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RESEARCH ARTICLE

IMPACT OF EMERGENCY FOOD TEMPERATURE AND PRIVACY ON THE STRESS OF LIVING IN AN EVACUATION CENTER

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Abstract

This study investigated the impact of emergency food temperature variation andthe presence of privacyon stress with the aim of potentially reducing the stress of living in an evacuation center during large-scale disasters. Salivary amylase activity of the subjects was measured. Results showed no statistically significant impact on stress due to variations in the temperature of emergency food or privacy. However, the survey noted points for improvement, including experiment settings and relationships between subjects, which highlighted the need for future research and surveys. This study is expected to aid with initiatives that reduce stress in evacuation centers;however, more detailed condition settings are required in order to eliminate individual stress level differences.

Introduction:-

As of 2023, 100 years have passed since the Great Kanto Earthquake of 1923. In order for future generations to learn from this catastrophe, the Great Kanto Earthquake and Tokyo Great Air Raid Memorial Museum, which displays a vast range of materials such as various mementos, photographs, and charts showing the damage from the disaster, displays photographs of evacuation centers of that time. The photographs show evacuees camping on mats laid out on the ground with lanterns placed next to them. Many victims of multiple large-scale disasters were thereafter forced to live in evacuation centers, including during the Showa period Tonankai (1944) and Nankai (1946) earthquakes, the Niigata earthquake (1964), the Heisei eruption of Unzen Fugendake (1990), and the Hyogo-ken Nanbu earthquake (Great Hanshin-Awaji Earthquake, 1995).

Each time a large-scale disaster occurred, various issues arose in the evacuation centers. While studies have been conducted toward resolving those issues, numerous unresolved challenges remain in Japan, which is a disaster-prone country. For example, Koyama et al. studied evacuation center management manualsand pointed out that the national government and administrative manuals do not provide measures for people with special needs during disasters (Koyama et al., 2019). Having conducted disaster risk assessment based on the location of evacuation centers in the Osaka Bay area, which are key evacuation centers for people with special needs during disasters, Uno et al.pointed out that many facilities are situated in places that are vulnerable to tsunami flooding (Uno et al., 2015). Further, Hsiao et al. highlighted the insufficiencies in evacuation center arrangements during sudden disasters (Hsiao et al., 2021).

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In addition, extended evacuation center life during various large-scale disasters, including major earthquakes, wide-area flooding, and hurricanes (in other countries), bring about an increase in various stress-related issues (Basile, 2020; Gerstner et al., 2020; Mills et al, 2007; Ohira et al., 2016; Tian et al., 2014).Because people are forced into abnormal situations when living in evacuation centers, it is common to feel stressed about the complete change in one's usual way of life. As a measure to deal with the accumulation of stress in such evacuation centers, countermeasures are implemented to reduce stress by means of physical activities such as physical exercise (Knappe et al., 2019; Kumamoto, 2016; Sjögren et al., 2020).However, not everyone in evacuation centers is capable of physical activity.

This study focuses on emergency food distributed to and eaten by everyone in the evacuation center as another measure of reducing stress. Via an experiment, the study investigated whether the temperature of emergency food yields stress reduction among those taking refuge in an evacuation center. Numerous prior studies have analyzed the impact of food temperature on the body (Kissileff et al., 1984; Rolls et al., 1990; Stroebele and Castro, 2004).However, there are few studies about how food temperature impacts stress, particularly regarding whether the temperature of emergency food has any impact on those taking refuge. Therefore, this study is a pioneering study that can help improve food distribution systems in evacuation centers in the future. Moreover, because the small amount of private space available to individuals in evacuation centers in Japan remains an important issue, whether privacy in evacuation centers impacts stress reduction was also studied via an experiment.

Research Method:-

Experiment summary

In the experiments conducted in this study, certain areas were set up as simulated evacuation centers. These areas were 2m in length and 1m in width with a partition of 1m in height. The size of each area was almost the same as that of the evacuation center used during the Kumamoto earthquake in 2016. According to the Sphere standards, residential spaces must be safe, appropriate, and dignified, with access to living spaces suitable for activities essential to family life and work. Additionally, when using temporary group accommodation, special measures are required to ensure the prevention of sexual exploitation and sexual violence (Sphere Association, 2018).The key indicator, according to these standards, is not the size of the area but the suitability in terms of gender and individual needs. In Japan, in line with the Sphere standards, a residential space of at least 3.5 $m^2$is necessary per person. However, actual evacuation centers in Japan are not greatly dissimilar to the evacuation centers used during the North Izu earthquake in 1930, and the reality is that living spaces are only about 2 m^2per person (Fig 1) (Tokunaga et al., 2015; Yamato et al., 2019).In view of these facts, in this study, and in line with the realities in Japan,areas of 2 m^2per person were used. Cardboard walls were removed to increase stress.

