

Biometeorological Study on the Relationship between Weather and Chronic Disease—Possibility of Weather Forecasting for Health and Disease

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Abstract

The present study was an attempt to elucidate the relationship between weather and diseases from a biometeorological perspective based on a survey conducted using TERUMO Co.'s "Questionnaire on Health and Weather." Most of the respondents replied with "I have experienced the effect of the weather on my body condition." Many people have some kind of chronic disease such as arthritis, neuralgia or backache which is closely related to the weather. It can be concluded that the patterns of body conditions and disease distribution are connected with some of the bioclimatic divisions obtained by Yoshino and Fukuoka (2002), and that there are, in general, four typical patterns. In addition, it was concluded that ancient weather proverbs and old sayings transmitted as wisdom of aged persons are effective in weather forecasting for health and disease.

Key words: bioclimate forecast, bioclimatic division, disease, weather-health relationship, weather proverb

1. Introduction

Recently many kinds of weather forecasts related to everyday life have been offered for people engaging in sports, shopping, fishing, washing, transportation, touring, etc., in Japan. But very little information or weather forecasts related to health and disease are provided on TV or in newspapers, whereas in Germany medical weather forecasting (Medizin-meteorologische Vorhersage) has been carried out since 1952 in relation to more than 20 diseases.

In the century of health care through environmental management, it is said that everyone's dependence on the weather is heightening (Fast, 1979; Rosenthal, 1992; Sasaki, 1982; Yoshino & Fukuoka, 2002, 2003). Little is known on what degree of interest in the weather there is or what kinds of weather information are needed for people with chronic diseases. Based on a survey using the "Questionnaire on Health and Weather" provided by TERUMO Co. in Tokyo, this study tried to elucidate in biometri-

ological terms the level of interest in the relationship between weather and diseases which respondents had experienced and to confirm the possibility of weather forecasting for health and disease by applying or revitalizing old sayings and proverbs related to the weather and health.

2. Previous Studies

There have been very few studies on weather forecasting for health even though such forecasts are supplied on TV in Japan as well as in Germany and in German newspapers. The relationship between weather and diseases has been researched by many biometeorologists (Yoshino & Miyashita, 2007; Hoppe, 1982, 1999; Jendritzky, 1992, 1998; Kalkstein, 1991; Momiyama, 1980; Terjung, 1966a, 1966b, 1967, 1968 and others). However, only a very small number of papers can be found on weather forecasting for disease and health, consisting of studies by practitioners such as Shoji (2003), Ito (2003) and Matsumura (2003) in

Japan. Those forecasts are applicable only to local areas, yet people try to apply them to all of Japan without the considering climatic regionality. The Japanese Archipelago is so long from north to south and so different between the Pacific Ocean side and the Japan Sea side that we need to modify the weather forecasts for health to reflect climatic divisions. It is worth noting that Yoshino and Fukuoka (2003) attempted to divide Japan into various regions bioclimatologically and to indicate differences in vulnerability to hot or cold weather, medical conditions, mortality, and so on.

3. Study Method

During January 8-14, 2004, the questionnaire survey was conducted by fax (J-FAX Research System of JMAR Co.), dividing Japan into six blocks (Tohoku-Hokkaido, Kanto, Tokai-Shinetsu-Hokuriku, Kinki, Chugoku-Shikoku and Kyushu-Okinawa) involving 1,500 men and women in almost equal numbers. The ages of persons to whom questionnaires were sent were the forties, fifties and sixties, consisting of approximately 500 in each age group. The response rate was 78%. There were 1,168 respondents, consisting of 602 healthy persons and 566 chronic patients. The ratio of males to females was 48.5 : 51.5, while the ratio of the age groups forties, fifties and sixties was 32.0 : 32.9 : 35.1.

The relationship between weather and diseases is considered for each region in Yoshino's bioclimatological division of Japan as shown in Fig. 1 (Yoshino & Fukuoka, 2003). His division consists of five primary regions, namely, Macro-scale Regions I to V. The border between Regions I and II corresponds to the annual average isotherm of 20°C. Regions II

and III are divided along the boundary where the monthly mean minimum temperature is 0°C. The boundary between the Pacific Ocean side and the Japan Sea side corresponds to the boundary between Regions III and IV. The boundary line between Regions IV and V is the line where there are four months of mean temperature of 0°C. Each primary division has one or five secondary regions, indicated as I₁, II₂, III₅ and so on. These are further subdivided into two to five tertiary regions, that is, meso-scale divisions. Figure 1 shows the five primary divisions, thirteen secondary divisions and 39 tertiary divisions. Further details are given elsewhere (Yoshino & Miyashita, 2007).

