



ADAPTATION ISSUE

Counterattack from heat waves,
the silent murderer

ADAPTATION

KOREA ADAPTATION CENTER FOR CLIMATE CHANGE

KACCC'S NEWS

6th International
Symposium on Climate
Change Adaptation

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Heat wave response policies
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CLIMATE CHANGE ADAPTATION RESEARCH

A study of factors influencing the
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6th International Symposium on Climate Change Adaptation

The Ministry of Environment hosted the 6th International Symposium on Climate Change Adaptation along with the Korea Adaptation Center for Climate Change (KACCC) of the Korea Environment Institute (KEI) and the Asia Pacific Adaptation Network (APAN) on July 8, 2014 at the Incheon Songdo Convensia. This symposium was sponsored by Incheon Metropolitan City and the Ministry of Environment of Japan, and participating international organizations and institutes included the United Nations Environment Programme (UNEP), the Institute for Global Environmental Strategies (IGES), the Regional Resource Centre for Asia and the Pacific (RRC.AP), and the Stockholm Environment Institute (SEI). Prepared in celebration of the fifth anniversary of the KACCC, this symposium is the largest conference on climate change adaptation in Korea. It has great significance in that over 300 domestic and international climate change adaptation experts gathered to discuss the new paradigms of climate change adaptation.



This symposium was held under the main theme of "New Paradigms of Climate Change Adaptation." In <Plenary 1>, various countries, including Korea, Germany, Australia, and Nepal, discussed their climate change adaptation status and future development directions. In <Parallel Session 1>, useful lessons from the past related to climate change information and finance were discussed. In <Parallel Session 2>, the new changes and development directions of adaptation were discussed. In the final session, <Plenary 2>, the prospects for climate change risks in Asia and new adaptation paradigms were discussed together with Doctor Yasuaki Hijioka,

the Coordinating Lead Author of IPCC WG II AR5. Dr. Hijioka (Senior Researcher, National Institute for Environmental Studies) said, "Many social infrastructures in Asia are suffering damage due to increased flooding resulting from climate change. Furthermore, climate change is threatening the health and food security of mankind. We need adaptation measures, such as land use plans, urban planning to reduce heat island effects, and early warning systems." This international symposium provided an opportunity for us to strengthen our adaptation capabilities by sharing the excellent adaptation knowledge and experience of advanced countries and international organizations. In addition, our active exchanges with international society served to provide momentum for achieving a position of leadership for our country in climate change adaptation.

ADAPTATION ISSUE

Counterattack from heat waves, the silent murderer

Diseases and deaths from exceptional heat waves are occurring one after another across the world. Not only human beings, but also livestock are also suffering death en masse and crops are withering away. Human and property damage due to heat waves are increasing. In Europe and North America, several hundreds of people are dying from abnormally high temperatures. They call heat waves a "silent killer". Korea is also gradually turning into a subtropical climate region due to climate change, and we often hear such expressions as "the worst heat wave on record". There is a concern that damage from heat waves will increase, because the elderly population who are most vulnerable to heat waves is increasing rapidly. Therefore, we should first understand the summer weather and the status of heat waves in Korea and accurately grasp the damage from heat waves before establishing appropriate plans for those people most vulnerable to them. In this issue, we will examine the status and dangers of worsening heat waves due to climate change.

CHARACTERISTICS OF SUMMER WEATHER AND CAUSES OF HEAT WAVES IN KOREA

Dr. Jiyoung Kim

Senior Researcher, Korea Meteorological Administration

When the Korean weather is divided into four seasons, June to August is generally regarded as summer. However, the summer weather or climate that is actually felt by the public often does not entirely conform to this. From the perspectives of the climate phenomena of heat waves or high-temperature events, summer weather varies greatly by year depending on early or late summer heat. What are the major factors that govern the summer weather of Korea? To answer this question, we must first understand the monsoon (or seasonal wind) behavior in East Asia. Simply put, the East Asian monsoon refers to the change of the wind system in the yearly cycle due to the large scale circulation caused by the difference in specific heat resulting from the location of the Korean Peninsula at the boundary between the Eurasian Continent and the North Pacific. As we experience it every year, the East Asian monsoon is the cold dry northwesterly wind coming from the Asian Continent in winter and the hot and humid wind from the North Pacific in summer. Furthermore, there are spring and autumn seasons between winter and summer, but it appears that these two seasons are becoming shorter and shorter. We might think that it is obvious that Korea has four seasons, but when we look into it, the facts becomes more complex.

In fact, the hot and humid summer often begins with the end of Changma*, which is a representative phenomenon of



The degree of the development, location, extension of influence, and duration of the North Pacific high determine the weather and heat waves in summer

the East Asian monsoon. The Changma front is a type of stationary front at the border between two different air masses. To the north of the Changma front is an air mass that has a cold or cool thermal property (the air mass is dry if it is located in the continent, and it is wet if it is located in a sea area, such as the Sea of Okhotsk), and to the south of the Changma front is the hot and humid North Pacific air mass. From a climatological point of view, Changma starts in the last part of June and ends in the middle part of July. Changma often starts in the southern region, including Jeju Island, and goes up and down to the north and south for some time before heading north of the Korean Peninsula and finishing as the Changma front perishes. When Changma starts, it often becomes cloudy and rainy. Localized torrential downpours sometimes lead to many losses of lives and property damage by causing floods and landslides. The formation or development of the Changma front and the location of the front largely depend on the properties and differences of the two air masses that

Dry Changma can cause the long-lasting and strong heat waves

face each other around the Changma front. If these two air masses, which have different thermal properties, meet with similar forces above the Korean Peninsula, the air becomes very unstable. Moreover, if hot and humid air comes from the south of Korea, a lot of rain falls continuously until the Changma front system weakens. Changma is one of the major causes of damage from natural disasters in Korea, along with typhoons, but it also has a positive function from the perspective of summer heat waves. The cloudy weather during the Changma period, which usually lasts one month, blocks heat. The rains produced also prevent the heating of the ground by providing excess water to the ground. What would summer weather become if the Changma event was weak or there was an extended state of lull in the Changma front (expressed as a dry Changma by some people)?

