B-10.3 Effects of Global Warming on Health and Lifestyle in Asian-Pacific Region

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Abstract

We predicted mortality risk by global warming using statistics of 1972-1995. The relationship between daily maximum temperature and daily mortality was confirmed to show clear V-shape in 65 years old and over when the daily maximum temperature exceeds 33 degrees in Celsius. Chronological changes between three phases (1970-79, 1980-89, and 1990-95) showed simple shift of the bottom in V-shape to the right in Hokkaido, but lowering of deaths at 33 degrees and over (from V-shape to L-shape) in Kyushu and Tokyo during last two phase (1980-89, 1990-1995). It suggests the possibility of different adaptation to global warming. Prediction of the future health risk by GIS specification was done based on the temperature-death rate model (Honda, 1995). However, the analysis of more complex effects other than death, which change by time and location, and of factors in urban environment. As a trial we will select proper indices of solar radiation and heat load and develop models of dynamic changes including both individual and environment.

On the other hand, it is difficult to get precise death statistics with death cause in Thailand, we collected individual death records accompanied by date and cause from major hospitals in and around Bangkok. Because of most death causes are sepsis due to tropical infections and delayed treatment, and poor seasonal and daily change in ambient temperature, it is difficult to evaluate temperature effects and to find strategies to reduce deaths.

We studied spectrum analysis of the R-R interval deviation of the ECG (analysis of R-R interval) to identify the response of elderly men (60-75 years old) under heat stress. They showed clearly decreased responsiveness to adapt autonomic nervous system to heat stress compared with young men of 20 years old, though changes in other physiologic parameters (rectal temperature, blood pressure, heart rate, skin temperature, and perspiration) were not consistent. It suggests that elderly people have poor subjective sensation against heat stress, lack of more sympathetic tone than parasympathetic tone or even rather reversed balance which indicate the presence of subgroup with absence or prolonged delay of normal adaptation mechanism shown by young people. In addition, in Thailand and Japan, we are analyzing adaptation mechanisms against global warming based on these indices under daily living environments.

Studies in this phase, from above results, we can say that elderly people are high risk group against global warming, and estimation of health risk of global warming in Asian countries in tropical region is requested new methodology due to the difference of death structure and age structure of population as the research object in the future.

1. Introduction

The risk of sustaining health and survival against global warming and their strategies were assessed from the five aspects, that is, (a) shifting the study from health effects to health risk, (b) surveillance and development of risk indices, (c) gathering risk-relevant informations, (d) risk analysis, and (e) risk prediction and presentation of risk strategies.

2. Research Objective

This study aimed to clarify the effects of global warming on health and lifestyle in Asian-Pacific region, which was directed more into the population effects in tropical countries and their lifestyle as the comparison with the results in Japan (1990-1995).

However, through the surveys, data collection, and their analyses, we understood that the risk-oriented approach was more important and clearly focused than effects-oriented approach. Because, various differences in social and cultural conditions control more strongly the exposure and the endurance to the temperature environment at individual level (described as the risk) than geographic and meteorological conditions at population level (described as effects). Thus, we reorganized the results from the viewpoint of describing health risk.

3. From Health Effects to Health Risk

Human beings have tried to make the natural environment comfortable for daily living. Global warming can be regarded as one of such results and requests us more rational strategy for temperature comfort in the history of human evolution. The factors which decide the strategy should be divided into ① energy saving to eliminate the cause of global warming, ② control of living space mostly via air-conditioning (temperature, individual variation, exposure period)、③ physiological adaptation (generation, work and urban life). For case ②, however, there are problems in personal deviation of the temperature comfort and period under control, and for case ③, there are so many factors relating to the problems of long-term adaptation beyond generation in addition to short-term adaptation, and the difference in work conditions and lifestyles between urban and rural living. In addition, the important fact is that we don't understand so well the temperature environment of the spaces where we live and behave ourselves, as to know health effects and strategy against them, and to judge rationally what we should study and suggest. Due to this uncertainty, there are diverse variation of basic recognition and judgement between researchers, administrators, and general population and there are so many predictions on what will develop in the future. These necessarily make us turn from effect study to risk study.