Some examples of questions given in the questionnaires are as follows:

- Q1.** How is your health? **Ans:** 1. I'm very healthy, 2. I'm rather healthy, 3. I'm of average health, 4. I'm rather unhealthy, 5. I'm very unhealthy.
- Q2.** What kind of disease(s) are you suffering from? **Ans:** 1. hypertension, 2. hypotension, 3. diabetes, 4. asthma, 5. rheumatism, 6. gout, 7. neuralgia, or others.
- Q4.** What kinds of information for health do you receive? **Ans:** 1. On TV, 2. In newspapers, 3. Information from friends, 4. From magazines, 5. From doctors, 6. On the Internet, or others.
- Q7.** What do you think of the relationship between weather or seasonal changes and health? **Ans:** 1. Bad weather causes old wounds to hurt, 2. Sudden changes in weather cause headaches, 3. Dry weather brings about itchiness, or other relationships.
- Q8.** Do you experience changes in your health related to changes in weather or seasons? **Ans:** 1. frequently, 2. sometimes, 3. never.
- Q12.** Do you know of any bioweather forecasts?

4. Analysis of Study Results

1) Seventy percent of the respondents had some kind of chronic disease. The three commonest chronic diseases were arthritis, neuralgia and backaches, which were closely related to weather.

2) Most of the respondents, that is, 81%, answered that there was a relationship between weather or seasons and health (left hand side of Fig. 2). Another large percentage, 72.9%, replied that they had experienced the effects of weather on their health, as shown in Fig. 2 (right hand side). Positive responses to Q7 were 8% higher among the chronic patients than among the respondents in good health.

3) More than 70% of the persons who answered that they thought there was a relationship between weather and health had experiences such as "I get stiff shoulders when it becomes cold," "Dry weather brings about itchiness all over," "I become depressed when bad weather continues," "Old wounds start to hurt

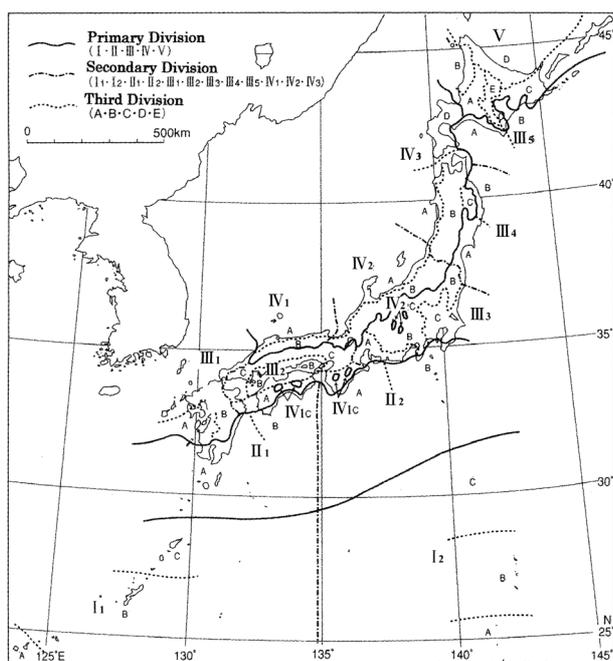


Fig. 1 Bio-climatic Divisions of Japan. (Yoshino & Fukuoka, 2003)

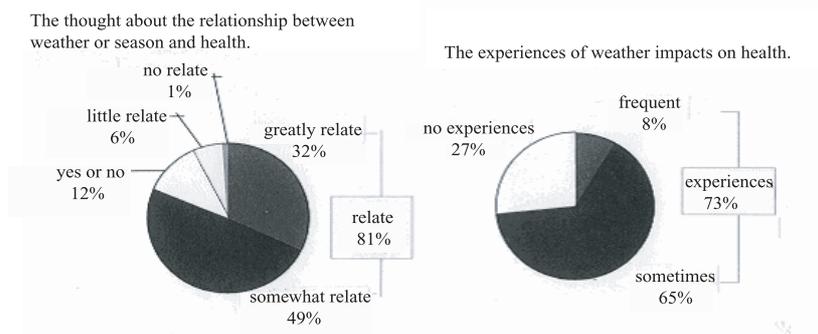


Fig. 2 Weather change and health.

