, 2013, JEHS)

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2. Adaptation plan & tools to tackle health impacts of heat wave

National Climate Change Adaptation Plan(NCCAP)

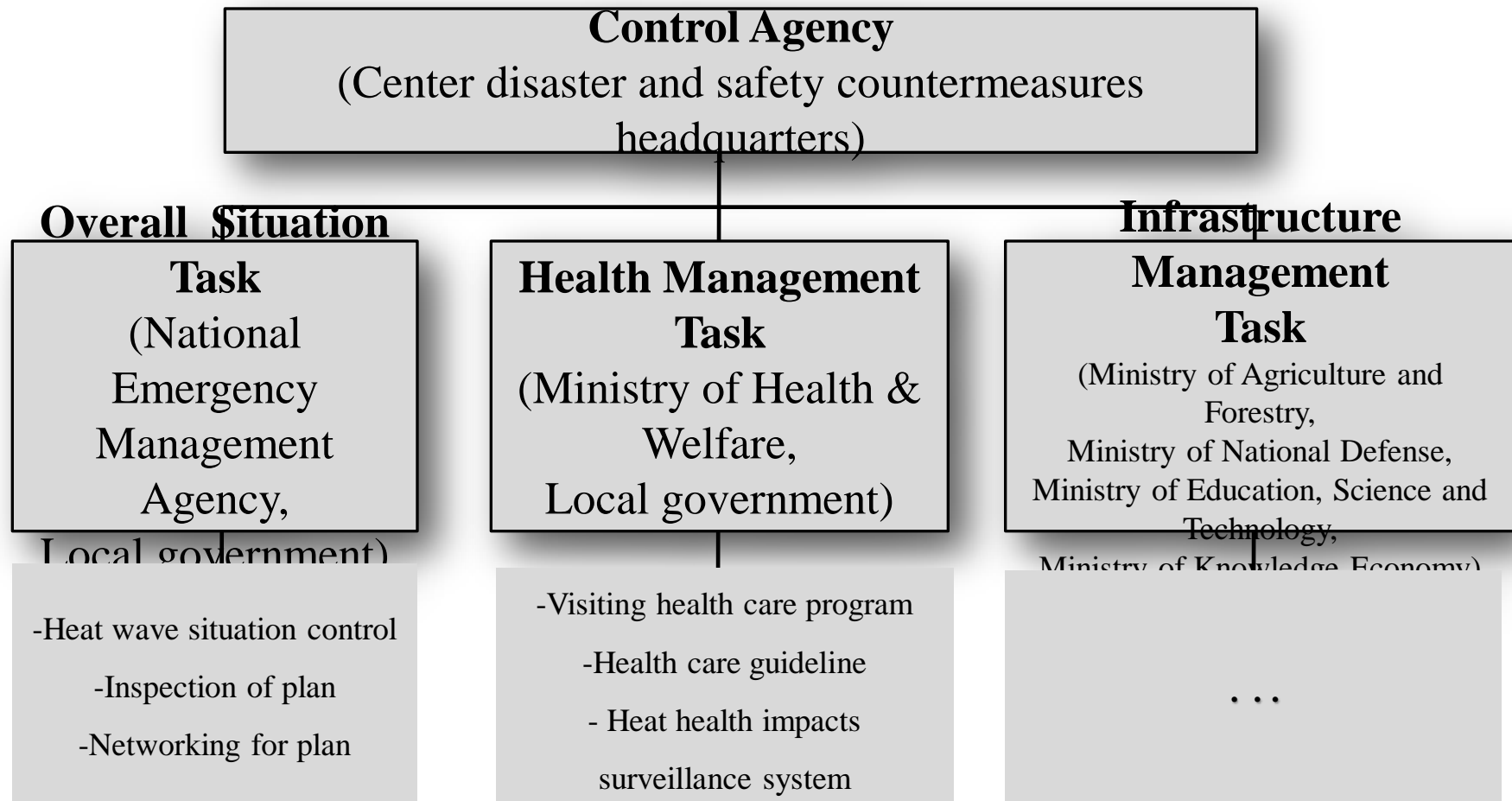
Extreme heat response plan to prevent impacts of heat wave



2. Adaptation plan & tools to tackle health impacts of heat wave

Extreme heat response plan when heat wave hits

Organization chart of Extreme heat response plan



Definition of Heat wave

Extreme heat watch/warning system

- Operated by **Korea Meteorological Administration** since 2011
- Temporal resolution : daily (June 1 ~ September 30)
- Spatial resolution : lower level local government (si / gun / myeon)
- Watch & Warning criteria

Criteria	
Watch	In case of being expected to hold out 2 days in $\geq 33^{\circ}\text{C}$ of daily max temperature from June to September
Warning	In case of being expected to hold out 2 days in $\geq 35^{\circ}\text{C}$ of daily max temperature from June to September