Working groups of IPCC has reported health effects from relatively macroscopic view based on region (McMichael et al.: Climate change and Human Health, WHO, 1996), and Bentham and Sevak specifically analyzed the effects of 1995 heat-wave in U.K. (Paltikof,JP, et al.: Economic Impacts of the Hot Summer and Unusual Warm Year of 1995, Department of Environment, UK, 1997). On the other hand, Gendritzky applied fine

diversity of the temperature sensation related with the height from sea level as mesh data of living zone urban planning in Germany (Applied Urban Climatology and Stadoekologie, Deutscher Wetterdienst, 1997). We analyzed national death statistics, measured personal temperature environment, and surveyed health effects under climate and social conditions of tropical Asia (Ando, M. ed.: Study on human living environment and risk by global warming, Agency of Environment and NIES, 1996).

Human beings has never exposed simply ambient temperature, instead it is followed by behavioral adaptation and adaptation through man-made environment controled by comfort which changes by time. Based on these consideration, the study of 1996-1998 was focused on analysis of health risk of global warming by comparison of living environment in Japan and Thailand. Though, geographic, socio-economic, technologic, and cultural differences contribute to them so largely, homogeneous value systems and lifestyles seem to make rather similar living behavior and environmental problems.

As the first phase, we focused our survey on what is compared, how different or similar. The analysis is undergoing in part and assessment and suggestion on health risk by global warming require future study. However, at least we can expect to know the modernization and urbanization of the region suffered from chronic heat and to serve as one of the prerequisite to judge what are similar to those of Japan and utilized to simulate the state of future warming in Japan.

4. Indices of Risk Assessment

This study aims to make clear the risk related with concept of health effects (health risk) by global warming, and the characteristics of the subjects and problems in social populations. The health risk should be reasonably divided into three stages; risk at macro-level (prediction of ecological effects on biosphere, land and water resources in the region, and on human environment for survival), risk at micro-level (personal comfort in living environment, behavioral selection, physical state, etc.), and integrated risk assessment of both (mutual relationship between risk factors and total evaluation).

Though the integrated risk assessment may be possible to do through the development of risk prediction described later, it is impossible to discuss individual issues at present. Rather it is practical to assess how the living condition and social system may relate with health effects, we should focus on the methodology to develop indices of risk assessment. Risk indices available at present are personal physiologic indices such as fluctuation of R-R interval of ECG and energy consumption which reflect the heat load and stress. At population level, the difference in conditions of disease recognition, treatment behavior, medication environment under appropriate medical system may effect on health, and the interaction of these differences will reflect on the long-term structure of diseases and deaths. Therefore, the development of analysis method to detect these differences from actual data and measurements is practical object. Based on them, we must clarify the risk mechanisms of various diseases and deaths by global warming, and characterize the priority difference of prevention strategies between countries and localities, as the prerequisite of practical decision making.

We studied spectrum analysis of the R-R interval deviation of the ECG (evaluation of the autonomic nervous system, analysis of R-R interval) to identify the response of elderly men (60-75 years old) under heat stress in an artificial temperature room (room temperature of 25 and 35 degrees in Celsius, relative humidity 50%). They showed clearly

decreased responsiveness to adapt autonomic nervous system to heat stress (LF/HF ratio) compared with young men of 20 years old, though changes in other physiologic parameters (rectal temperature, blood pressure, heart rate, skin temperature, and perspiration) were not consistent (Figure 1). It suggests that elderly people have poor subjective sensation against heat stress, lack of more sympathetic tone than parasympathetic tone or even rather reversed balance which indicate the presence of subgroup with absence or prolonged delay of normal adaptation mechanism shown by young people. It should be regarded as risk of death by heat wave and in patients of circulatory diseases, which can be prevented by diagnosis and examinations. We are analyzing the relationship between temperature environment and R-R interval of elderly people during daily life including outdoor works such as removing illegal pooled bicycles and road sweeping. In addition, we plan to evaluate adaptation ability of autonomic nervous system for different age and sex groups with various living environments.