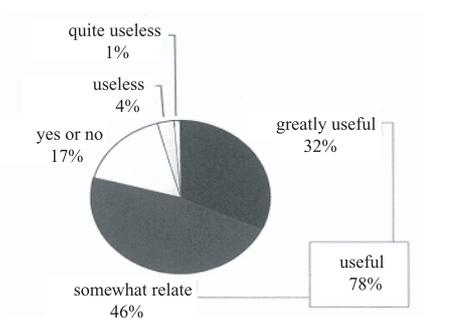


Fig. 3 Distribution of responses to question on if one thinks information about the relationship between weather and health is useful.

when bad weather continues,” and so on, as shown in Fig. 3. Furthermore, the relationship between weather and health conditions varied depending upon the climatic divisions shown in Fig. 1, as indicated in Figs. 4(1) ~ 4(8). It is worth noting that 90% of patients had had such experiences with the effects of weather change.

4) Regarding diseases which may be effected by the weather, 80.4% of respondent indicated arthritis, neuralgia and backaches. About 65% indicated asthma and dermatological allergies, while about 61% indicated rheumatism, influenza, chronic bronchitis, angina pectoris, cardiac infarction and hypertension symptoms, as shown in Fig. 5.

5) The respondents who had experienced the most effects of weather were aware of the relationship between the weather and health or disease. It is therefore concluded that old weather proverbs and old sayings transmitted as wisdom of aged persons are effective in predicting the impact of weather conditions on health or disease (Yoshino & Fukuoka, 2003).

6) Examples of old sayings include “When it is cold, one may have a stiff – neck” (from a proverb in Japan and China), “Dry weather makes one itchy from head to foot” (also from a proverb), “If bad weather is approaching, there will be pain in old sores” (from a proverb in China as well as in Japan), “The toes hurt when it rains” (proverb in America), and so on. Generally speaking, most health or disease proverbs express the relationship between causes and effects in reverse order, i.e., the effects first.

7) Remarkable features of major diseases:

7)-1 Chronic headaches, migraines

A larger number of women complained of these disease than men, and more young than old. They suffered from stiff shoulders, backaches, eye strain, lack of energy and constipation more than other persons. More than 90% had experienced the effects of weather on their health.

7)-2 Rheumatism

More than 60% of persons who replied that there was a relationship between weather and health suffered from rheumatism. In daily life, 85% of persons complained of pain in their knees or lower back when the weather changed suddenly.

7)-3 Hypotension (low blood pressure)

This is taken less seriously than hypertension (high blood pressure), but it occurred among many persons who were in poor health with stiff shoulders, eye fatigue, sluggishness, headaches, etc.

7)-4 Angina pectoris, cardiac infarction

Very few of the respondents suffered from angina pectoris or cardiac infarction but some of them had the complication of hypertension which brought about ‘breathlessness,’ ‘numbness of limbs,’ and so on. About 60% of the angina-pectoris patients felt effects of weather change. For example, they said their chest felt constricted when bad weather prevailed.

7)-5 Asthma

This disease was most affected by weather conditions, at a rate of more than 95%. Remarkably, it was complicated by skin allergies.

8) It can be concluded that the patterns of disease distribution were connected with some of the bioclimatic divisions obtained by Yoshino and Fukuoka (2003). There were four typical patterns as follows:

A-type (Western Japanese climate, including III₁, III₂, IV_{1C} and IV_{2C}): in winter, bad weather or cold weather brings about stiff finger joints, a stiff back and skin allergies. For instance, see Fig. 4(4) for the distribution of answers that when the weather changes one suffers stiff finger joints and Fig. 4(6) for that of cold weather bringing about stiff shoulders.

