**Graduation thesis from Watanabe Laboratory, School of Liberal Studies, Chukyo University**

Environment of "watching sports" for the older adults in Japan

Kan Hayashi

Age-related changes in preference for mineral rich water

Tomoki Ishikawa

Relationship between health food purchase and exercise habits in older adults

Nao Kobayashi

Neuromuscular activation of masseter muscle during eating Japanese traditional foods and imported fast food

Ryota Kondo

Relationship between motivation for food and the physique in female university students

Ayumi Ichiki

Effect of oral communication through physical activity on a non-native language proficiency

Hazuki Miyamoto

Kendo vocalization by Japanese and Chinese

Kohei Morimatsu

The effect of shoe sole thickness on body sway and heart rateduring walking with platform shoes

Akira Ohneda

Effect of coffee temperature on the physical performance during exercise

Vanessa Ventocilla

Differences of the dietary intake between chopsticks and a spoon from the features of chewing

Takahiro Yoshida

Differences of Characteristics of Informing with Using SNS to Fans
from Professional Football Clubs between Japan and Germany

Midori Yoshinaga

*These articles were accepted as Graduation thesis from Watanabe Laboratory of Chukyo University*

*Kohei Watanabe, Ph.D., Chukyo University, Japan, Dec. 11, 2019*

# Environment of “watching sports” for the older adults in Japan

国際社会系(渡邊ゼミ)

S116094

林寛

Kan Hayashi

**Abstract**

**Environment of “watching sports” for the older adults in Japan**

Aim: The purpose of this paper is to investigate whether there is an environment in which the older adults can actively watch sports. Methods: A questionnaire (14 questions in total) was conducted on 85 older adults aged 60 and over living in Nagoya, Japan. Results: In the question of the frequency of “watching sports” on TV and through media, 25 respondents (31.6%) answered “once a month”. In the question of the frequency of “watching sports” at stadiums and gymnasiums, 38 respondents (47.5%) answered “never”. In the degree of satisfaction of “watching sports” on TV and through media, “satisfied” and “slightly satisfied” were the most popular answer (32.1%). In the degree of satisfaction of “watching sports” at stadiums and gymnasiums, “be more of satisfied” was the most popular answer (27.9%). Conclusion: The survey found that if there was an environment where older adults could watch sports, they would watch sports. Moreover, many older adults were satisfied with “watching sports”, thus, measures are needed to reduce the risk of going out for the older adults.

**日本の高齢者にとっての「観るスポーツ」の環境**

目的：本研究の目的は、高齢者が能動的にスポーツを観ることが出来る環境が整備されているかを調査することである。 方法：日本の名古屋に住む 60 歳以上の 85 人の高齢者にアンケート調査（全 14 問）を実施した。 結果：テレビやメディアでのスポーツ観戦の頻度の質問では、最多の 25 人（31.6%）の回答者が「月に一回」と回答した。 一方で、スタジアムや体育館でのスポーツ観戦の頻度の質問では最多の 38 人（47.5%）の回答者が「全く観ない」と回答した。 テレビやメディアでのスポーツ観戦の満足度は「満足」と「やや満足」が並んで最多であった（32.1%）。 スタジアムや体育館でのスポーツ観戦の満足度は「どちらかと言えば満足」が最多であった（27.9%）。 考察：高齢者にとってスポーツを観ることができる環境があれば、彼らはスポーツを観るということがこの調査から分かった。 また、多くの高齢者はスポーツを観ることに満足していたので、高齢者にとっての外出のリスクを軽減するための対策が必要だ。

**Entorno de "ver deportes" para adultos mayores en Japón**

Objetivo：El propósito de este documento es investigar si existe un entorno en el que los adultos mayores puedan ver deportes activamente en la actualidad. Métodos：Se realizó un cuestionario (14 preguntas en total) a 85 adultos mayores de 60 años o más que viven en Nagoya, Japón. Resultados: En la cuestión de la frecuencia de "ver deportes" en la TV y en los medios de comunicación, 25 encuestados (31.6%) respondieron "una vez al mes". En la pregunta de la frecuencia de "ver deportes" en estadios y gimnasios, 38 encuestados (47.5%) respondieron "nunca". En el grado de satisfacción de "ver deportes" en la TV y en los medios de comunicación, "satisfechos" y "ligeramente satisfechos" fueron la respuesta más popular (32.1%). En el grado de satisfacción de "ver deportes" en estadios y gimnasios, "estar más satisfecho" fue la respuesta más popular (27.9%). Conclusión: La encuesta encontró que si hubiera un ambiente donde los adultos mayores pudieran ver deportes, ellos verían deportes. Además, muchos adultos mayores estaban satisfechos con "ver deportes", por lo tanto, se necesitan medidas para reducir el riesgo de salir para los adultos mayores.

**Introduction**

In recent years, the older population has been increasing around the world. In particular, comparing the proportion of the older adults in the total population in 2018, Japan (28.1%) is the highest in the world (Ministry of Internal Affairs and Communications Statistics Bureau, 2018). On the authority of the data of the Statistics Bureau, the Ministry of Internal Affairs and Communications, the population aged 65 and over (the old age population) is 35.75 million (28.3% of the total population) by the definite value of April 1, 2019 (Ministry of Internal Affairs and Communications Statistics Bureau, 2019). Furthermore, the number of older people aged 65 and over is expected to reach 36.57 million in 2025 and its peak in 2042 (38.87 million) (Ministry of Health, Labor and Welfare, 2018) in Japan.

Moreover, fifty-six years after having organized the Olympic Games, the Japanese capital will be hosting a Summer edition for the second time, from 24 July to 9 August 2020 (International Olympic Committee, 2019). Therefore, the hosting of the Olympic has various effects and influences on the host city and nation. There are tangible effects and impacts along with Olympics such as economic effects, tourism and infrastructure development. In addition, there are intangible effects and influences brought by sports promotion, sports policy and education, and the event experience of the Olympic (Masumoto, Honma, 2014). The economic ripple effect of the 2020 Tokyo Olympics is expected to be 13,820.0 billion yen (Ministry of Economy, Trade and Industry, 2016). Therefore, creating relationships between the 2020 Tokyo Olympics and many people is very meaningful in order to further increase the economic ripple effect of the Tokyo Olympics and achieve the Olympic legacy.

In addition, the emphasis on people (people who do, people who watch, and people who support) is the

basic concept of the sports nation strategy (Ministry of Education, Culture, Sports, Science and Technology, 2011). Being happy and enriched through sports is one of the rights which is ensured for everyone (Ministry of Education, Culture, Sports, Science and Technology, 2011). This paper focuses on “watching sports”, but it also investigates “doing sports” and “supporting sports”.

Regarding the Japanese sports market, the size of the Japanese sports market in 2002 (approximately 7 trillion yen) was retail (approximately 1.9 trillion yen), sports facilities (approximately 3.3 trillion yen), entertainment and broadcasting (approximately 1.8 trillion yen). In 2012, the size of the market (approximately 5.5 trillion yen) was retail (approximately 1.7 trillion yen), sports facilities (approximately 2.1 trillion yen), entertainment and broadcasting (approximately 1.7 trillion yen). From 2002 to 2012, retail sales (-0.2 trillion yen) and sports facilities industry (-1.2 trillion yen) decreased, and entertainment / broadcasting are almost flat (Japan Sports Agency and Ministry of Economy, Trade and Industry, 2016). In 2018, the US sports market is approximately US $ 130 billion (approximately 14.4 trillion yen), the largest in the world (Japan External Trade Organization, 2019). Hence, Japan's sports industry is smaller than other developing countries. In Japan, further development of the sports industry is indispensable, and participation of the older adults, whose population is increasing, must help the Japan’s sports industry. Therefore, this paper investigates the interest of older adults in sports.

Moreover, Oda (2001) reported that only a few respondents answered “within 1 hour” including “never watch” for the question about watching time of TV. Over 90% of the older adults watched TV for more than 2 hours a day, and approximately 20% of respondents exceeded 6 hours. Some respondents watched it for more than 8 hours. The most common was "within 3 hours", accounting for approximately 20% of the total. Next, “within

4 hours" and "within 5 hours" were each about 17%. Approximately half of the older adults watched over 4 hours. Furthermore, there is a paper that analyzed the program organization of terrestrial broadcasting stations (11 channels) and BS digital broadcasting stations (8 channels) by genre, using the program table data for 8 weeks in 2010. The total broadcast time ratio of sports was 7.399% out of 20 genres (The sixth of 20 genres) (Asai, 2011). Therefore, TV can be a medium for "watching sports" for the older adults.

The data from the Ministry of Land, Infrastructure, Transport and Tourism (2017) showed the outing characteristics of the older adults. In households including the older adults, the composition of "single households" and "households with a couple" has been increasing in recent years. The number of cases in which older adults have to move on their own for activities necessary for daily life has been increasing, and it is necessary to secure the means of transportation for older adults. In addition, the number of driver license holders over the age of 65 is on the rise, and the number of self-returned licenses has been increasing rapidly in recent years. The annual income of older adults is about 2.5 million yen lower than the average of all households, and many older adults receive pensions and other benefits. The going-out rate of the older adults is low compared to non-older adults. In addition, the older adults without a driver license is much lower than the other ages. Thus, the older adults are getting harder to go out by themselves.

From these social backgrounds, the question arises: how much do older adults really participate in watching sports via TV and other ways? Therefore, the purpose of this paper is to investigate whether there is an environment in which the older adults can actively watch sports at present. To investigate it, this paper asked the older adults about the frequency and satisfaction of "watching sports", and the kinds of sports that they watch on TV/ through

media such as live streaming service and movies on internet and at stadiums/ gymnasiums. In addition, one of the purposes of this paper is to investigate the relationship between “watching sports” and “doing/ supporting sports”.

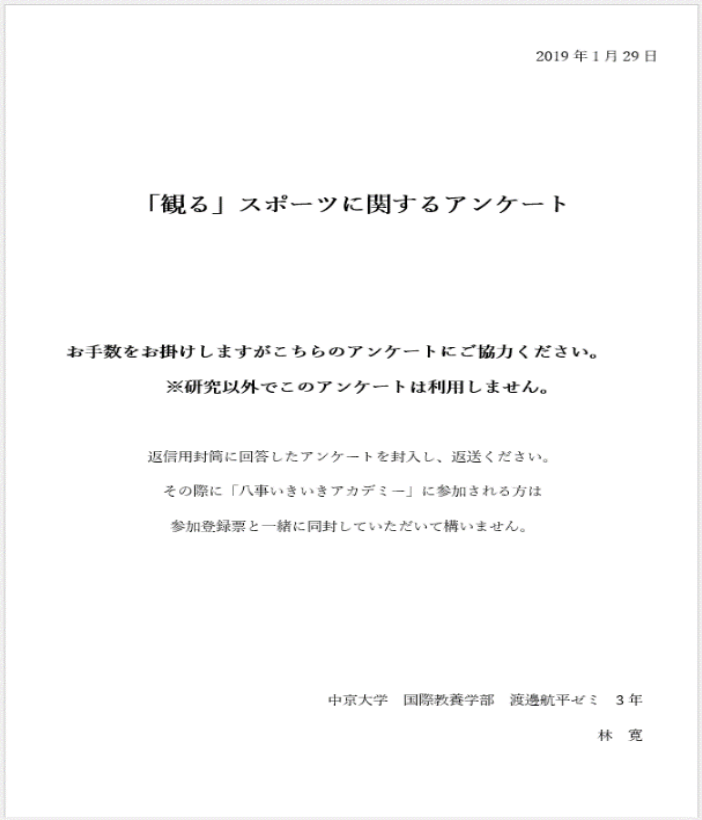
The hypothesis of this paper was that the frequency of watching sports on TV and through media is expected to be high, based on the length of TV viewing time of older adults and the data of the broadcast time ratio of sports programs. On the other hand, the frequency of watching sports at stadiums and gymnasiums is expected to be lower due to the current situation of older adults going out.

Furthermore, according to the research of Mochizuki et al. (2013), "having experience of sports and exercise" affects the contact with sports information. Therefore, it can be expected that the frequency of “doing sports” increases as the frequency of “watching sports” increases.

**Materials and Methods**

The subjects of this study were 85 older adults (males and females) living around Nagoya, Japan. The research period was from October 2018 to April 2019, and a questionnaire survey was used in this study. The questionnaire was sent to 85 older adults on January 29, 2018.

The contents of this questionnaire were consisted 14 questions in total (Figs. 1-4). As details of the contents of this survey, first of all, this questionnaire asked respondents about the frequency, the degree of satisfaction of “watching sports” and the kinds of sports that respondents watch at stadiums and gymnasiums. Then, this questionnaire asked respondents about the frequency of “doing sports” and whether respondents participated in “supporting sports” or not. In the question of frequency of “watching sports” (Question no.1 and 6), this paper



2019 年 1 月 29 日

「観る」スポーツに関するアンケート

お手数をお掛けしますがこちらのアンケートにご協力ください。
※研究以外でこのアンケートは利用しません。

返信用封筒に回答したアンケートを封入し、返送ください。
その際に「八事いきいきアカデミー」に参加される方は
参加登録票と一緒に同封していただいて構いません。

中京大学　国際教養学部　渡邊航平ゼミ　3 年
林　寛

**Figure 1.** The questionnaire for survey

(English annotation)

January 29th, 2018

A questionnaire about “watching Sports”

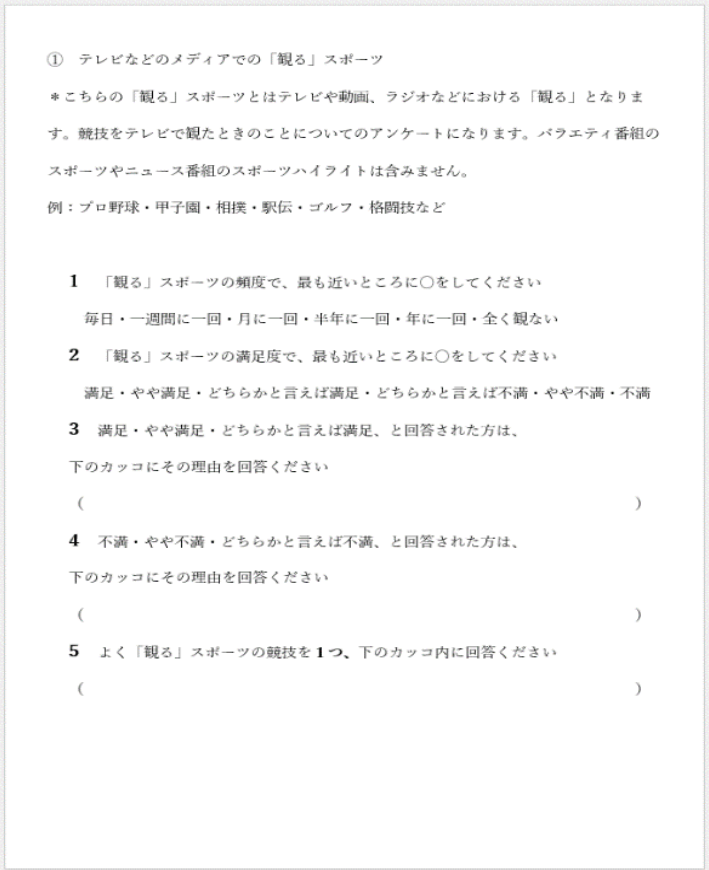
Please cooperate with this questionnaire.

*We will not use this questionnaire only for research purposes.

Please send it back using the enclosed envelope for returning

Kan Hayashi

Junior, School of International Liberal Studies, Chukyo University



① テレビなどのメディアでの「観る」スポーツ

＊こちらの「観る」スポーツとはテレビや動画、ラジオなどにおける「観る」となります。競技をテレビで観たときのことについてのアンケートになります。バラエティ番組のスポーツやニュース番組のスポーツハイライトは含みません。

例：プロ野球・甲子園・相撲・駅伝・ゴルフ・格闘技など

1 「観る」スポーツの頻度で、最も近いところに○をしてください

毎日・一週間に一回・月に一回・半年に一回・年に一回・全く観ない

2 「観る」スポーツの満足度で、最も近いところに○をしてください

満足・やや満足・どちらかと言えば満足・どちらかと言えば不満・やや不満・不満

3 満足・やや満足・どちらかと言えば満足、と回答された方は、

下のカッコにその理由を回答ください

（ ）

4 不満・やや不満・どちらかと言えば不満、と回答された方は、

下のカッコにその理由を回答ください

（ ）

5 よく「観る」スポーツの競技を**1つ**、下のカッコ内に回答ください

（ ）

**Figure 2.** The questionnaire for survey

(English annotation)

① The questionnaire is about “watching sports” on TV and through media. Variety shows on sports, sports news and game highlights are not included.

Example: baseball, sumo, ekiden, golf,

1, Circle the nearest place with your frequency of "watching sport".

Daily・Once a week・Once a month・Once a half year・Once a year・Never

2, Circle the nearest place with your degree of satisfaction of “watching sports”

Satisfied・Slightly satisfied・Be more of satisfied・Be more of dissatisfied・Slightly dissatisfied・Dissatisfied

3, If you answered "Satisfied", “Slightly satisfied” and “Be more of satisfied”, please write the reason below.

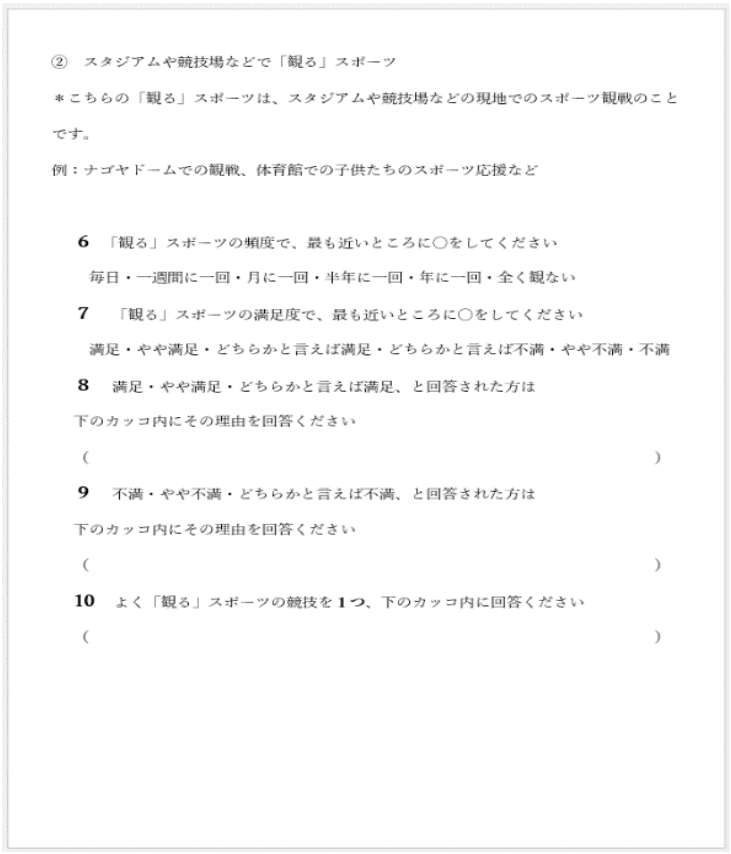
( )

4, If you answered "Dissatisfied", “Slightly dissatisfied” and “Be more of dissatisfied”, please write the reason below.

( )

5, Please answer one sport you often watch in the brackets below.

( )



② スタジアムや競技場などで「観る」スポーツ

＊こちらの「観る」スポーツは、スタジアムや競技場などの現地でのスポーツ観戦のことです。

例：ナゴヤドームでの観戦、体育館での子供たちのスポーツ応援など

**6** 「観る」スポーツの頻度で、最も近いところに○をしてください

毎日・一週間に一回・月に一回・半年に一回・年に一回・全く観ない

**7** 「観る」スポーツの満足度で、最も近いところに○をしてください

満足・やや満足・どちらかと言えば満足・どちらかと言えば不満・やや不満・不満

**8** 満足・やや満足・どちらかと言えば満足、と回答された方は

下のカッコ内にその理由を回答ください

（ ）

**9** 不満・やや不満・どちらかと言えば不満、と回答された方は

下のカッコ内にその理由を回答ください

（ ）

**10** よく「観る」スポーツの競技を**1つ**、下のカッコ内に回答ください

（ ）

**Figure 3.** The questionnaire for survey

(English annotation)

② The questionnaire is about “watching sports” at stadiums and gymnasiums.

Example: watching games at the Nagoya Dome, children's games at the gymnasium.

6, Circle the nearest place with your frequency of "watching sport".

Daily・Once a week・Once a month・Once a half year・Once a year・Never

7, Circle the nearest place with your degree of satisfaction of “watching sports”

Satisfied・Slightly satisfied・Be more of satisfied・Be more of dissatisfied・Slightly dissatisfied・Dissatisfied

8, If you answered "satisfied", “Slightly satisfied” and “Be more of satisfied”, please write the reason below.

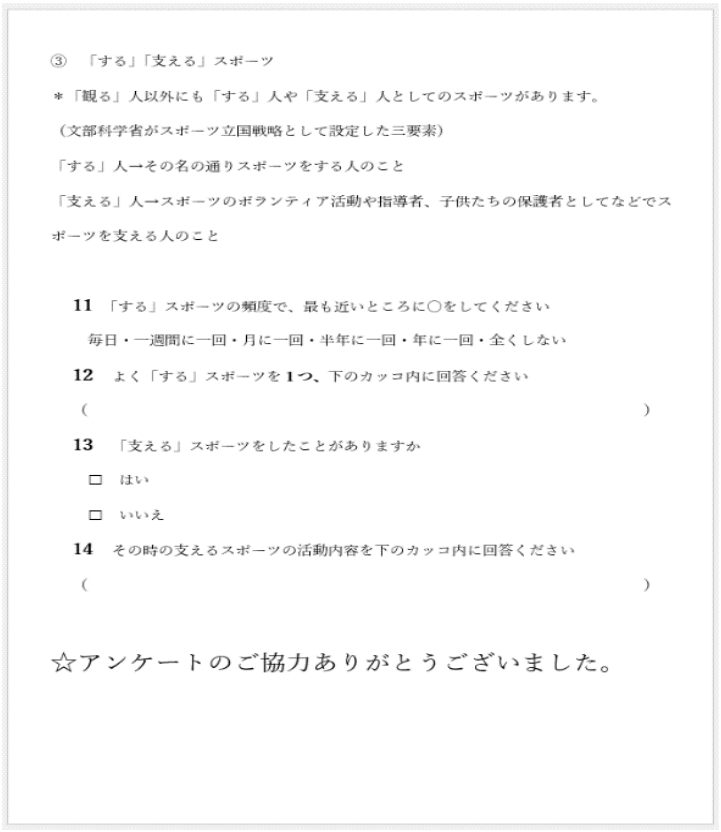
( )

9, If you answered "Dissatisfied", “Slightly dissatisfied” and “Be more of dissatisfied”, please write the reason below.

( )

10, Please answer one sport you often watch in the brackets below.

( )



③ 「する」「支える」スポーツ

＊「観る」人以外にも「する」人や「支える」人としてのスポーツがあります。

（文部科学省がスポーツ立国戦略として設定した三要素）

「する」人→その名の通りスポーツをする人のこと

「支える」人→スポーツのボランティア活動や指導者、子供たちの保護者としてなどでスポーツを支える人のこと

11 「する」スポーツの頻度で、最も近いところに○をしてください

毎日・一週間に一回・月に一回・半年に一回・年に一回・全くしない

12 よく「する」スポーツを1つ、下のカッコ内に回答ください

（ ）

13 「支える」スポーツをしたことがありますか

□ はい

□ いいえ

14 その時の支えるスポーツの活動内容を下のカッコ内に回答ください

（ ）

☆アンケートのご協力ありがとうございました。

**Figure 4.** The questionnaire for survey

(English annotation)

③ The questionnaire is about “doing sports” and “supporting sports”.

In addition to “watching” people, “doing” and “supporting” people are the three elements of the sports nation strategy set by the Ministry of Education, Culture, Sports, Science and Technology.

“Doing sport” → This means people who do sports.

“Supporting sports” → This means people who support as a volunteer, coach and parents.

11, Circle the nearest place with your frequency of "doing sport".

Daily・Once a week・Once a month・Once a half year・Once a year・Never

12, Please answer one sport you often do in the brackets below.

( )

13, Have you ever participated in “supporting sports”?

☐ Yes

☐ No

14, Please answer the activity details of “Supporting Sports” in the brackets below.

( )

☆Thank you for your cooperation in the questionnaire.

separated the choices into “every day・once a week・once a month・once a half year・once a year・never”. The reason for this division is that major sports events in Japan are held throughout the year (NPB, 2019). In addition to that, it was separated in order from "Once a year" to make it easier for older adults to answer. In the question of the degree of satisfaction of “watching sports” (Question no.2 and 7), this paper equally separated the options from “satisfied” to “dissatisfied” into 6 parts. The reason why question numbers 3, 4, 8 and 9 were added to the questionnaire was because the reason for the degree of satisfaction of “watching sports” for the older adults was necessary. Question number 5, 10 and 12 were added to the questionnaire to investigate the sports of interest to the older adults. Question number 11 was assigned to six options to match question number 1 and 6. Question numbers 13 and 14 were added to the questionnaire to investigate the “supporting sports” experience and activities of the older adults. Furthermore, this paper analyzed the relationship between the frequency of “watching sports” and the frequency of “doing sports”, and the relationship between the frequency of “watching sports” and the experience of “supporting sports”.

To quantify the results of questionnaire, percentages for number of each answer for each question were calculated in this study. In this paper, the second decimal place is rounded off.

**Results**

The total number of respondents of the questionnaire was 85 including 20 male, 50 female and 15 unidentified. To summarize the questionnaire results, in the question of the frequency of “watching sports” on TV and through media, 25 respondents (31.6%) answered “once a month”, which was the most popular answer. Then,

24 people (30.4%) answered, “every day” (Table. 1).

Regarding the question of the degree of satisfaction of “watching sports” on TV and through media, “satisfied” and “slightly satisfied” were the most popular answer (32.1%). Then, 25 respondents (30.9%) answered “be more of satisfied” (Table. 2).

The following opinions are the reasons why respondents answered “satisfied”, “slightly satisfied” and “be more of satisfied” of “watching sports” on TV and through media.

・It was fun even if I can’t play sports ・“Watching sports” gives me the spirit of fighting

・The whole body fighting, powerful, great teamwork ・I get satisfaction

・Team strength, tactic ・I understand the game ・I can watch the game all the time on NHK BS1

・Easy to understand with commentaries and replays ・I can watch the points on the big screen

・I am impressed by the greatness of stamina and desperate effort ・I can watch the topic sports

・I am impressed by the seriousness of sports and great performance

・The players are committed to fair play ・Beautiful posture, glide with great form

・A female tennis player won and I was looking forward to watching her playing on TV

・The effort is great ・I can watch techniques that I can't do

・I can watch the points in a short time ・Video and commentary

・Slow playback ・Just watching is fun ・I want to do the sport that I watched on TV

・Pounding feeling, feeling sensation, wonderful movement, body ・Player’s hard work

・I am impressed by the hard support ・My favorite player is in the game

**Table 1.** Frequency of “watching sports” (TV, through media)

| | Respondents | % |
|---|---|---|
| Daily | 12 | 15.2 |
| Once a week | 24 | 30.4 |
| Once a month | 25 | 31.6 |
| Once a half year | 13 | 16.5 |
| Once a year | 3 | 3.8 |
| Never | 2 | 2.5 |

**Table 2.** Degree of the satisfaction of “watching sports” (TV, through media)

| | Respondents | % |
|---|---|---|
| Satisfied | 26 | 32.1 |
| Slightly satisfied | 26 | 32.1 |
| Be more of satisfied | 25 | 30.9 |
| Be more of dissatisfied | 3 | 3.7 |
| Slightly dissatisfied | 0 | 0 |
| Dissatisfied | 1 | 1.2 |

・My favorite team wins the games ・The games are broadcast from start to finish

・I can kill my time by “watching sports” ・The games are broadcast to the end on a pay program

・I like watching ・I can watch the results of the practice

・Player’s hard work ・TV broadcast is easy to understand

・Be thrilled ・I can watch easily ・Player’s willingness

・I can watch calmly and hear commentary ・Professional performance ・Heat the games

・I like sports ・I can learn ・It’s fun ・I can watch many things

・I can be thrilled by the whereabouts of the game ・I can expect ・There are players I support

・I can watch the games that held in a distant place ・Agility, ugliness

・I can watch sports at my convenient time ・I like ・I can watch on time

・I can watch without being affected by the weather ・I can support players hard

・I can watch my favorite sport ・Time zone ・Unexpected things happen

・I can watch in my house ・Player’s performance ・Interesting

・I can watch as long as I have time ・Length of broadcast time ・I can see the result

・Performance ・Easy to understand with commentary

・I am impressed by the performance of Naomi Osaka ・I can watch at a good angle

The following opinions are the reasons why respondents answered “dissatisfied”, “slightly dissatisfied” and “be more of dissatisfied” of “watching sports” on TV and through media.