Main actions

- **Breaking news on public TV**
- **Notification to the related agency**



Fig 1. Breaking news in public TV

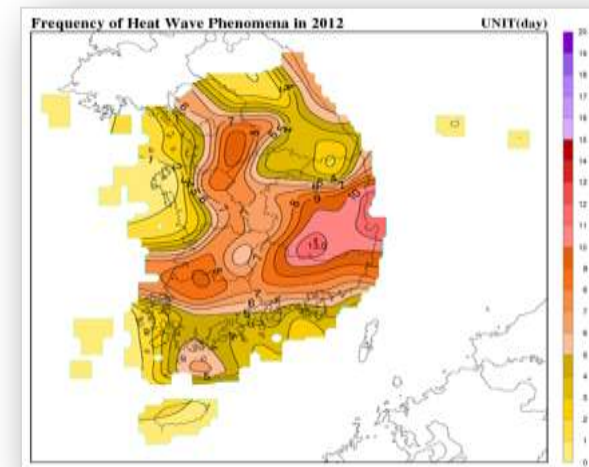


Fig 2. frequency of heat wave in 2012

2. Adaptation plan & tools to tackle health impacts of heat wave

Main adaptation tools of Ministry of Health & Welfare and Local governments

Materials to prevent health impacts of heat wave

Health care guidelines for general population



Health care guidelines for the elderly



Manuals for guide on how to deal with heat waves



For elderly nursing homes

For child care teacher

For heat wave guide

Main adaptation tools of Ministry of Health & Welfare and Local governments

Visiting health care program for the elderly

- Management by **public health center in a lower-level local government** (si/gun/gu)
(※Visiting health care worker, elderly helper)
- Operating period : when heat wave hits in June 1 ~ September 30
- Visiting health subjects (154,000 people in 2012)
 - Single elderly, disabled
- Main actions
 - Calling to subjects
 - A personal visit for health care
 - Network of emergency contacts(recipient– elderly helper – recipient relative)



Fig. visiting health care for the elderly

Main adaptation tools

of Ministry of Health & Welfare and Local governments

Heat-health impacts surveillance system

- Surveillance based on emergency medical treatment center (458 in 2012)
- Operating period : June 1 ~ September 30
- Reported information : the daily number of thermal patients, as well as sex, age, address, job , etc.

(※ Thermal disease: heat stroke, heat exhaustion, heat cramps, heat edema, heat syncope)

- Reporting system: Emergency medical treatment center → Public health center → Ministry of health & welfare →

Center disaster and safety countermeasures

- Information utilization

- To analyze key features of health effects of heat
- To promote perception of heat risk to health
- To develop new adaptation tools

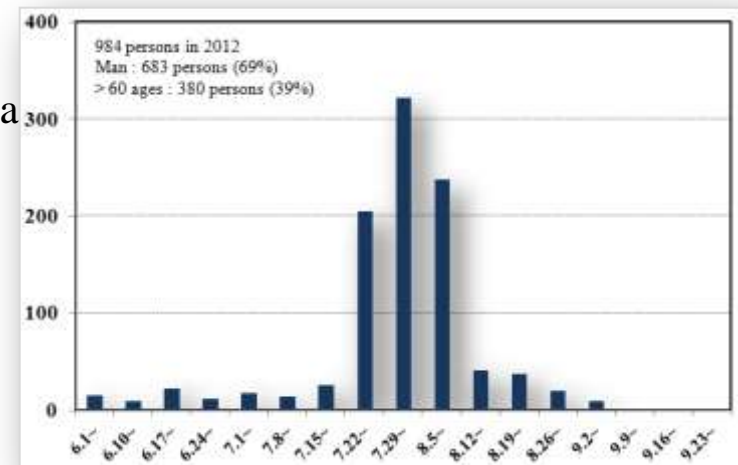


Fig. results of surveillance system in 2012
(modified in source :Ministry of Health & welfare)

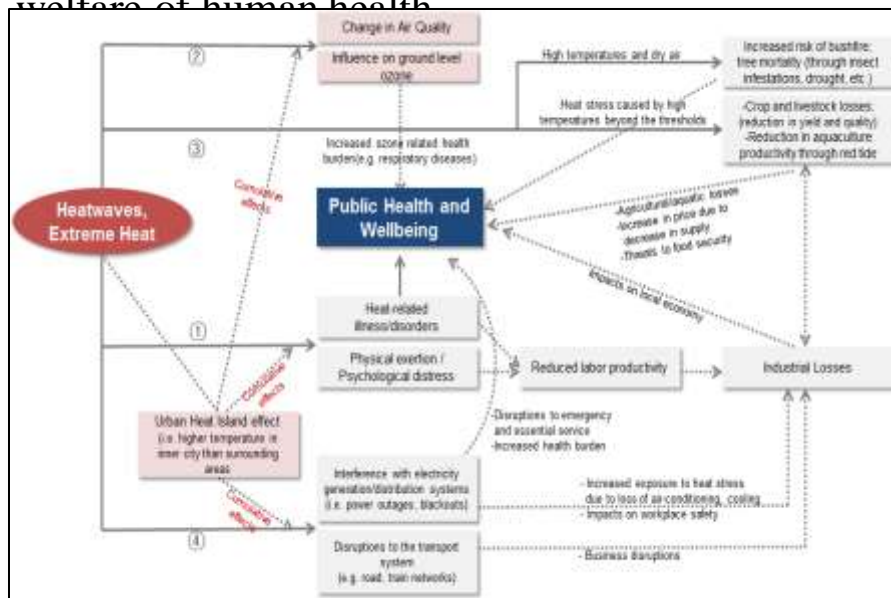
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Background : Impact pathway of heat wave, Heat wave due to climate change