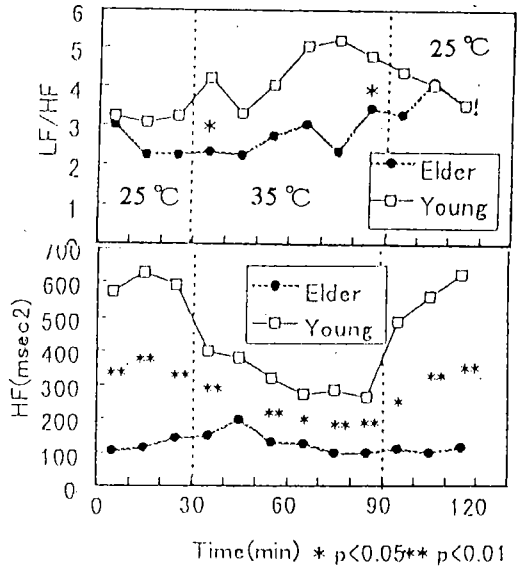

Fig.1 Changes in HF and LF/HF

We also study the relationship between data of R-R interval and temperature environment during daily living and work for people living around Bangkok in Thailand (Manomaipiboon et al, 1998). These subjects indulging in indoor office work and outdoor works had so different heat exposure according to the state of air-conditioning, work period during day or night, and vehicles of transportation. As the next step, we will analyze how they adapt to heat with different stress levels and behavior pattern by age groups. It is required to develop methodology to speculate if they will suffer from more serious effects by global warming who live in pre-existing hot region of Asia.

On the other hand, in health effects via global and regional environmental changes, ambient temperature will never become direct parameter of it but the mechanisms proper to each environment works mostly. In addition, temperature can not be measured at absolute scale like chemical agents but measured at relative scale, which seem to make it difficult to evaluate based on dose-response relationship (Tango, 1996). To escape it, if we can synthesize the load by temperature and solar radiation at time-space level using methods such as GIS and simulation modeling, it will be possible to quantify the complex phenomenon and express it as a practical health risk.

5. Collection of Risk-related Information

As the regional risk information, we can utilize national statistics and Internet information (Hyoi,1998), and domestic commercial database on specific themes such as heat wave death in parked cars (Takahashi, 1999; Kobkaew, 1999). In addition, as the informations related with living environment and behavioral selection, we can measure or collect data at various scales on living temperature, availability of air-conditioning in various spaces, consumption of electric power, statistics of moving and transportation (Sasaki, 1996). Though there is serious difficulty in coverage of data collection and load-down to routine monitoring for indices with high individuality such as living behavior

and health state, these informations condition the framework of database on risk information which has been discussed for several years.

6. Risk Analysis

The subject of risk analysis is to observe and analyze statistically the phenomena priority of controlling factors due to global warming and localized high risk groups by area, age, behavior, and other characteristics on the risks observed in death statistics and in living environment described before, then to make models of health risk for temperature increase. Analysis of domestic death statistics progressed earlier due to information availability, the time-series analysis of changes in living environment and temperature environment is still under development.

The foregoing studies of 1972-1990 confirmed mainly that daily maximum temperature (Tx) and death rate in 65 years old and over, showed V-shaped relationship. Present study added by data of 1991-1995 showed chronological change of three phases. That is, the basement of V-shape shifted simply to the right (increase in Tx) in Hokkaido (Figure 2), in Kyushu and Tokyo change in shape from V to L (lowering of death rate at 33 degree in Celsius) like Okinawa which showed it already during 1981-1990 (figure 3). It suggests the possibility of different mechanisms of adaptation to global warming (Honda Y, 1998 and 1999).