In this case, the summer heat waves may begin in early summer, much sooner than in an average year, which may lead to serious problems. There are three important climatological factors that determine the effects of heat waves: the strength, duration, and starting times of heat waves. If the activity of the Changma front is abnormal and weak, it is highly likely that the heat waves would start early, last longer, and be very strong (except during so-called cool summers, which happen when the cold and cool air mass to the north of the Changma front influences the entire Korean Peninsula for a long time). Representative examples are the summers of 1994 and 2013, when record-breaking heat waves continued throughout the summer period. Considering that the top extreme values of temperature for summer heat waves at meteorological stations in Korea most appeared in these

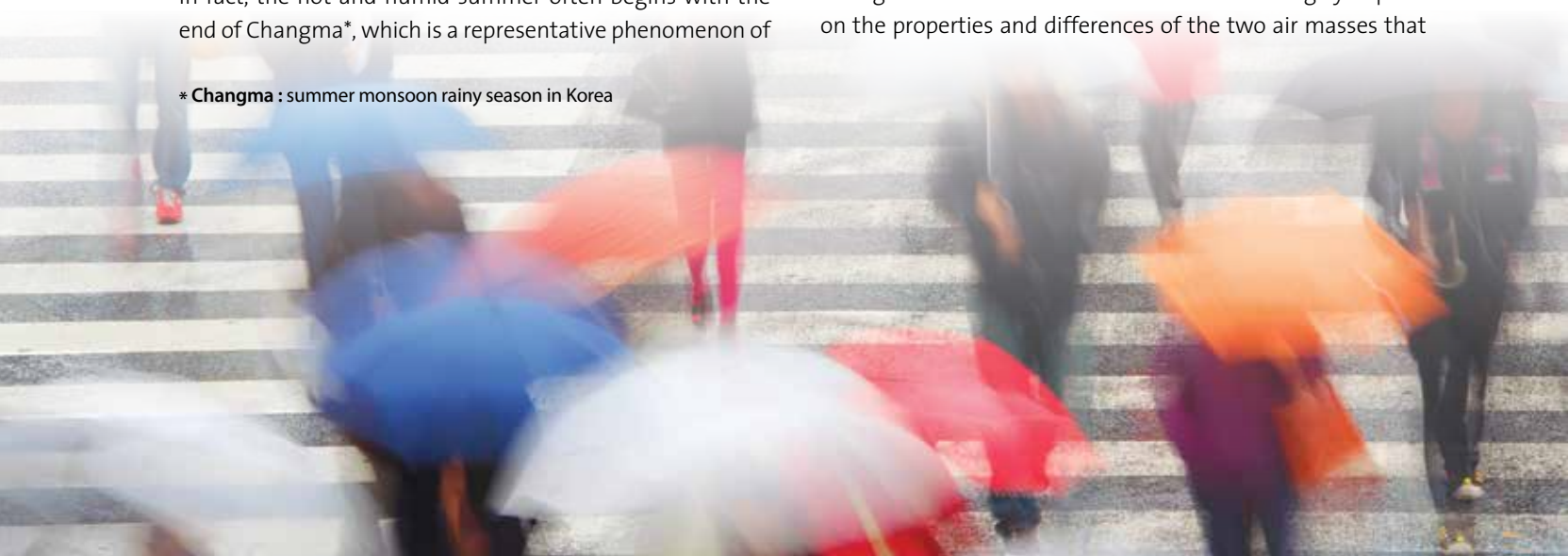
two years, we can see how the evolution of the Changma are closely related to heat wave events. Based on the average temperatures of summer in Korea, the average of daily mean temperature was 25.4°C in 2013, followed by 25.3°C in 1994. The average of daily maximum temperature in summer across the country was 30.7°C in 1994 and that of daily minimum temperature was 21.7°C in 2013. The number of days over 33°C was 29.7 days in 1994, which leads the list by a large margin, followed by 18.2 days in 2013. The number of tropical nights was 17.4 days in 1994, which is no. 1, followed by 15.8 days in 2013.

Another critical factor that influences the summer weather and heat waves in Korea along with the movements of the Changma front is the activity of the North Pacific high. As mentioned above, the North Pacific high or the air mass is obviously one of the important factors in the formation, development, and termination of the Changma front, but from the last part of July when the Changma front terminates in general, the development and location of the North Pacific high, the extension of its force, and the duration of its effects are the core factors that have the greatest impact on the summer weather and heat waves. In particular, the abnormal high temperatures that appeared in Korea during the summer of 2013 are highly correlated with the development of the North Pacific high. As the North Pacific high (meteorologically, the region where the geopotential height is 5,880 m or higher on the 500 hPa isobaric surface is classified as the North Pacific high region) extended more broadly to Korea compared to the average year, heat waves continued, and this barometer pattern blocked the typhoon from moving north toward Korea, which acted as a key factor in the long-term duration of heat waves. The development and duration of the North Pacific high is also closely related to the time when heat wave events come to an end.

