THE DANGER OF DEHYDRATION AND HEATSTROKE IN THE WALKING OF MIDDLE-AGED AND ELDERLY PERSONS IN THE SUMMER

AKIRA YORIMOTO\(^1\), NAOKO NISHIKAWA\(^2\) and SEIJI SAKATE\(^1\)

Abstract

In this study, the danger of dehydration and heatstroke in a walking event in the summer was examined. Subjects were 64 males, 11 females, and the average age was 62.3 ± 7.8 years old. The following were measured before and after 25 km walking: body weight, blood pressure, heart rate, tympanic temperature, and fluid intake. WBGT in the walking event was 22.6°C mean value. Time of the 25 km walking was 5 hours 45 minutes, and the number of steps were 36,570 ± 2,741 steps. The body weight loss by the walking was 1.36 ± 0.57 kg; 2.24 ± 0.96%. This body weight loss rate increased with the age. The fluid intake was 1,327 ± 606 g, and sweat loss was 2,621 ± 740 g in the walking. The tympanic temperature after walking was 38.02 ± 0.60°C, and increased 0.99 ± 0.67°C from before walking. In the walking of middle-aged and elderly persons in the summer, there is danger of dehydration and heatstroke, therefore enough water and salt intakes are necessary.

(key word: Dehydration, Heatstroke, Walking, Water and salt intake, WBGT

Introduction

Walking is an exercise effective for maintaining and promoting health and preventing lifestyle-related diseases, and many people, especially middle-aged and elderly persons, love walking. Walking lovers walk for long distance even in the summer, regardless of seasons. According to the Japan Walking Association, there are as many as about 1,500 walking events annually. Exercise during the summer tends to cause dehydration and an increase in body temperature, due to increased perspiration caused by influence of the environmental temperature, in addition to generation of heat energy resulting from physical activity, and risk of heatstroke increases. Heatstroke is the generic term for disorders due to a hot environment, and it is said to have shown an increasing tendency along with global warming in recent years. The rate of death caused by heatstroke is high among middle-aged and elderly persons of age 65 years and older\(^2\), and the reason is considered to be lowered body temperature adjustment function due to aging, such as decreased sweat rate and blood flow of the skin\(^3\), and decreased liquid intake due to reduced thirst\(^7\).

In the past, we have researched relatively short-time walking and walking during daily life, targeting middle-aged and elderly persons, and reported the state of dehydration and body temperature adjustment during walking\(^10\). In long-hour and long-distance walking, however, dehydration advances, and risk of heatstroke is considered to increase. In this study, therefore, we researched middle-aged and elderly persons’ states of fluid intake and dehydration during long-distance walking, targeting participants in walking events in the summer, from the viewpoint of heatstroke prevention.

Methods

Subjects were 75 persons who cooperated in the participation of 25 km walking event. They were 64 males, 11 females, and the average age was 62.3 ± 7.8 years old. Written informed consent was obtained after a detailed description of the purpose and procedures of this study were provided. The following were measured before and after 25 km walking: body weight, blood pressure, heart rate, and tympanic temperature. The quantity of fluid ingested

\(^1\) The University of Shiga Prefecture
\(^2\) Suita Municipal Hospital

was determined by weighing the bottles provided to each subject. Total sweat loss was determined by the body weight obtained before and after 25 km walking using a balance with an accuracy of 50 g, and it were corrected for fluid intake and urine volume. The wet bulb (WB), dry bulb (DB), and globe temperature (GT) were measured every 10 min during the walking, and the wet bulb globe temperature (WBGT, °C) was obtained from the equation: $0.7WB + 0.2GT + 0.1DB^3$.

**Results**

Environmental temperature (WBGT) in the walking event was 22.6°C mean value, and the maximum was 24.4°C. Time of the 25 km walking was 5 hours 45 minutes ± 46 minutes, and the number of steps were 36,570 ± 2,741 steps. Systolic blood pressure, diastolic blood pressure, and heart rate before walking was 144.9 ± 20.6 mmHg, 81.5 ± 12.4 mmHg, and 75.1 ± 12.0 bpm, respectively, and that after walking was 123.9 ± 22.5 mmHg, 72.8 ± 13.4 mmHg, and 103.6 ± 16.3 bpm, respectively.