There are several limitations of statistical analysis; urban-rural difference, chronological changes of death place from homes to hospitals with different ratio by sex, age, and diseases, and lack of compensation against increase in death within air-conditioned hospitals. Development of the way to estimate mechanisms of environmental factors is delayed (Moji, 1994). From this viewpoint, the Nagasaki A-bomb exposed cohort had advantages that they experience hot summer, living in urban area with many slopes, well

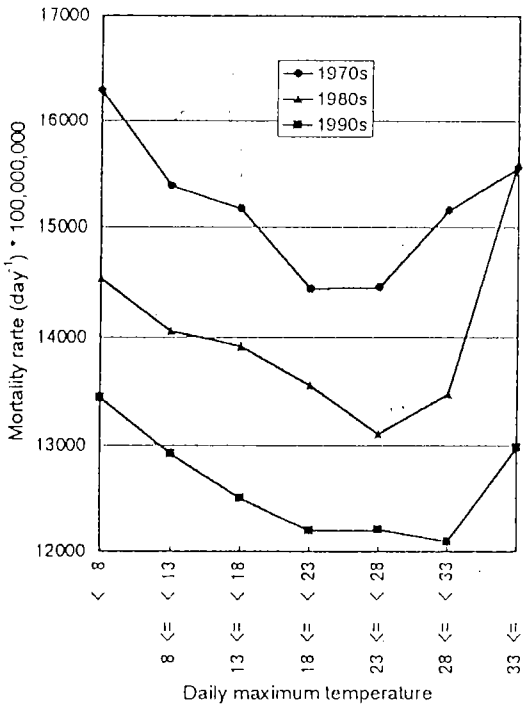

Fig. 2 Relationship between daily maximum temperature and mortality rate from all causes by era (Hokkaido, 65+ years old males)

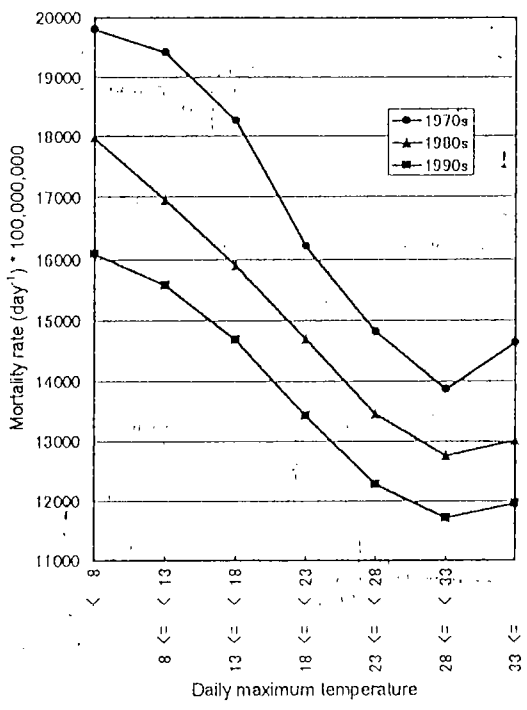

Fig. 3 Relationship between daily maximum temperature and mortality rate from all causes by era (Kyushu, 65+ years old males)