Impact pathway of heat wave

- Not only health, heat wave has given a variety of effects.
- But in the end, the consequences to the impact are health and

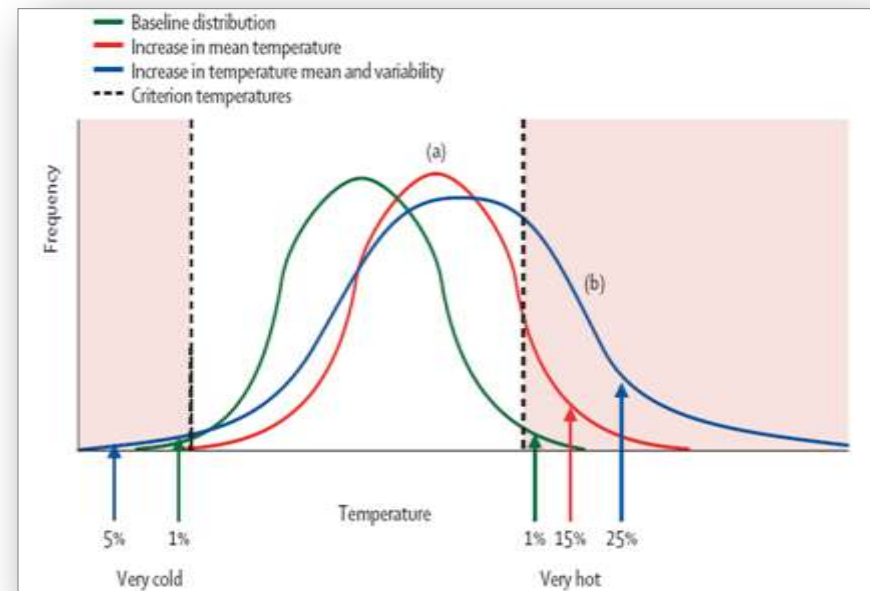
welfare of human health



[Fig. 1] Impact Pathway to Health and Wellbeing of Heat wave

Heat wave due to climate change

- More intense and frequent hot weather events are expected as a consequence of predicted climate change (source : IPCC, 2007)



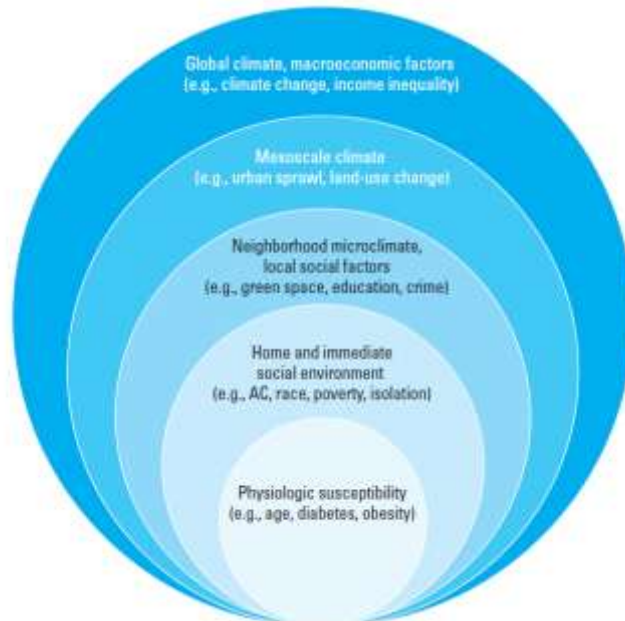
[Fig. 2] The changes of temperature distribution in the future from climate change (source: McMichael AJ et al., 2006, Lancet)

Direction : Integrative and adjustable approach

Policy Integration

- To incorporate a range of factors at multiple scales, from physiologic susceptibility to macroeconomic factors

on a preventive basis(Meijers and Stead, 2004;
OECE



[Fig. 1] Components of heat-related morbidity and mortality risk operative at various spatial scales
(Source: Hess et al., 2012)

Adaptive Management

- To adjust a policy through social learning on a basis of uncertainty and complexity of climate change(Hess et al., 2012)



[Fig. 2] Adaptive Management Cycle
(Source: Hess et al., 2012)

Thank you !

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