B-type (Pacific-seaside Tohoku climate, including III₄ and III₃): from late spring to early summer, north-easterly winds, called Yamase, with cold, foggy weather cause rheumatism, gout, asthma and chronic

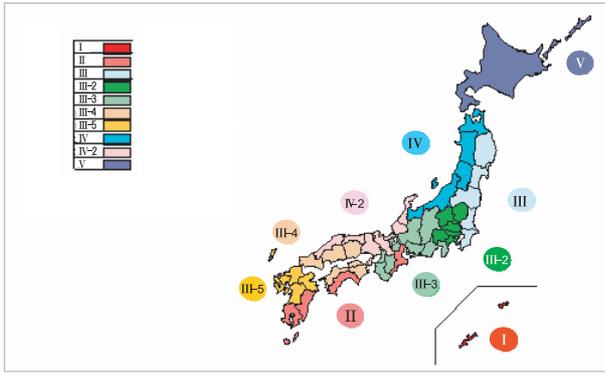


Fig. 4 (1) Bioclimatic divisions on the prefectural scale.

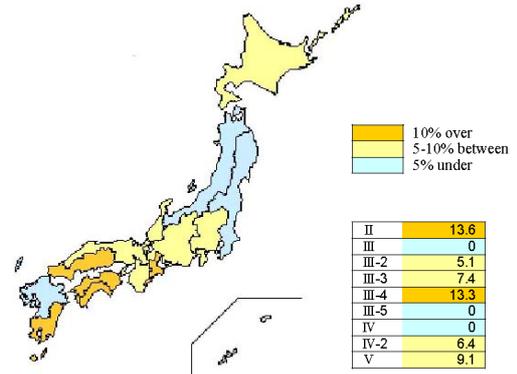


Fig. 4 (5) Percent experiencing that “When the weather changes, one suffers headaches.”

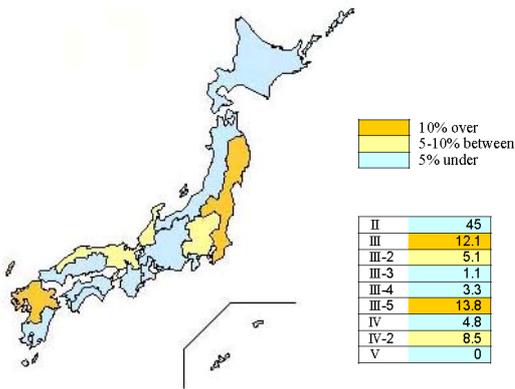


Fig. 4 (2) Percent experiencing that “When temperature changes abruptly, one suffers headaches or dizziness.”

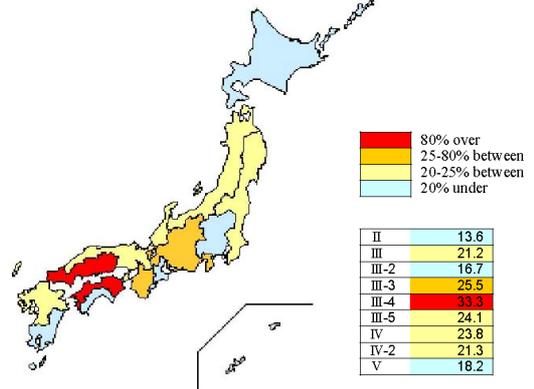


Fig. 4 (6) Percent experiencing that “Cold weather brings about stiff shoulders.”

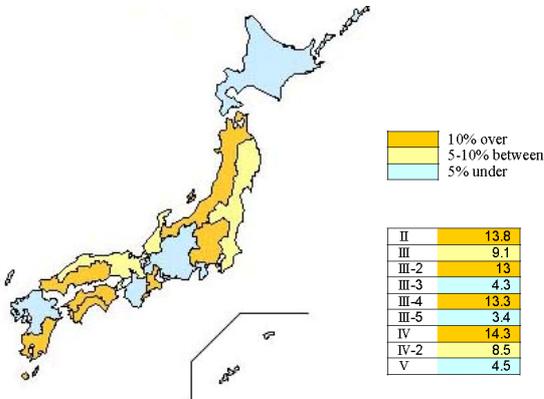


Fig. 4 (3) Percent experiencing that “Old wounds begin to hurt when bad weather continues.”