・Insufficient study by commentators ・There are not many rugby broadcasts

・Only major sports appear in the media

Moreover, 17 respondents (21.5%) answered that they watch “baseball”, then, 12 respondents (15.2%) answered they watch “sumo” (Fig. 5) on TV and through media. Additionally, there are documents on the frequency and the degree of satisfaction of “watching sports” for each sport (Fig. 6, 7).

Furthermore, in the question of the frequency of “watching sports” at stadiums and gymnasiums, 38 respondents (47.5%) answered “never”, which was the most popular answer. Then, 19 people (23.8%) answered “once a year” (Table. 3).

Regarding the question of the degree of satisfaction of “watching sports” at stadiums and gymnasiums, “be more of satisfied” was the most popular answer (27.9%). Then, each 11 respondents (25.6%) answered “satisfied” and “slightly satisfied” (Table. 4).

The following opinions are the reasons why respondents answered “satisfied”, “slightly satisfied” and “be more of satisfied” of “watching sports” at stadiums and gymnasiums.

・I can hear the cheering and feel presence ・Impressive to be on site ・I can get tickets easily

・I can watch as if I was playing ・I am impressed by the players performance

・I can watch happily with my friends ・On site is great ・Presence

・I can watch as if I was playing ・There is presence different from watching on TV

・I am impressed by the players hard work ・Players or team wins

・Everyone plays hard ・It was fun to watch ・There are many audiences

・The player I know is in the game ・Powerful ・I can actually watch the players

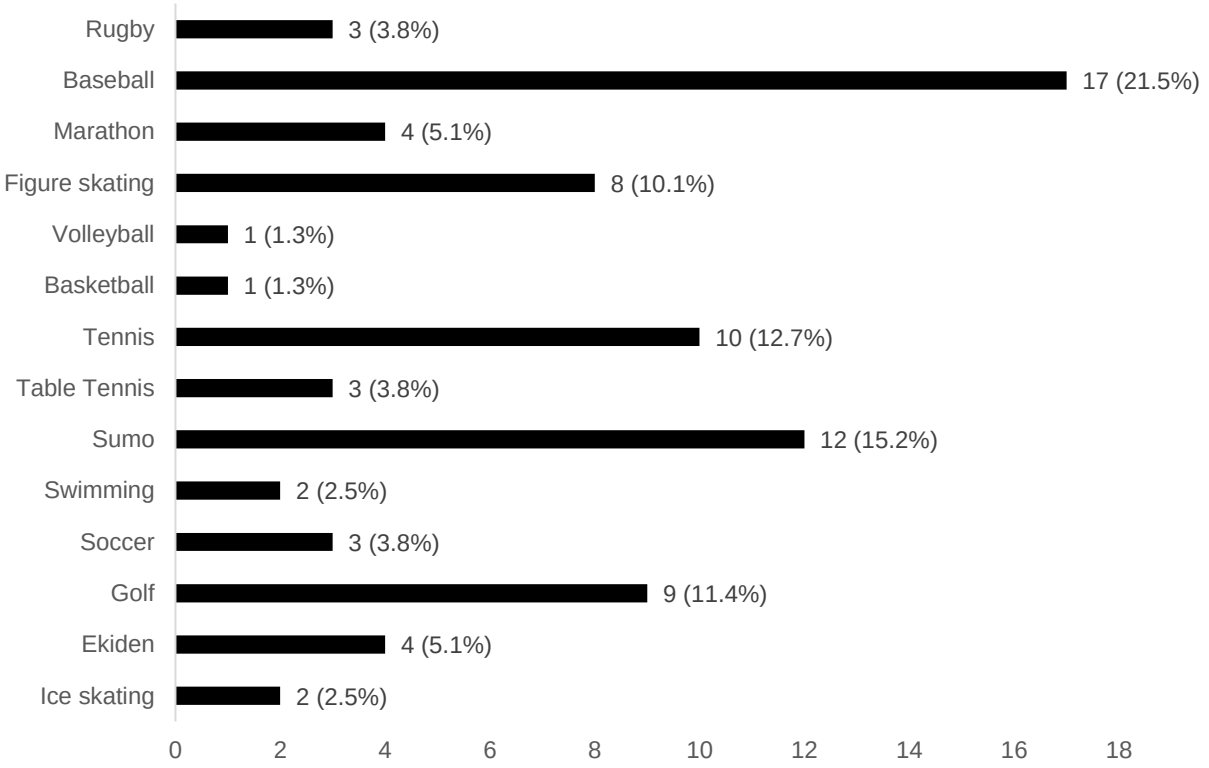



**Figure 5.** The kinds of sports that the respondents watch on TV and through media

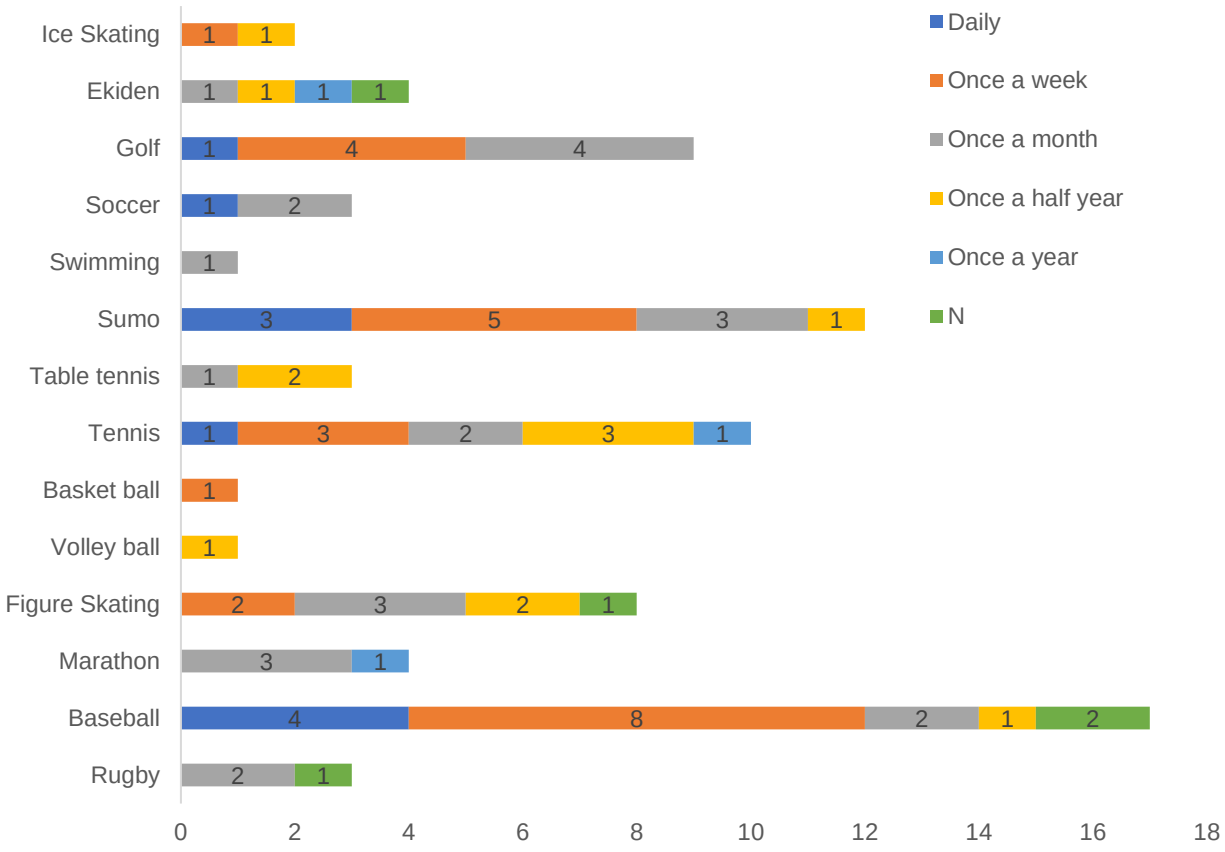



**Figure 6.** The kinds of “watching sports” and breakdown of the frequency of “watching sports” on TV and through media.

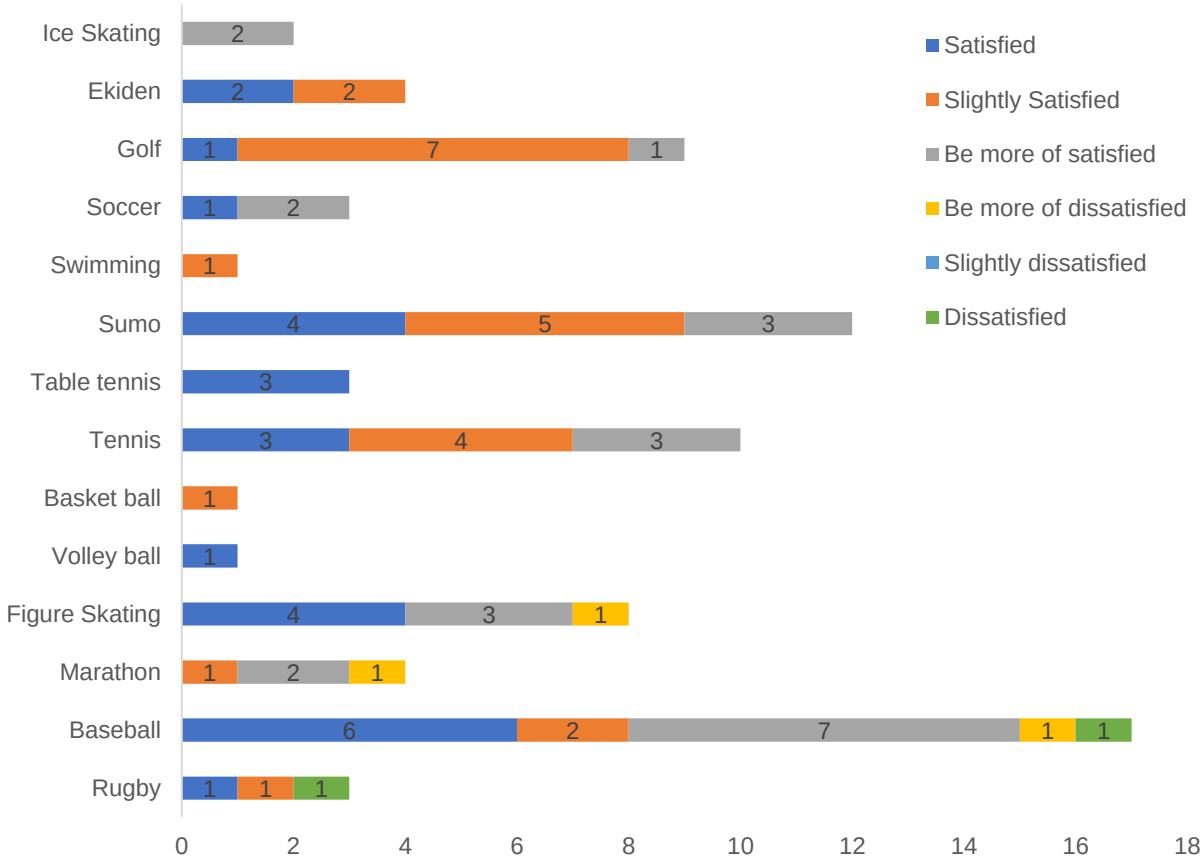



**Figure 7.** The kinds of “watching sports” and breakdown of the degree of satisfaction of “watching sports” on TV and through media.

**Table 3**. Frequency of “watching sports” (stadiums, gymnasiums)

| | Respondents | % |
|---|---|---|
| Daily | 2 | 2.5 |
| Once a week | 1 | 1.3 |
| Once a month | 2 | 2.5 |
| Once a half year | 18 | 22.5 |
| Once a year | 19 | 23.8 |
| Never | 38 | 47.5 |

**Table 4.** Degree of the satisfaction of “watching sports” (stadiums, gymnasiums)

| | Respondents | % |
|---|---|---|
| Satisfied | 11 | 25.6 |
| Slightly satisfied | 11 | 25.6 |
| Be more of satisfied | 12 | 27.9 |
| Be more of dissatisfied | 3 | 7.0 |
| Slightly dissatisfied | 3 | 7.0 |
| Dissatisfied | 3 | 7.0 |

・My family is in the game ・Interesting ・I feel like I am participating

・Presence ・Atmosphere ・The place of the game is near ・Presence

・I can support my favorite player ・Team play ・Presence

The following opinions are the reasons why respondents answered “dissatisfied”, “slightly dissatisfied” and “be more of dissatisfied” of “watching sports” at stadiums and gymnasiums.

・There are not many big games in Nagoya ・The venue of the game is far away

・I don't want to go far for watch the game ・I’m not interested

・I don’t like crowds ・The price of the tickets are expensive ・I can't watch the details

Moreover, 28 respondents (35.4%) answered that they watch “baseball”, then, 3 respondents (7.3%) answered they watch “marathon” (Fig. 8) at stadiums and gymnasiums. Additionally, there are documents on the frequency and the degree of satisfaction of “watching sports” for each sport (Fig. 9, 10).

In the questions of “doing sports”, 37 respondents (47.4%) answered, “never”, which was the most popular answer. Then, 24 respondents (30.8%) answered, “once a week” (Table. 5) and this paper analyzed the frequency of “doing sports” by the frequency of “watching sports” on TV/ through media and at stadiums/ gymnasiums (Fig. 11, 12). In addition, “swimming” is the most popular “doing sports” for older adults (29.3%) (Fig. 13).

There were 17 “yes” (22.4%) and 59 “no” (77.6%) respondents on “supporting sports” (Table. 6), and this paper analyzed the relationship between the frequency of “watching sports” on TV/ through media and at stadiums/ gymnasiums (Fig. 14, 15). In addition, 4 respondents (23.5%) were classified as “Coaches”, 11 respondents (64.7%) were classified as “Support/help” and 2 respondents (11.8%) were classified as “Volunteer” (Table. 7).

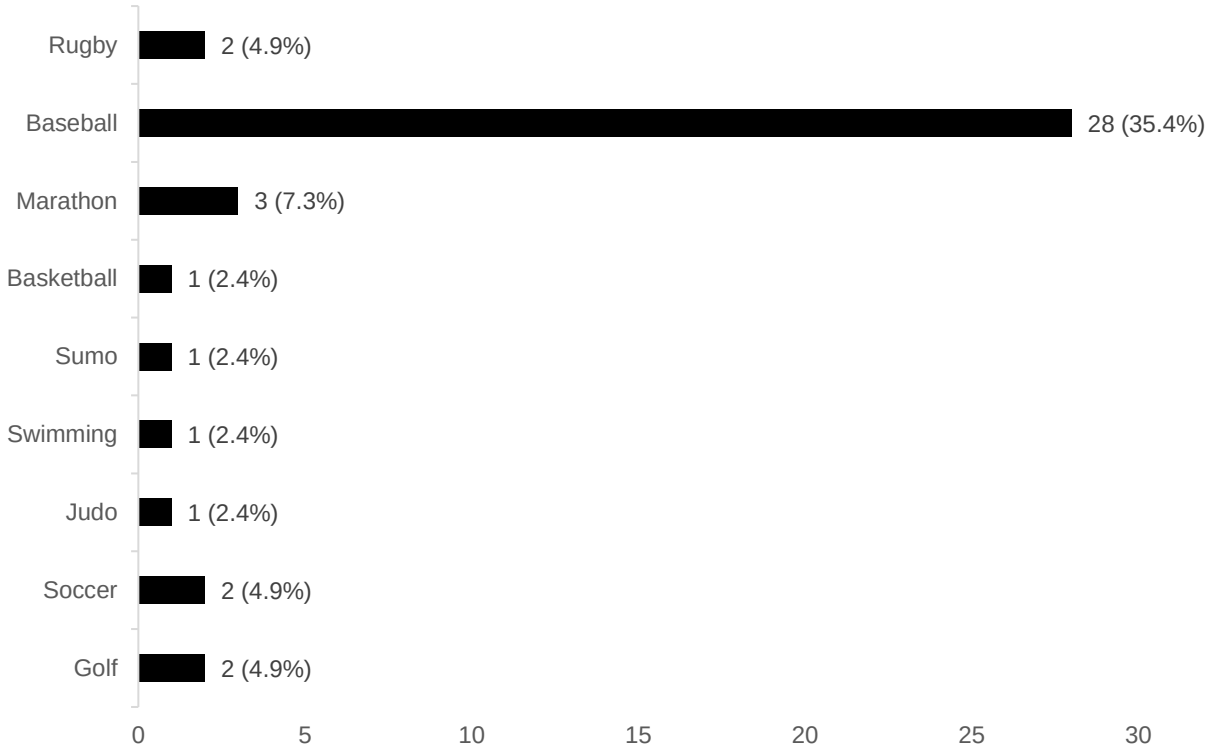



**Figure 8.** The kinds of sports that the respondents watch at stadiums and gymnasiums

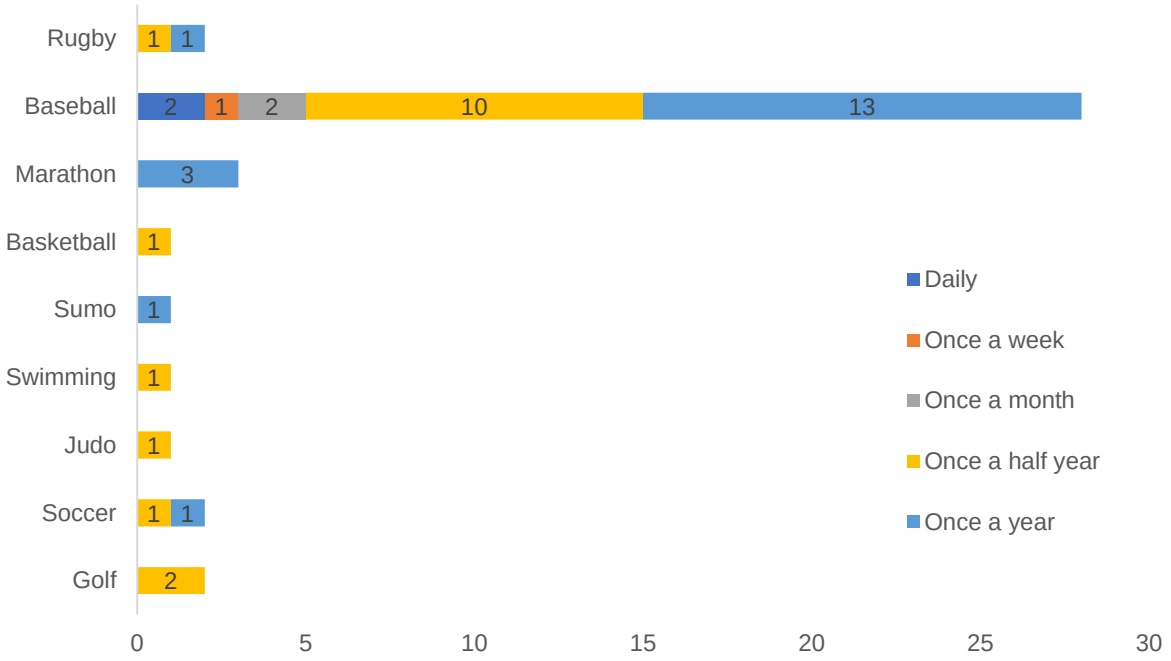



**Figure 9.** The kinds of “watching sports” and breakdown of the frequency of “watching sports” at stadiums and gymnasiums.

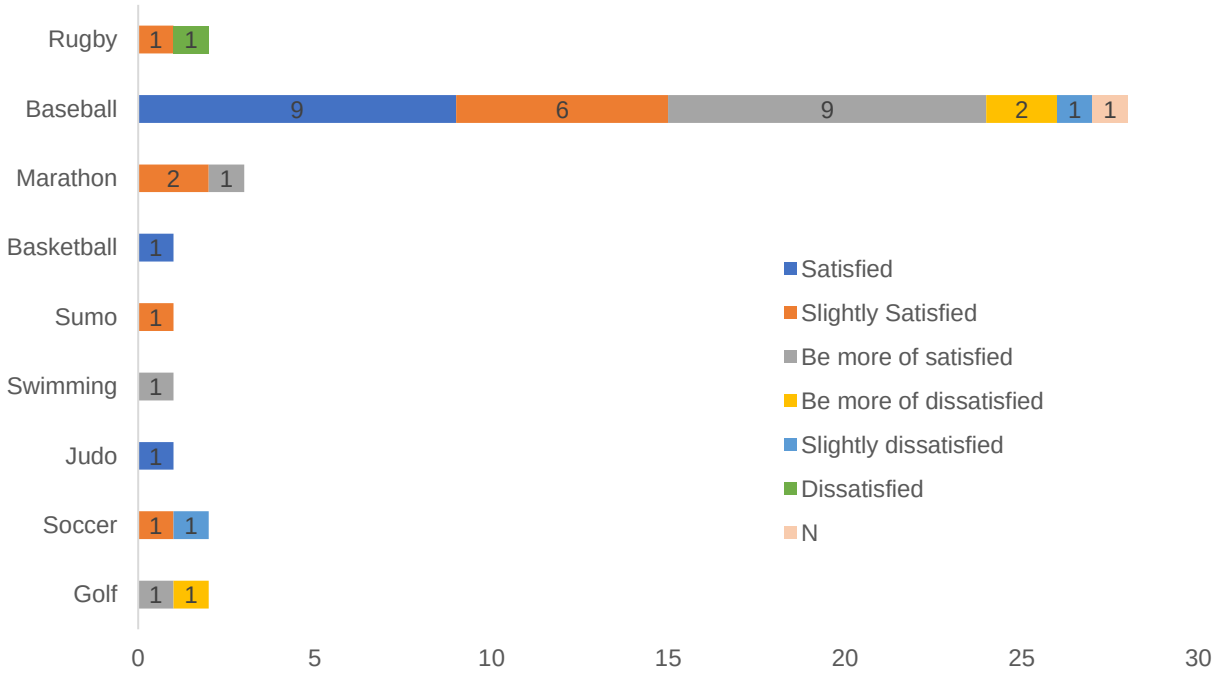



**Figure 10.** The kinds of “watching sports” and breakdown of the degree of satisfaction of “watching sports” at stadiums and gymnasiums.

**Table 5.** Frequency of “doing sports”

| | Respondents | % |
|---|---|---|
| Daily | 5 | 6.4 |
| Once a week | 24 | 30.8 |
| Once a month | 8 | 10.3 |
| Once a half year | 1 | 1.3 |
| Once a year | 3 | 3.8 |
| Never | 37 | 47.4 |