[Peak values of high temperatures in summer (1 Jun- 31 Aug) in Korea (nationwide average data)]

	Average of Daily Mean Temperature	Average of Daily Maximum Temperature	Average of Daily Minimum Temperature	Number of days over 33°C	Number of Tropical Nights
1	2013 25.4	1994 30.7	2013 21.7	1994 29.7	1994 17.4
2	1994 25.3	2013 30.1	2010 21.2	2013 18.2	2013 15.8
3	2010 24.9	2010 29.6	2012 21.0	1990 17.0	2010 12.0
4	2012 24.7	1978 29.5	1978 20.9	1996 16.8	2012 10.2
5	1978 24.7	1973 29.5	1994 20.7	1978 16.6	1995 9.5

* Changma : summer monsoon rainy season in Korea

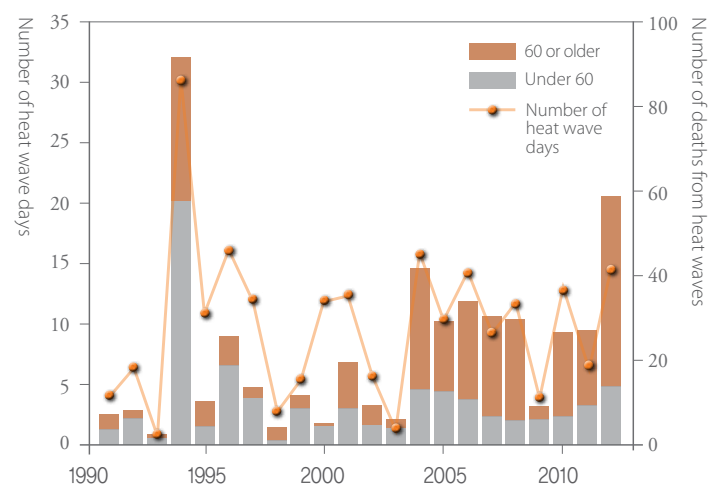


ANALYSIS OF HEAT WAVE DAMAGE IN KOREA

Do-Woo Kim
Climatological Researcher, National Disaster Management Institute

Throughout the nation, about 23 persons (501 persons in 22 years) lose their lives from heat waves in a year on average. In 1994 when the heat waves lasted the longest on record, 92 lives were lost, and 59 people lost their lives due to heat waves during the summer in 2012. The losses of lives from heat waves have been increasing since the late 2000s. One reason for this is the worsening effect of heat waves, but a more important reason is the increasing population who are most vulnerable to heat waves with the aging society. Compared to 1991, the elderly population had increased 2.8 times by 2014. To infer this statistically, if the extreme heat waves that occurred in 1994 were to appear again in 2014, the number of losses of lives is expected to increase from 92 to 115, by 23, at least.

> Number of heat wave days and deaths from heat waves by year

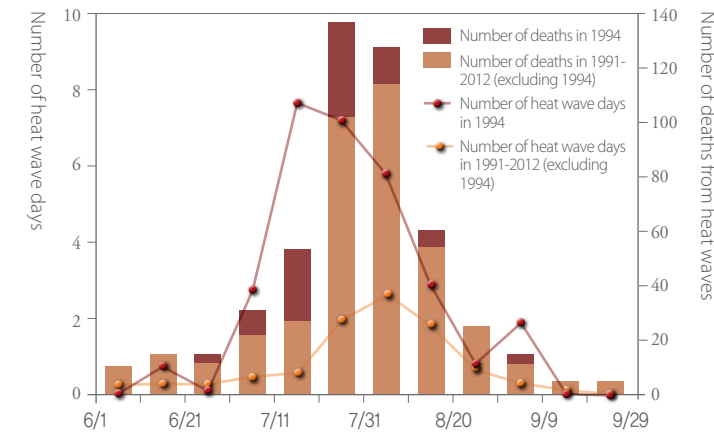


Rapid increase of the population vulnerable to heat waves and the increase of losses of lives due to heat waves are expected

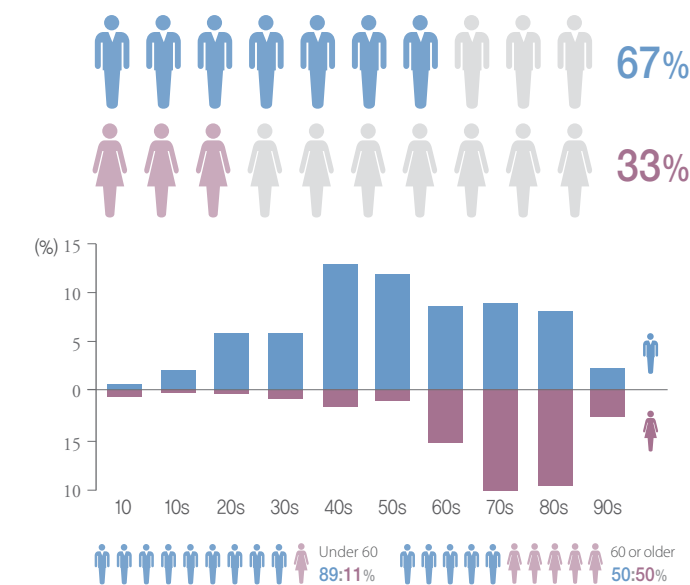
The damage from heat waves appears differently by time even during summer. The time when losses of lives occur most frequently is the early part of August when the temperatures are the highest. In the last part of July, however, the temperatures are similar to the middle part of August, and as much damage from heat waves occur as in the early part of August. This is because the last part of July is the time when the hot midsummer suddenly begins after Changma, and human bodies that have not acclimatized to high temperatures yet are especially vulnerable to heat waves. Heat wave damage in the last part of July distinctly increases in rural areas with the rise of outdoor activities such as the spraying of agricultural chemicals to control harmful insects after Changma. In 1994, extreme heat waves continued abnormally from mid-July, and 26 people lost their lives during the middle part of July, which clearly demonstrated how dangerous early heat waves can be.