Asalivary amylase monitor made by Nipro Corporation that can measure salivary amylase activity was used to measure stress. When people suffer an unpleasant stimulus, salivary amylase increases, whereas it decreases in the case of a pleasant stimulus. Therefore, comfort and discomfort can be determined based on salivary amylase (Ali and Nater, 2020; Chojnowska et al., 2021;De Pero et al., 2021).In this study, stress was evaluated based on the measurement of salivary amylase activity as an objective indicator.

There were two experiments: In Experiment A, hot emergency food was eaten. In Experiment B, cold emergency food was eaten. Commercially-available emergency food was used. In each experiment, experiments were conducted simultaneously with regard to environments without privacy (Fig 1) and private environments (Fig 2).

Twelve university students participated in Experiment A and 9 university students participated in Experiment B. This study and the experiments were conducted after obtaining ethical approval from the Ethics Committee of Osaka Kyoiku University, Japan.

Experiment flow

Each experiment was conducted according to the following procedures. Prior to the measurement of salivary amylase, subjects underwent oral rinsing with mineral water. Both experiments were conducted after explaining the details of each experiment to the subjects who signed a consent form and completed an allergy questionnaire.

Experiment A

(1) Salivary amylase measurement
(2)Waiting in privacy (10 minutes)

(3) Salivary amylase measurement
(4) Meal (hot dry curry using quick-cook rice)
(5) Salivary amylase measurement
(6) Waiting without privacy (10 minutes)
(7) Salivary amylase measurement
(8) Meal (warm vegetable soup)
(9) Salivary amylase measurement

Experiment B
(1) Salivary amylase measurement
(2) Waiting with privacy (10 minutes)
(3) Salivary amylase measurement
(4) Meal (crackers (not warmed))
(5) Salivary amylase measurement
(6)Waiting without privacy (10 minutes)
(7) Salivary amylase measurement
(8) Meal (bread)
(9) Salivary amylase measurement

Results:-

Fig 3 shows the five measurements of salivary amylase activity in Experiment A and in Experiment B. The first measurement was taken prior to the experiment (in normal conditions), the second was taken after waiting for 10 minutes while maintaining privacy, the third was taken 5 minutes after hydrating following a meal consumed in5 minutes, the fourth was taken after waiting for 10 minutes without maintaining privacy, and the fifth was taken after the second meal. The measurements show the stress value. Fig 3(a) shows the change in salivary amylase activity in the case of a warm meal, whereas Fig 3(b) shows the change in the case of a cold meal.

Based on these figures, the average value of salivary amylase activity after intaking the first warm meal was 4.66, with a standard deviation (SD) of 0.98. The average value at the second time was 5.75, with an SD of 4.41. In contrast, the average value of salivary amylase activity after intaking the first cold meal was 6.11, with an SD of 3.79. The average value at the second time was4.22, with an SD of0.44. The combined value for salivary amylase activity after intaking the warm emergency food in the first and second instance was an average of 4.22, with an SD of 0.44. In contrast, the combined value for salivary amylase activity after intaking the cold emergency food in the first and second instance was an average of 5.17, with an SD of 3.21.

As for salivary amylase activity depending on the presence of privacy, when combining the values in the case of intaking warm and cold emergency food, the average value with privacy was 4.81, with an SD of 1.78. The average value in the case of no privacy was 5.81, with an SD of 3.19.

A Mann–Whitney test (certified in both cases) was used to investigate whether there was a statistically significant difference. First, as shown in Table 1, with regard to the statistical difference in salivary amylase activity based on emergency food temperature variation, there was no significant difference after either the first meal ($P = 0.351$) or the second meal ($P = 0.704$). There was no significant difference in the combined value of salivary amylase activity after the intake of emergency food in the first and second instance ($P = 0.398$). As shown in Table 2, there was no statistically significant difference in salivary amylase activity based on the presence or absence of privacy ($P = 0.387$).

All analyses conducted in this study were performed using BellCurve for Excel version 3.20 (Social Survey Research Information Co., Ltd.).