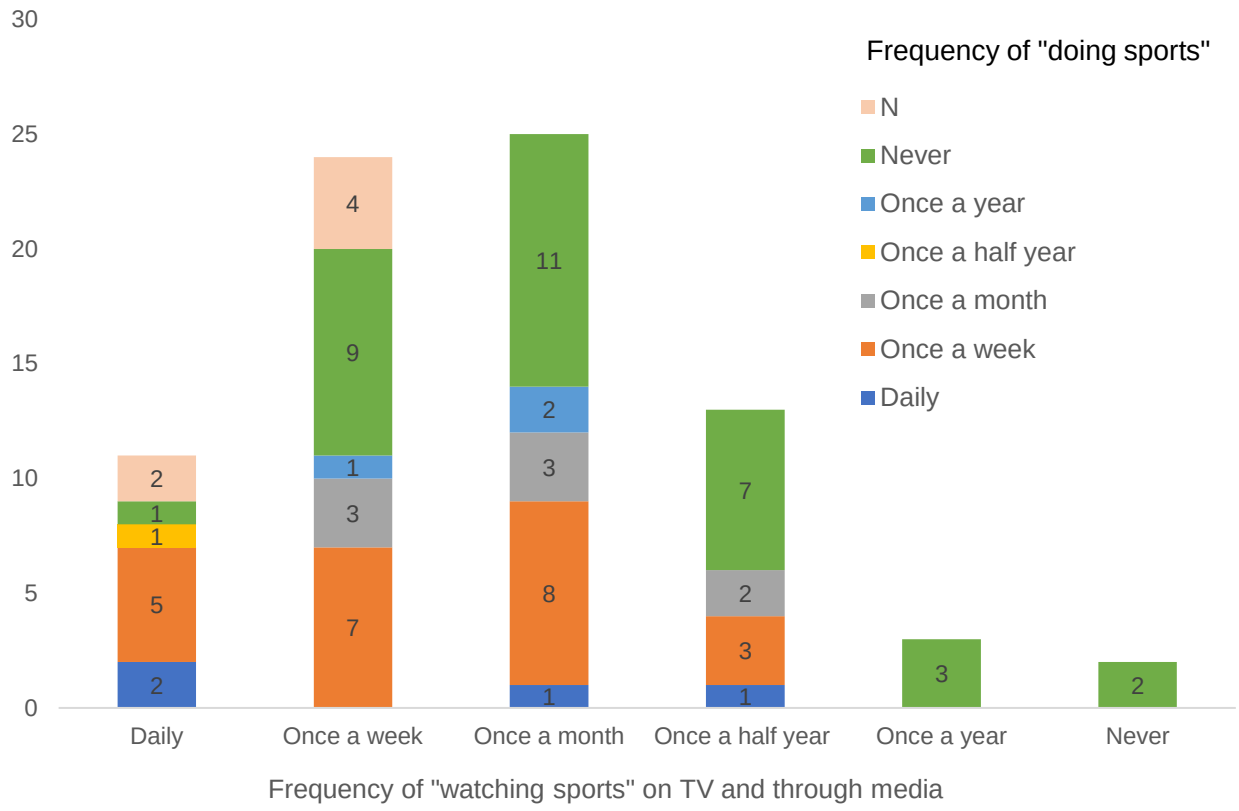



**Figure 11.** The frequency of “watching sports” on TV and through media and the frequency of “doing sports”.

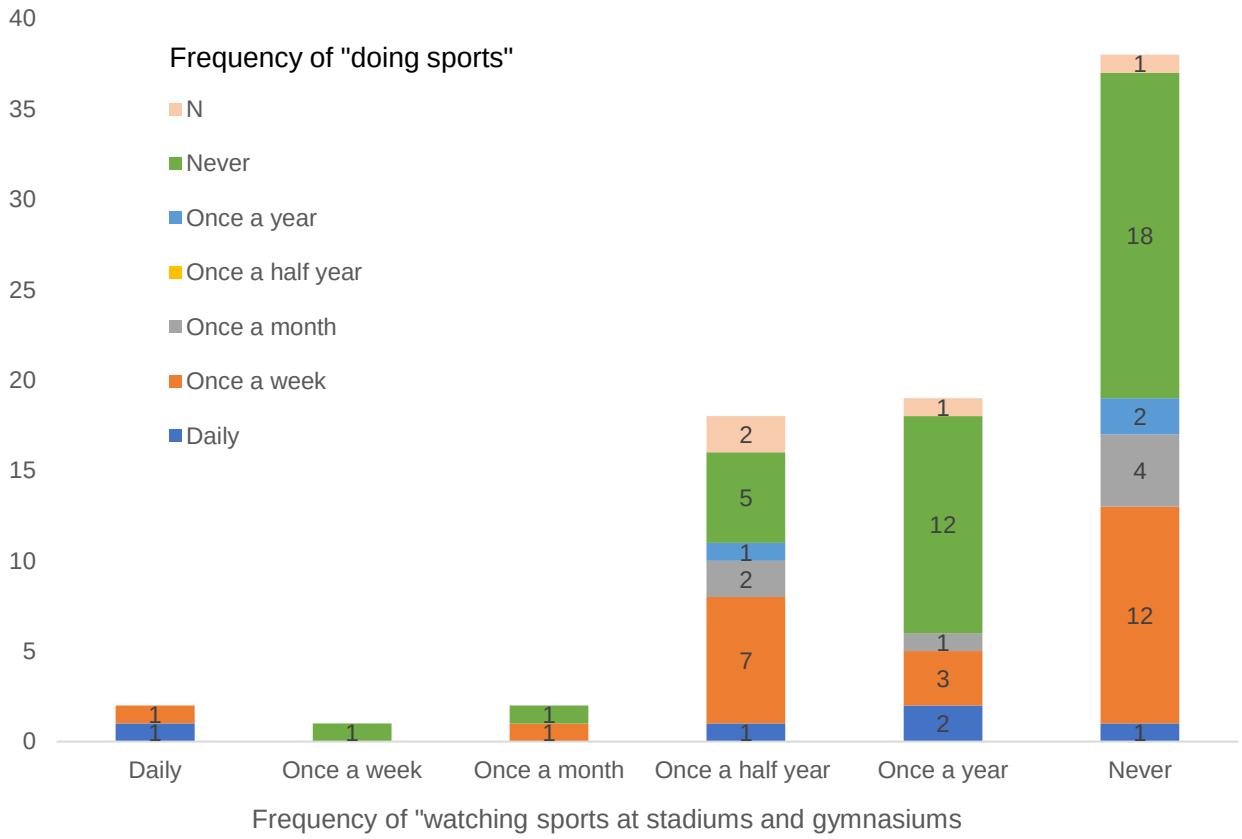



**Figure 12.** The frequency of “watching sports” at stadiums and gymnasiums and the frequency of “doing sports”.

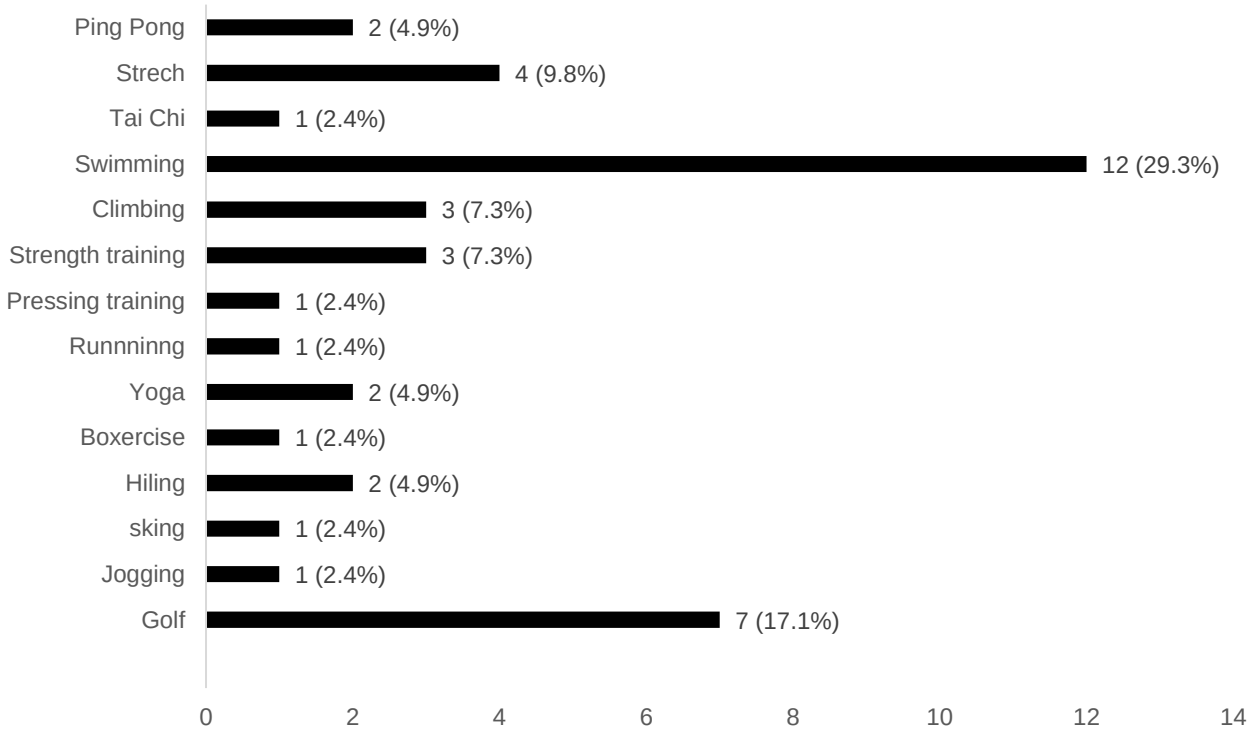



**Figure 13.** The kinds of “doing sports”

**Table 6.** Have you ever participated in “supporting sports”?

| | Respondents | % |
|---|---|---|
| Yes | 17 | 22.4 |
| No | 59 | 77.6 |

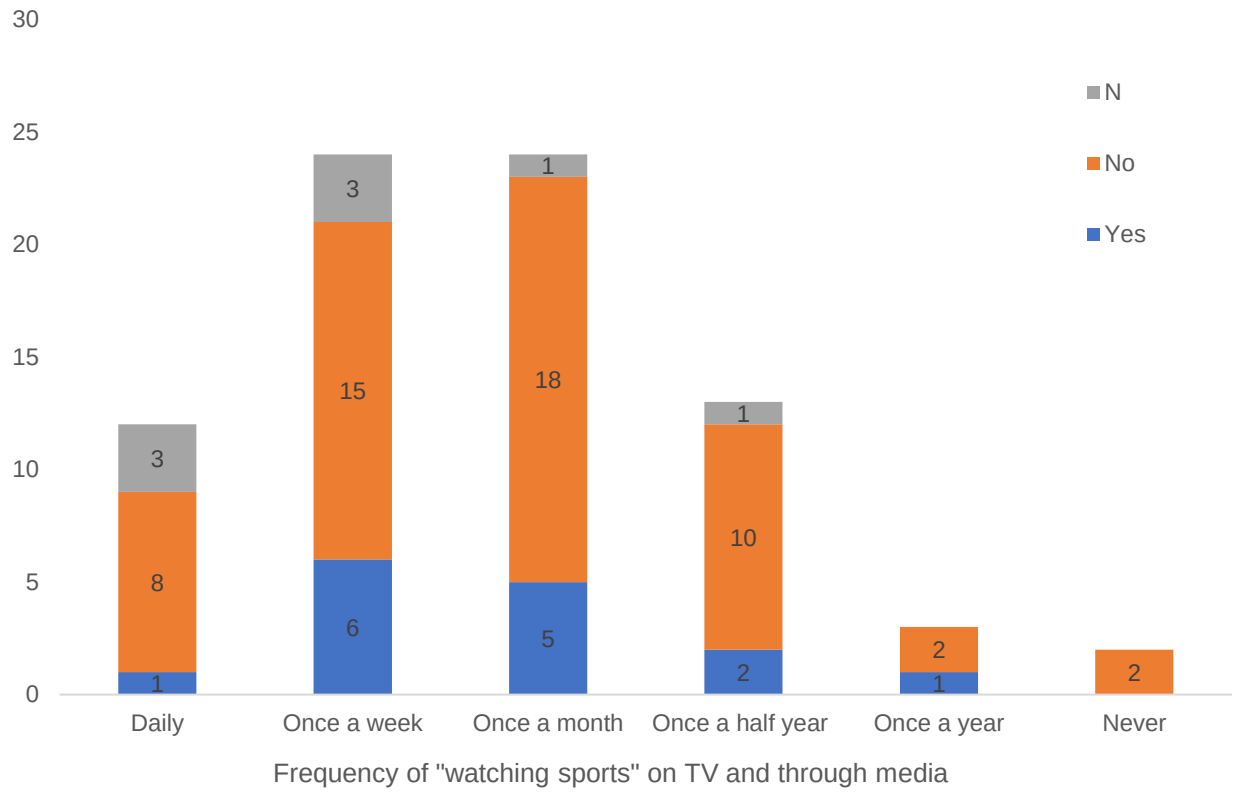



**Figure 14.** The frequency of “watching sports” on TV and through media and the experience of “supporting sports”.

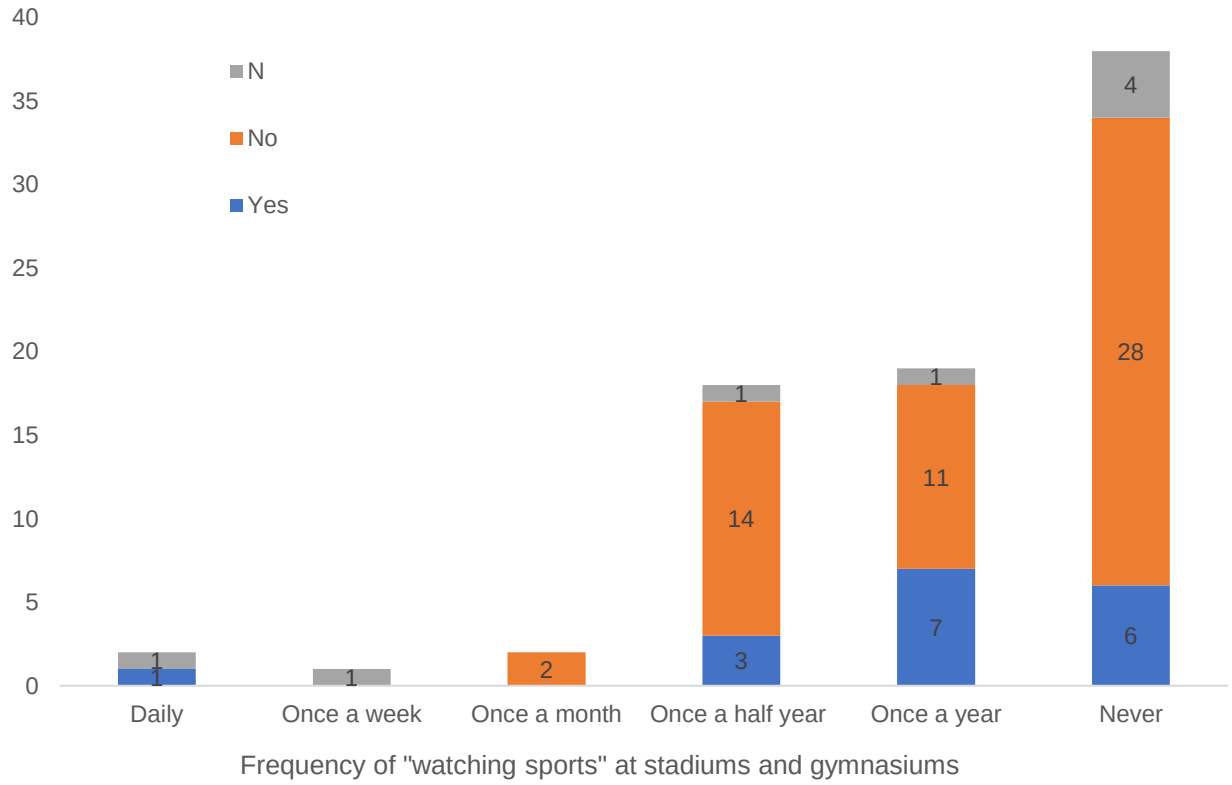



**Figure 15.** The frequency of “watching sports” at stadiums and gymnasiums and the experience of “supporting sports”.

**Table7.** Lists of “supporting sports”

| | Respondents | % |
|---|---|---|
| Coach | 4 | 23.5 |
| Support / help | 11 | 64.7 |
| Volunteer | 2 | 11.8 |

**Discussion**

The purpose of this paper was to investigate whether there is an environment where the older adults can actively watch sports at present. From the results, first of all, from the aspect of "watching sports" on TV and media, many older adults watched sports on TV and through media. More than half of the older adults felt "satisfied", "slightly satisfied" and "be more of satisfied" with regard to "watching sports" on TV and through media. The reason is that older adults can watch in an environment that is convenient for them, and older adults can understand sports through commentaries and various video technologies.

On the other hand, many older adults answered "never" or "once a year" with regard to "watching sports" at stadiums and gymnasiums. However, in terms of the degree of satisfaction, more than half of the older adults were "satisfied", "slightly satisfied" and "be more of satisfied". The reason is that many respondents answered that there was an atmosphere, presence, and excitement that could only be obtained on site. In other words, it was found that as long as there was an environment for older adults to watch sports, they would actively watch sports. However, the frequency of "watching sports" at stadiums and gymnasiums has been reduced because of the risk of going out. In order to further expand the sports market, this paper says that measures to reduce the risk of going out for the elderly are necessary.

In addition to that, the paper found many older adults chose baseball as an option to watch sports from the results of the kinds of sports that they watch on TV/ through media and at stadiums/ gymnasiums. Focusing on baseball, one of the competitions of Tokyo 2020 (TOKYO2020, 2019), may lead to the expansion of the sports watching population of the older generation. With regard to the frequency of "watching sports" for each sport, the

frequency of “watching sports” is increasing in sports (for example, baseball and sumo) that many older adults watch on TV and through media. In terms of the frequency of “watching sports” at stadiums and gymnasiums, this paper was unable to find the frequency characteristics because there were few responses other than “baseball”. Regarding the degree of satisfaction of “watching sports” for each sport on TV and through media, “golf”, “sumo”, and “tennis”, which received many answers, were highly satisfied by the older adults. The characteristics of the degree of satisfaction of “watching sports” for each sport at stadiums and gymnasiums were not found because there were few answers other than “baseball”.

According to the questionnaire results of “doing sports” and “supporting sports”, 37 respondents (47.4%) answered “never”, and many older adults have never participated in “supporting sports”. The relationship between the frequency of “watching sports” and “doing sports” was not as expected. Even if the frequency of “watching sports” is high, this paper cannot be said that the frequency of “doing sports” is high. On the other hand, when the frequency of “watching sports” is low, the frequency of “doing sports” also is low. There was a variation in the relationship between “watching sports” and “supporting sports”. Increasing the older population of “doing sports” and “supporting sports” through “watching sports” is one of the challenges of the sports industry.

However, this survey method was not statistically good. This is because the survey mainly prepared questions that allowed respondents to choose an answer. As a result, this paper only gave simple results. The survey also failed to compare the frequency and the degree of satisfaction of “watching sports” between TV / media and stadiums / gymnasiums. This is because there was a problem in how to make a questionnaire. In addition, the disadvantage of this survey method was that all of the answers were only within the memory of the older adults.

Therefore, in this questionnaire, older adults answered while remembering their experiences of “watching sports”. The results of this survey were the numerical value of each questions and the free description answers. From this survey, the most important harvest of this survey was to understand the current state of participation in sports watching for the older adults.

Until today, there has been a lot of discussion about sports with the older adults. However, those are “sports for improving the quality of life of the older adults” (Yamaguchi et al., 1996) and “regular physical activity in the older adults promotes healthy aging” (Oka et al., 2004). As described above, there are many cases where sports are linked to the quality of life and health promotion of the older adults. There are few surveys on older adults and “watching sports” as in this paper. In addition, participation of older adults is indispensable for the expansion of the sports industry, which is one of the social issues in Japan.

In conclusion, this paper should be used for older adults to participate in the sports industry, and it should be used to make “watching sports” more accessible to many older adults.

**Acknowledgement**

I would like to thank Prof. Kohei Watanabe for setting up a questionnaire survey for the older adults, your advice and review of this paper.

**References**


Asai, S. (2011). Programming of Terrestrial Broadcasters and BS Digital Broadcasters by Genre, JSICR Journal, 29(3), 1-12

International Olympic Committee. (2019.10/20/2019). 2020 Olympics - Next Summer Olympic Games | Tokyo 2020, 2019, https://www.olympic.org/tokyo-2020

Japan External Trade Organization. (2019.03/31/2019). 世界に向かうスポーツ産業, 2019, https://www.jetro.go.jp/world/reports/2019/02/03f9994684b788e5.html

Japan Sports agency and Ministry of Economy, Trade and Industry. (2016.12/10/2018). スポーツ未来開拓会議中間報告, 2019, https://www.meti.go.jp/press/2016/06/20160614004/20160614004-1.pdf

Masumoto, M., Honma, K. (2014). Olympic spiritual culture as an intangible Olympic legacy, The Philosophic study of sport and physical education, 36(2), 97-107

Ministry of Economy, Trade and Industry. (2016.12/13/2017). 全体報告書, 2019, https://www.meti.go.jp/meti_lib/report/2016fy/000755.pdf

Ministry of Education, Culture, Sports, Science and Technology. (2011.07/27/2011). スポーツ立国戦略, 2019, http://www.mext.go.jp/a_menu/sports/kihonhou/attach/1308935.htm

Ministry of Health, Labor and Welfare. (2018.06/02/2018).今後の高齢者人口の見通しについて, 2019, https://www.mhlw.go.jp/seisakunitsuite/bunya/hukushi_kaigo/kaigo_koureisha/chiiki-houkatsu/dl/link1-1.pdf

Ministry of Internal Affairs and Communications Statistics Bureau (2019.09/20/2019). 人口推計 － 2019 年（令

和元年）９月報 －,

2019, https://www.stat.go.jp/data/jinsui/pdf/201909.pdf

Ministry of Internal Affairs and Communications Statistics Bureau (2018.10/26/2019). 国際比較で見る高齢者,

2019, https://www.stat.go.jp/data/topics/topi1135.html

Ministry of Land, Infrastructure, Transport and Tourism (2017.03/17/2017). 高齢者の生活・外出特性について,

2019, http://www.mlit.go.jp/common/001176318.pdf

Mochizuki, T., Kuwahara, J., Tomita, H. (2013). Research on Lifestyles, Sports Activities and Contact with The Sports Information in University Students. Bulletin of the Shizuoka Institute of Science and Technology, 21, 83-93

Nippon Professional Baseball Organization (2019.11/22/2019). 2019 Schedules, 2019, http://npb.jp/eng/

Oda, T. (2001). Predictors of the Length of TV-Watching of Elderly Japanese and Their Preference for TV Programs. Bulletin of the Faculty of Human Development, 8(2), 283-302

Oka, K., Togo, F., Aoyagi, Y. (2004). A Prospective Study on Determinants of Objectively Measured Physical Activity among Elderly Japanese. Descente sports science, 25, 72-81

TOKYO2020. (2019.11/17/2019). Olympic Sports, 2019, https://tokyo2020.org/en/games/sport/olympic/

Yamaguchi, Y., Tohi, T., Takami, A. (1996). Assessing the Relationship between Quality of Life and Sport and Leisure Activities A Comparison between the Middle-ages and the Elderly. Japan Journal of Sport Sociology, 4, 34-50

# Relationship between motivation for food and the physique in female university students

国際社会系(渡邊ゼミ)

S116012

一木歩

Ayumi　Ichiki

**Abstract**

**Relationship between motivation for food and the physique in female university students**

**Aim** The purpose of the present study is to investigate relationship between motivation for food and the physique in female university students. **Methods** Thirty female university students (21.6 ± 0.8 years) answered survey on interest in food and dietary behavior and performed body composition. In this study, motivation for food is considered the height of the interest in food. The visual analogue scale (VAS) method used as a measurement for survey about the height of the interest in food and meal amount of dietary behavior. The amount of physical activity per week was evaluated using International Physical Activity Questionnaire Short Version. Body composition was measured using a body composition analyzer (InBody). This study calculated the correlation coefficient among food interest, eating behavior, physical activity, Body composition. **Results** Significant positive correlations were found between food interest and eating behavior, between food interest and physical activity. **Conclusion** These results suggested that the relationship between motivation for food and body composition, physique is not recognized.

**女子大学生の食に対するモチベーションと体型との関連性**

本研究の目的は、女子大学生の食に対するモチベーションと体型との関連性を調査することであった。30人の女子大学生(21.6 ± 0.8 歳)が食に対する興味と食事行動のアンケートに答え、体組成測定を行いました。本研究では、食に対するモチベーションを食への関心の高さと考えた。食への関心の高さ、食行動の食事量のアンケートの計測に、Visual analogue scale (VAS) を用いた。一週間あたりの身体活動量は国際標準身体活動質問票簡易版（IPAQ）を使い、評価した。体組成の測定は、体成分分析装置（InBody）を用いた。食への関心の高さと食行動の食事量、1 週間当たりの身体活動量、体組成の間の相関関係を計算した。解析の結果、食への関心と食事行動、食への関心と身体活動の間に有意な正の相関関係がみられた。これらの結果から、女子学生において、食のモチベーションと体組成・体型の関係性は、認められないことが示唆された。

**Relación entre la motivación por la comida y el físico de las estudiantes universitarias**

El objetivo del presente estudio es investigar la relación entre la motivación por la comida y el físico en estudiantes universitarias. Treinta estudiantes universitarias (21,6 ± 0,8 años) respondieron la encuesta sobre el interés en el comportamiento alimentario y dietético y realizaron la composición corporal. En este estudio, la motivación por la comida se considera la altura del interés en la comida. El método de escala analógica visual (VAS) utilizado como método de medición para la encuesta sobre la altura del interés en los alimentos y la cantidad de comida del comportamiento dietético. La cantidad de actividad física por semana se evaluó utilizando la versión corta del Cuestionario internacional de actividad física. La composición corporal se midió usando un analizador de composición corporal (InBody). Este estudio calculó el coeficiente de correlación entre interés alimentario, comportamiento alimentario, actividad física, composición corporal. Se encontraron correlaciones positivas significativas entre el interés alimentario y el comportamiento alimentario, entre el interés alimentario y la actividad física. Estos resultados sugieren que no se reconoce la relación entre la motivación para la alimentación y la composición corporal, físic.

**Introduction**

There are various dishes all over the world, and they report that represent the food culture of each country. Japanese food draws many people's attention. For example, the first place that foreign tourists expect at the date and time of their visit is meals, the first foreign food that foreigners like is Japanese food (National Health and Nutrition Survey, 2013). In addition, the number of overseas Japanese restaurants increased significantly (National Health and Nutrition Survey, 2013). Furthermore, Japanese food recognized by UNESCO as an intangible cultural heritage in 2013.

While Japanese food is attracting worldwide attention, recently young people have many problems about food. For example, a diet that is too nutritionally unbalanced, irregular meals, habits of skipping breakfast, increasing tendency of solitary meals (eating alone) and individual meals (family eating different dishes) (Healthy Japan 21, 2013). Moreover, The Ministry of Health, Labor and Welfare points out any problems such as insufficient intake of vegetables and fruits, excessive intake of salt, overweight and lack of nutrition (Healthy Japan 21, 2013). For example, for young people in 20s and 30s, 26.9% of people does not take breakfast (Ishihara and Hotta, 2014). They report that skip breakfast due to lack of time or lack of appetite (Ishihara and Hotta, 2014). There is a strong relationship between food intake and academic performance (Hamaguchi et al. 2010). Accordingly, students who often skip their breakfast feel apathy and lazy during their class and their problem solving capacity is very low (Hamaguchi et al. 2010). Besides, the restaurant industry and the home-meal replacement industry developed in Japan, young people said that they are fulling their belly with a short stuff on an empty stomach (Asakura et al. 2007). People reports that intake high calorie food with careless nutrition called "Empty calorie" (Definition of Empty

Calories, 2018). Fast food, snack food, alcoholic beverages, carbonated beverages, and cakes are categorized as food that contain empty calorie. Taking extremely “Empty calorie” causes gain a weight. National Health and Nutrition Survey (2018) reported that the intake of “Empty calorie” foods is higher in the younger generation (National Health and Nutrition Survey, 2013).

Takahashi et al. (2002) investigated the degree of interest in the physique and food among male and female students aged 18 to 20. As the result, male students take exercise than female students, but male students have no interest about food and skipping meal than female students. As for the physique, the percentage of thin woman BMI<18.5kg/m$^2$ aged 20 to 50 exceed 10% in any age, especially it is 21.7% in the 20s (National Health and Nutrition Survey, 2018). The proportion of females in their 20s who are trying to lose weight is high at 28.1% of those categorized as “skinny” (based on their BMI) and 62.8% of those in the “normal” group (Citizen Health and Nutrition Study, 2008). In addition, despite the standard weight, they are many females who think that they are fat. They report that unconsciously recognize the female body type that appears in the media on a daily basis as fashionable (Mori et al. 2012). Their tendency is speculated that this is one factor that increases the health risk of young women who do not need to lose weight in the first place. Moreover, a decreasing trend in their physical activity reported because it decreased by 4.1% in 10 years (Healthy Japan 21, 2013).

Kato (2004) reported students understand the importance of dietary behavior and knowledge of food, but they do not practice. Japan Broadcasting Corporation (2016) showed female focus on the emphasizing taste (preference) and price and neglecting the effort and quantity (satisfaction) to prepare (make) (Japan Broadcasting Corporation, 2016). Female need for understand individual healthy weight and appropriate dietary intake.

Healthy Japan 21 showed the importance of dietary eating, because lifestyles such as inappropriate eating and lack of exercise affect the shortness of life expectancy.

Today, people in twenties are called convenience store generations and are considered to be generations with a high degree of externalization of food (Kajiwara, 2006). Tanabe et al. (2001) announced that university students report to eat delicious and easy food while watching TV alone. The changes in the food environment have increased obesity in male by about 1.5 times and leanness in female in twenties by two times compared to 20 years ago (Ministry of Health, Labor and Welfare, 2006). Therefore, it can be said that changes in dietary habits have affected physique.

Thus, these were a lack of the necessary knowledge and skills to properly intake food and exercise, resulting from changes in female lifestyles. Therefore, this study elucidate the relationship between motivation for food and the physique of female university students. In this study, “motivation for food” is considered as “interest in food”. “Interest in food” was judged to be related to the following items: the fun of eating and like to eat, watching and interest in cooking programs and videos, purchase of cookbooks, food records, interest in local and special food, Knowledge of seasonal ingredients. Regarding the watching and interest of cooking programs and videos, and the purchase of cookbooks, Omori (2011) surveyed about university students' food consciousness, about 70% of respondents answered that they would like to learn knowledge and skills. Therefore, it was considered that watching and interest in cooking programs and videos, and purchasing cookbooks are methods to increase interest in food. Shiota (1998) reported that making special food helps to understand the characteristics of special food, experience the joy of cannibalism, raise interest in special food, and raise awareness of traditions. Murakami et al. (2010)

reported that dietary records not only lead to awareness of the amount and pattern of meals, but also raise interest and understanding of the significance of eating habits. A variety of ingredients is available regardless of the season, and the sense of seasonal food has disappeared (Ministry of Education, Culture, Sports, Science and Technology, 2009). However, it is assumed that those who are interested in food know the seasonal ingredients.

This study hypothesized that female students with higher motivation for food has smaller difference between it BMI and standard value. Because 69.9% of people regularly recognize weight and recognize food to prevent and improve lifestyle-related diseases (Ministry of Agriculture, Forestry and Fisheries, 2017). Therefore, we assumed if they have highly motivated for food, they understood the standard value of BMI and their own proper weight. Therefore, we assumed that there is correlation between the score of motivation for food and the difference from BMI standard value.

## Materials and Methods

### *Participants*

Thirty female university students (mean age ± SD: 21.6 ± 0.8 years, range: 20-24 years) participated in this study. The participants who participated written informed consent for the study after receiving a detailed survey of the purposes and ethical considerations.

### *Experimental design*

In this study, we conducted for all participants survey on Eating behavior and Interest in food, Physical activity survey using International Physical Activity Questionnaire Short Version, and a measurement of body

composition.

i. Survey on dietary behavior and interest in food

The survey included a question asking which extent a participant ate per meal in comparison with amount of meal recommended based on Japanese Food Guide Spinning Top issued by Ministry of Health, Labour and Welfare and Ministry of Agriculture, Forestry and Fisheries (Japanese Food Guide Spinning Top, 2005). Firstly, using Japanese Food Guide Spinning Top, the recommended amount of meals per day was divided into three parts: breakfast, lunch, and dinner. In this study, we express them as the quantity of breakfast, lunch, dinner. An average of the quantity of breakfast, lunch and the dinner based on the Japanese Food Guide Spinning Top call dietary behavior score, and indicates he average amount of food that participants are taking per day. If the Dietary behavior score is high, the recommended quantity of food is satisfied. Secondary, using the illustrations on the Japanese Food Guide Spinning Top, we considered the recommended amount per meal. We used Visual analogue scale (VAS) as a measurement method for the questionnaire results. When the recommended amount was satisfied, it was determined as 10 and when it was not satisfied at all, it was determined as 0. The following questions were answered with a choice of YES or NO; “Do you always eat three meals a day? “Do you eat a certain time every day?” Therefore, it showed as a percentage. Interest in food indicates the level of interest in food. The calculation of level of interest in food uses a 10-line segment for each question that constitutes an interest in meals in this study, and evaluates the subjective degree of the question item on a straight line. If the number is high, it is judged that the interest in food is high. This survey about interest in food included searching for and viewing cooking programs and videos, watching gourmet programs and books, searching for recipes and cooking methods, whether you prefer to eat, whether you

have meal records, knowledge of seasonal ingredients and special events. The questions that participants were asked are shown in Fig.1~5.

ii. International Physical Activity Questionnaire Short Version (IPAQ-SV)

IPAQ is an assessment index that measures physical activity for 18 to 65 years of age, and is highly reliable and valid (Kitamura et el. 2010). IPAQ-SV is an internationally standardized indicator for measuring self-reported average weekly physical activity from the perspective of high-intensity physical activity, moderate-intensity physical activity, and walking. All participants answered total physical activity per a week. Total physical activity Met-minutes/week was calculated from following equations (IPAQ, 2005).