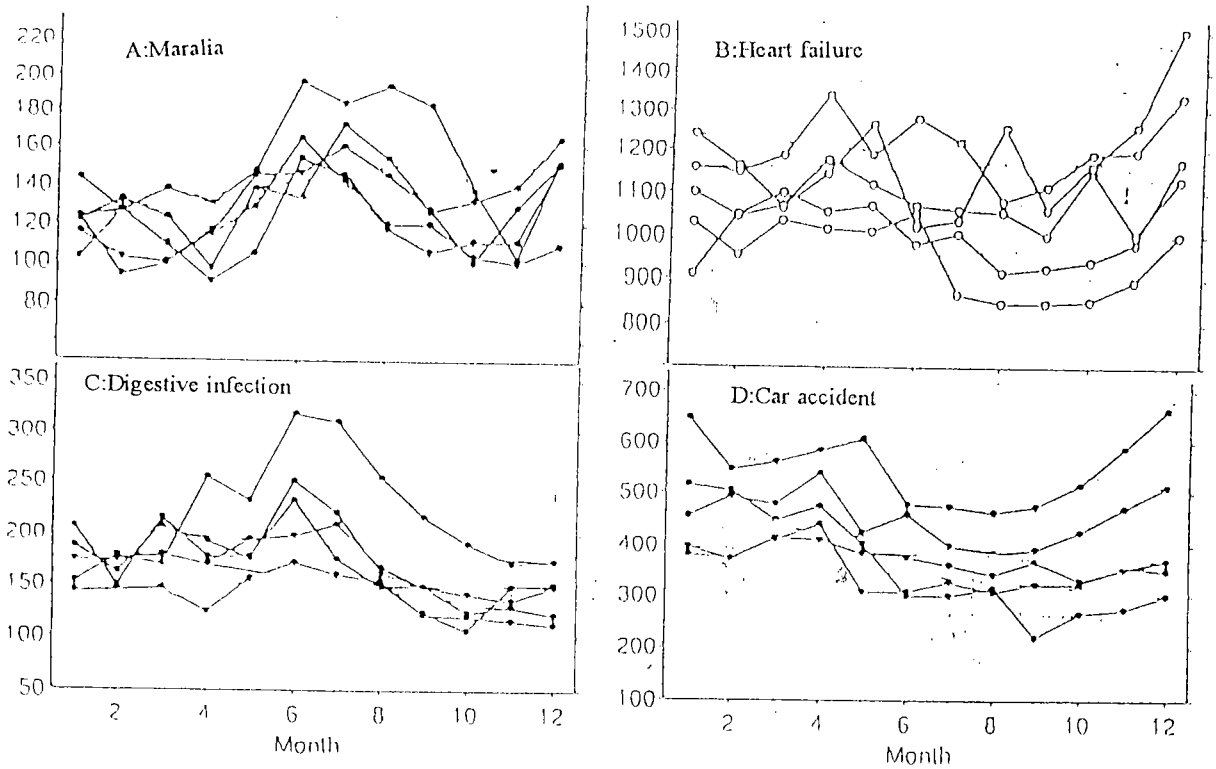

Fig.4 Monthly trend of deaths in Thiland (1986-1989) A:Maralia, B:Heart failure, C:Digestive infection, D:Car accident

observed by long data of examinations and medication, so that they could have resolved above problem (Honda S, 1997). However at present, the study is just describing the relationship between temperature and death cause which is basically the same as that of national statistics.

In addition, we analyzed deaths by car accident as a possible cause of death related with heat, and found the death rate showed different temperature dependence between south and north Japan (Mori et al, 1996). But, the mechanism of temperature effect could not be analyzed from the aspect of driver and else. We also surveyed individual deaths of small children by heat stroke within parked cars by the cooperation of National Police Science Institute for 1985-1998, and clarified the relationship between ambient temperature and accident risk (Takahashi et al, 1999). We could supply new view on the increased risk of moving and outdoor environments of cars by global warming, and methods of information delivery and understanding on it. It is expected that they could be identified as the issue of risk recognition as well as disease prevention described below.

On the other hand, it is difficult to get precise death statistics with death cause in Thailand, we collected individual death records accompanied by date and cause from major hospitals in and around Bangkok. Because of most death causes are sepsis due to tropical infections and delyed treatment, and poor seasonal and daily change in ambient temperature. Besides death structure in Thiland is very different from that in Japan (Figure 4). It is difficult to evaluate temperature effects and to find policy strategies to reduce deaths (Thong-Nop, 1997). We can not adopt the relationship in Japan and other developped countries which have clear temperature dependence in specific diseases, thus we should develop new analytical methods which is effective in this region. Because, in spite of reports on increased possibility of Malaria by vector propagation due to global warming,

we still lack the information on the temperature dependence of prevalence and treatment, especially worsening or elongation of expected death.

In this aspect, the previous study done in Papua-New Guinea highland showed that analysis of small children's deaths by mostly malaria, aside of living condition at 1000 m height from sea level, could not demonstrate the relationship with daily ambient temperature (Ohtsuka and Nakazawa, 1996). We need methodology to clarify how the temperature in tropical climate is related with death structure of different age groups. As the background of it, the information on dying in tropical environment lack in spite of preparation of international statistics, and we should survey more the relationship between lifestyle and living environment.