Heat wave damage shows different patterns by sex, age, and

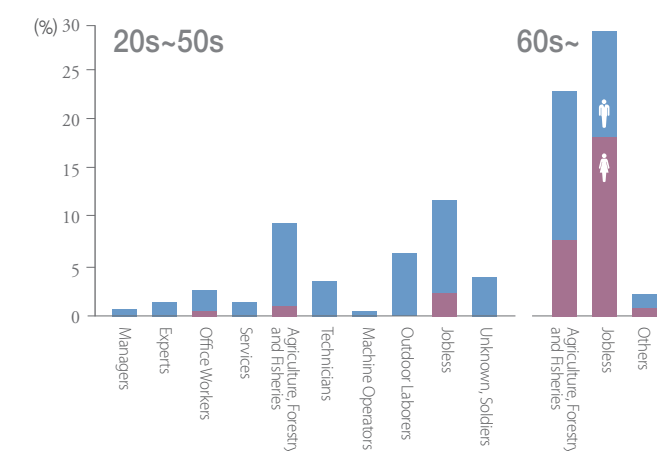
> Number of heat wave days and deaths from heat waves by period in summer



> Ration of deaths by gender



> Deaths from heat waves by occupation



Males rather than females · the elderly · workers in agriculture, forestry, and fishery are vulnerable members of the population

occupation. 67% of all the deaths from heat waves are men, twice as many as women. This unbalanced gender ratio mainly appears in ages in the 50s or younger people who work. The percentage of the aged (60 or older) in the total deaths from heat waves is 58.7%, which is over a half, and which is almost entirely unrelated to gender.

By occupation, workers in agriculture and forestry and fishery who are in their 60s or older account for about 22.4% of the total deaths from heat waves, which is very high. The age group below 60 has the highest percentage of jobless people at 11.7%. Jobless people include housewives, but actual jobless people who die from heat waves are mostly men, which suggests that many male homeless people must be included in this number. The occupations that had many deaths were workers in agriculture, forestry and fishery, outdoor laborers, unknown occupations, and soldiers, in that order.

To compare deaths from heat waves per 100,000 people, the southern provinces, including Gyeongbuk, Jeonnam, Gyeongnam, and Jeonbuk, showed high numbers among the provinces. Among the seven metropolitan cities, Daegu and Ulsan, which are also located in the southern region, showed high values. Some previous studies reported that the southern regions suffer less heat wave damage because the people have greater adaptability to high temperatures, but the regions with higher temperatures experienced more frequent cases of heat strokes and sunstrokes, which are directly influenced by heat waves. The areas that had the highest number of deaths from heat waves by population were Uiryeong-gun, Sancheon-gun, and Hapcheon-gun, which are all rural areas in the inland part of Gyeongsang Province where heat waves occur frequently.

The heat wave death rate in rural areas is ten times higher than that of cities, and health damage in cities arise at a lower temperature than that in rural areas.

When the highest temperatures are compared between rural and urban areas, the heat wave mortality sharply increased when the daily peak temperature rose above 33°C, which is the base temperature for heat wave warning (Korea Meteorological Administration), especially the death rate per head of population in rural areas was ten times as high as in urban areas. The urban areas were characterized by the fact that the mortality began to increase from 29°C, which is lower than that of rural areas. In the cities, the elderly living alone, people with mobility problems, and homeless people who were not in good health suffered health damage even in weaker heat. The major vulnerable group in rural areas was workers (especially elderly people) in agriculture who did not recognize heat wave alerts or who had to work in hot environments such as fields, paddies, and vinyl houses, even if they knew about the heat wave alert.

Because weather anomalies occur frequently due to climate change and the elderly population who are most vulnerable to heat waves is rapidly increasing, large-scale heat wave damage such as that which occurred in 2003 in Europe are feared in Korea in the near future. In Japan, which has the most similar geographical, climatological, and sociocultural environments, the percentage of the aged population has increased to 24% (Korea is forecasted to reach 24% by 2030), and 1,718 people died from heat stroke and sunstroke in 2010 when serious heat waves lasted for an extended period.

Loss of lives frequently occurs in rural areas on days when heat wave alerts are issued. The education of rural residents about the dangers of heat waves should be reinforced.

Therefore, accurately identifying domestic heat wave damage and setting up and carrying out appropriate measures for them is a matter of urgency. According to findings from this article, damage can occur from relatively lower temperatures in urban areas; therefore, it is necessary to reinforce welfare measures such as cooling centers and elderly helpers, which are in operation now. As damage often occurs due to outdoor labor on days when heat wave alerts are issued in rural areas, even though welfare measures are important, more emphasis must be placed on education and publicity measures, such as education programs for elderly people in rural areas, on the dangers of heat waves and effective heat wave alert systems.



Picture of education of rural residents about the dangers of heat waves



HEALTH RISKS OF HEAT WAVE

Sangil Jun

President of the Korea Institute of the Environment and Health



Heat waves are fearful because they are not just temporary weather events, but ones that cause substantial damage, both tangible and intangible. Health damage is the most distinctive and significant. When exposed to hot environments such as heat waves, humans try to maintain a normal body temperature by actively discharging heat. The 'external temperature detection sensor' of the skin is activated and temperature information is transmitted to the body temperature control headquarters, which issues the command to expand the skin blood vessels and increase blood circulation through the skin. As a result, the skin temperature rises and the body heat discharge increases through the radiation phenomenon. If the body recognizes that it is difficult to maintain a normal temperature simply through heat discharge, it releases additional sweat to lower temperatures. One cc of sweat has the effect of releasing heat of 0.58 kcal.

Heat waves can harm everyone, regardless of gender and age, but some people are more vulnerable to them than others. The elderly belong to the most vulnerable group be-

It needs to be recognised that heat waves are the cause of terrible diseases

cause their body temperature controls, cardiovascular system functions, and their perspiration functions are weaker. When the record-breaking heat wave hit Korea in 1994, most people who died were those aged 70 or older. The elderly are also disadvantageous in that many of them are socio-economically weakened. The housing structures and living quarters of poor elderly people make them more vulnerable to heat waves. It is not easy for them to use means for avoiding heat waves, such as air conditioning, and the increasing number of the elderly living alone is another risk factor. The Harvard Study that analyzed 30 million coronary death cases for 55 years revealed that the mortality of people living in houses well equipped with heating and cooling facilities was low.