Total physical activity Met-minutes/week=Walking Met-minutes/week+ Moderate Met-minutes/week+ Vigorous Met –minutes/week

Walking Met-minutes/week=3.3*walking minutes*walking days

Moderate Met-minutes/week=4.0*moderate-intensity activity minutes*moderate days

Vigorous Met-minutes/week=8.0*vigorous-intensity activity minutes*vigorous-intensity days.

iii. Body component measurement

A body component analyzer (InBody, InBody430, Japan) was used for measuring the body composition. BMI, amounts of skeletal muscle, and body fat percentage were measured. Before using InBody, participants wiped the palms and soles with an electrolytic tissue to increase conductivity. With bare feet, participants put their heel on the round electrode and got on the scale. Next, participants entered the height and gender of their personal information and started measuring. InBody used the same procedure as performed by Nonaka et al. 2018. BMI is a body mass

≪第一部≫

Q1.一日三食必ず食べますか？

Do you always eat three meals a day？

（いいえ）　　（はい）

(No)　　(Yes)

Q2.毎日決まった時間に食べますか？

Do you eat a certain time every day?

（いいえ）　　（はい）

(No)　　(Yes)

Q3.朝食は以下のようなメニューが推奨されています。

以下の食事の量を十分にとっているまたそれ以上の時を１０、全くとっていない時を０として、あなたはどのくらいとっていますか？

Breakfast introduces the following menu. How much do you eat? If you have enough of the following meals and any more, you get 10 points. If you eat not at all, you get 0 points.

牛乳コップ一杯分

A glass of milk

ウインナーのソテー

vienna sausage

サラダ

salad

ごはん 1 杯 A bowl of rice

味噌汁 miso soup

0　　10

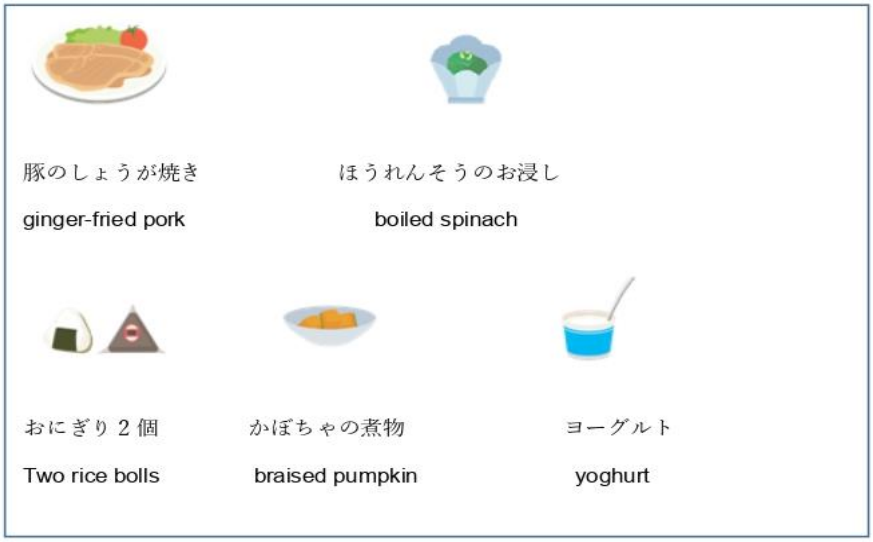
3

Fig.1 Questionnaire for survey about dietary behavior

Q４. 昼食は以下のようなメニューが推奨されています。

以下の食事の量を十分にとっているまたそれ以上の時を１０、全くとっていない時を０として、あなたはどのくらいとっていますか？

Lunch introduces the following menu.
How much do you eat? If you have enough of the following meals and any more, you get 10 points.
If you eat not at all, you get 0 points.




0 10

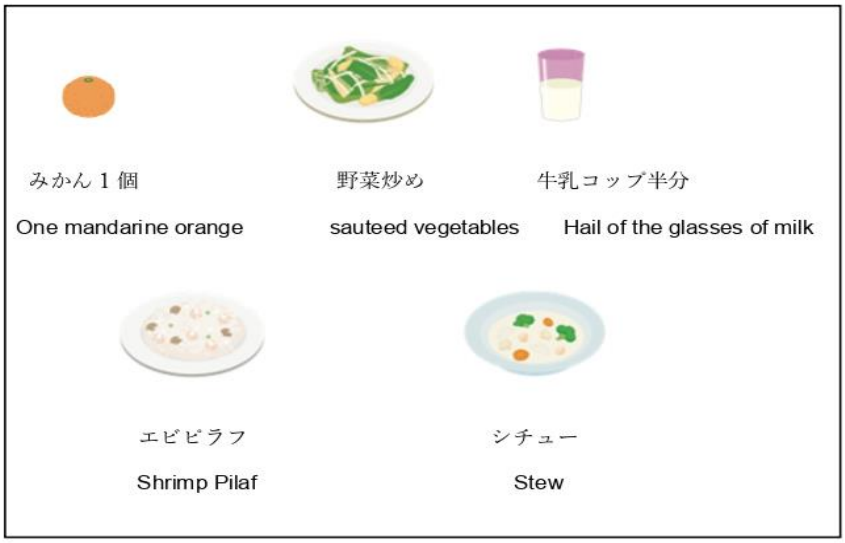
4

Fig.2 Questionnaire for survey about dietary behavior

Q5. 夕食は以下のようなメニューが推奨されています。

以下の食事の量を十分にとっているまたそれ以上の時を１０、全くとっていない時を０として、あなたはどのくらいとっていますか？

Dinner introduce the following menu.
How much do you eat? If you have enough of the following meals and any more, you get 10 points.If you eat not at all, you get 0 points.




0 10

年齢 （ 歳）

Age: ( years old)

居住形態: 実家 一人暮らし 寮

Type of residence: parent's home, live by oneself, dormitory

アルバイト: 有 無

Part-time job: Yes, No

5

Fig.3 Questionnaire for survey about dietary behavior

≪第二部≫

Q1. 食べることが好きですか？

Do you like to eat?

（全く好きではない） （とても好き）

(Not at all) ( like very much)

Q2. 料理番組、動画を見ることに興味がありますか？

Are you interested in watching cooking programs and videos?

（全く興味がない） （とても興味がある。）

(Not at all) (be very interested)

Q3. グルメを紹介している番組や本を見ますか？

Do you watch programs which introduce food?

（全く見ない） （よく見る）

(Not at all) (frequently watch)

Q4. 料理本を購入しますか？

Do you buy cooking books?

（全く購入しない） （よく購入する）

(Not at all) (frequently buy)

Q5. ネットで料理（レシピや方法）を検索することがありますか？

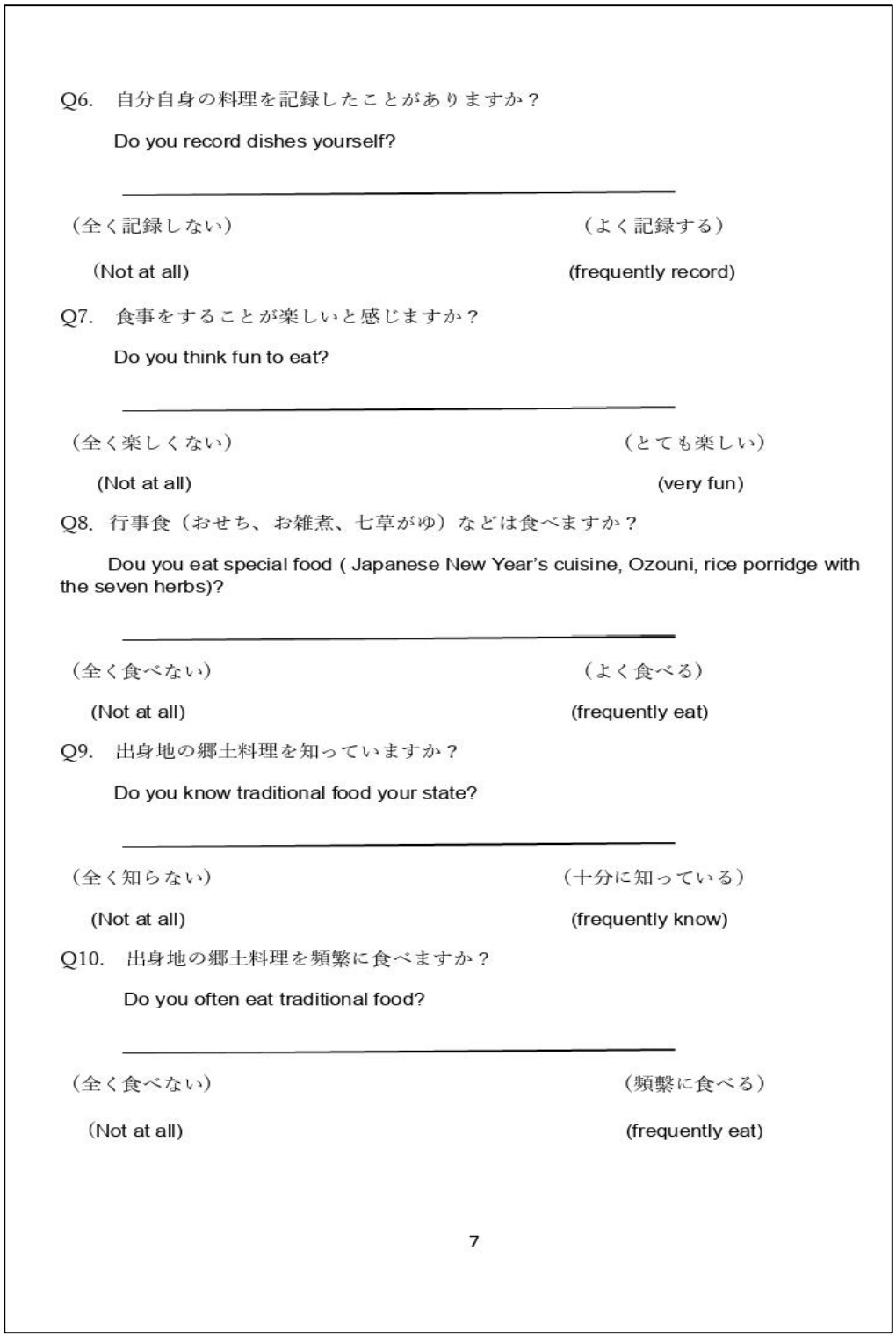
Do you search for food (recipes and methods) online?

（全く検索しない） （よく検索する）

(Not at all) (frequently search)

6

Fig.4 Questionnaire for survey about interest in food


Q6. 自分自身の料理を記録したことがありますか？

Do you record dishes yourself?

（全く記録しない） （よく記録する）

（Not at all) (frequently record)

Q7. 食事をすることが楽しいと感じますか？

Do you think fun to eat?

（全く楽しくない） （とても楽しい）

(Not at all) (very fun)

Q8. 行事食（おせち、お雑煮、七草がゆ）などは食べますか？

Dou you eat special food ( Japanese New Year's cuisine, Ozouni, rice porridge with the seven herbs)?

（全く食べない） （よく食べる）

(Not at all) (frequently eat)

Q9. 出身地の郷土料理を知っていますか？

Do you know traditional food your state?

（全く知らない） （十分に知っている）

(Not at all) (frequently know)

Q10. 出身地の郷土料理を頻繁に食べますか？

Do you often eat traditional food?

（全く食べない） （頻繁に食べる）

（Not at all) (frequently eat)

7

Fig.5 Questionnaire for survey about interest in food

Q11. 地場産物を購入し、食べますか？

Do you buy food with local production and eat?

（全く食べない） （よく買い、食べる）

(Not at all) (frequently buy and eat)

Q12. 人と雑談するときに、「食」の話をしますか？

Do you talk about “food” with friends?

（全くしない） （よくする）

(Not at all) (frequently talk)

Q13. 旬の食材を知っていますか？

Do you know seasonal ingredients?

（全く知らない） （よく知っている）

(Not at all) (frequently know)

Q14. 旬の食材がいつおいしいか知っていますか？

Do you know that seasonal ingredients is good?

（全く知らない） （よく知っている）

（Not at all) (frequently know)

8

Fig.6 Questionnaire for survey about interest in food

index, which is an internationally used physique index as an indicator of obesity. BMI is calculated by [weight (kg)] ÷ [height (m) $^2$]. JASSO announced a BMI value of 22 as the appropriate weight (standard weight), statistically the least likely to get sick. BMI standard value was calculated from following equations. BMI standard value= |22- participant's BMI|

*Statistics*

The following questions were answered with a choice of YES or NO; "Do you always eat three meals a day?" and "Do you eat a certain time every day?". Therefore, it showed as a percentage without applying the statistics. Other date is provided as mean. Before the analysis, the normal distribution of the date was confirmed using Shapiro-Wilk test. Since the data of this study were not normally distributed, the non-parametric analysis was used in this study as a result. Firstly, relationship among interest for food, eating behavior score, the total physical activity Met, BMI, the difference from BMI standard value were analyzed using Spearman's rank Correlation Coefficient. Secondly, relationship among the amount of breakfast, the amount of lunch, the amount of dinner, interest for food, were analyzed using Spearman's rank Correlation Coefficient. Observing the amount of meals per day, if there is a bias for meals in the morning, noon and night, it cannot be accurately evaluated. Therefore, considering the preamble, we extracted and analyzed relationship among the quantity of breakfast, lunch, dinner and food interests. The level of statistical significance was set at $p < 0.05$. Statistical analyses were performed using SPSS software (version 25.0; SPSS, Tokyo, Japan).

**Results**

In response to the question, “Do you always eat three meals every day?” 50% of the participants answered Yes and 50% answered No. In response to the question “Do you eat a certain time every day?”13% of the participants answered Yes and 50% answered No.

There is a strong correlation between interest in food and dietary behavior score ($r=0.413$, $p<0.05$) (Fig.7). There is a correlation between interest in food and the physical activity per week ($r=0.375$, $p<0.05$) (Fig.8). There is no correlation between BMI and interest in food ($r=-0.133$, $p>0.05$) (Fig.9). There is no correlation between interest in food and the difference with BMI standard value ($r=0.047$, $p>0.05$) (Fig.10). There is no correlation between interest in food and amounts of skeletal muscle ($r=0.069$, $p>0.05$) (Fig.11). There is no correlation between interest in food and Body Fat percentage ($r=-0.195$, $p>0.05$) (Fig.12). The correlation between the items that make up the interest in food in this study and the physique and body composition is shown in Table.1, 2.

**Discussion**

Participants with higher eating behavior scores interest in food more ($r=0.413$, $p<0.05$) (Fig.7). We considered that those who are more interested in food take the amount of meal that recommended per day based on Japanese Food Guide Spinning Top. It suggested that participants are aware of the amount of meal on a daily basis. The participants with more interest in food has greater physical activity per week ($r=0.375$, $p<0.05$) (Fig.8). We considered that those who are interest in food reports that they perform physical activities such as walking, exercise, and sports. We thought that having an interest in food would be effective in increasing the amount of total physical

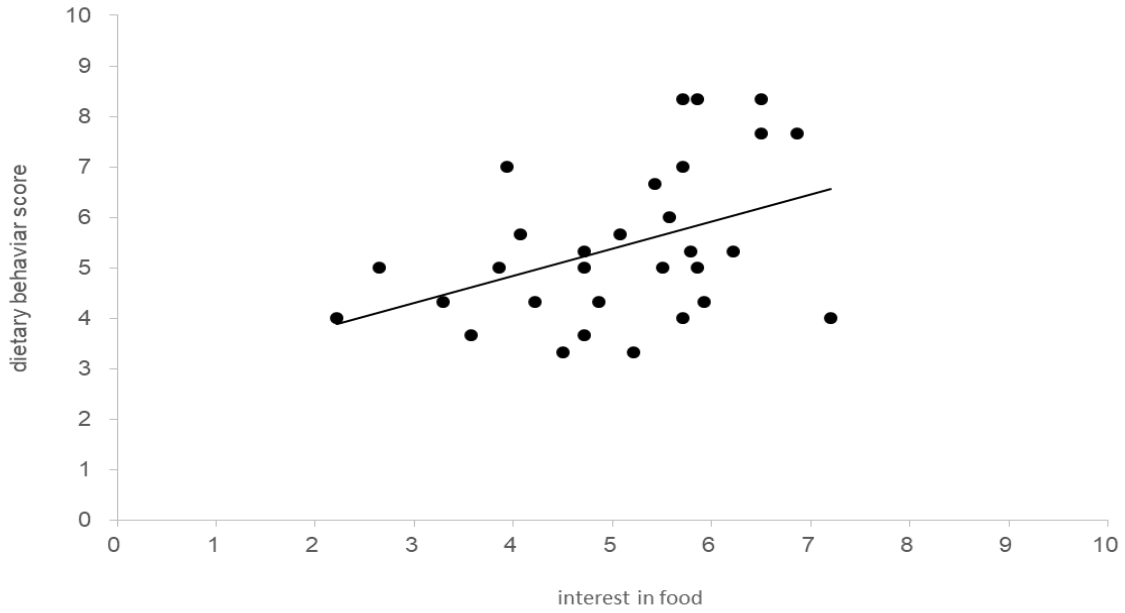



Fig.7 This is a correlation between interest in food and dietary behavior score ($r=0.413$, $p<0.05$)

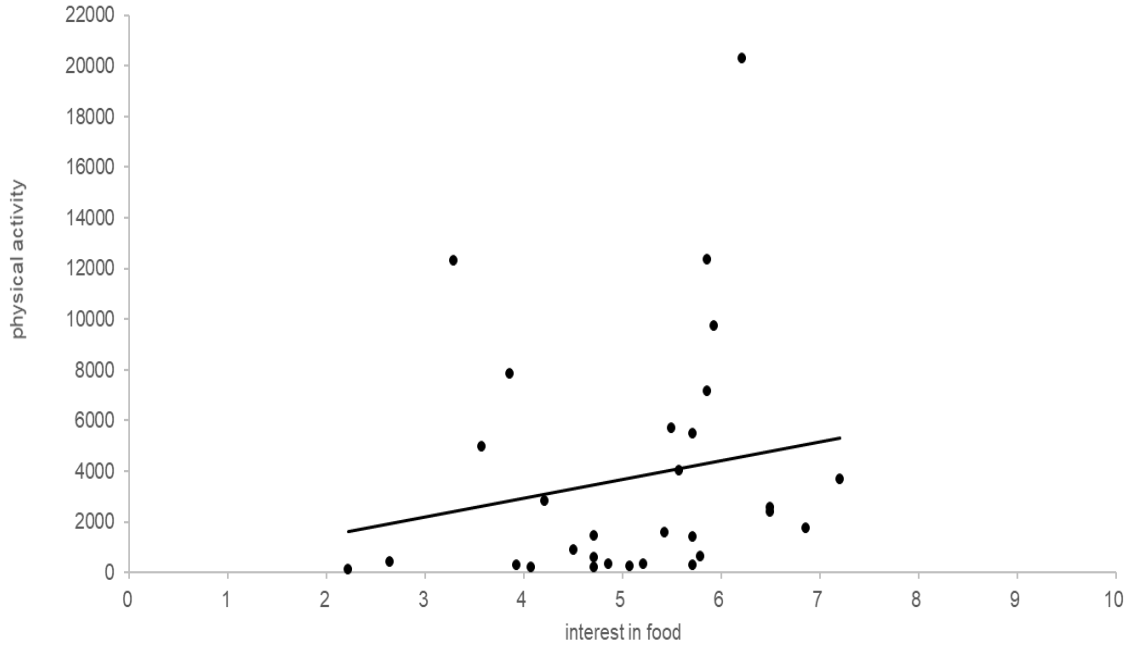



Fig.8 This is a correlation between interest in food and the physical activity ($r=0.375$, $p<0.05$)

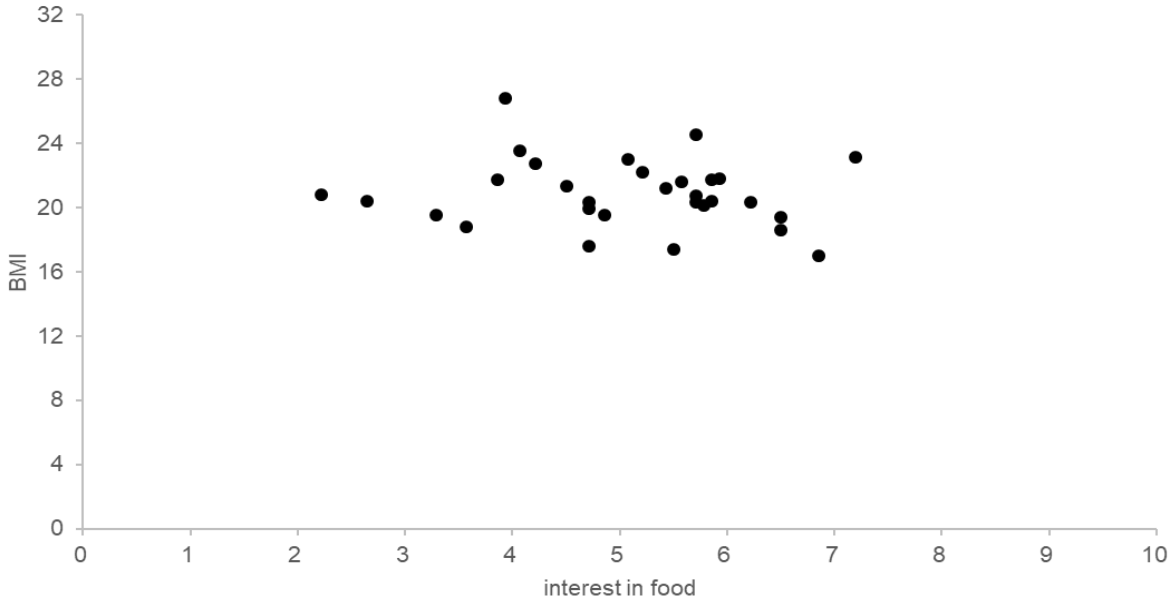



Fig.9 There is no correlation between BMI and interest in food (r=-0.133, p>0.05).

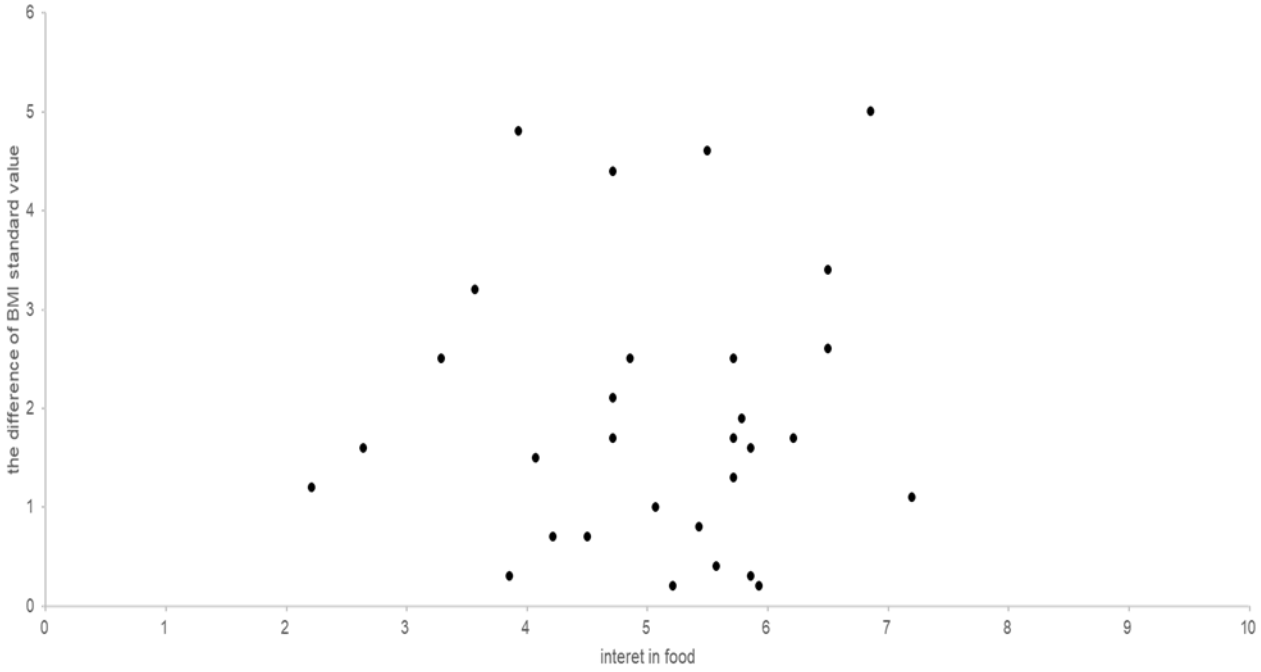



Fig.10 There is no correlation between interest in food and the difference with BMI standard value ($r=0.047$, $p>0.05$).

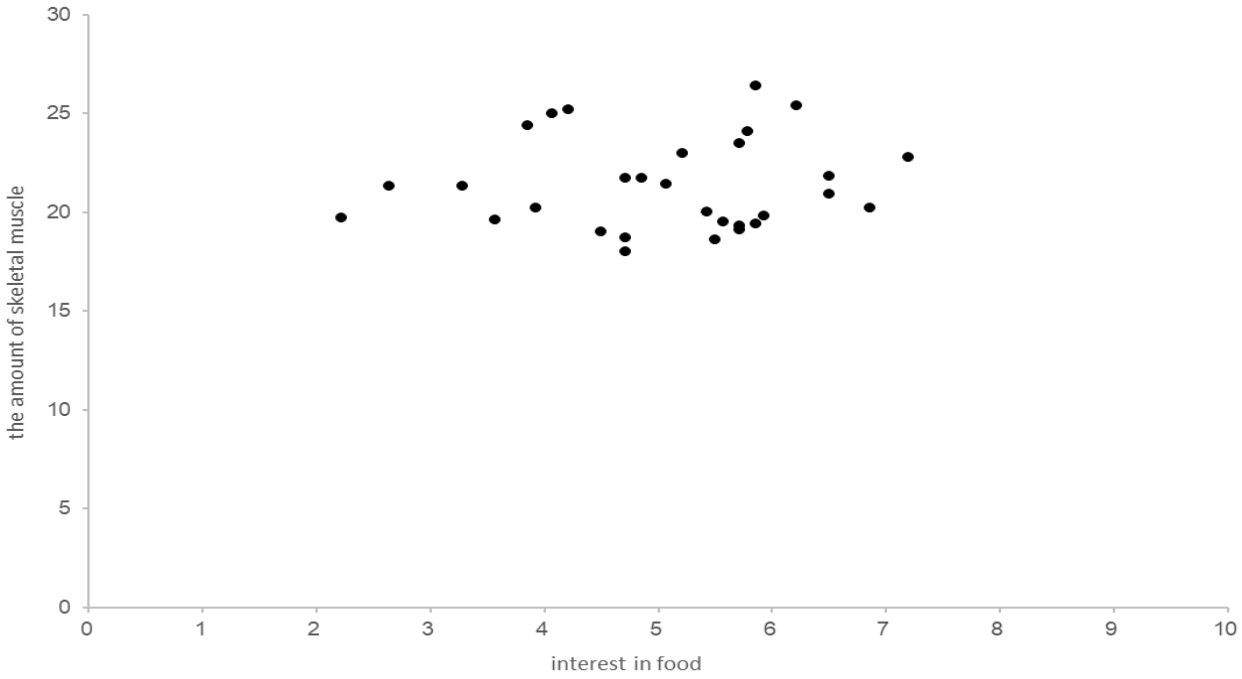



Fig.11 There is no correlation between interest in food and amounts of skeletal muscle ($r=0.069$, $p>0.05$).