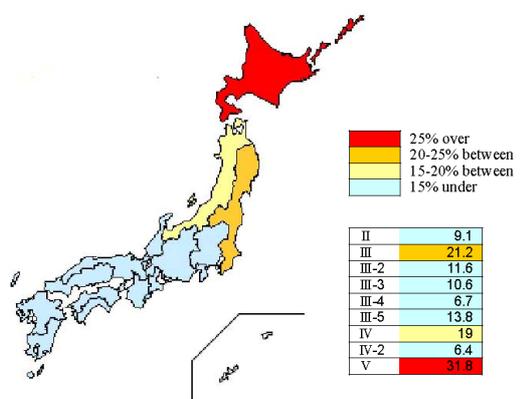


Fig. 4 (7) Percent experiencing that “When bad weather continues, one becomes depressed.”

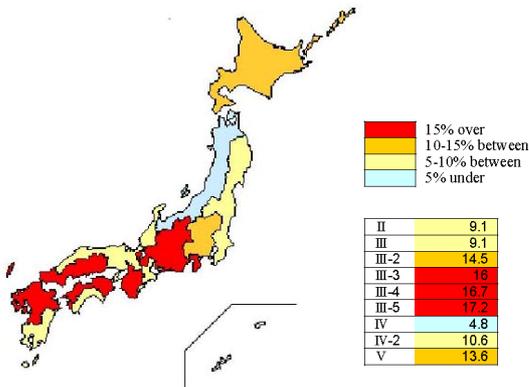


Fig. 4 (4) Percent experiencing that “When the weather changes, one suffers stiff finger joints.”

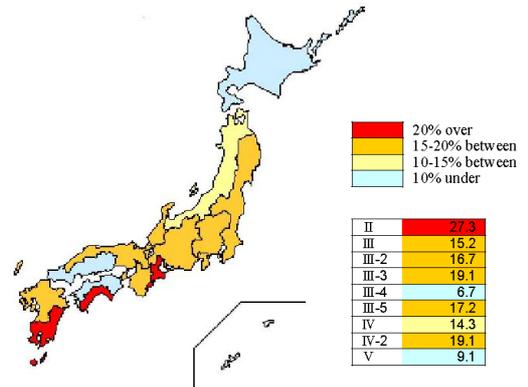


Fig. 4 (8) Percent experiencing that “Dry weather causes itchiness.”

bronchitis. For instance, see Fig. 4(2) for the distribution of answers that when temperature changes abruptly one suffers headaches and dizziness, Fig. 4(7) for that of bad weather bringing continued depression, and Fig. 6(3) for that of weather changes bringing about rheumatism.

C-type (Japan-Sea side climate of Western Japan, including IV₁ and IV₂): featureless weather causes hypertension, stiff finger joints, neuralgia, backaches, chronic headaches and migraines. For instance, see Fig. 4(5) for the distribution of answers that when the weather changes one suffers headaches and Fig. 6(2) for that of weather changes bringing about hypertension.

D-type (Southwestern Japanese climate, including

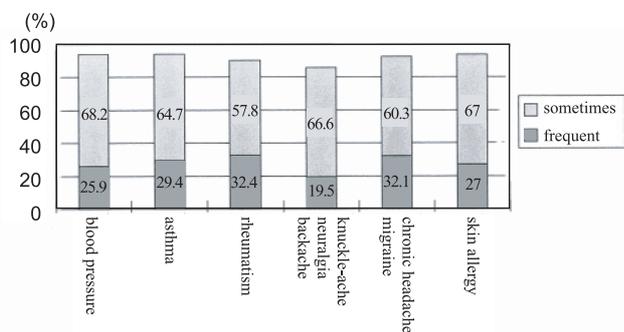


Fig. 5 90% of patients have experienced the effects of weather change.

II₁, II₂, etc.): cold, dry weather brings about influenza and generalized itchiness all over the body. For instance, see Fig. 4(8) for the distribution of answers that dry weather causes general itchiness and Fig. 6(5) for that of weather changes causing influenza.

5. Conclusion

We can conclude that the patterns of disease distribution are connected with certain bioclimatic divisions such as the A-type (Western Japan), B-type (Pacific-seaside Tohoku), C-type (Japan-Sea side of Western Japan) and D-type (Southwestern Japan).