Heat waves in early summer when it is before the body acclimatizes to high tempera- tures are more dangerous



People with cardiovascular diseases are more likely to suffer serious damage such as death from heat waves because the cardiac output increase and the pulse gets faster while the body is trying to lower temperature, which burdens the heart. Furthermore, heart disease patients have a high risk of dehydration because they often take diuretics. There are some heart disease drugs that prevent the heart rate from becoming too fast, thus preventing the body cooling system from working properly. In fact, in 2003, many people who died from heat waves had cardiovascular diseases. Hypertension patients who must reduce the ingestion of salts have a high risk of heat stroke because when the salt concentration in the body is low, heat stroke can happen in a lower temperature. Diabetic patients have a higher risk of dehydration if they fail to control their blood sugar and when they are dehydrated, perspiration does not occur normally.

People with multiple sclerosis experience worsening symptoms when they are exposed to high temperatures. Multiple sclerosis is a disease that makes the body become gradually hardened and paralyzed. Patients with multiple sclerosis must take special care not to be exposed to high temperatures. People with mental diseases, such as anxiety disorders, also belong to the high-risk group for heat stroke because the tranquilizers that they take interfere with the body's effective release of heat.

Patients with lupus, an autoimmune disease, have rashes, a sense of fatigue, and joint pain when exposed to strong sunlight. To prevent the skin from being exposed to sunlight, they must wear long trousers and long sleeves and a hat even in summer and frequently apply sunscreen lotion. Heat waves are not welcomed by asthma patients, either.

Although the high temperatures do not directly aggravate asthma symptoms, the concentration of various allergy materials in the air that can worsen asthma symptoms increases. If temperature rises, ozone concentration increases, and after the Changma season, mold spores increase sharply, which can worsen asthma symptoms. Ozone enters the body through the respiratory organ and stimulates the mucous membrane, which may lead to various respiratory diseases and aggravate asthma symptoms.

Obese people are afraid of heat waves. When you put on fat, the ability to send blood to the skin drops and the body heat release is not smooth due to the presence of thick subcutaneous fat cells. Additionally, babies also belong to the vulnerable group because their ability to discharge heat is weak. Alcoholics and drug addicts are at risk because their ability to respond to heat waves is poor.

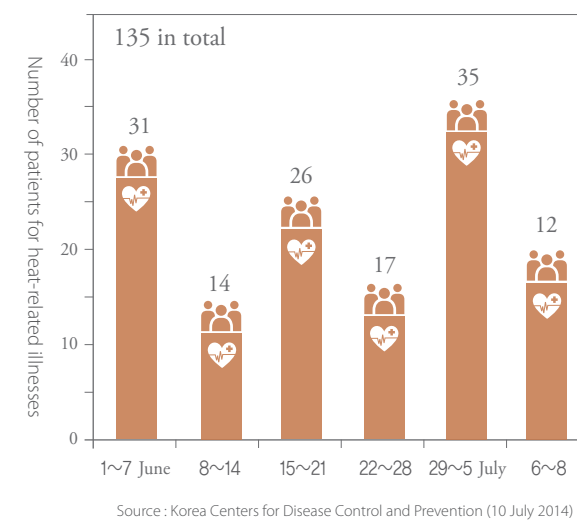
The existence of weak group to heat waves suggests that heat wave management system must be customized. The government should prepare special policies to protect the vulnerable groups.

The timing of heat waves is also important. Sudden heat waves in early summer are more dangerous. When we are exposed to high temperatures while enjoying the spring weather, we are not yet adapted to high temperatures. Many people died from heat waves in Saint Louis in the USA in 1980, but when the same area was hit by heat waves in 1995, the damage was not significant. The reason for this was speculated to be the later start of the heat waves in 1995 compared to 1980.

When people are suddenly exposed to high temperatures, their perspiration speed may be slow, but their skin temperature, rectal temperature, and heart rate increase. If they



> Health Damages from Heat waves in early summer
(1 June~8 July 2014)



continue being exposed to high temperatures in this condition, their tolerance reaches the limit, and their heart rate, rectal temperature, and skin temperature return to normal, but perspiration speed increases. This phenomenon is called 'adaptation' or 'acclimatization'. The perspiration rate of most people who are not acclimatized does not exceed 700 cc per hour, but it can increase to 2 L per hour after they are exposed to high temperatures for 1-6 weeks. The larger sweat pores of people living in hot regions than those of people living in cold regions are associated with this. Furthermore, when people are acclimatized to high temperatures, the hormone called aldosterone is secreted at higher levels, which decreases the salt concentration in sweat. Even if people shed the same amount of sweat, those who are acclimatized to high temperatures have lower amount of salt loss. In this regard, Korean people are more vulnerable to heat waves than those in tropical regions because people in tropical areas are physiologically and culturally better adapted to high temperatures at ordinary times. Even though it depends on the person, at least 1-2 weeks are required for acclimatization to high temperatures. At the end of summer, our body is acclimatized to high temperatures to some degree and heat waves are less difficult to cope with than they are in early summer.

COUNTERMEASURES TO HEAT WAVES DUE TO ABNORMAL CLIMATE AND THE REINFORCEMENT OF CONNECTIONS WITH THE URBAN RESTORATION PROJECT

Seung-Wook Han

Metropolitan Policy Research Division, Busan Development Institute

Damage from heat waves is becoming more serious in urban areas. Vulnerability to heat waves appears in different patterns by city. In metropolitan cities in particular, losses of lives due to heat waves are occurring extensively. The reason for this is the heat island effect, by which the temperatures in urban areas are higher than in suburban areas. The size of cities is closely related with stronger heat island effects. The damage of heat waves is particularly centered on those areas where the elderly, babies, patients with chronic diseases, low-income groups, and foreigners reside.