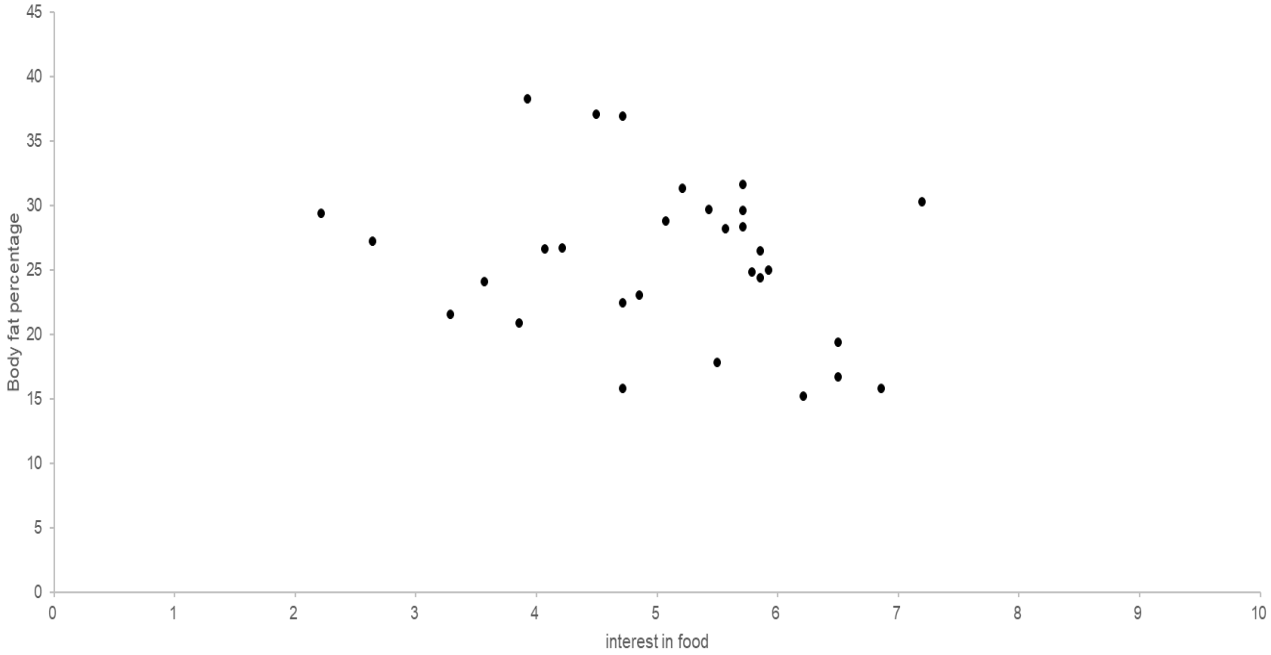



Fig.12 There is no correlation between interest in food and Body Fat percentage ($r=-0.195$, $p>0.05$).

Table.1 The correlation between the items that make up the interest in food in this study and the physique and body composition

| | BMI | difference with BMI standard value | Amount of skeletal muscle | Body Fat percentage |
|---|---|---|---|---|
| the fun of eating and like to eat | r=-0.044<br>p>0.05 | r=-0.091<br>p>0.05 | r=-0.137<br>p>0.05 | r=-0.030<br>p>0.05 |
| Watching in cooking programs and videos | r=0.051<br>p>0.05 | r=-0.047<br>p>0.05 | r=-0.203<br>p>0.05 | r=0.052<br>p>0.05 |
| purchase of cookbooks | r=0.092<br>p>0.05 | r=0.163<br>p>0.05 | r=0.137<br>p>0.05 | r=0.212<br>p>0.05 |
| Food records | r=-0.342<br>p>0.05 | r=0.225<br>p>0.05 | r=-0.234<br>p>0.05 | r=-0.078<br>p>0.05 |

Table2. This is the correlation between the items that make up the interest in food in this study and the physique and body composition.

| | BMI | difference with BMI standard value | Amount of skeletal muscle | Body Fat percentage |
|---|---|---|---|---|
| knowledge of seasonal ingredients | r=-0.212<br>p>0.05 | r=0.180<br>p>0.05 | r=0.108<br>p>0.05 | r=-0.297<br>p>0.05 |
| interest in traditional food | r=-0.031<br>p>0.05 | r=0.023<br>p>0.05 | r=0.221<br>p>0.05 | r=-0.128<br>p>0.05 |
| interest in special food | r=-0.077<br>p>0.05 | r=0.012<br>p>0.05 | r=0.246<br>p>0.05 | r=-0.267<br>p>0.05 |

activity per week. There is no significant positive correlations among BMI and interest in food ($r=-0.133$, $p>0.05$) (Fig.9). If participants had more interest in food, we judged that there was no relationship with BMI. Therefore, we considered that there is no relationship among interest in food and the physique. There is no significant positive correlation among interest in food and the difference with BMI standard value ($r=0.047$, $p>0.05$) (Fig.10). Even if participants are more interested in food, BMI of participants cannot be said to be close to the BMI standard value. There is no significant correlation among interest in food and amounts of skeletal muscle ($r=0.069$, $p>0.05$) (Fig.11). Even if participants have more interest in food, it shows to be unrelated to skeletal muscle. There is no significant correlation among interest in food and Body Fat percentage ($r=-0.195$, $p>0.05$) (Fig.12). Even if participants have more interest in food, it shows to be unrelated to Body Fat percentage. Thus, there is no significant correlation among interest in food and body composition and physique. In short, the relationship between motivation for food and body composition, physique is not recognized in this study.

The hypothesis of this study was that female students were more motivated to eat, the smaller the difference from the BMI reference value. Nevertheless, from the results of the survey, only the dietary behavior score of motivation for food have relation to the physique, indicating that the hypothesis was not supported. I assumed that the reasons of this results are that the age range of participants was small in this study, and because there were no differences in physique due to focusing on female university students. There is a previous study that Japanese BMI is gathered around the average compared to Americans (Fujise, 2003). Furthermore, in both university students, BMI of Japanese university students is $20.9 \pm 1.3$, and that of American university students is $23.3 \pm 3.3$ (Fujise, 2003). Therefore, it can be said that the dispersion from the average value is small.

In order to detect correlation, this study requires a small number of people. Therefore, it can be said that the examination power is insufficient due to the small number of samples. There were many data with a significance level exceeding 5% ($p > 0.05$)

From the above results, we propose to introduce home economics classes to universities. Although there was no relationship between food interest and physique and body composition, the participants of this study are low in search rates for recipes, knowledge on seasonal ingredients and traditional food. Many of the questionnaire items for food included in this survey related to voluntary attitudes. In order to acquire a voluntary approach, we think it is necessary to provide support from around. Therefore, we considered that by incorporating home economics as part of the class, students could cook dishes in class and gain knowledge of seasonal ingredients and traditional food. Currently, practical dietary education is being conducted for elementary and junior high school students. On the other hand, only students who specialize in food and nutrition in university get practical dietary education. Students who are not conscious of their own eating habits have no dissatisfaction with their eating habits, and they have no attitude to change their eating habits (Hamaguchi et al, 2010). Therefore, educational guidance may make improvements on food thinking and attitudes. In addition, cooking class has the effect of improving the development of decision-making abilities regarding eating habits (Hamaguchi et al, 2007). There is a positive connection between the quality of the meal and the academic (Zainab and Ayesha, 2017). Thus, the introduction of home economics classes may improve

We explored relationship between motivation for food and the physique of female university students using questionnaire surveys that referred to motivation for food, the physical activity and BMI measurement. As a result,

there is no relationship between motivation for food and body composition, physique. From these results, the hypothesis of this study was not supported. However, having highly motivation for food can revaluate people's life style and lead to a better and healthier life.

**Acknowledgement**

The author is sincerely grateful to Pro. Kohei Watanabe for helpful suggestions and the support in the use of SPSS software and the questionnaire survey.

**References**


Asakura, Y., Takeda, H., & Nishiyama, C. (2007). Inquiry into dietary habit and health consciousness of university and junior college students. Bulletin of Toyohashi Sozo Junior College, 3, 11-16.

Fujise, T. (2003). Comparison of the body images between Japanese and Caucasian female students. Journal of phydical Fitness and Sports Medicine, 51, 425-426.

Hamaguchi, I., Adachi T., Ohkita, S., Tamiko, T, Maeda, A., Uchida1, H., Kitamoto, N., & Okuda, T. (2010). Relationship between the Consciousness and Behavior in Dietary Life of University Student, Journal of home economics of Japan, 61, 13-24.

International Physical Activity Questionnaire. (2005). 国際標準化身体活動質問票のデータ処理および解析に関するガイドライン. 2019, http://www.tmu-ph.ac/pdf/180327_1.pdf?

Ishihara, E. & Hotta, C. (2014). Awareness Research Relevant to New Pre-university students: Dietary Habits. Journal of the Japanese Society of Food Education, 8, 129.

Japan Broadcasting Corporation. (2016). 調査から見える日本人の食卓～「食生活に関する世論調査」から①～. 2019, www.nhk.or.jp/bunken/research/yoron/pdf/20161001_7.pdf

Japan Society For The Study Of Obesity. (2000). 表 肥満度分類 WHO 基準. 2019, http://www.jasso.or.jp/data/magazine/pdf/chart_A.pdf

Kato, C. (2004). 大学生への食育のあり方に関する研究. 関西教育学会紀要, 28, 136-140.

Kajiwara, K. (2006). People's life-style and awareness on eating concerned with a study of the young

“Shoku-no-gaibuka”. Journal of the Integrated Study of Dietary Habits. 17(1), 59-67.

Kitamura, N., Sato, T., Shioya, T., Kawagoe, A. & Satake, M. (2010). Evaluation of Physical Activity in the Daily Life of Healthy Young Subjects with Special Reference to the Reliability and Validity of IPAQ as Evaluated by a Triaxial Accelerometer. Physical Therapy Research, 25 (5), 767-771.

Kamimura, Y., Sumioka, Y., Kitabayashi, S. & Morita, K. (2014). Relationships Between Eating Fast Food and Daily Living Habits, Health Conditions and Eating Habits of University Students. Bulletin of Hijiyama University, 21, 197-206.

Ministry of Agriculture, Forestry and Fisheries. (2017). Survey report on food education. 2019, http://www.maff.go.jp/j/syokuiku/ishiki/h29/3-4.html

Ministry of Education, Culture, Sports, Science and Technology. (2009). 家庭や地域における取組. 2019, http://www.mext.go.jp/a_menu/shotou/eiyou/syokuseikatsu/kyouzai05/008.pdf

Ministry of health, Labour and Welfare. (2006). National Health and Nutrition Survey. 2019, https://www.mhlw.go.jp/bunya/kenkou/eiyou08/dl/01-kekka.pdf

Ministry of health, Labour and Welfare. (2013). Citizen Health and Nutrition Study “Changes in Eating-out Rates and Ready Meal Rates”. 2019, https://www.mhlw.go.jp/bunya/kenkou/kenkou_eiyou_chousa.html

Ministry of health, Labour and Welfare. (2013). National Health and Nutrition Survey. 2019, https://www.mhlw.go.jp/content/10904750/000351576.pdf

Ministry of health, Labour and Welfare. (2018). National Health and Nutrition Survey. 2019, https://www.mhlw.go.jp/bunya/kenkou/kenkou_eiyou_chousa.html,

Ministry of Health, Labor and Welfare (2013). Healthy Japan 21. http://www.kenkounippon21.gr.jp/

Ministry of Health, Labor and Welfare & Ministry of Agriculture, Forestry and Fisheries. (2005). Japanese Food Guide Spinning Top. 2019, http://www.maff.go.jp/j/balance_guide/b_use/pdf/eng_reiari.pdf

Murakami, Y., Oshikata, R., Miyamoto, N. & Imamura, H. (2010). Validity of 1,2, 3 and 4day Dietary Records in Comparison with 7day Weighed Dietary Records. Health Evaluation and Promotion, 37(3), 405-413.

Nishio, E., Ohta, S. &Tanaka, Y. (2014). The study on dietary habits and lifestyle of university students based on the residence form. Journal for the integrated study of dietary habits, 24, 278-288.

Nonaka, K., Murata, S., Shiraiwa, K., Abiko, T., Nakano, H., Iwase, H., Naito, K & Horie, J. (2018). Effect of Skeletal Muscle and Fat Mass on Muscle Strength in the Elderly. Healthcare (Basel), 6(3), 72.

Omori, R. (2011). The dietary knowledge and awareness of university students. Bulletin of the Faculty of Education, Utsunomiya University, 63, 201-210.

Siota, K. (1998) Guidelines on Cookery for the Annual Events. Kwassui women's college:kwassui women's junior college, 41, 18

Takahashi, H., Yamada, S., Yamaguchi, A., & Ymada, E. (2002) Body image and dietary habits in adolescent males and females desiring weight loss. Bulletin of School of Health sciences Sapporo Medical University, 5, 9-12.

Tanabe, Y. & Kaneko, K. (2001) Factors Affecting a Feeling of Satisfaction about Eating among College Students. Journal of home economics of Japan, 52 (9), 839-848.

United States department of Agriculture. (Unkown). Definition of Empty Calories, 2019 United States department of Agriculture. 2019, Choosemmyplate.gov

Zainab Taha and Ayesha S. Rashed. (2017). The Effect of Breakfast on Academic Performance among High School Students in Abu Dhabi. Arab Journal of Nutritional and Exercise, 2 (1), 40-48.

# Age-related changes in preference for mineral rich water

国際社会系(渡邊ゼミ)

S116008

石川　友規

Tomoki Ishikawa

**Abstract**

**Age-related changes in preference for mineral rich water**

**Aim** The purpose of the present study is to investigate whether the preference for mineral rich water changes by aging. **Methods** Eleven Japanese older adults and eleven Japanese young adults drank three kinds of water with different mineral contents (at normal temperature) twice and expressed the degree of preference from 1 to 100 and impression for each mineral water. **Results** Among older adults, the degree of preference for mineral very rich water was significantly lower than for mineral rich water and Japanese mineral water ($p < 0.05$), but there were no significant differences for mineral rich water and Japanese mineral water ($p > 0.05$). Among young adults, the degree of preference for mineral very rich water was significantly lower than for mineral rich water and Japanese water and that for mineral rich water was lower than for Japanese mineral water ($p < 0.05$). **Conclusion** These results suggest that older adults tend to like mineral rich water and young adults tend to prefer Japanese mineral water to mineral rich water.

**加齢によるミネラル豊富な水に対する嗜好性の変化**

目的：ミネラルが豊富な飲料水に対する評価が加齢によって変化することを検証することを目的とした。方法: 日本の高齢者と若齢者の人それぞれ１１人に常温の３種類のミネラルウォーターを二回ずつ飲用させ、それらの味に対する評価（1 から 100）と印象を質問紙によって調査した。結果: 高齢者では、ミネラルが非常に豊富な飲料水に対する評価は、ミネラルが豊富な飲料水と日本の飲料水よりも有意に低かったが ($p < 0.05$)、ミネラルが豊富な飲料水と日本の飲料水では有意な差は見られなかった ($P > 0.05$)。若齢者では、ミネラルが非常に豊富な飲料水に対する評価はミネラルが豊富な飲料水と日本の飲料水よりも有意に低く、ミネラルが豊富な飲料水の評価は日本の飲料水よりも有意に低くなった($p < 0.05$)。結論: これらの結果は、高齢者の人はミネラルが豊富な飲料水を好む傾向にあり、若齢者の人はミネラルが豊富な飲料水よりも日本の飲料水を好む傾向にある。

**Edad-relacionada cambia en la preferencia pare el agua mineral rica**

Objectivo El propósito del presente estudio es investigar si la preferencia por el agua mineral rica. Métodos once adultos mayores japóneses y once adultos jóvenes japóneses bebieron tres aguas minerales (temperatura normal) dos veses y expresaron el grado de preferencia de 1 a 100 y la impresión cada aguas minerales. Resultados Entre los adultos mayores, el grado de prefrencia por el agua mineral muy rica fue significativamente menor que para el agua mineral rica y el agua mineral japonesa($p < 0.05$), pero no hubo diferencias significativas para el agua mineral rica y el agua mineral japonesa($p > 0.05$). Entre los adultos jóvenes, el grado de preferencia por el agua mineral muy rica fue significativamente menor que para el agua mineral rica y el agua mineral japonesa y para el agua mineral rica fue significativamente menor que para el agua mineral japonesa($p < 0.05$). Conclusión Estos resultados sugieren que muchos adultos mayores les gusta el agua mineral rica y muchos adultos jóvenes tienden a preferir el agua mineral Japonesa al agua mineral rica

**Introduction**

It is well known that calcium and magnesium are essential for human body (Kožíšek,2003). Over 99% of total body calcium is found in bones and teeth, where it functions as key structural element. The remaining body calcium plays a key role in metabolism, serving as a signal for vital physiology processes, including vascular contraction, blood clotting, muscle contraction and nerve transmission. Inadequate intake of calcium increases risk of osteoporosis, nephrolithiasis, colorectal cancer, hypertension and stroke, coronary artery disease insulin resistance and obesity. Most of these disorders have treatments, but not cures (WHO, 2011). Magnesium is the fourth most abundant cation in the body and the second most abundant cation in intracellular fluid. It is a cofactor for some 350 cellular enzymes, many of which are involved in energy metabolism. It is also involved in protein and nucleic acid synthesis and is needed for normal vascular tone and insulin sensitivity. Inadequate intake of magnesium is associated with endothelial dysfunction, increased vascular reaction, elevated circulating levels of C-reaction protein and decreased insulin sensitivity. Low magnesium status has been implicated in hypertension, coronary heart disease, type 2 diabetes mellitus and metabolic syndrome (WHO, 2011).

According to the statistics of ministry of health, Labor and Welfare, many Japanese people are inadequate intake of calcium and magnesium. There is about 150mg lack of calcium and about 100mg lack of magnesium on a day (ministry of health, Labor and Welfare, 2018). This is a problem that we need to solve to live healthier.

In many countries, it's the custom to drink mineral rich water. For example, Berlin's water contains about 11.0mg calcium and 1.4mg per 100ml (Berlinar Wasserbetriebe, 2015). On the other hand, Tokyo's Water contains about 2.3mg Calcium and 0.5mg magnesium per 100ml (Bureau of Waterworks Tokyo Metropolitan

Government, 2019). In Japan, domestic mineral water tends to have less minerals than imported mineral water (ministry of health, Labor & Welfare, 2018). It is well known that domestic water is related to a country's topography and stratum (Esumi & Ohara, 1999). However, Japanese recently can easily reach mineral rich water in supermarket. Drinking mineral rich water is one of good way to increase calcium and magnesium intake because it is said that mineral rich water may important supplementary contribution to total calcium and magnesium intake (Galan, et al., 2002; Kožíšek, 2003).

Calcium chloride, magnesium chloride and magnesium sulfate were characterized by bitter taste (Lawless, et al., 2003). There is a possibility that many Japanese people doesn't favor a bitterness of mineral rich water, because Domestic mineral water have less minerals and bitterness (Esumi & Ohara, 1999). However, loss of the sense of taste with aging is well known (Toffanello, 2013). Thus, Japanese older adults may not dislike mineral rich water because of aged-related changes in sense of taste. If older adults have lower sensibility to bitterness of mineral water and they like mineral rich water, drinking it may be one of the strategies to increase calcium and magnesium intake in older adults.

The objective of this study is to investigate whether the preference for mineral rich water changes by aging. Loss in taste perception as well as distortions of gustatory function occur with greater frequency in older individuals (Schiffman, 2009). Therefore, I hypothesized that 1) older adults tend to like both Japanese mineral water and mineral rich water because it's hard to feel bitterness. 2) young adults tend to prefer Japanese mineral water to mineral rich water because they feel bitterness.

## Materials and Methods

*Participants*

Eleven Japanese older adults (age: 79.0 ± 5.6 years) and eleven Japanese young adults(age: 21.5 ± 1.0 years) participated in this study. Experiment was conducted a few hours after meal to avoid any effect from it. All subject gave written informed consent for the study after receiving detailed explanation of the purpose, potential benefits and risks associated with participation. The major cause of hypermagnesemia is renal insufficiency associated with a significantly decreased ability to excrete magnesium. Increased intake of magnesium salts may cause a temporary adaptable change in bowel habits, but seldom causes hypermagnesemia in persons with normal kidney function (WHO,2011). They were healthy with no history of kidney disease.

*Study design*

This study was conducted about 30 min in the laboratory of Chukyo university. Participants drank three kinds of water with different mineral contents twice per one kind of water (total: 6 times). After drinking each water, they expressed the degree of preference and impression for each mineral water. Three kind of water was offered randomly and the order changed between first trial and second trial. They drank 30ml at one time (total: 180ml). There were at least 3-minute intervals to avoid any effect from other mineral water.

*Mineral water*

This study used three kinds of mineral water with different mineral contents. We selected Japanese mineral water (I LOHAS, Coca-Cola Japan Ltd., Tokyo, Japan), mineral rich water (Evian, Danone Japan Ltd., Tokyo, Japan) and Mineral very rich water (Contrex, Nestle Japan Ltd., Hyogo, Japan) that are able to buy in

general Japanese supermarket. Detailed mineral contents are shown in Table1.

*Measurement*

The degree of preference for each mineral water was measured by visual analog scale (VAS). Subjects marked the degree of preference for each mineral water on the 100mm line. A range of score is from 0-100 (Figure 1). 0 means dislike and 100 means really like. Also, subjects wrote the impression for each mineral water. (Figure 1)

*Statistics*

Each result is given as the mean and Standard deviation. The non-parametric analysis was used in this study. The degree of preference for each mineral water was confirmed using Friedman test. When there was a significant effect of types of water, degree of preference was compared between different types of mineral water by using Wilcoxon test. The level of statistical significance was set at $p < 0.05$. Statistical analyses were performed using SPSS software (version 15.0; SPSS, Tokyo, Japan).

**Results**

Among older adults and young adults, there were no significant differences between first trial and second trial.

Among older adults, the degree of preference for mineral very rich water was significantly lower than for Japanese mineral water and mineral rich water, ($p < 0.05$) but there were no significant differences between Japanese mineral water and mineral rich water ($p > 0.05$) (Figure 2). Same results were observed in second trial.

Table 1 | Ca, Mg contents of three mineral water (per 100ml)

| | I LOHAS | Evian | Contrex |
|---|---|---|---|
| Ca | 0.95mg | 8.00mg | 46.80mg |
| Mg | 0.30mg | 2.60mg | 7.45mg |


コメント(impression):

Fig. 1　Visual analogue scale for measure the degree of preference.

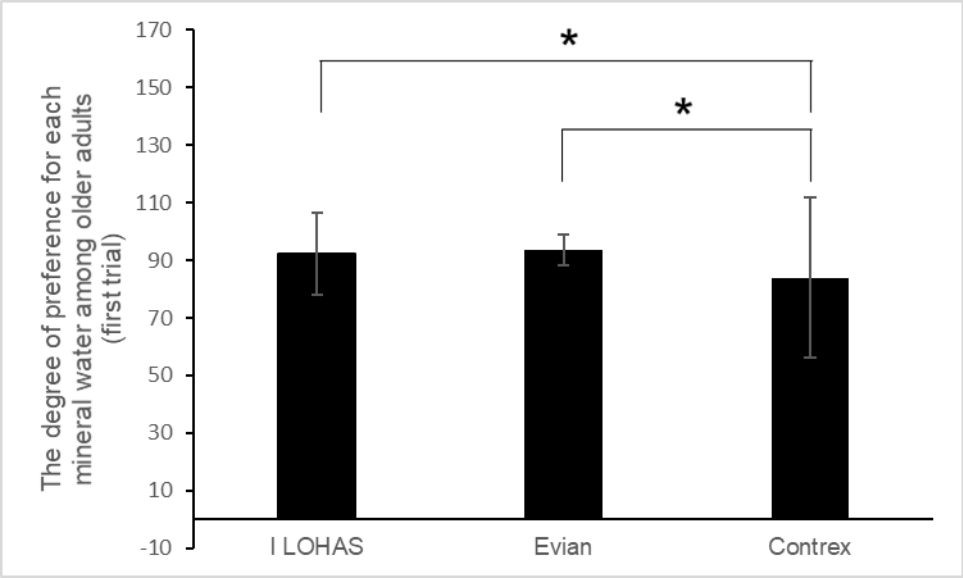



Fig. 2 The degree of preference for each mineral water among older adults (Frist trial). *$p < 0.05$

The degree of preference for all mineral water was high.

Among young adults, the degree of preference for mineral very rich water was significantly lower than for mineral rich water and Japanese water and that for mineral rich water was lower than for Japanese mineral water ($p < 0.05$) (Figure 3). There were no significant differences between first trial and second trial ($p > 0.05$) (Figure 3).

**Discussion**

We investigated whether the preference for mineral rich water changes by aging. The findings of present study were that in older adults the degree of preference for mineral very rich water was significant lower than for mineral rich water and Japanese mineral water ($p < 0.05$), but there were no significantly differences for mineral rich water and Japanese mineral water ($p > 0.05$) and the degree of preference for all mineral water was high (Figure 2). These results support the hypothesis 1 that many older adults tend to like both Japanese mineral water and mineral rich water. The findings of present study about young adults were the degree of preference for mineral very rich water was significantly lower than for mineral rich water and Japanese water and that for mineral rich water was lower than for Japanese mineral water ($p < 0.05$) (Figure 3). These results support the hypothesis 2 that many young adults tend to prefer to Japanese mineral water to mineral rich water.

As shown in the present study (Figure 2, 3), the degree of preference for Japanese mineral water was high both older adults and young adults. According to their impression for Japanese mineral water, they felt tasty and clean (supplementary date). These results are reasonable since Japanese mineral water have less mineral and bitterness (Esumi & Ohara, 1999), and they are accustomed to drinking it. Thus, we suggest that Japanese older

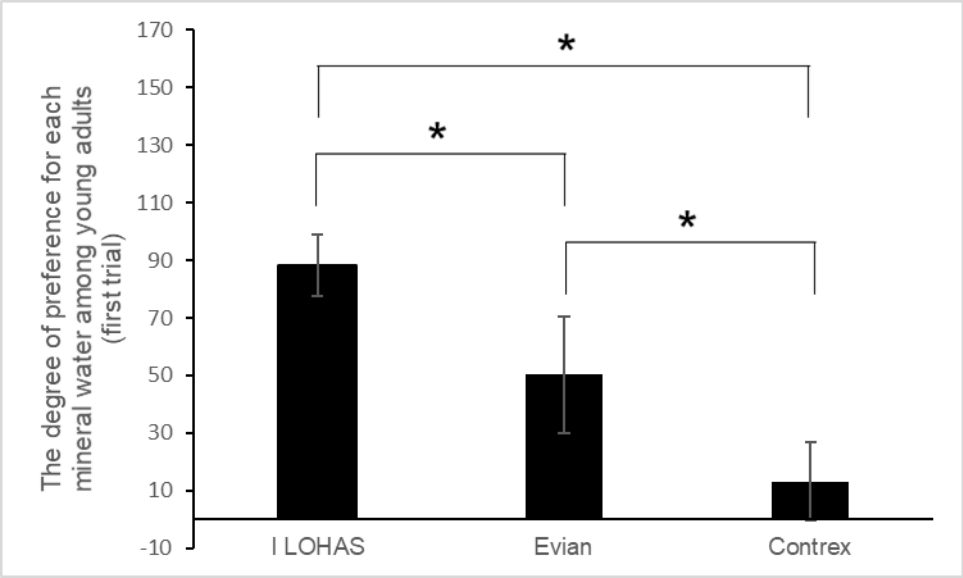



Fig. 3 The degree of preference for each mineral water among young adults (first trial). *P < 0.05

adults and young adults prefer Japanese mineral water.

The degree of preference for mineral rich water was as high as Japanese mineral water among older adults (Figure 2). According to their impression for mineral rich water, they feel tasty (supplementary date). However, it was significantly lower than Japanese mineral water among young adults ($p < 0.05$) (Figure 3). We estimated that this is related to loss of the sense of taste with aging (Toffanello, 2003). According to their impression for mineral rich water, they feel unique taste and prefer Japanese mineral water to mineral rich water. This could be due to bitterness of Calcium chloride, magnesium chloride and magnesium sulfate (Lawless, et al., 2003). Thus, our results suggest that Japanese older adults like mineral rich water as much as Japanese mineral water, but Japanese young adults prefer Japanese mineral water to mineral rich water.

The degree of preference for mineral very rich water was significantly lower than for Japanese mineral water and mineral rich water among older adults ($p < 0.05$) (Figure 2). However, it was high even if it was lower than for other two mineral water. According to their impression for mineral very rich water, many of them don't feel bitterness and discomfort, but there were also subjects who feel bitterness. On the other hand, it was significantly lower than for mineral rich water among young adults ($p < 0.05$) (Figure 3). According to their impression for mineral very rich water, they feel strong bitterness. From these results, we consider that bitterness increases in proportion to the amount of mineral.

