CLIMATE CHANGE, HUMIDITY, AND HUMAN HEALTH IN JAPANESE COASTAL CITY OF SANIN

Luo H,*,1,2 Kurozawa Y,1 Li Y,3 Wang H,2 Nose T1

1. Faculty of Medicine, Tottori University, Yonago, Tottori and Global COE, RPRS of MEXT, JSPS, Japan;
2. Chinese Academy of Medical Sciences (CAMS) and Peking Union Medical College (PUMC), Beijing, China;
3. Capital Medical University, Beijing, China

Abstract

The affects of climate and human being each other are taken more and more attentions along with global climate change, in which environment factors are key points. The studies of symbiosis and sustainable developing health life are emerging challenges especially in longevous society. Japan is a modern longevous country and Sanin is a typically aging area in middle north of Japan. The relationships of bioclimates, meteorology and human life in Sanin cities were studied.

Sanin area, where faces to the Japanese Sea and backs onto mountain, is rainy and damp. Various weather, environment and human health factors had significant correlations each other, in which the correlation between environmental minimum relative humidity and human mortality was believed as an important discovery. The possible reason could be mold, insect, other allergens, bacteria and hygrophilous viruses such as enterovirus (polio etc) in association with rising air moisture especially after extreme storms which have been expected increasing in coastal and mountain areas with climate changes resulting in widespread indoor (main living environment of ages) moisture problems.

This study provided useful information for improving environment and health not only, but also for coastal urban designing to build symbiosis and sustainable developing society especially in modern longevous country.

Key words: Climate change, Minimum relative humidity, Health, Mortality, Coastal urban area, Longevous society, Kelvin effect

1. INTRODUCTION

It has been taken more attention that worming change of climate affects human health; while relative fewer studies about humidity especially humid in longer duration have been reported. Damp is a typical environment of coastal urban area, which has been prospected to more humid along with global climate change. It is an emerging study how humidity affects human health.

On the other hand, Japan is a modern longevous country and moving distance of senior is limited in local area. Symbiosis and sustainable developing health and longer lives with high QOL are required by the modern society.

Sanin area is a typically aging area in the middle north of Japan, facing to the Japanese Sea and backing onto mountain, where is rainy and humid. The effects of humidity on resident health were studied.

2. MATERIALS AND METHODS

Health data were collected from vital statistics of the Ministry of Health, Labour and Welfare, Japan and metrological data were coming from Japan Metrological Agency, to explore associations between hearth and weather condition in Sanin area of Japan using the mortality in coastal cities of Sanin, and minimum relative humidity simultaneously.

The linear association of mortality with relative humidity expressed as percentage was assessed using a Pearson correlation coefficient (SPSS for Windows and Microsoft Office Excel).

3. RESULTS

There was a positive association between environmental minimum relative humidity and human mortality in the coastal cities of Sanin (r=0.91, Fig.1). For one percentage rise of the environmental minimum relative humidity, mortality increased by 0.65‰ in the area.

Relative humidity (%) for equilibrium can be determined from the following formula:

Relative humidity (%) for equilibrium = \frac{\text{Absolute humidity of air} - \text{Saturated humidity at temperature}}{\text{Saturated humidity at temperature}}

*: Corresponding author: Hong LUO, Faculty of Medicine, Tottori University
86, Nishimachi, 683-8503, Yonago, Tottori, JAPAN
Email: luo_jsp@hotmail.com, luo@med.tottori-u.ac.jp
where $p_s$ is the saturation vapor pressure above a particle at equilibrium (around a curved liquid droplet), $p_0$ is the saturation vapor pressure (flat surface of the same liquid) and $S$ is the saturation ratio.

\[
RH = \left( \frac{p_s}{p_0} \right) \times 100\% = S \times 100\%
\]

Fig. 1, Effect of environmental minimum relative humidity on resident mortality in coastal cities of Sanin Japan

4. DISCUSSIONS

We found minimum relative humidity to be highly predictive of mortality in coastal urban area of Sanin Japan associating with the previous reports about humidity and human health (1-10), but we did not find other report about minimum humidity and human mortality.

Reasons of humid damage to human

The mechanism of humid increase mortality of human being could be every complex, but at least two kinds of reason could be involved: direct effect and indirect effect through microorganisms, insects and airborne particles, which disturbed the metabolome of human being.

A positive correlation between human mortality especially cardiac-respiratory cause of death and Humidex has been predicted in Toronto (1). Dampness in living room is one of important reason of sick building syndrome (2). Rainfall and high relative humidity increase the Barmah forest virus transmission in coastal areas of Australia (3). Bi et al. have found a positive correlation between monthly notification of Japanese encephalitis and monthly mean relative humidity in China through mosquito pathway (4).