Larger cities experience greater damage due to the heat island effect.

In Busan, average summer temperatures increased by about 1.4°C over the last ten years due to the effects of climate change. In August 2013 in particular, the average peak temperature and the number of heat wave days recorded the highest in the country at 32.1°C and 13 days, respectively, and the tropical nights continued for 20 days. As the heat waves continued, Busan City raised a heat wave alert for the first time after holding a heat wave countermeasure meeting of eleven related agencies. They organized a task force team with the Disaster and Safety Officer of the Disaster and Safety Countermeasures Headquarters. They secured 856 Cooling Centers and implemented measures to prevent

damage to those most vulnerable to heat waves, including the old and weak and people with mobility problems.

For specific preventive measures, they established the Emergency Care Headquarters at the Health and Hygiene Departments of cities, gus, and guns, emergency care and rescue systems to prepare for heat wave damage so that emergency patients could be quickly transferred and receive appropriate care. Furthermore, they recommended the operation of Heat Break for the hottest hours from 2 p.m. to 5 p.m. during which the old and weak refrained from going out and students and construction workers took breaks. In addition, a visiting healthcare program was actively promoted according to which disaster helpers and public servants sent text messages to or called the elderly living alone and people with mobility problems to check their health condition. For homeless people and residents of dosshouses, they increased patrols in the concentrated areas of homeless people to 2 to 3 times a day and operated a field response team. Private companies and related agencies also donated 3,600 fans.

However, the heat wave countermeasures of Busan City revealed a few problems. The first was the problem of the organization that carries out the heat wave measures. The task force team with the Disaster and Safety Officer is operated temporarily in summer, and it only has around ten mem-

The poor residential environment of those vulnerable to heat waves aggravates damage.

bers, which is insufficient to take charge of the entire city of Busan. Furthermore, they have limitations because they cannot control other departments when carrying out their heat wave measures. Secondly, there is no comprehensive plan for heat waves that are expected to occur every year. The present heat wave countermeasures are to deliver the General Plan for Heat Waves of the National Emergency Management Agency to gus and guns, which is a kind of after action and does not reflect the characteristics of Busan City, which is vulnerable to heat waves. The third problem is associated with the designation and operation of Cooling Centers. At present, the places closest to the living spaces that are easily accessible by the vulnerable people are to be used as Cooling Centers. However, there is no analysis or assessment of the type of shelter, the presence of air conditioners, occupancy, and accessibility. Many senior citizens centers and social welfare facilities that are used as Cooling Centers have been stopped because there is no basis for supporting the power expense, and the public agencies and supermarkets which can serve as alternative shelters are finding it difficult to play their role due to the power regulations of the government.

The fourth and final problem is associated with the poor residential environment of those areas where vulnerable people are concentrated. The decrepit areas that are classified as vulnerable areas to heat waves have many illegal houses, which are mostly not well insulated from heat and do not have cooling equipment such as air conditioners. Moreover, green spaces around them are insufficient, and Cooling Centers are far from them or have steep slopes making it difficult to approach them. They are placed in this poor physical environment that is vulnerable to heat waves. In particular, those living here include many people who find it difficult to actively cope with heat waves, such as low-income groups, the elderly, the disabled, and one-person households. There are limitations faced by disaster helpers to manage them solely through text messages and calls.

In order to prepare comprehensive measures to reduce heat wave damage, urban planning measures to organize disaster prevention infrastructure for reducing heat island effects and responding to abnormal climate conditions are required, as well as emergency healthcare in the event of heat waves. At the city level, green spaces in the downtown area must be expanded to control temperature. At

the community level, infrastructure such as street planning in consideration of wind paths and the expansion of roads with low radiation rates need to be expanded to reduce the percentage of mechanical cooling devices in development and downtown areas. In addition, the rooftops and walls of individual buildings should be afforested and for buildings for which this is difficult, paints with heat insulating effects to prevent rising indoor temperatures can be an effective means of relieving heat wave damage. Furthermore, information about the urban places where the vulnerable people are concentrated and their social attributes needs to be analyzed and actively reflected in future urban planning.

Comprehensive response measures to heat waves using urban planning techniques are urgently required.



While applying the heat wave measures to urban planning may be difficult in the short term, heat wave measures could be introduced together with the urban restoration projects that are being pursued by various local governments. Most of the urban restoration project sites are lagging areas in the cities, and the demographic attributes of the target sites overlap with those people most vulnerable to heat waves. Therefore, when urban restoration projects are carried out, proper techniques to reduce heat wave damage should be actively introduced in community unit projects and in the process of remodeling individual buildings. Damage from heat waves in cities will continue. Therefore, each local government should consider comprehensive heat wave countermeasures that actively use urban planning techniques as fundamental and structural response measures to heat waves.



HEAT WAVE RESPONSE POLICIES OF THE GOVERNMENT

Gyeong-Woo Hong
Manager of the Climate Change Response Department,
National Emergency Management Agency

Joint preparation of the 'General Response Plan to Heat Waves' of the relevant agencies

To prevent and minimize heat wave damage, the Ministry of Health and Welfare, relevant government agencies including the Ministry of Employment and Labor, and the Ministry of Agriculture and Food and Rural Affairs, and local governments have jointly prepared and have been carrying out the General Response Plan to Heat Waves (June d September) at the level of the Central Disaster and Safety Countermeasures Headquarters since 2005. As many elderly people die while working on the fields and paddies, farmers are being trained and informed about the heat wave action guidelines through cultivation training courses at the Agricultural Technology Center. At the same time, they decided to utilize such media as electronic display boards, street broadcasting, and village amplifiers, and reinforce publicity and patrol activities for farming workplaces in rural areas in connection with the crime prevention and public order activities of local police forces.