In the present study, we selected three kinds of mineral water with different mineral contents. Berlin's water has more calcium and magnesium than Japanese mineral water, but has less calcium and magnesium than mineral water and mineral very rich water. Thus, we consider that older adults like Berlin's water because they

like mineral rich water.

We used three mineral water at normal temperature in the present study. However, a study reported that temperature has a strong influence on how we taste (Talavera, 2007). In addition to it, it is well known that loss of the sense of taste with aging (Toffanello, 2003), but it is not yet clear how old the taste loss is. In the future studies, we need to investigate whether the preference for mineral water changes by temperature and how old will it change.

The present study has demonstrated that older adults (age: 79.0 ± 5.6 years) tend to like mineral rich water because it's hard to feel bitterness. On the other hands, young people (age: 21.5 ± 1.0 years) tend to prefer to Japanese mineral water to mineral rich water because they feel bitterness of mineral rich water. These results suggest that many older adults can drink deliciously mineral rich water in daily life. Drinking mineral rich water would be good way to live healthier as many older adults because it can increase calcium and magnesium intake.

**References**

ED Toffanello, EM IneLmen, A Imoscopi, E Perissinotto, A coin, F Miotto, LM Donini, D cucinotta, M Manzato and G sergi. (2013). Taste loss in hospitalized multimorbid elderly subject. Clinical Interventions in Aging, 167-174.

František Kožíšek, M.D., Ph.D. (2003). Health significance of drinking water calcium and magnesium. National

Institute of Public Health.

Galan P, Arnaud MJ, Czernichow S, Delabroise AM, Preziosi P, Bertrais S, et al., (2002). Contribution of mineral water to dietary calcium and magnesium intake in a French adult population. J am Diet Assoc, Nov;102 ,1658-1662.

H.T Lawless, F Rapacki J horne, A Hayes. (2003). The taste of calcium and magnesium salts and anionic modification. Food Quality and Preference, 14, 319-325.

K. Talavera, Y.Ninomiya, C. WinkelT. VoetsB. Nilius. (2007). Influence of temperature on taste perception. Cellular and Molecular life science, 64, 377.

Susan. Schiffman (2009). Effect of aging on the Human taste system. Annals of the New York academy of science, 725-729.

Yukiko Esumi, Ikuo Ohara. (1999). Similar preference for natural mineral water between female college student and rats. J.Home Econ.Jpn, vol50, No.12, 1217-1222.

Berlinar Wasserbetriebe. (2015).

https://www.bwb.de/content/en/html/1592.php

Bureau of Waterworks Tokyo Metropolitan Government. (2019).

https://www.waterworks.metro.tokyo.jp/eng/

Ministry of health, Labor and Welfare. (2018).

https://www.mhlw.go.jp/content/000451759.pdf

https://www.mhlw.go.jp/file/05-Shingikai-11121000-Iyakushokuhinkyoku-Soumuka/0000178391.pd

WHO. (2011).

Hardness in Drinking-water. https://www.who.int/water_sanitation_health/dwq/chemicals/hardness.pdf

**Supplementary data**

older adults

| participants | I LOHAS | Evian | Contrex |
|---|---|---|---|
| 1 | no resistance | no sence of inconguity | no resistance |
| 2 | tasty | tasty | feel a bit bitterness |
| 3 | no resistance | no resistance | no resistance |
| 4 | not feel taste | normal | feel bitterness |
| 5 | mellow | there is a sence of inconguity | mellow |
| 6 | tasty | tasty | there are sour |
| 7 | good throat | aftertaste remains | refreshing |
| 8 | like | easy to drink | easy to drink |
| 9 | feel natural | feel sweet and thick | there is a sence of inconguity |
| 10 | better than tap water | feel sweet | tasty |
| 11 | there is refreshing and no dirt | like | mellow |

young adults

| participants | I LOHAS | Evian | Contrex |
|---|---|---|---|
| 1 | clean and easy to drink | not tasty | there are sour and habits |
| 2 | like | normal | unpalatable |
| 3 | not tasty | clear | dislike it |
| 4 | used to drinking | feel a little bitterness | feel bitterness |
| 5 | mellow | mellow | hard to drink |
| 6 | easy to drink | there are many minerals | there is a taste |
| 7 | Tasty | easy to drink | feel a little bitterness |
| 8 | I LOHAS | taste is hard | not tasty |
| 9 | used to drinking | not tasty | taste like foreign water |
| 10 | tasty | taste like foreign water | not tasty |
| 11 | easy to drink | feel a little bitterness | there is strong habit |

# Relationship between health food purchase and exercise habits in older adults

国際社会系(渡邊ゼミ)

S116048

小林奈央

Nao Kobayashi

**Abstract**

**Relationship between health food purchase and exercise habits in older adults**

This study aimed to clarify whether the purchase amount and purchase volume of health food of older adults are proportional to the amount of exercise. In addition, this study clarified whether the purchase amount and purchase volume of health food are related to grasping the correct knowledge about health food. A questionnaire survey was conducted on 62 elderly people over the age of 65. The results showed that there was no correlation between the purchase amount and the test score, nor between the purchase amount and the IPAQ result (total physical activity) ($p > 0.05$). In addition, an examination of whether there was a difference between the test scores and the IPAQ results, depending on whether or not you purchased health food, found that there was no difference between the two ($p > 0.05$). These results suggest that there was no relationship between health food purchases and exercise habits in older adults.

**高齢者の健康食品購入と運動習慣の関係性**

本研究の目的は、高齢者の健康食品の購入量や購入額の多さが運動習慣（運動量）に比例しているのか、また、健康食品の購入量や購入額の多さが健康食品に関する正しい知識の把握に関連しているかを明らかにすることであった。アンケート調査を 65 歳以上の高齢者 62 人を対象として行った。アンケートは、健康食品に関するアンケートと国際標準化身体活動質問票(IPAQ)の 2 つを実施した。結果は、健康食品の購入額と健康食品に関する正しい知識のテストの得点に関する相関係数、また健康食品の購入額と IPAQ の結果(総身体活動量)に関する相関係数はどちらも統計的に有意な相関関係がなかった($p>0.05$)。さらに、健康食品の購入の有無で健康食品に関する正しい知識のテストの得点・IPAQ の結果の差が生まれるかどうかを調査したところ、どちらも差がないことが明らかになった($p>0.05$)。これらの結果から、高齢者の健康食品の購入と運動習慣の間に関係性がないことが示唆された。

**Relación entre las compras de alimentos saludables de los ancianos y los hábitos de ejercicio.**

Este estudio tuvo como objetivo aclarar si la cantidad de compra y el volumen de compra de alimentos saludables de los adultos mayores son proporcionales a la cantidad de ejercicio. Además, este estudio aclaró si la cantidad de compra y el volumen de compra de alimentos saludables están relacionados con la comprensión del conocimiento correcto sobre alimentos saludables. La encuesta del cuestionario se realizó a 62 personas de 65 años o más. Los resultados mostraron que no había correlación entre el monto de la compra y el puntaje de la prueba, ni entre el monto de la compra y el resultado del IPAQ (actividad física total) ($p > 0.05$). Además, un examen de si hubo una diferencia entre los puntajes de las pruebas y los resultados del IPAQ, dependiendo de si compró o no alimentos saludables, encontró que no había diferencia entre los dos ($p > 0.05$). Estos resultados sugieren que no hubo relación entre las compras de alimentos saludables y los hábitos de ejercicio en los adultos mayores.

**Introduction**

This study surveyed older adults in Japan. Now, Japan is a longevity country and the Japanese population has been rapidly aging. As a result, various health activities are carrying out. The media picks up health and actively trying to know about health. According to the Zaikei Shimbun, the reason for the increase in health programs is that older people watch TV for a longer time and appeal to these older age groups (Zaikei Shinbun,2013). Among these activities, this study focused on two areas, food and exercise. For older adults, exercising has the effect of reducing the risk of chronic illness and extending life expectancy (American College of Sports Medicine Position Stand, 2009). In addition, according to a survey on the health of older adults, the most common health activity was “eating nutritionally balanced meals” (Cabinet Office, 2017), indicating that they are highly interested in food. For these reasons, it considered that food and exercise are likely related to the health of older adults, and investigated the relationship between food and exercise in older adults.

In Japan, as interest in food increases one third of people feel that there is a problem with their own diet (Sumi Sugiyama, Takae Bungo, 1999). Thus, it can be said that interest in food has been increasing. This study focuses more on the “food” and look at “health food”. Health food has increased its sales from 523.4 billion yen to 642.6 billion yen from 2015 to 2017 (Fuji Keizai, 2017). In addition, according to a survey of The Asahi Shinbun, three out of four people prove that they eat health food (Satoshi Ono, 2018). From this, it can be considered that health food gradually blend into the lives of Japanese people.

Although health food does not have a legal definition, it generally refers to anything sold or used as food contributing to the maintenance and promotion of health. Among them, as a national system, there is food with

health claims system that meets the safety and effectiveness standards established by the government (Ministry of Health, Labor and Welfare). Food with health claims in Japan is categorized into three types: food with nutrient function claims, food for specified health uses, and food with function claims (Ministry of Health, Labor and Welfare). In this paper, these food with health claims are collectively referred to as health food.

The United States would be a representative for comparison with health food situations overseas. According to the CRN Consumer Survey of Dietary Supplements in the United States (2018), three-quarters of Americans eat dietary supplements (Council for Responsible Nutrition, 2018). In the United States, 70% of men and women from their 20s to 60s eat of food with function claims (Goto et al, 2009), and health food are also popular in the United States. Although health food consumed by many people both in Japan and in the United States, consumers' knowledge of health food is scarce. In the United States, "Two thirds of all respondents falsely believe that herbal products and dietary supplements pose no risk to the general population" (Jacqueline et al, 2017). Also in Japan, only 12% chose the "information on safety etc. provided by the administrative agency" as a reference in the survey of the Consumer Agency（Cabinet Office, 2012). From that, it can be considered that knowledge about health food is scarce.

According to the definition of the World Health Organization (WHO) of the United Nations, people over the age of 65 are considered older adults (Ministry of Health, Labor and Welfare, 2008). In Japan, older adults reached the highest ever in September 2018, at 28.1% of the total population (Statistics Bureau, Ministry of Internal Affairs and Communications,2018). A survey called "National Health and Nutrition Survey" (2017) by the Ministry of Health, Labor and Welfare in Japan reported that proportion of people with exercise habit was up to about 28%

for male aged 20 to 59, and that for female was about 23%. However, for people aged 60 and over, males were more than 40%, and females more than 30% (Ministry of Health, Labor and Welfare, 2017 ). Thus, older adults are more made a habit of exercise.

In addition, from the relationship between health food and older adults in Japan, it can assume that the average monthly spending on health food and supplements is 3,698 yen per month (Kato and Saitou, 2018). By their age group, 60s was 4,422 yen (Kato and Saitou, 2018). From that, it can be seen that older adults buy more health food than the other age groups do. In addition, from the fact that "There was a significant linear increase in dietary supplement users among the older age groups" (Ishihara et al, 2003), it can be seen that the health food purchase rate for older adults is high in Japan and other countries such as the United States.

In this study, this study aimed to clarify whether the purchase amount and purchase volume of health food of older adults are proportional to the amount of exercise. In addition, this study clarified whether the purchase amount and purchase volume of health food are related to grasping the correct knowledge about health food.

The present study hypothesized that older adults who purchase more health food and spend more have more physical activity. In addition, older adults who purchase more health food have higher scores on health food knowledge tests.

## Materials and Methods

### *Participants*

Subject of this research is roster registrants of lecture for older adults (65 years of age or older) on health

and exercise. The total number of survey respondents was sixty-two (twenty-one men and forty-one women).

*Surveys*

This study conducted a questionnaire survey. This questionnaire was description type and was returned by hand after mailing. There are two major categories in this questionnaire surveys.

1. International Physical Activity Questionnaire (IPAQ) short version (Murase et al, 2002) : In this study, the total physical activity during one week was investigated. To determine the total physical activity, we asked (1) walking, (2) moderate- intensity activities, and (3) vigorous-intensity activities. For different exercise intensities from (1) to (3), the number of exercises per week and how much time per day was conducted was investigated. All continuous scores are expressed in MET-minutes/week as defined below. In addition, the following values continue to be used for the analysis of IPAQ data: Walking = 3.3 METs, Moderate = 4.0 METs and Vigorous = 8.0 METs. The following is the calculation method.

   (1) Walking MET-minutes/week = 3.3 x walking minutes walking days

   (2) Moderate MET-minutes/week = 4.0 x moderate-intensity activity minutes moderate days

   (3) Vigorous MET-minutes/week = 8.0 x vigorous-intensity activity minutes vigorous-intensity days

   Total physical activity MET-minutes/week = Walking + Moderate + Vigorous MET- minutes/week scores

2. A survey on health food: This questionnaire asked the following items: gender, age, work status, working and leisure time for a week, whether health food have been purchased, presence of prescription

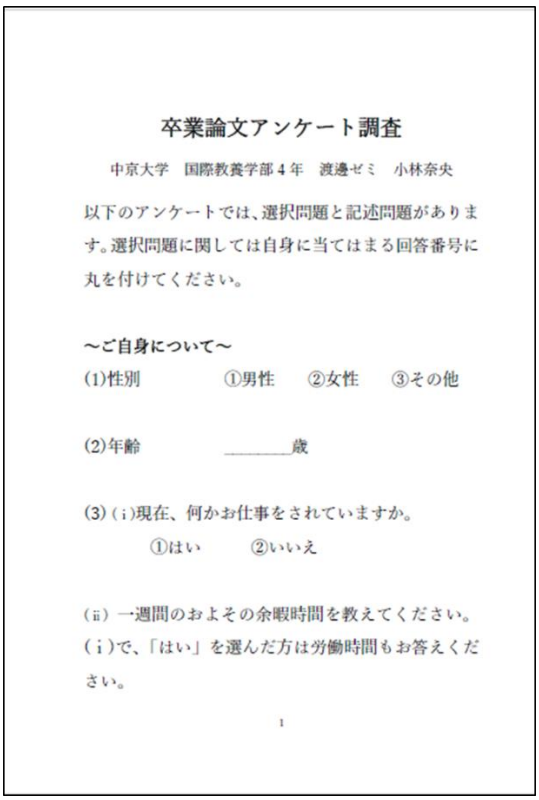
drugs, monthly purchase price, test of the right knowledge about health food, etc. Test of the right knowledge about health food was created so that it would reach a maximum score of 50 with reference to the Consumer Affairs Agency website and the display of actual products (Consumer Affairs Agency, 2018). There are four questions (1) to (4), and (1), (2), and (4) were created from the website of the Consumer Affairs Agency. For the question on the effect of health food in (3), we selected 5 items that were actually written with reference to actual products and used them as options (Gorokichi Co. ,2019). In addition, options 1-5 were all set to the correct display. The ratio of responses to this questionnaire was calculated by the number of responses per the total number of responses (Fig.1,2,3,4,5,6,7,8).

*Statistics*

Health food purchase amount, health food knowledge test scores and IPAQ results (total physical activity) were compared using spearman correlation coefficient. In addition, purchase of health food whether or not, health food knowledge test scores and IPAQ results (total physical activity) was compared using Mann-Whitney-test. The level of statistical significance was set at $p < 0.05$. Statistical analyses were performed using SPSS software (version 21.0; SPSS, Tokyo, Japan).

**Results**

A total of 62 older adults, both men and women (twenty-one men and forty-one women), answered the questionnaire. There were 19 people who work and 43 people who did not work (Table 1). Their average leisure



卒業論文アンケート調査

中京大学　国際教養学部４年　渡邊ゼミ　小林奈央

以下のアンケートでは、選択問題と記述問題があります。選択問題に関しては自身に当てはまる回答番号に丸を付けてください。

～ご自身について～

(1)性別　　①男性　②女性　③その他

(2)年齢　　_____歳

(3)(ⅰ)現在、何かお仕事をされていますか。

①はい　②いいえ

(ⅱ)一週間のおよその余暇時間を教えてください。(ⅰ)で、「はい」を選んだ方は労働時間もお答えください。

1

**Figure 1.**

**The questionnaire for survey**

**(English annotation)**

**In the questionnaire below, there are choice questions and description questions. For choice questions, please circle the answer number that applies to you.**

**~About yourself~**

**(1) Gender**

**1.male　2.female　3.other**

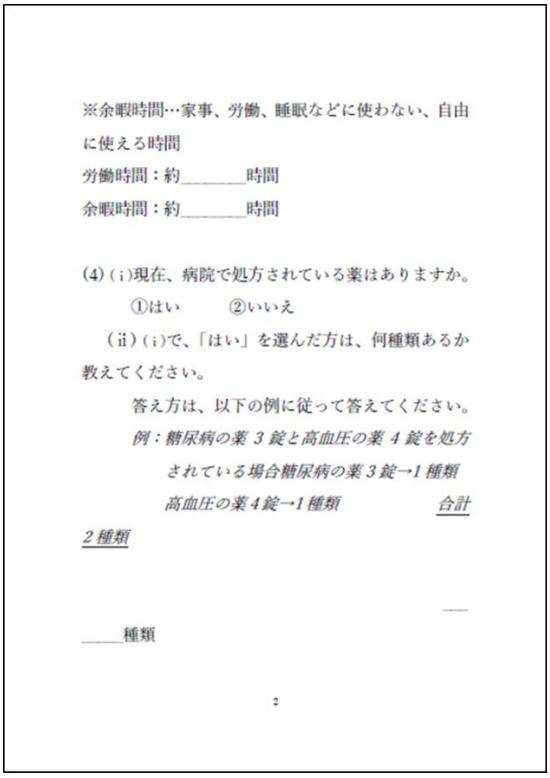
**(2) Age　(　) years old**

**(3) (i) Are you doing any work now?**

**1.Yes　2.No**

**(ii) How many leisure hours do you have in a week?**

**If you selected "Yes" in (i), please write your working hours, too.**



※余暇時間…家事、労働、睡眠などに使わない、自由に使える時間
労働時間：約_____時間
余暇時間：約_____時間

(4)（i）現在、病院で処方されている薬はありますか。
①はい　②いいえ
（ii）（i）で、「はい」を選んだ方は、何種類あるか教えてください。
答え方は、以下の例に従って答えてください。
例：糖尿病の薬 3 錠と高血圧の薬 4 錠を処方されている場合糖尿病の薬 3 錠→1 種類
高血圧の薬 4 錠→1 種類　合計 2 種類

____種類

**Figure 2.**

**The questionnaire for survey**

**(English annotation)**

***Leisure time: Free time not used for housework, work, sleep, etc.**

**Working time: about (  ) hours**

**Leisure time: about (  ) hours**

**(4) (i) Are there any currently prescriptions?**

**1.Yes  2.No**

**(ii) If you selected "Yes" in (i), please tell me how many types.**

**Please answer according to the following example.**

**Ex. If you are prescribed 3 tablets of antidiabetic drug and 4 tablets of antihypertensive drug.**

**3 tablets of antidiabetic drug → 1 type**

**4 tablets of antihypertensive drug → 1 type  total 2 types**

**(  ) types**


**Figure 3.**

**The questionnaire for survey**

**(English annotation)**

**~About health food~**

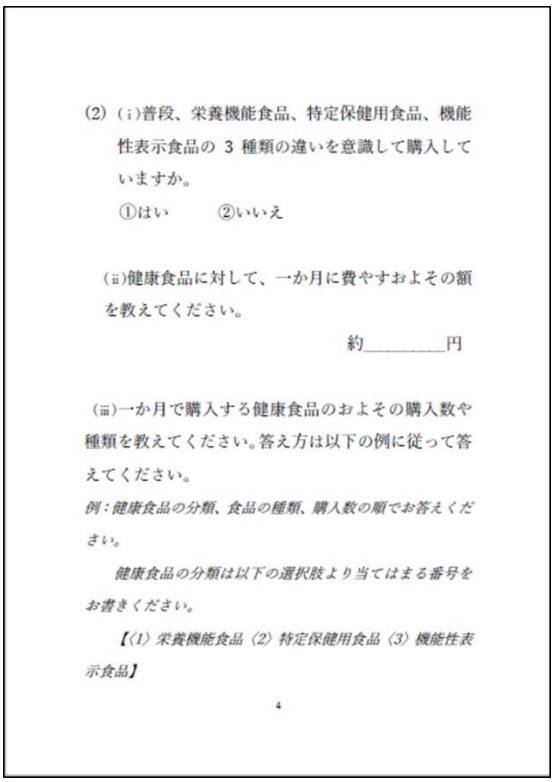
**(1) Have you ever purchased health food with the following displayed?**

**○Food with nutrient function claims**

**○Food for specified health uses**

**○Food with function claims**

**1.Yes → Go to (2)　　2.No → Go to (3)**



(2)（ⅰ)普段、栄養機能食品、特定保健用食品、機能性表示食品の 3 種類の違いを意識して購入していますか。

①はい　　②いいえ

（ⅱ)健康食品に対して、一か月に費やすおよその額を教えてください。

約＿＿＿＿＿円

（ⅲ)一か月で購入する健康食品のおよその購入数や種類を教えてください。答え方は以下の例に従って答えてください。

*例：健康食品の分類、食品の種類、購入数の順でお答えください。*

*健康食品の分類は以下の選択肢より当てはまる番号をお書きください。*

*【〈1〉栄養機能食品〈2〉特定保健用食品〈3〉機能性表示食品】*

4

**Figure 4.**

**The questionnaire for survey**

**(English annotation)**

**(2) (i) Do you usually purchase health food with an awareness of the differences between food with nutrient function claims, food for specified health uses, and food with function claims?**

**1.Yes　2.No**

**(ii) What is approximate amount of money spent per month for health food?**

**About (　　)yen**

**(iii) What is the approximate number and type of health food purchased in a month?**

**Please answer according to the following example.**

**Ex. Answer in the order of health food classification, food type, and number of purchases.**

**For health food classification, write the number that applies from the following options.**

**【<1> Food with nutrient function claims　<2> Food for specified health uses　<3> Food with function claims】**

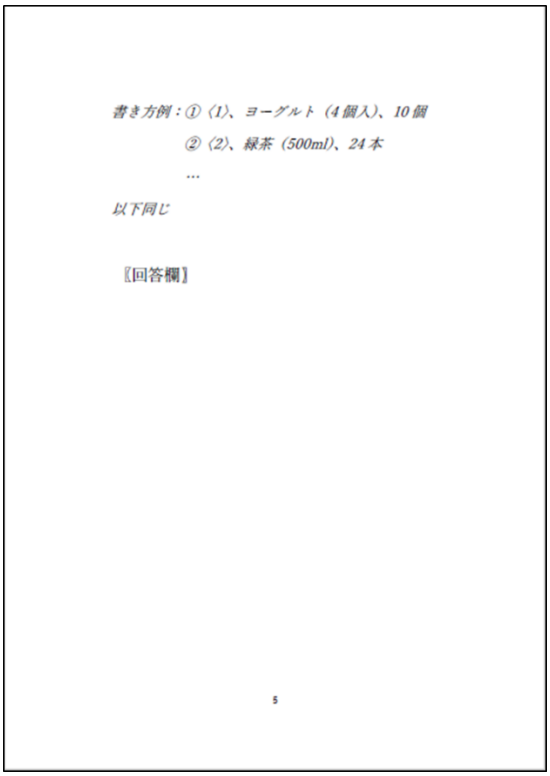



**Figure 5.**

**The questionnaire for survey**

**(English annotation)**

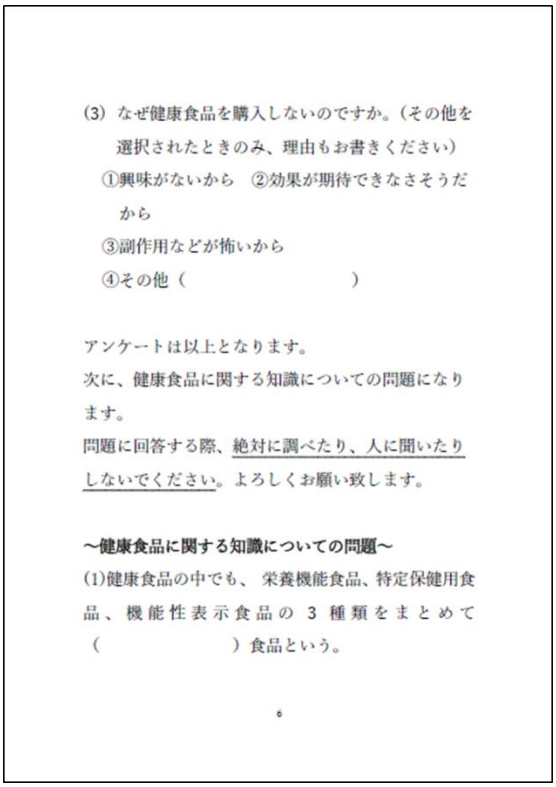
**Ex(how to write): 1.<1>, Yogurt, ( in 4 pieces), 10 pieces**

**2.<2>, Green tea (500ml), 24 bottles**

**…**

**The same applies to the following**

**〖 Answer column 〗**



(3) なぜ健康食品を購入しないのですか。(その他を選択されたときのみ、理由もお書きください)
①興味がないから ②効果が期待できなさそうだから
③副作用などが怖いから
④その他 (　　)

アンケートは以上となります。
次に、健康食品に関する知識についての問題になります。
問題に回答する際、絶対に調べたり、人に聞いたりしないでください。よろしくお願い致します。

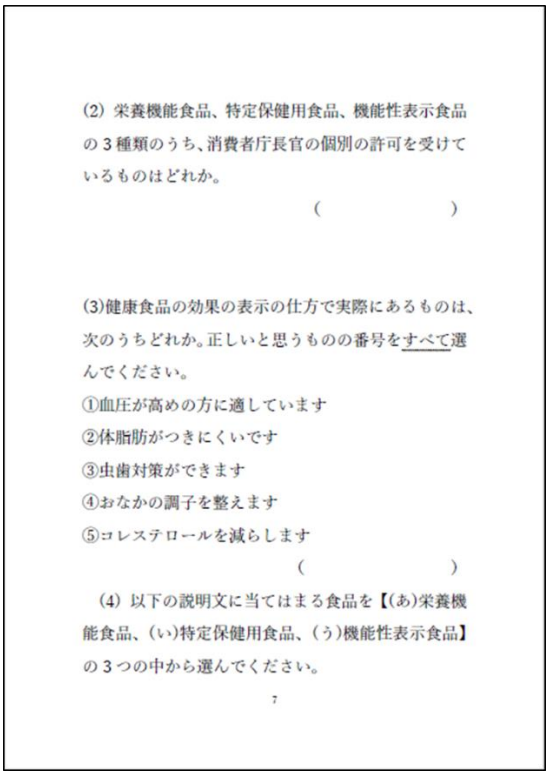
**～健康食品に関する知識についての問題～**
(1)健康食品の中でも、栄養機能食品、特定保健用食品、機能性表示食品の3種類をまとめて
(　　)食品という。

**Figure 6.**
**The questionnaire for survey**
**(English annotation)**

**(3) What is the reason not to purchase health food?**
**(Please write the reason only when you select "Other".)**
**1. Because I'm not interested**
**2. Because the effect is not be able to be expected.**
**3. Because side effects are scary.**
**4.Other (　　)**

**This concludes the questionnaire.**
**Next is the problem of knowledge about health foods.**
**When answering a problem, never look into it or ask someone in advance.**

**~The problem of knowledge about health foods~**
**(1) Food with nutrient function claims, food for specified health uses, and food with function claims, are collectively referred to as (　　) foods.**



(2) 栄養機能食品、特定保健用食品、機能性表示食品の３種類のうち、消費者庁長官の個別の許可を受けているものはどれか。

(　　)

(3)健康食品の効果の表示の仕方で実際にあるものは、次のうちどれか。正しいと思うものの番号をすべて選んでください。

①血圧が高めの方に適しています
②体脂肪がつきにくいです
③虫歯対策ができます
④おなかの調子を整えます
⑤コレステロールを減らします

(　　)

(4) 以下の説明文に当てはまる食品を【(あ)栄養機能食品、(い)特定保健用食品、(う)機能性表示食品】の３つの中から選んでください。

7

**Figure 7.**

**The questionnaire for survey**

**(English annotation)**

**(2) Which of food with nutrient function claims, food for specified health uses, and food with function claims are individually approved by the Commissioner of the Consumer Affairs Agency?(　　)**