Discussion:-

In view of the above, in this study, there was no statistically significant difference with regard to the impact of varying emergency food temperature on stress. In the experiments, crackers and bread that can be eaten without heating were used as the cold emergency food,but in disasters during winter, it is possible that emergency food stored in storage rooms will become incredibly cold. In such cases, the temperature variation may be more extreme

than in these experiments, which may change the impact on stress. Warm meals can raise the internal body temperature, including that of internal organs, which has various relaxing effects, including supporting better sleep (Kronholm et al., 2011)and suppressing the effort required to maintain wakefulness, thereby supporting better sleep (Peuhkuri et al., 2012).In view of this, when considering salivary amylase activity as an outcome, it may be necessary to include more extreme meal temperature variations in future studies. Further, the experiments used emergency food that can be eaten when heated and when unheated from among the commercially availableemergency foods. The experimentswere conducted without regard for the food preferences of the subjects. Therefore, there may also be a need to eliminate the influence of such preferences by, for example, conducting interviews regarding the subjects' preferences prior to the experiment.

With regard to the impact of the presence of privacy on stress, although no statistically significant difference was observed, the subjects in these experiments were university students who already know each other. Therefore, the subjects may not have experienced highstress even when privacy was not maintained. It may be necessary to conduct an experiment with a greater number of subjects who do not know each other to understand the effect of privacyon stress in greaterdetail.

Table 1:- Mann–Whitney U Test of difference in salivary amylase activity levels due to temperature variations in emergency food.

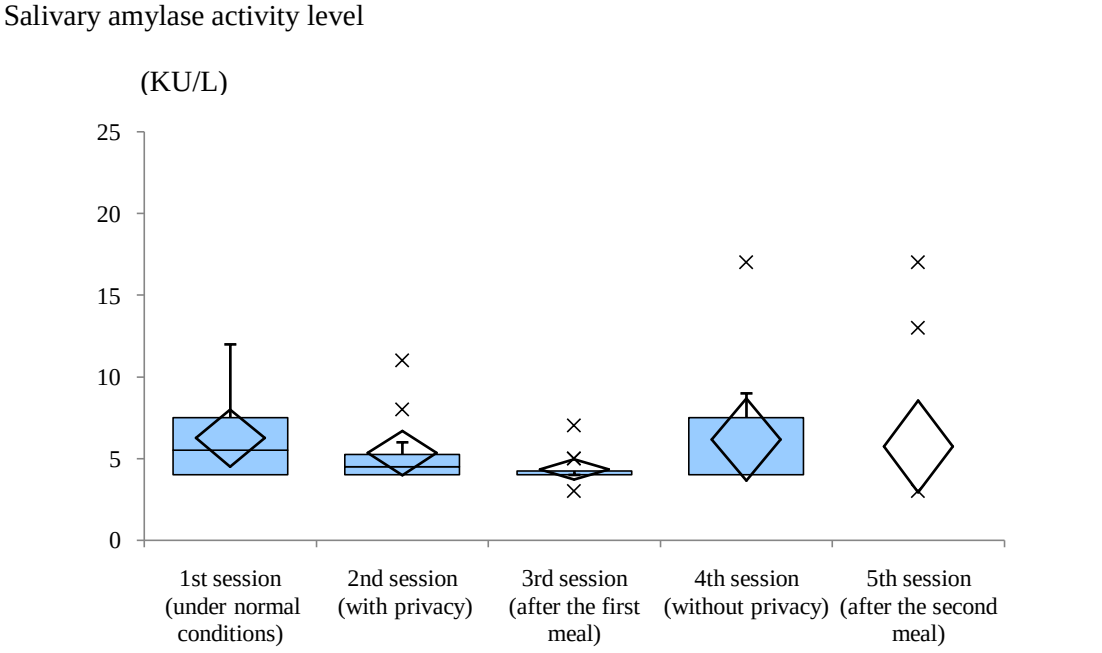
Groups	After warm meal		After cold meal		P
	Mean (SD)	Min–Max	Mean (SD)	Min–Max	
Salivary amylase activity levels (1st session)	4.33 (0.98) (N = 12)	3–7 (N = 12)	6.11 (3.79) (N = 9)	4–15 (N = 9)	0.351
Salivary amylase activity levels (2nd session)	5.75 (4.41) (N = 12)	3–17 (N = 12)	4.22 (0.44) (N = 9)	4–5 (N = 9)	0.704
Salivary amylase activity levels (1st + 2nd session)	5.04 (3.21) (N = 24)	3–17 (N = 24)	5.17 (3.21) (N = 18)	4–15 (N = 18)	0.398

Table 2:- Mann–Whitney U Test of difference in salivary amylase activity levels due to privacy variations.