In addition to potential effects on outdoor mold growth and allergen release related to humidity, there is also concern about indoor mold growth in association with rising humidity especially after extreme storms, which can cause widespread indoor moisture problems from flooding leaks in the building envelope (5). Mold growth and water damage nearly doubt the risk of recurrent wheezing in infants, and increase it 5-fold in food- or aeroallergen-sensitized infants, that increase 6-fold in whom sensitizing to aeroallergens (6).

Ambient ultrafine particles have gained attention with recent evidence showing them to be more toxic than larger ambient particles. It has been observed at riverside but not upland of Los Angeles in summer and autumn that higher humidity increases ammonium nitrate formation partitioning to the ultrafine particulate phase then volatilizing dependent on the Kelvin effect (7, 8). It is suggested that chemical pollution is more dangers in higher humidity environments such as fog, drizzle, riverside and coastal urban area.

The minimum relative humidity is a character to show the continuously high humidity. Alive Fungi, bacteria and some kinds of virus need minimum humidity not only average humidity above required level (9, 10).

The current study found the lower minimum relative humidity the lower mortality in humid area that implies control minimum relative humidity lower than living level of the microorganisms and keeping average relative humidity within human health range to regular the balance between human being and environment. It could be a useful method to improve health and decrease mortality. The optimum level should be studied in detail.
Keeping balance with nature

As one of the living things on the earth, person should keep balance with nature. The climate change and damage to health have been induced by human active, that are feedback of ignorant nature rules. To stop climate change, the first step should understand the mechanism.

Humidity is a key player in the weather. The Earth has about 326 million cubic miles of water, which cycles around, on or in the earth, as results, distributing in the oceans, underground, air and locked up as ice. Only about 3,100 cubic miles of this water is in the air, mostly as water vapor, but also as clouds or precipitation (Fig. 2, The U.S. Geological Survey’s, USGS).

Humidity as a production of water cycle (water vapor) on the earth, neither too low nor too high is so good for living thing in the earth including person. Too Low can make cracks in skin and decrease the effect of epithelial barrier but too high can breed mold, rot, pests and microorganisms, in turn make human health problems.

Humidity is the amount of water vapor in the air. It has been prospected that there will be more rain on rainy area and less rain on dry area with global climate change. Heat provides the energy to break the bonds between water molecules and induces evaporation, therefore the hotter the higher moisture in the area around oceans, seas, lakes, and rivers. Only about 10 percent of the water evaporated from the oceans is transported over land and falls as precipitation, in turn the global climate change will increase the humidity of beach and riverside and induce health problem in the areas residents (Fig. 2, USGS).

Protecting environment and keeping the balance with universe is an emerging challenge.

To stop the damage of climate change, the second step should protect human body. Human body just likes a small universe living in the natural universe. Homeostasis in the body and out of the body (with nature) has been emphasized ether old Traditional Chinese Medicine (TMC) and Hippocrates medicine or modern physiology and western medicine. Local productions have been lived in the area and the metabolomes have adapted nature environment, therefore taking the productions can help person adapt the local environment. In our previous works, improving metabolome and anti- metabolic syndrome effects of some local product have been reported (11-17)

Spices produced in Sanin, such as green onions, garlic, onion, chili peppers, ginger, perilla and Japanese horseradish, which contain various anti-fungi, anti-bacteria and anti-virus components such as, capsaicin, allicin, zingerone, shogaols, gingerols, perillaldehyde and sinigrin, would be good candidates of health foods to help person adapt high humidity environment. Most of the spices are herbs of TCM. Different made processes, seasons and places as well as cooking methods even fresh or dry, will give the herbs different characteristics,

Fig. 2, The evaporation in water cycle from USGS. Climate change will make more humidity around water area
because TCM is a traditional personal medicine and builds on the unique theories of Yin-yang, the Five-Phases (Five-Elements), the human body channel system and Zang Fu organ. On the other hand, person also has individual type of body and lives in different stages. How to select individually from the candidates for personal application should be studied in detail; other way, health damage could happen (18), that just like taking alcohol with disinfecting effects, but liver damage could happen if taker do not mind about personal type and stage. Another suggestion could be ventilation in building to decrease indoor humidity. The optimum condition and style could be various in different areas (19-21).

5. CONCLUSIONS

This study explored mortality association with minimum relative humidity and provided useful information for improving environment and health not only, but also for coastal urban designing to build symbiotic and sustainable developing society especially in modern longevous country.

6. REFERENCES