**(3) Which of the following texts actually show the effects of health foods?**

**Choose all the numbers that you think are correct.**

**1. Suitable for people with high blood pressure.**

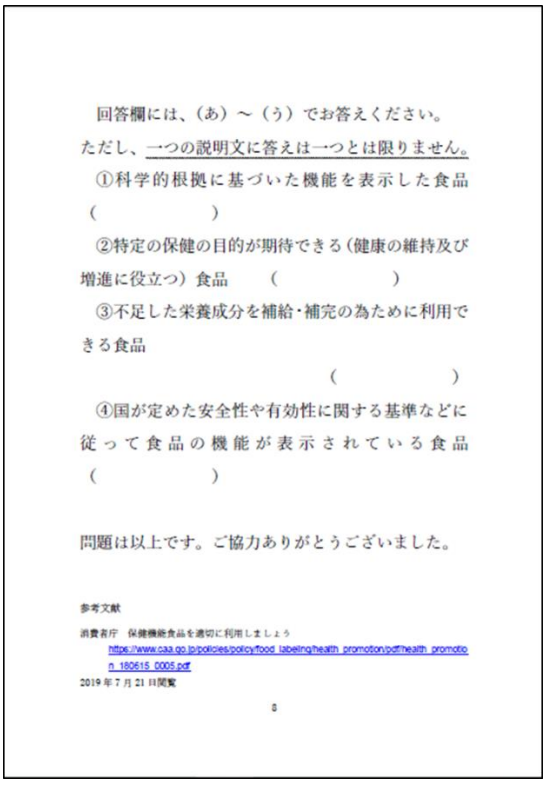
**2. It becomes difficult to increase body fat.**

**3. You can take measures against tooth decay.**

**4.Relieve intestinal ailments**

**5. Reduce cholesterol　　(　　)**

**(4) Please choose the food that fits the following explanation from (あ)food with nutrient function claims, (い)food for specified health uses, and (う)food with function claims.**



回答欄には、(あ) ～ (う) でお答えください。
ただし、一つの説明文に答えは一つとは限りません。
①科学的根拠に基づいた機能を表示した食品
(　　)
②特定の保健の目的が期待できる(健康の維持及び増進に役立つ) 食品　(　　)
③不足した栄養成分を補給・補完の為ために利用できる食品
(　　)
④国が定めた安全性や有効性に関する基準などに従って食品の機能が表示されている食品
(　　)

問題は以上です。ご協力ありがとうございました。

参考文献

消費者庁　保健機能食品を適切に利用しましょう
https://www.caa.go.jp/policies/policy/food_labeling/health_promotion/pdf/health_promotion_180615_0005.pdf
2019 年 7 月 21 日閲覧

8

**Figure 8.**
**The questionnaire for survey**
**(English annotation)**

**Please answer (あ), (い), (う) in the answer column.**
**However, there is not always one answer per explanation.**
**1.Foods that display functions based on scientific evidence　(　　)**
**2.Foods that are able to be expected purpose of specific health(Helps maintain and increase health)**

**(　　)**

**3.Foods that are able to be used to supplement missing nutrients**

**(　　)**

**4. Foods whose functions are displayed according to safety and efficacy standards provided by a nation**
**(　　)**

time was 20.27 hours per week. The average working hours of working people was 12.42 hours per week. At present, 46 people have regular medicines, and 16 have not taken medicine (Table 1). Those who regularly use drugs take an average of 2.23 types. There were 30 older adults who had purchased health food and 32 older adults who had never purchased health food (Table 1). Of the 30 people purchased, three people answered "We purchase paying attention to the difference between the three types. (food with nutrient function claims, food for specified health uses, and food with function claims) " (Table 1). In addition, the most common reason for not purchasing health food was that they were not interested (14/31, 45%) (Table 2). The average amount per month of health food purchasers was 5049.44 yen. The person with the most purchase amount was 30,000 yen. In the health food knowledge test (Perfect 50), the overall average score was very low at 6.94 points. The highest score was 30 points. The overall average total physical activity was 2759.28 MET-minutes per week. The largest number was 14,931 MET-minutes per week and the lowest was 160 MET-minutes per week. The correlation between the purchase amount and the total physical activity was shown in Figure 9 (Fig.9). The correlation coefficient was 0.230 and the significance probability was 0.269 ($p>0.05$). The correlation between the purchase amount and the test score was shown in Figure 10 (Fig.10). The results showed that there was no correlation between the correlation between the purchase amount and the test score, or between the purchase amount and the total physical activity ($p> 0.05$). The correlation coefficient was -0.017 and the significance probability was 0.973 ($p>0.05$). The test score in purchaser and non-purchaser was shown in Figure 11 (Fig.11). There was no significant difference in test scores between purchaser and non-purchaser ($p > 0.05$). The total physical activity between purchaser and non-purchaser was shown in Figure 12 (Fig.12). There was no significant difference in total physical activity between purchaser and non-purchaser (p

> 0.05).

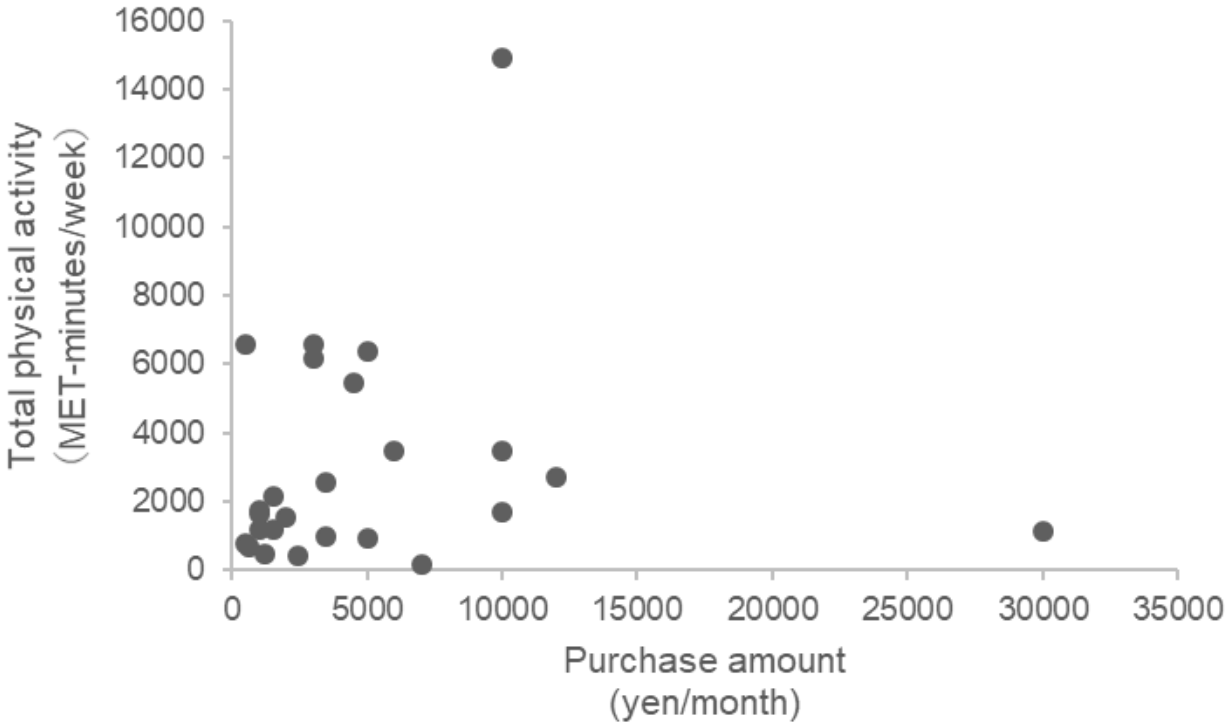



**Figure 9.**

**Correlation between purchase amount and total physical activity**

**The figure showed the correlation coefficient between the purchase amount and the total physical activity.($p>0.05$)**

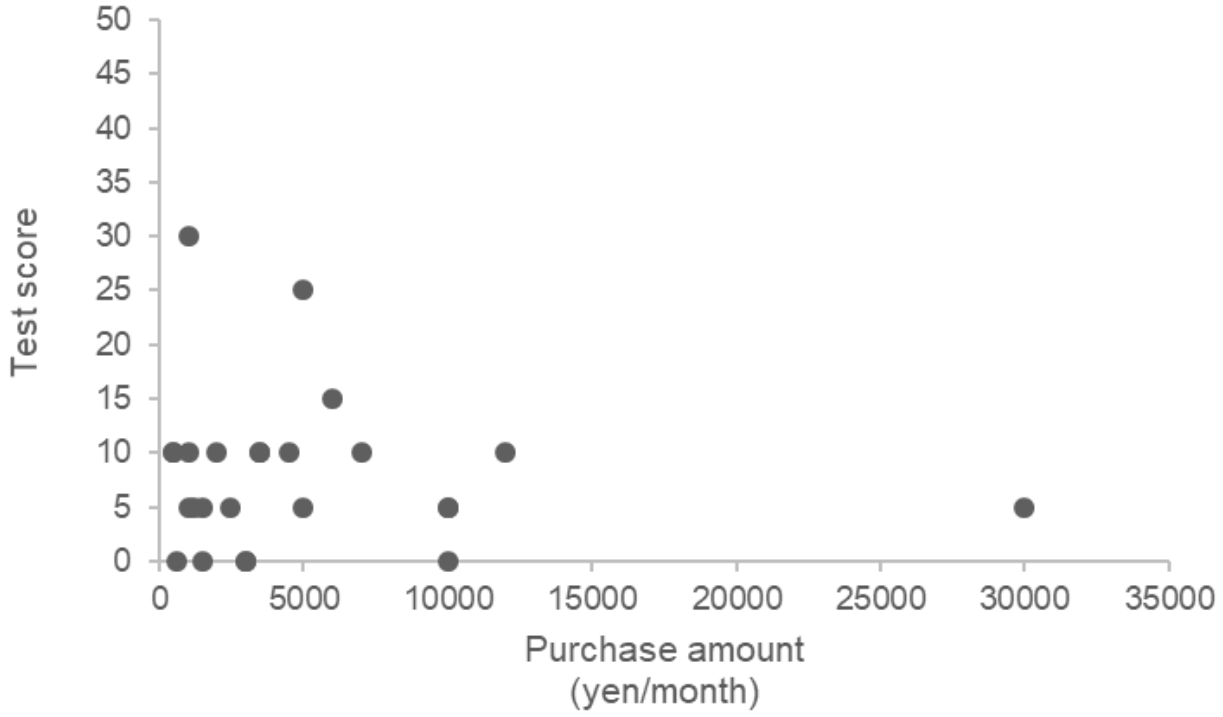



**Figure 10.**

**Correlation between purchase amount and score of correct knowledge test on health food**

**The figure showed the correlation coefficient between the purchase amount and test score of correct knowledge test on health food.($p>0.05$)**

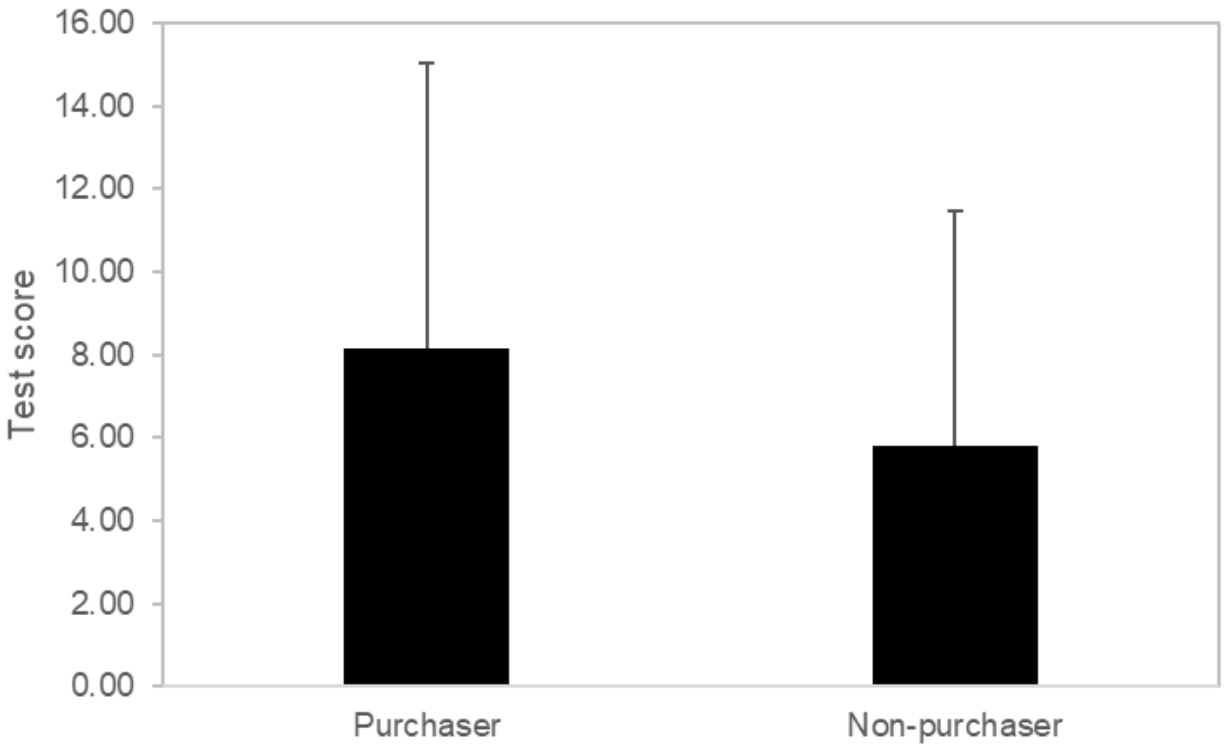



**Figure 11.**

**Difference in score of correct knowledge test on health food between purchaser and non-purchaser**

**The figure showed the difference of score of correct knowledge test on health food of the purchaser and non-purchaser of health food. (p> 0.05)**

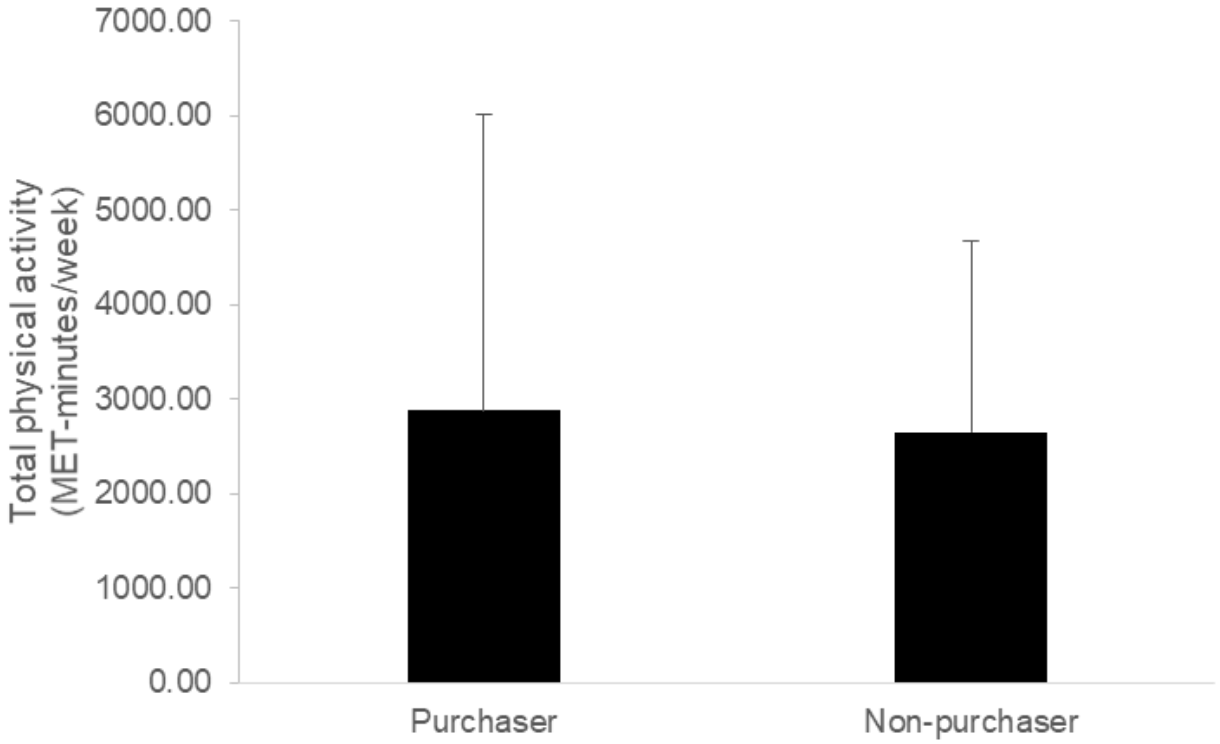



**Figure 12.**

**Difference in total physical activity between purchaser and non-purchaser**

**The figure showed the difference of the total physical activity of the purchaser and non-purchaser of health food. (p> 0.05)**

**Table 1. Results of yes / no responses in the health food questionnaire.**

| | Work | Prescription | Purchase | Difference awareness |
|---|---|---|---|---|
| Yes | 19 (31%) | 46 (74%) | 30 (48%) | 3 (10%) |
| No | 43 (69%) | 16 (26%) | 32 (52%) | 27 (90%) |

**Work: Are you doing any work now?**

**Prescription: Are there any currently prescriptions?**

**Purchase: Have you ever purchased health food with the following displayed?**

**(Each 62 people: Work, Prescription, and Purchase)**

**Difference awareness: Do you usually purchase health food with an awareness of the differences between food with nutrient function claims, food for specified health uses, and food with function claims?**

**(Total 30 people: Difference awareness)**

**Table 2. Reasons for not purchasing health food**

| | Total |
|---|---|
| 1 | 14 (45%) |
| 2 | 5 (16%) |
| 3 | 5 (16%) |
| 4 | 7 (23%) |

**1. Because I'm not interested**

**2. Because the effect is not be able to be expected.**

**3. Because side effects are scary.**

**4.Other**

**(Total 31 people)**

**Discussion**

In this study, we investigated the relationship between health food purchases and exercise habits in older adults and the relationship between health food purchases and knowledge about health food in older adults based on the results of a questionnaire survey and the International Physical Activity Questionnaire (IPAQ). Main finding of this study was that there was no relationship between health food purchases and exercise habits in older adults ($r = 0.230$, $p > 0.05$) (Fig. 9). The results of this study suggested that even if many health food were purchased, older adults were not always actively exercising, and the first hypothesis of this study was not supported. According to previous research, the most common purpose of using health food is to maintain health and promote health, as in the results of the Consumer Affairs Agency questionnaire（Cabinet Office, 2012), and 46% of people with obesity, lifestyle-related diseases (including their reserves), and allergies used prescription drugs and health food in combination (Kamohara, 2014). In addition, as modern people want to be healthy, but they have a weak attitude to actively engage in activities that lead to health promotion such as exercise (Wada, 2009). From the results of these previous studies, as a cause of not supporting the hypothesis, we consider that older adults may use health food to compensate for lack of exercise. The study also revealed that health food purchases and health food knowledge test scores were not related ($r = -0.017$, $p > 0.05$) (Fig. 10). One of the reasons for the results not supporting the hypothesis is that, regarding health food knowledge, “Most information about health food available in Japan is advertisements. Information obtained from advertisements is biased." (Onai, 2005), as stated, the current situation in Japan, where consumers are without trying to know the correct information unless they want to know from themselves, may have led to a low test score. In addition, according to previous research, older adults were high

percentage of health hazards from health food and supplements and some of the users answered that it was for the purpose of treating illnesses (Koike, 2013). From this research result, as another cause for not supporting the hypothesis, we consider that some of older adults take a lot of health food due to incorrect knowledge (ex. To treat disease etc.).

In conclusion, this study provided an opportunity for older adults to clarify whether health food were successfully incorporated into their lives and to rethink the way health food should be. In addition, a low recognition rate of correct knowledge about health food were clarified as an issue for health food for older adults from now on. In Japan, where people are aging, it is necessary to review meals and exercise habits in order to live a healthy life. In order to maintain good health, supplementing the nutrients that are lacking in daily meals, and taking health food well into daily life for further improvement of physical activity will be important. In addition, it can be said that knowing the purchasing behavior of older adults leads to further expansion of the health food market. As the market expands, the number of health food purchasers of older adults will increase and the health awareness of older adults is expected to increase.

**References**

American College of Sports Medicine Position Stand. (2009). Exercise and Physical Activity for Older Adults. Medicine & science in sports & exercise, 41(7), 1514-1515.

Cabinet Office. (2012). Survey on Consumers' Use of "Health Foods.

https://www.cao.go.jp/consumer/iinkaikouhyou/2012/houkoku/201205_report.html

Cabinet Office. (2017). Survey results on the health of older adults.

https://www8.cao.go.jp/kourei/ishiki/h29/gaiyo/pdf/sec_2_2.pdf

Consumer Affairs Agency. (2018). Check the label and use food with health claims properly.

https://www.caa.go.jp/policies/policy/food_labeling/health_promotion/pdf/health_promotion_180615_0005.pdf

Council for Responsible Nutrition. (2018.10.18). 2018 CRN Consumer Survey on Dietary Supplements. 2019.03.25,

https://www.crnusa.org/CRNConsumerSurvey

Fuji Keizai. (2017). Food for specified health uses investigates the domestic market for food with health claims such as functional labeling foods. 2018.10.22, https://www.fuji-keizai.co.jp/market/17037.html

Gorokichi Co. (2019.08.04). Classification and types of Food with health claims(food with nutrient function claims, food for specified health uses, and food with function claims). 2019.11.22

https://gorokichi.com/food-with-health-claims/

Hideyuki Kato, Isamu Saitou. (2018,03.31). The average spending on “health food” in one month is ¥ 3,698. 40% of the 60s "use health food and supplements".2019.03.25, https://moneyzine.jp/article/detail/215001

Kazuhisa Goto, Soutarou Inoue, Osamu Watanabe. (2009). International comparison of functional food intake and selection: From the results of Japanese, American, British and Italian consumer surveys. The Food System Research, 16(3), 27-28.

Jacqueline S. Marinac, Colleen L. Buchinger, Lincoln A. Godfrey, James M. Wooten, Chao Sun, MD, Sandra K. Willsie, DO.(2017). Herbal Products and Dietary Supplements: A Survey of Use, Attitudes, and Knowledge Among Older Adults. January 2007, 107, 13-23.

Junko Ishihara, Tomotaka Sobue, Seiichiro Yamamoto, Satoshi Sasaki, Shoichiro Tsugane. (2003). Demographics, lifestyles, health characteristics, and dietary intake among dietary supplement users in Japan. International Journal of Epidemiology, 32(4), 546-553.

Masahiro Wada. (2009). Thinking about health foods and supplements: Functional food science and the “Food with health claims system”. Japan Pharmaceutical Library Association, 54(2), 110-111.

Mayu Koike, Fumiko Ohtsu, Jinsaku Sakakibara, Nobuyuki Goto. (2013). The Current Status of Health Food- or Supplement-Related Adverse Health Effects. Japanese Journal of Drug Informatics, 14(4), 139-141.

Ministry of Health, Labor and Welfare. (2008). E-health net. 2019,

https://www.e-healthnet.mhlw.go.jp/information/dictionary/alcohol/ya-032.html

Ministry of Health, Labor and Welfare. "Health Food" Website.

https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/kenkou_iryou/shokuhin/hokenkinou/

Murase N., Katsumura T., Ueda C., Inoue S., Shimomitsu T. (2002). Validity and reliability of Japanese version of International Physical Activity Questionnaire. Journal of Health and Welfare Statistics, 49 (11), 1-9.

Satoshi Ono. (2018). Three out of four people use, Is health food safe?.2019.03.25,

https://www.asahi.com/articles/SDI201804166966.html

Seika Kamohara. (2014). 6.Clinical significance of functional foods and supplements in elderly medical service. Journal of the Japan Geriatrics Society , 51(4), 141-142.

Statistics Bureau, Ministry of Internal Affairs and Communications. (2018). Older adults population.

https://www.stat.go.jp/data/topics/topi1131.html

Sumi Sugiyama, Takae Bungo. (1999). Awareness of Functional Food and Health Behavior on Food. Journal of the Japanese Society of Home Economics, 50(9), 965-971.

Tokyo Medical University. (unknown). International Physical Activity Questionnaire.2018.12.12,

http://www.tmu-ph.ac/pdf/IPAQ%20Japanese%20version(short%20version%20usual%20week).pdf

Toru Onai. (2005). How to Choose Best Dietary Supplement:—The Issues of Information on Dietary Supplements in Japan—. Journal of Japan Society for Complementary and Alternative Medicine, 2(1), 24.

Zaikei Shinbun. (2013,07.21). Health programs that increase as young people leave TV, 90% of doctors "feel the impact". 2019.11.18, https://www.zaikei.co.jp/article/20130721/141739.html

# Neuromuscular activation of masseter muscle during eating Japanese traditional foods and imported fast food

国際社会系(渡邊ゼミ)

S116050

近藤良多

Kondo Ryota

**Abstract**

**Neuromuscular activation of masseter muscle during eating Japanese traditional foods and imported fast food**
**Aim** The purpose of the present study is to compare the change rate of neuromuscular activation of the masseter muscle between Japanese traditional foods and imported fast food. **Methods** Nine healthy men ate rice, salt-grilled mackerel, braised chicken and vegetable, spinach fried in butter and miso soup as Japanese traditional foods and hamburgers and French-fries were used as imported fast food. Using the surface electromyography (sEMG) and recorded video, on the basis of the first measurement using a gum, the Averaged rectified value (ARV) per chew of the first to eighth set was calculated and total number of chews was counted. **Results** The normalized ARV of each set and mean total number of chews in Japanese traditional foods were lower than imported fast food ($p < 0.05$). **Conclusion** From these results, we suggested that Japanese traditional foods require lower neuromuscular activation of the masseter muscle and number of chews than imported fast food.

**和食とファストフードの食事中における咬筋活動**
**目的** 本研究の目的は、和食とファストフードにおける一咀嚼当たりの咬筋における神経筋活動の変化率を同じカロリーの下で比較した。**方法** 9 人の健康な男性が、ご飯、鯖の塩焼き、筑前煮、ほうれん草のバター炒め、みそ汁を和食として摂取し、ハンバーガーとフライドポテトをファストフードとして摂取した。2 食分を 8 等分した食事を摂取し、1 食目の前後と 2 食目後に 1 秒に 1 回のペースで 1 分間ガムを噛ませた。2 種類の食事メニューとガムの摂取挙動は、左右の咬筋電位とビデオ観察を用いて解析した。1 食目の前のガムを基準にして、1 等分毎の 1 咀嚼あたりの平均 EMG と総咀嚼回数を求めた。**結果** 和食の変化率はファストフードと比べて低い結果が見られた ($p < 0.05$)。さらに、和食は平均総咀嚼回数が少ないことも確認された ($p < 0.05$)。**結論** これらの結果から、和食の食品はファストフードの食品と比べて、一咀嚼当たりの咬筋における神経筋活動が小さく、咀嚼回数が少ない可能性があるということが示唆された。

**Neuromuskuläre Aktivierung der Muskelmasse während des Essens japanischer traditioneller Lebensmitteln und importierten Fast food**
**Ziel** Ziel der vorliegenden Studie ist es, die Veränderungsrate der neuromuskulären Aktivierung des Massetermuskels zwischen traditionellen japanischen und importiertem Fast Food zu vergleichen. **Methoden** Neun gesunde Männer aßen Reis, Salzmakrele, geschmortes Hühnchen und Gemüse, gebratenen Spinat in Butter und Miso-Suppe als japanische traditionelle Essen und Hamburger und Pommes-Frites als importiertes Fast food. Unter Verwendung der Oberflächenelektromyographie (sEMG) und des Videos wurde auf der Basis der ersten Messung unter Verwendung eines Gummis der gemittelte gleichgerichtete Wert (ARV) des ersten bis achten Satzes berechnet und die Gesamtzahl der Kauen gezählt. **Ergebnisse** Die normalisierte ARV jedes Satzes und der mittleren Gesamtzahl an Kaugegenständen in traditionellen japanischen Essen war geringer ($p < 0,05$). **Schlussfolgerung** Aufgrund dieser Ergebnisse schlugen wir vor, dass japanische traditionelle Essen eine geringere neuromuskuläre Aktivierung des Massetermuskels und eine geringere Anzahl von Kauen erfordern.

Abbreviations:

SEMG: Surface electromyography.

ARV: Averaged rectified value.