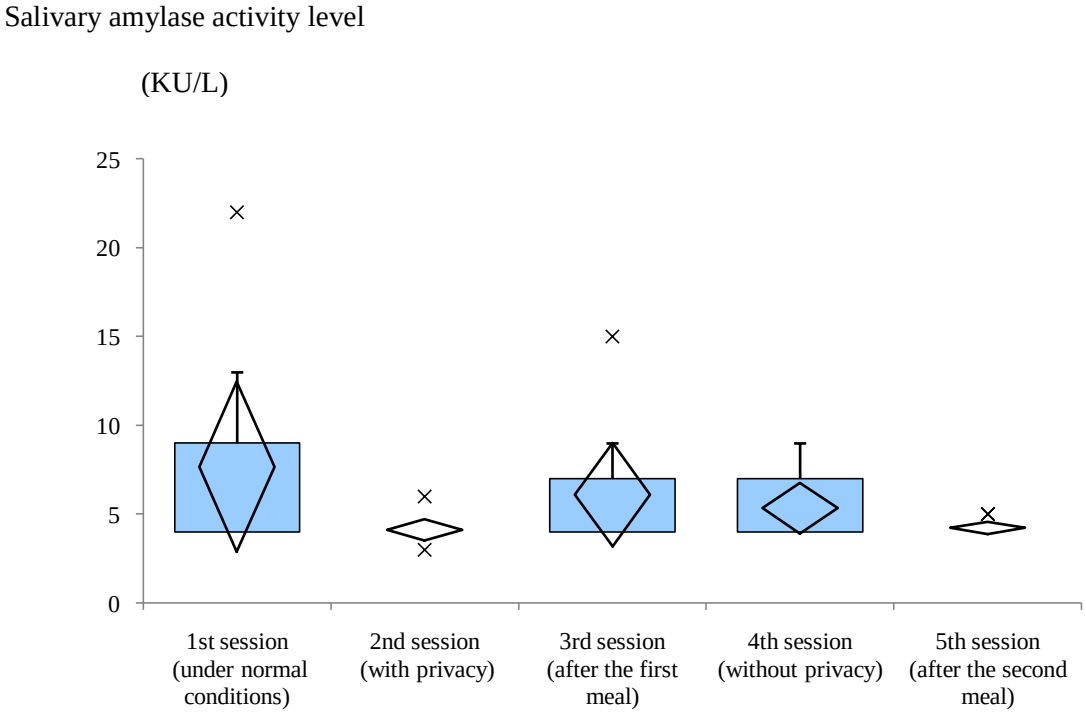
Groups	2nd session (with privacy) (N = 21)		4th session (without privacy) (N = 21)		P
	Mean (SD)	Min–Max	Mean (SD)	Min–Max	
Salivary amylase activity levels	4.81 (1.78)	3–11	5.81 (3.19)	4–17	0.387

Fig 1:- Experimental setup with individual occupancy area of 2 m^2.

Fig 2:- Experimental setup without privacy.



(a) Experiment A (in the case of warm emergency food)



(b) Experiment B (in the case of cold emergency food)

Fig 3:- Changes in salivary amylase activity levels.

Conclusion:-

In this study, experiments were conducted to investigate the impact of emergency food temperature variations and presence of privacy on stress based on changes in salivary amylase activity. Results showed no significant difference for either emergency food temperature variations or presence of privacy; thus, it was determined that these factors have no impact on stress. However, with regard to the impact of emergency food temperature variations on stress, it was clear that there were various issues with the experiments, such as the need to set more extreme emergency food temperature variations and to survey the food preferences of subjects. Additionally, with regard to the impact of privacy variations on stress, it may be necessary to investigate whether the subjects already know each other. Further investigations and analyses are required in view of these issues.

Japan suffers extensive damage every year from flooding, landslides, typhoons, earthquakes, and tsunamis, frequently making it necessary for people to live in evacuation centers. The stress of living in an evacuation center is always an issue in such cases, which results in other difficulties. We hope that the results of this study can facilitate further research aimed at reducing stress in evacuation centers. Each individual experiences stress differently. Therefore, in experiments and surveys, it is necessary to find ways to eliminate differences in the experience of stress by setting precise conditions.

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