It is pointed that the increase of people with aging and some diseases will become major issue of medical treatment and public health. (Heyes, 1999). The risk of heat ware is demonstrated to be highest in elderly people by previous studies, the surveys difficult to get understanding and cooperation of medical and nursing sides for patients with chronic non-infectious diseases (hypertension, atherosclerosis, heart disease, and diabetes), even though they will become elder, because the problems of living environment to do treatment (going out, transportation for outpatients, sleep environment, and air-conditioning) are not overt yet. Foregoing survey on hospital health check showed that people with abnormality in several indices for non-infectious diseases prefer 1-2 degrees lower environment both in office and home that in those with normal subjects (Sasaki et al, 1996). It suggests that we must understand the effect of temperature against disease and treatment, based on the relationship between historical changes of human life and living environment and changes in health state.

7. Risk Prediction and Issues of the Presentation of Risk Strategy

Prediction of the future health risk by GIS specification was done (Harasawa, 1998) based on the temperature-death rate model (figure 5). However, the analysis of more complex effects other than death, which change by time and location, and of factors in urban environment. As a trial we will select proper indices of solar radiation and heat load and develop models of dynamic changes including both individual and environment.

The working groups of the third report of IPCC discuss the overall effects of adaptation, uncertainty, and fragility. However, it is difficult to generalize the effecting factors irrespective of national conditions in order to classify these effecting factors of population health at social level. More over, the presentations of risk and of remedies effect for planning risk strategy are required to get social consensus (to systematize risk prevention), but we are just at the entrance in this respect.

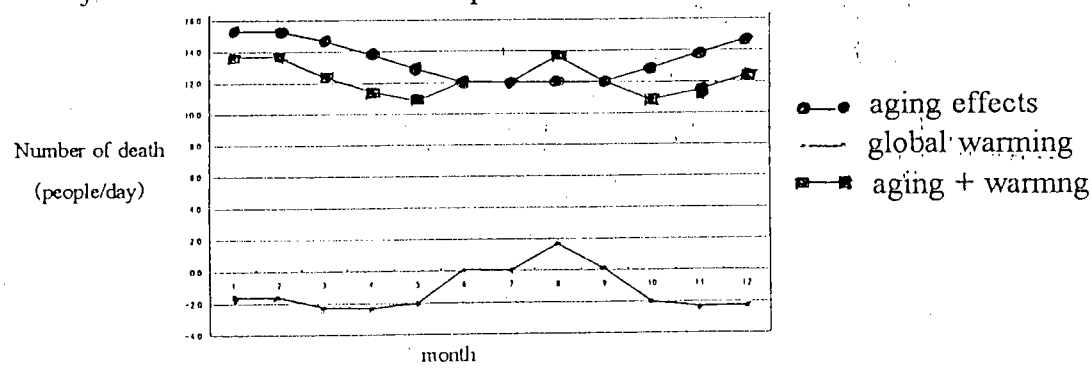

Fig. 5 Estimated total deaths of 65 and over in 2025 in I prefecture, Japan

8. Studies of Health Risk

Themes of these three years consists of five sub-themes as follows to which this article was described:

(1) The risk of sustaining health and survival against global warming and their strategies (Sasaki, A and Uchiyama, I)
(2) Risk prediction by GIS (Harasawa H)
(3) Analysis of death statistics in Japan (Honda Y)
(4) Analysis of death structure of Nagasaki A-bomb cohort (Honda S et al)
(5) Variation of the heart-rate in the elders during heat adaptation (Nagai Y et al)
(6) Living temperature and variation of heart rate-- comparison between Japan and Thailand (Manomaipiboon K et al)
(7) Hospital death statistics in Thailand (Thong-Nop L et al)
(8) Heat-related death of small children in parked cars (Takahashi M et al)
(9) Social infrastructure and risk information in Asia (Hyoi N)