It is clear that some old sayings about health and weather remain relevant even at the present time in

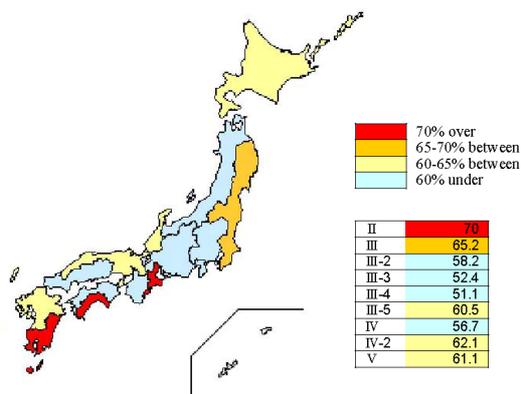


Fig. 6 (3) Percent experiencing weather effects on rheumatism.

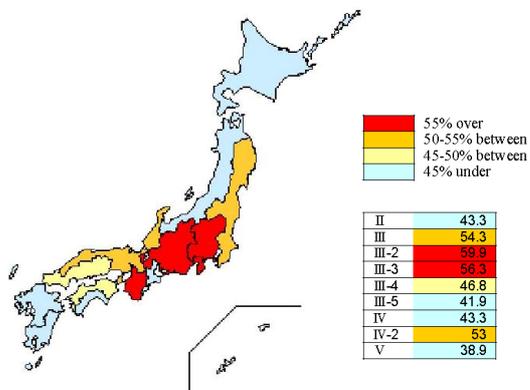


Fig. 6 (1) Percent experiencing weather effects on angina pectoris and cardiac infarction.

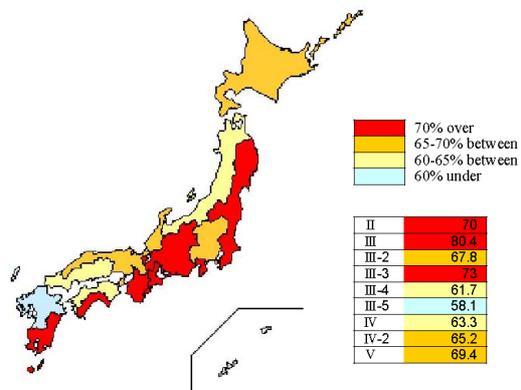


Fig. 6 (4) Percent experiencing weather effects on asthma.

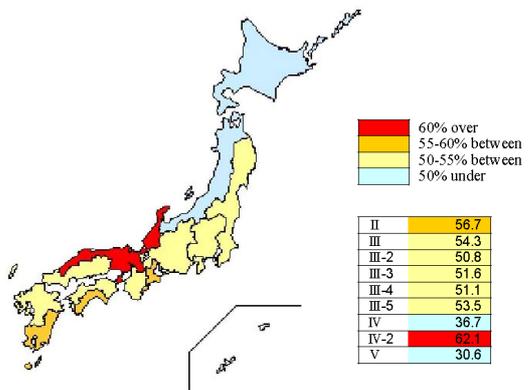


Fig. 6 (2) Percent experiencing weather effects on hypertension.

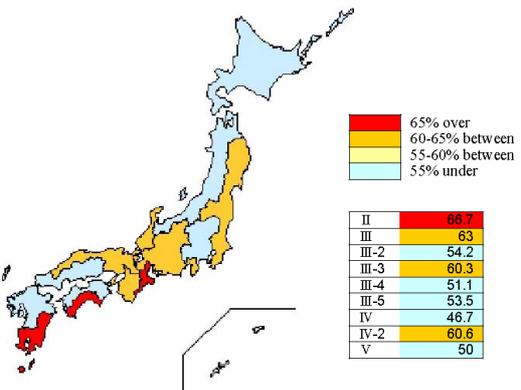


Fig. 6 (5) Percent experiencing weather effects on influenza.

order to forecast weather for health; for example, "When the shoulders are stiff, it will become cold," "When the whole body becomes itchy, it will become dry," "When one is depressed, bad weather will continue," "When old wounds begin to hurt, bad weather will continue," and so on. However, these expressions of the old sayings, that is, weather proverbs, are almost always in reverse order of the cause and effect relationship. In other words, the proverb indicates that variations in body conditions (or chronic disease) predict weather changes.

It can be concluded that there is a definite relationship between weather changes and disease. Therefore, we may be able to forecast the weather conditions which cause diseases to some extent. The results of the questionnaire show that many persons including patients expect information and weather forecasting for health and disease in daily life.

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