> Measures against Heat waves

Important measures	Description	Agency name
Establishment of a heat wave status management and response system	- Organization and operation of task force teams in related agencies and local governments - Propagation of action guidelines for the public during heat wave alerts (disaster text broadcasting, CBS, etc.)	Central Disaster and Safety Countermeasures Headquarters
Heat wave information delivery system	- Heat wave alert text service (SMS) to related agencies and local governments	Korea Meteorological Administration, Local governments
Operation of Heat Break (14:00-17:00)	- Encourage the elderly, students, farmers, soldiers, and workers to take a rest during heat wave hours - Train and publicize action guidelines during heat waves	Agencies, Local governments
Designation and operation of Cooling Centers	- Places near the daily living spaces that are used frequently by the elderly - Let disaster helpers visit Cooling Centers often, publicizing and educating people on action guidelines during heat waves. * Designated Cooling Centers in 2014: 36,000 places, including senior citizen centers and town centers	Local governments
Special protection and management of vulnerable people	- Designation of visiting nurses, managers of the elderly living alone, and village foremen as disaster helpers to protect vulnerable people (safety checks through phone calls and visits, education and publicity) * 93,000 disaster helpers in 2014	Ministry of Health and Welfare, Local governments
Operation of a heat wave damage monitoring system	- Operation of a heat wave damage monitoring system at emergency medical centers across the country (over 560)	Ministry of Health and Welfare, Korea Center for Disaster Control and Prevention
Promotion of countermeasures to heat waves in kindergartens and elementary, middle, and high schools	- Restrict outdoor activities and review closures of schools in the event of a heat wave alert	Ministry of Education
Promotion of safety measures for workplaces vulnerable to heat waves	- Administrative instructions to prevent health problems from heat waves, such as the provision of water and shaded areas and the operation of heat wave break times	Ministry of Employment and Labor

Construction of 119 emergency rescue systems in preparation for heat waves	- Every emergency service is on standby to mobilize with related equipment in the event of a heat wave alert. * 7,883 emergency service members and 1,280 ambulances	National Emergency Management Agency
On-site technical support to prevent heat wave damage to agricultural and livestock products	- Mobilize the on-site technical support teams of the Rural Development Administration and local governments, provide guidance on crops and stock keeping, and the operation of a disaster response operation room for speedy recovery	Ministry of Agriculture, Food and Rural Affairs, Local governments
Safety measures for vulnerable sections of high-speed railways, etc. to prevent train accidents	- Rail temperature detection and deployment of guards to vulnerable sections, regulation of train operation in high temperatures, and water spraying	Ministry of Land, Infrastructure and Transport
Patrol activities to prevent damage from heat waves at farming workplaces	- Patrol activities for farming workplaces in rural areas in connection with the crime prevention and public order activities of local police forces - Education of local police and outdoor service police, such as traffic police, on the emergency treatment of heat wave patients	National Police Agency
Intensive publicity activities for action guidelines in response to heat waves	- Publicize heat wave action guidelines through the media, broadcasting stations, electronic display boards, Internet (SNS), Safety Didimdol (smart phone app), etc. - Broadcast of heat wave warnings through village amplifiers, street broadcasting, and civil defense alarms	government agencies, Local governments

To prevent heat wave damage, it is most important to memorize and practice the action guidelines to heat waves at ordinary times. You should listen to weather news in summer, and refrain from going out when a heat wave alert is issued. If you have to go out or work outdoors, drink water often and rest in shaded areas. You can stay healthy in summer by acting wisely in preparation for heat waves. You can check the action guidelines for people in response to heat waves through the 'Safety Didimdol', a smart phone app of the disaster and safety portal of the government



> Action Guidelines to Heat Waves

Refrain from sports or outdoor activities during the middle of the day when the sun is hot, and dress casually when going out. The elderly, physically weak persons, and patients who have mobility problems should not go outdoors.

If you are in the fields and paddies or construction sites during the day, **take a rest in shaded areas frequently and drink sufficient water.**

Drink water often and do not drink beverages that are sweet or contain caffeine or alcohol.

Check everyday the weather news related to heat waves through the radio or TV.

If there are any old or weak people or children in your neighborhood, family members, or relatives who are vulnerable to heat waves, **call or visit them often to check on their safety.**

Do not leave old and weak people or children **alone** in a car.

Immediately call 119 if you suspect or witness a heat wave emergency patient.

Disaster and Safety Information Portal 'Safety Didimdol' (Disaster and safety information portal app of the government, 'Safety Didimdol') - Integration, interconnection, and sharing of fifteen disaster and safety information applications from eleven organizations - Disaster reporting service (119, 112, etc.), disaster information service (disaster text alert, disaster information search), and action guidelines for the general public (first aid method, action guidelines), etc.

CLIMATE CHANGE ADAPTATION RESEARCH

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A Study of Factors Influencing the Estimation of Future Disease Burdens ; Focused on High Temperatures Resulting from Climate Change

Estimation of future disease burdens due to environmental risk factors is very important because it can be used as the scientific basis in the establishment of mid- to long-term environmental health policies. Many different environmental risk factors according to climate change are being discussed. Among them, the increasing frequency and strength of heat waves in summer are known to be direct health factors and the greatest health burdens. Many health impacts of heat waves and high temperatures in summer have been reported, but studies on the health impact of future heat waves due to climate change are insufficient. Therefore, this study was conducted to investigate the future social and demographic influencing factors to estimate the disease burden of future heat waves and methods (or methodology) to improve them and use them as the basic data for the scientific grounds for the establishment of future climate change health adaptation policies. This study consists of three main parts: first, an estimation of the future health burden according to domestic and international climate change; second, an examination of future socio-demographic factors that must be considered when estimating the disease burden of future heat waves; and third, a methodological improvement in consideration of such future socio-demographic factors.