The body weight loss by the walking was 1.36 ± 0.57 kg, and the body weight loss rate (% of initial body weight) was 2.24 ± 0.96%. Figure 1 shows the relationship between age and body weight loss rate. The body weight loss rate significantly increased with the aging ($p < 0.05$). Figure 2 shows total sweat loss and total fluid intake. Total sweat loss was 2.621 ± 740 g and total fluid intake was 1,327 ± 608 g in the walking. Rehydration rate (% of fluid intake to total sweat loss) was 51.6%. Types of consumed liquid under walking were water, tea, sports drink (electrolyte liquid), juice, milk, beer, etc. All of the subjects drank water and tea, while only 18.7% of the subjects drank a sports drink (electrolyte liquid). On the other hand, two subjects did not take the moisture under walking.

The tympanic temperature after walking was 38.02 ± 0.60°C, and increased 0.99 ± 0.67°C from before walking. Figure 3 shows the relationship between body weight loss rate and tympanic temperature after walking. Though the significant relation could not be recognized between both ($p < 0.06$), the tympanic temperature tends to increase according to body weight loss rate.

![Graph](image)

Figure 1. Relationship between age and body weight loss rate (% of initial body weight).
Figure 2. Total sweat loss and total fluid intake in the walking.

Figure 3. Relationship between body weight loss rate and tympanic temperature after walking.

Discussion

The WBGT is an effective index regarding the thermal environment, and the WBGT in this study was 22.6°C, which was a temperature requiring caution for heatstroke.

The body weight loss from 25 km walking was 1.36 ± 0.57 kg, and the body weight loss rate was
2.24 ± 0.96%. A significant correlation was noted between age and the body weight loss rate: The body weight loss rate increased according to age; and, the older the person was, the more severe dehydration was. Generally, when dehydration of 3% or more of body weight occurs, possibility of heatstroke increases due to reduced physical capability and lowered body temperature adjustment function. Therefore, it is said necessary to supply water and salt, so dehydration does not exceed 2%. Especially for middle-aged and elderly persons, and people who are not used to exercise in a hot environment, there is risk of heatstroke from such walking, and adequate caution is necessary.

Total sweat loss during 25 km walking was 2.621 ± 740 g, and total fluid intake was 1,327 ± 608 g. Based on the relation of these two figures, the rehydration rate was 51.6%, which indicates that about half of the amount of lost water was resupplied. Further, as to the types of consumed liquid, all of the subjects drank water or tea, while only 18.7% of the subjects drank a sports drink (electrolyte liquid). When abundant perspiration occurs, it is necessary to supplement salt lost due to perspiration, and supply of only water or tea can result in salt deficiency. Especially when dehydration of 0 to 2% of body weight occurs, and salt is not supplied, dilutional inhibition of drinking (voluntary dehydration) occurs, making it difficult to maintain body fluid. When only water without salt in it is supplied in the event of such abundant perspiration, the electrolyte balance in the body becomes disrupted, causing a risk of heat cramps. Further, when an elderly person becomes dehydrated, recovery of the body fluid balance is reported to be delayed compared with younger adults, due to reduced thirst and kidney function, and as such, increased caution is required. On the other hand, as to the rehydration rate related to recovery from dehydration, it is reported that only 40 to 60% of even freely drunk water is taken in, during exercise in a high-temperature environment. The rehydration rate is higher with sports drinks, which contain salt, compared with water and juice, and drinking beverages that contain an appropriate amount of salt is considered to increase the amount of water drunk and restrict dehydration.

The tympanic temperature after walking was 38.02 ± 0.60°C, and the increase was 0.99 ± 0.67°C. Increase of the tympanic temperature by 2°C or more was noted in seven persons. Dehydration increases the internal body temperature during exercise, reduces physical capability, and increases risk of heatstroke. It is said that water loss of 1% of body weight causes an increase of the internal body temperature by about 0.3°C; as such, it is necessary to prevent dehydration as much as possible. In particular, middle-aged and elderly persons are considered to be more strongly influenced by dehydration, compared with younger adults, due to reduced body temperature adjustment function because of aging.

To prevent heatstroke, drinking water is important-drinking water promotes recovery from dehydration; it restricts lowering of physical capability, and reduces risk of heatstroke. In this study, we found that, in long-distance walking by middle-aged and elderly persons in the summer, adequate hydration was not implemented, despite loss of water and salt due to abundant perspiration. This indicates high risk of heatstroke during walking by middle-aged and elderly persons, and it is considered necessary to pay attention for more aggressive intake of water and salt.

References
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