The main problems in the estimation of health effect of future heat waves due to climate change are the complexity of health impact paths and the corresponding uncertainty. Until now, many studies have estimated excess mortality due to future heat waves, but there were no special guidelines related to the estimation of any future effects.

However, as important influencing factors, the degree of health impact and adaptation of heat waves at the current level, the degree of future temperature rises, health levels of future population members, and the degree of excess

deaths due to future deaths according to the changes in future demographic characteristics must be considered. Another characteristic that must be considered in the assessment of health impacts of climate change is the appearance of climate change over the long-term. Therefore, future deaths from high temperatures in summer may differ from present levels.

Climate change is known to increase deaths due to rising temperatures in summer, and the increasing population of the elderly in communities can increase mortality by increasing the sensitivity of the population. On the other hand, the improvement of socio-economic levels, including the qualitative improvements of residential spaces and urban planning and various adaptation measures, can decrease the mortality

*The factors influencing health
in relation to future heat waves
vary by the degrees of any tem-
perature rise due to climate
change, health levels of the pop-
ulation, changes in demographic
characteristics, improvement of
socio-economic levels, and level
of adaptation to climate change.*

rate from high temperatures. Judging from this, the health impact assessment of climate change requires an examination of the future social and demographic influencing factors due to climate change. Furthermore, in estimating the excess deaths due to future heat waves, the degree of the effect on deaths due to heat waves of the present level is used as the baseline effect for the estimation of excess deaths exposed to future heat waves due to climate change. Therefore, the degree of impact of current heat waves on deaths can have a great effect on the estimation of excess deaths from future heat waves. However, the baseline effect of deaths from current heat waves may decrease due to the (natural and artificial) adaptations of the population. If this is not taken into consideration, excess deaths from future heat waves due to climate change will be estimated excessively.

Climate change will gradually increase exposure to heat waves in the future, and this will lead to an increase of excess deaths. However, as various degrees of temperature rises due to climate change are being estimated according to the greenhouse gas emission scenarios, the number of excess deaths from future heat waves can be estimated to be of varying levels. Therefore, in this study, the degree of future temperature rises due to climate change was considered on the basis of greenhouse gas emission scenarios. In addition, the changes in population and population structures can impact the estimated number of excess deaths, even if people are exposed to the same level of heat waves in the future. The changes in population and population structures in this study used the estimations of the related government agency, and the disease burden (or death burden) was calculated for a direct comparison of the excess deaths between the present and the future. If the health level of the future population is low, the excess deaths from exposure to future heat waves will increase, and the health level can vary



depending on social conditions, including the development of medical technology, the economy, and health infrastructure, as well as any changes in population structures.

The fact that various influencing factors must be considered in the assessment of health impact by climate change implies that the final results have uncertainty. Furthermore, the disease burden estimation results of future heat waves performed at present can change as the related data are updated in the future. In general, when the results of a study for policy use have uncertainty, the policy makers will hesitate in the establishment and implementation of the policy. However, if there is unavoidable uncertainty, it is best to present the factors (or influencing factors) of the uncertainty and clearly show the results that may occur according to the uncertainty.

Tropical Fruits Made in Korea

Recently, tropical fruits were sold out in a department store. They were passionfruits produced in Daejeon, used as ingredients for drinks and jams. This fruit with a name that is still unfamiliar to domestic consumers is originally from Brazil and is a representative tropical fruit. Domestic consumers had to buy frozen products until a few years ago, but they have been successfully cultivated recently in Jeju, Jangheung, and Daejeon. As a result, we can now taste domestic passionfruit.

In fact, we can taste not only domestic passionfruit, but also other domestic tropical fruits such as bananas, kiwis, mangos, avocados, and papaya. Starting with Jeju Island with a subtropical climate, many areas around the country are actively cultivating various tropical fruits. Only a few tens of years ago, they believed that the cultivation of tropical fruits was difficult in Korea except on Jeju Island, but now the upper limits of their cultivation has been moving northward, even to Gyeonggi-do and Gangwon-do. What made it possible to produce tropical fruits, which once had to be imported, in Korea?

Global warming. To be sure, the development of cultivation techniques should have supported this, but the rising average temperature of Korea had a noticeable effect. The earth is getting warmer faster than at any other time, and Korea is not an exception. According to the Korea Meteorological Administration, the average temperature of Korea rose by 1.8°C over the last 100 years. The temperature of the earth had not changed by more than 1°C for 10,000 years, but the average temperature of the earth rose by 0.85°C over the last 133 years. Compared to this, the Korean climate is undergoing great change. The length of the Korean summer, when the daily average temperature is 20°C or higher and the daily peak



temperature is 25°C or higher, increased by at least 10 days in 2010 compared to 1980s.

The most affected by the warmer climate of Korea must be the agricultural industry. Korean farmers are working to cope with the changing climate by changing their crops. As tropical fruits emerge as new sources of income for farmers, fruits which they selected to adapt to global warming, they have high expectations that climate change may provide new opportunities for farmers. However, they should note one thing: the cultivation of tropical fruits can be a potential handicap for Korean agriculture. For example, a New Zealand kiwi fruit producer who developed the gold kiwi species is receiving over 3 million dollars in royalties from the cultivation of 100 ha on Jeju Island. For most tropical crops that are cultivated in Korea for the first time, Korean farmers have to pay high royalties to buy seeds or seedlings. If they are deprived of this by foreign companies in the process of settling new species in Korea, Korean farmers will be worse off. Local governments are making efforts to develop tropical crops as local specialties, but steady research and support is essential for tropical crops to be established as new high-income sources for farmers. There is a lot of attention being paid to whether the production of tropical fruits will be a win-win between consumers who want more diverse choices and farmers who are suffering from global warming.



KACCC NEWSLETTER · 2014 Vol.1

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