**Introduction**

Mastication is a physiological process controlled by the central nervous system and modulated by inputs from the mouth. Mastication is also an important exercise to chew food, mix saliva and form a bolus suitable for swallowing. Peyron., et al., (2017) reported that some mastication parameters are slightly changed by age, but ageing itself does not impair mastication. Further, decreased chewing ability is related to eating habits and eating consciousness (Teraoka., et al., 1994). In addition, the maintenance or recovery of sufficient chewing ability for older adults is related to a longer total life expectancy and strongly related to a longer active life expectancy (Ikuo., & Saito. 2006). Moreover, mastication activates motor function and activities of daily living (ADL) (Nakata. 1998). Actually, low chewing ability was associated with lower ADL, lower cognitive functioning, depression and food insufficiency (Kimura., et al., 2013; Ono., et al., 2010). On the other hand, mastication is not only the direct action of digestion in an oral cavity, but has a vital role in the life and health.

In recent years, Japanese food culture has changed, and as one of the changes, many types of processed foods have spread. As a result, it is assumed the decline in chewing ability due to the spread of processed foods such as fast food and it is reported various studies related to these problems. In many mastication studies, a bite of food was used to quantify mastication by surface electromyography (sEMG), mastication pressure, or mastication exercise (Brown., et al., 1998; Kohyama., et al., 1998, 2000; Mathoniere., et al., 2000). However, in an actual meal, various foods are put into the mouth at the same time and bitten the amount larger than a bite size. To take the significance of mastication in daily life into consideration, it is not enough to just discuss a bite size.

Fast food is sold in large quantities, especially for young people, but it has a serious negative impact on

health. In the US consumption of high-fat fast food may contribute to higher energy and fat intake, and lower intake of healthful nutrients. (Paeratakul., et al., 2003). In ages 20 years and older, grouped based on their fast food intake status, fast food consumption was also associated with a diet high in energy and energy density and frequent fast food consumption may contribute to weight gain. (Shanthy., et al., 2004). At the same time, among Japanese young people from schoolchildren to university students, especially male university students eat fast food and hamburgers are also the most commonly consumed in their use of fast food (Asano., et al., 2003). Although ample studies demonstrate that the fast food imposes a negative effect on health, few reports are available on the EMG activity of the masseter muscle. Moreover, there are no quantified studies that the masseter muscle activity in fast food has lower compared to other food cultures.

The purpose of the present study is to compare the change of neuromuscular activation of the masseter muscle between Japanese traditional foods and imported fast food under the same calorie. We hypothesized that change rate of sEMG in Japanese traditional foods was higher than imported fast food. The Japanese traditional foods contain the meals that require a large amount of mastication quantities (Shiono., et al., 1986). In addition, Japanese traditional foods are chewed in a balanced manner (Kohyama., et al., 2003). There are more types of dishes provided as one serving in Japanese traditional foods than fast food. Therefore, the masseter muscle requires more neuromuscular activities to Japanese traditional foods.

## Materials and Methods

*Participants*

Nine healthy men participated in this study. The participants gave written informed consent for this study after receiving a detailed explanation of the purposes, potential benefits, and risks associated with participation in this study.

*Experimental design*

Rice, salt-grilled mackerel, braised chicken and vegetable, spinach fried in butter and miso soup were used as Japanese traditional foods. The Japanese traditional foods were based on the Japanese style diet called one soup, three side dishes. A hamburger and French-fries (Hamburger and French-fries, McDonald's Holdings Japan Co., Ltd.) were used as fast food (Table 1).

In this study, two meals divided into each of four equal set for each type of food were prepared and the participants ate a total of eight sets to observe the change of neuromuscular activation of the masseter muscle. In order to compare the change in sEMG for Japanese traditional foods with those for imported fast food, the participants bit a chewing gum (Masticatory Performance Evaluating Gum, XYLITOL_* LOTTE Co., Ltd, Saitama, Japan). The participants bit the gum once per second for one minute before first and fourth set and after eighth set using metronome. After the chewing sixty times, the chewing gum was spat out. The participants were allowed to eat freely and were not allowed to speak during the eating. During eating chewing gum and meals, eating behavior was recorded by a video. When the participant finished eating, he raised his own hand. Each of participants ate one menu a day at lunch or dinner and the order of eating the meals was random.

Tabale 1　Two meals used in this study.　In Braised chicken and vegetable were contained taros konjaks, bamboo shoots, carrots and shiitakes.　In Miso soup were contained tofus and brown seaweeds.

| | Food | Weight (one meal : g) | Calorie (one meal : kcal) |
|---|---|---|---|
| Japanese traditional foods | Rice | 200.0 | 294.0 |
| | Salt-grilled mackerel | 50.0 | 155.0 |
| | Braised chicken and vegetable | 200.0 | 115.0 |
| | Spinach fried in butter | 40.0 | 52.0 |
| | Miso soup | 24.5 | 51.0 |
| | Total | 514.5 | 667.0 |
| Imported fast food | Hamburger | 104.0 | 256.0 |
| | French Fries | 135.0 | 410.0 |
| | Total | 239.0 | 666.0 |

*EMG recording*

SEMG were measured to assume the neuromuscular activation level of the masseter muscle and was recorded from left and right masseter muscles using electrodes with two 0.1 × 1 cm silver bars (FA-DL-141, 4 assist, Tokyo, Japan). This muscle was the powerful muscles of mastication that plays an important role during occlusion. The electrodes were connected to a differential amplifier with bandwidths of 5-500 Hz and gain of 1000-fold. Signals from the EMG system were sampled at 1000 Hz using an analog-to-digital converter (PowerLab, ADInstruments, Melborne Australia) and synchronized with a personal computer using LabChart software (version 8.1.13; ADInstruments, Melborne Australia). The three-axis acceleration sensor (FA-DL-111A, 4 assist, Tokyo, Japan) was also placed under the mouth to clarify the eating start time and synchronized with. Prior to attaching the electrode, the skin was cleaned with alcohol. The location of the electrodes is based on the method using landmarks (Castroflorio., et al., 2008; Saifuddin., et al., 2001). One line was drawn from the inferior border of tragus of ear to the angle of the mouth. The masseter muscle width was measured by palpation and half of the width of the muscle was marked with a landmark on that line. The electrode was placed so that the half of its upper edge overlaps the landmark on the line (Figure 1).

SEMG during biting the chewing gum were recorded before first set, after fourth and eighth set and also recorded during eating each of sets. To calculate the average rectified value (ARV) of the masseter muscle, the both of the right and left amplitudes were rectified. The muscle onset time was clarified based on the recorded video and the amplitude detected in the acceleration sensor. In order to count the total number of chews, the total number for each set was counted referring the recorded video and the electromyogram waveform. The ARV per chew of the

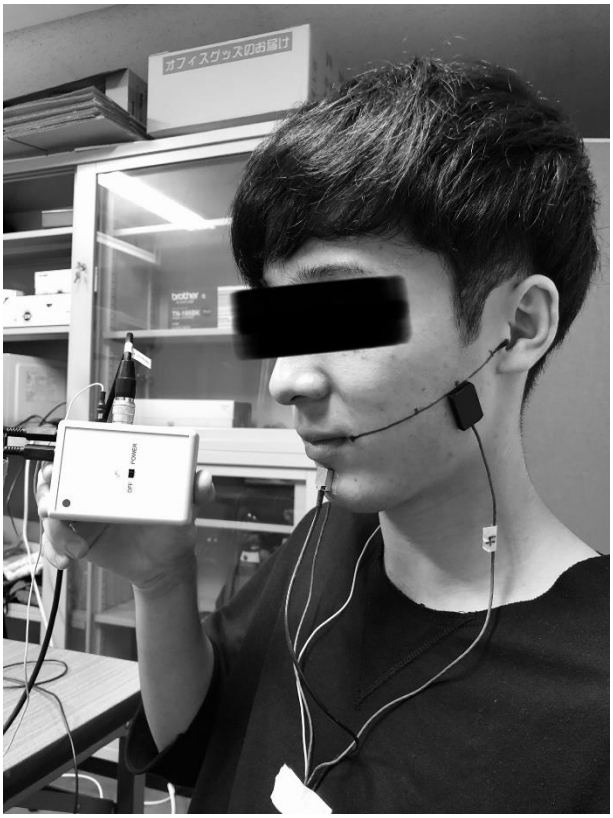



Fig. 1 Surface electromyography location of the masseter muscle using method of landmarks (Castroflorio., et al., 2008; Saifuddin., et al,. 2001) and a three-axis acceleration sensor was placed under the mouth.

first measurement using chewing gum was taken as one and compared to the second and third measurement using chewing gum. Moreover, the ARV of each set was normalized by the first measurement using chewing gum and the normalized ARV per chew of each set on the basis of first measurement using chewing gum was compared.

*Statistics*

All data are provided as mean and SD. Before the analysis, the non-parametric analysis was used in this study. Normalized ARV of first, second and third gum were compared between groups using Friedman test. Normalized ARV per chew of first to eighth set and the total number of chews were also compared to between the groups using Friedman test. In addition, each of the normalized ARV per chew and the total number of chews between same sets were compared between groups using Wilcoxon signed rank test. The level of statistical significance was set at $p < 0.05$. Statistical analyses were performed using SPSS software (version 25; SPSS, Tokyo, Japan).

**Results**

There were no significant differences between the groups in normalized ARV per chew of first, second and third gum in Japanese traditional foods and imported fast food ($p > 0.05$) (Figure 2). A significant difference between the groups was observed in the normalized ARV per chew of each set in each of the foods ($p < 0.05$) (Figure 3). Also, a significant difference between the groups was observed in the normalized ARV between two foods at first, second, third, seventh, and eighth ($p < 0.05$) and tendency of significant differences were observed at fourth, fifth, and sixth sets ($p = 0.051$) (Figure 4). There were significant differences between the groups in the total number

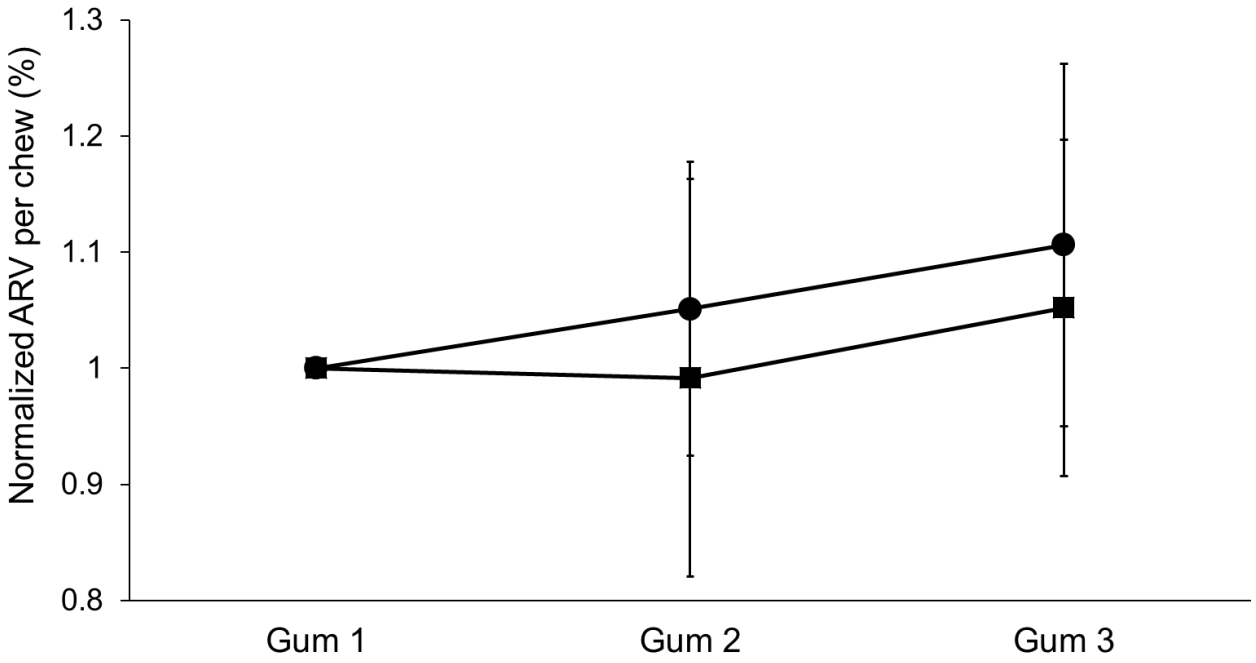



Fig. 2 Mean (SD ±) Normalized ARV per chew between first to third measurement using gum in Japanese traditional foods and imported fast food on the basis of the first measurement using chewing gum (● Japanese traditional foods ■ Imported fast food) ($p > 0.05$).

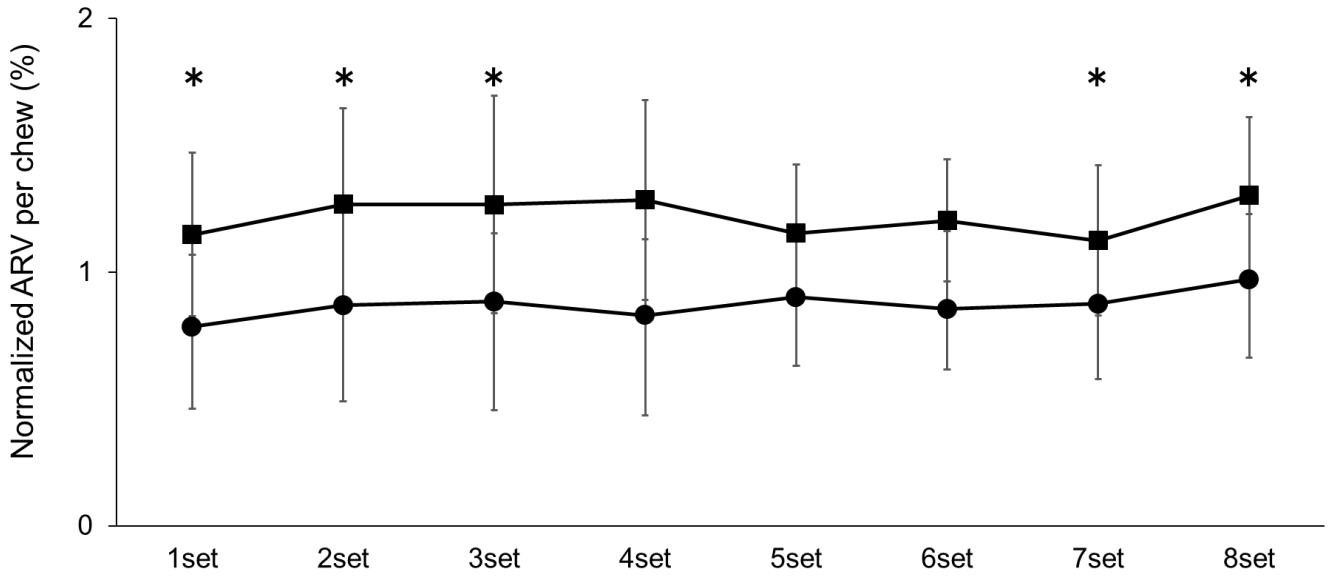
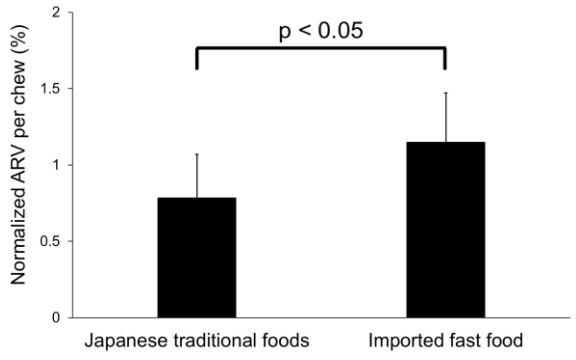
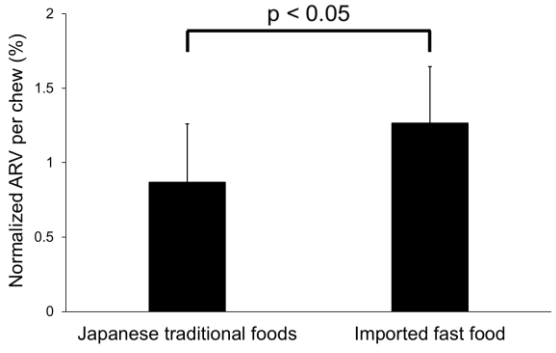


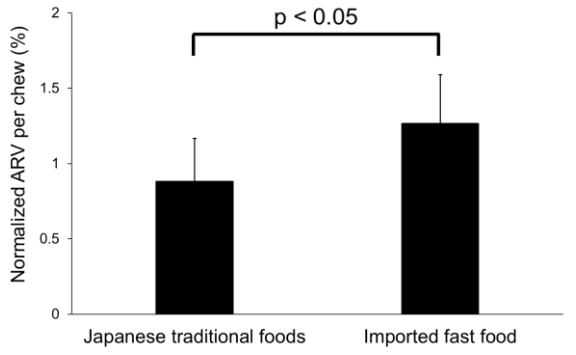

Fig. 3 Mean (SD ±) Normalized ARV per chew of each of sets in Japanese traditional foods and imported fast food on the basis of the first measurement using the gum (● Japanese traditional foods ■ Imported fast food). There were significant differences between the groups in normalized ARV per chew of each set in each of the foods (*$p < 0.05$ between two foods).



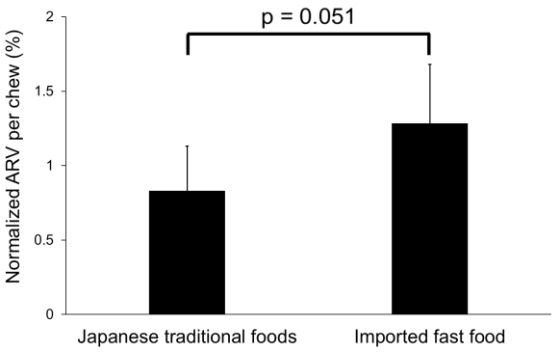

A The first set.



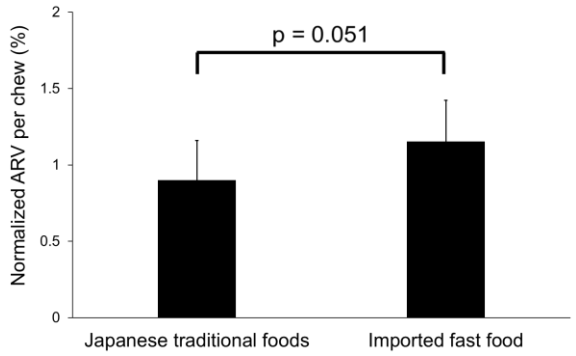

B The second set.



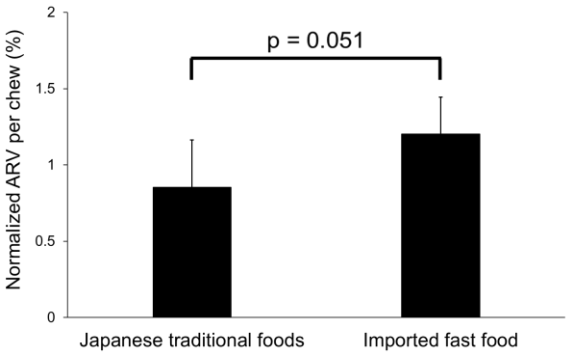

C The third set.



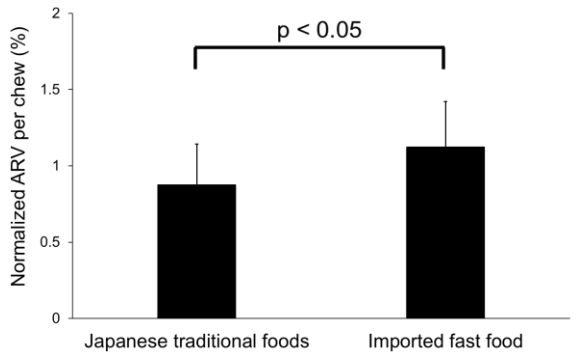

D The fourth set.



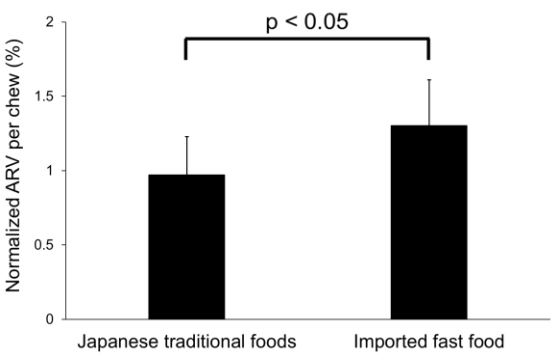

E The fifth set.




F The sixth set.




G The seventh set.




H The eighth set.

Fig. 4 The figures from A to H showed that mean (SD ±) each of Normalized ARV per chew between same sets in Japanese traditional foods and imported fast food on the basis of the first measurement using the chewing gum.

of chews of each food ($p < 0.05$) (Figure 5).

**Discussion**

In this study, there were no significant differences between the groups in normalized ARV per chew of first, second and third gum in Japanese traditional foods and imported fast food ($p > 0.05$) (Fig. 2). It is assumed that change was not occurred because the measurement time from end of meal to gum was not set. The time was left to the preparation of the participants. Also, the masseter muscle is almost restored motoneurone firing rates to normal within 3 minutes (Bigland., et al., 1986). Therefore, it is assumed that the masseter muscle has been restored motoneurone firing rates from the end of the meal to the next measurement using gum.

Normalized ARV per chew of the first to eighth set on the basis of the first measurement using gum was compared (Fig. 3). Also, each of normalized ARV per chew between same sets was compared (Fig. 4). The first measurement using gum is set at a fixed number of times and meal times, and chewing gum is a food with little change in toughness and elasticity. It is appeared that the normalized ARV per chew on the basis of the first measurement using gum tend to increase in each food, but the rate of fast food was higher than of Japanese food. The breakdown of food in mastication depends on the food the toughness and modulus of elasticity (Agrawal., et al., 1997). Horio & Kawamura (1988) reported that the duration of muscle discharge in the masseter muscle increased with hard food. Rice, salt-grilled mackerel, braised chicken and vegetable, spinach fried in butter and miso soup were used as Japanese traditional foods and hamburger and French-fries were used as fast food (Table 1). In Braised chicken and vegetable were contained taros, konjaks, bamboo shoots, carrots and shiitakes. In Miso soup were

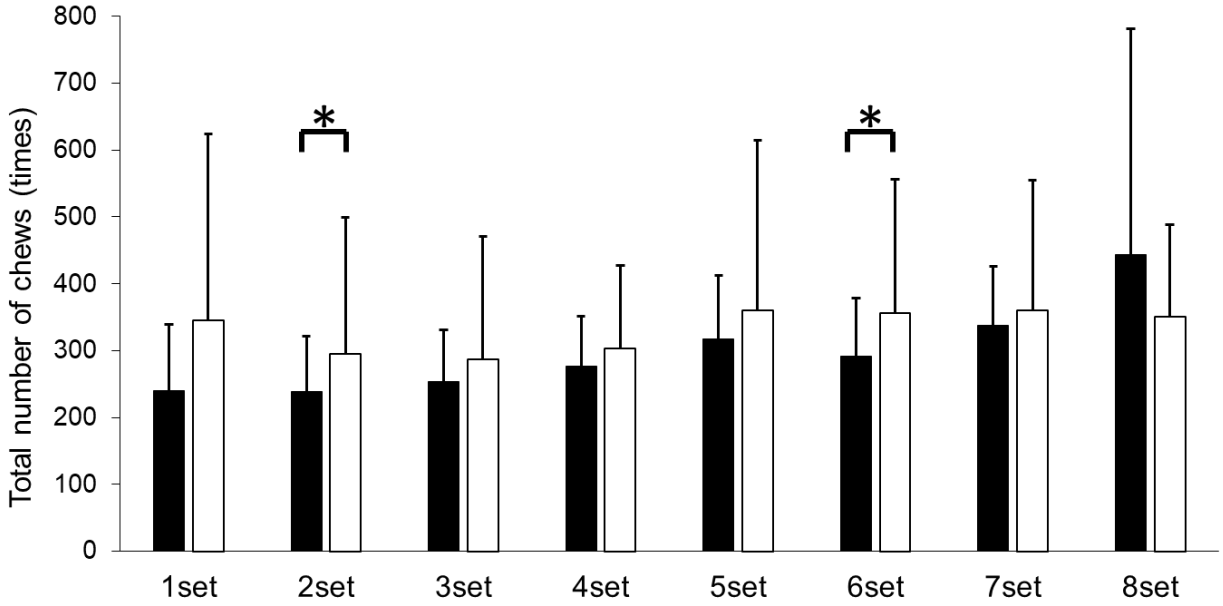



Fig. 5 Mean (± SD) Total number of chews each set in Japanese traditional foods and imported fast food (■ Japanese traditional foods, □ Imported fast food) (*$p < 0.05$ between two foods).

contained tofus and brown seaweeds. In Hamburgers were contained bread and hamburger steak. A study using the tactile sensor for detecting hardness showed that the hardness of the Japanese traditional foods used in this experiment is included in the first rank (≥ 0 Hz), second rank (≥ 500 Hz), and third rank (≥ 1000 Hz) excluding rice (Sekiguchi et al., 1996). Rice is included in the fourth rank (≥ 1500 Hz). Also, in imported fast food, French fries are included in the fourth rank (≥ 1500 Hz). Hamburger steak and breads included in hamburgers are ranked the fourth (≥ 1500 Hz). On the other hand, there is a possibility that imported fast food contains more food with higher hardness rank than Japanese traditional foods. From these results, it is considered that normalized ARV per chew increased during eating fast food.

Furthermore, in the total number of chews fast food was higher than Japanese traditional foods (Fig. 5). As mentioned above, in the foods used in this experiment, there is a possibility that imported fast food contains more food with higher hardness rank than Japanese traditional foods. In addition, hard foods require a greater number of chewing to swallow them (Nakamura 1987; Horio & Kawamura 1988). As a result, it is assumed that the number of chewing of imported fast food is greater than Japanese traditional foods.

In conclusion, using left and right masseter 1-channel surface electromyograms, the change rate of neuromuscular activation of the masseter muscle between Japanese traditional foods and imported fast food was compared under same calorie. Change rates of the sEMG per chew of each set in Japanese traditional foods were lower than imported fast food. In addition, mean total number of chews in Japanese traditional foods was also lower than imported fast food. Thus, we suggested that Japanese traditional foods require lower neuromuscular activation of the masseter muscle and number of chews than imported fast food.

**Acknowledgement**

This research was supported in Watanabe lab. The authors are sincerely grateful to associate Prof. Kohei Watanabe and Dr. Aya Tomita for helpful suggestions and the support in the use of surface electromyography system and offer of foods. The author would like to express his sincere gratitude to those who participated in this research.

**References**

Asano, M., Fukakura, N., Odachi J., Kawaraya C., Nanba, A., Yasuda, N., & Yamamoto, E. (2003). Use of Fast Foods among Young People. Journal of Japan Society of Nutrition and Food Sciences, 61(1) 47-54

B, R, Bigland Ritchie., N, J, Dawson., R, S, Johansson., & O, C, Lippold. (1986). Reflex origin for the slowing of motoneurone firing rates in fatigue of human voluntary contractions. Journal of Physiology, 379(1), 451-459

Brown, WE., Eves, D., Ellison, M., & Braxton, D. (1998). Use of combined electromyography and kinesthesiology during mastication to chart the oral breakdown of foodstuffs: relevance to measurement of food texture. Journal of Texture Studies, 29(2), 145-167

Horio, T., & Kawamura, Y. (1988). Influence of texture of food on chewing movements in human. Japanese Journal of Oral Biology, 30(4), 481-488

Ikuo, N., & Saito, Y. (2006). Active life expectancy for elderly Japanese people by chewing ability. Japanese Society of Public Health, 53(6), 411-423

K, R, Agrawal., P, W, Lucas., J, F, PRINZ., & I, C, Bruce. (1997). Mechanical properties of foods responsible for resisting food breakdown in the human mouth. Archives of Oral Biology, 42(1), 1-9

Kimura, Y., Ogawa, H., Yoshihara, A., Yamaga, T., Takiguchi, T., Wada, T., Sakamoto, R., Ishimoto, Y., Fukutomi, E., Chen, W., Fujisawa, M., Okumiya, K., Otsuka, K., Miyazaki, H., & Matsubayashi, K. (2013). Evaluation of chewing ability and its relationship with activities of daily living, depression, cognitive status and food intake in the community-dwelling elderly. Geriatrics & Gerontology International, 13(3), 718-725

Kohyaina, K., Ohtsubo, K., Toyoshima, H., & Shiozawa, K. (1998). Electromyographic study on cooked rice with different amylose contents. Journal of Texture Studies, 29(1), 101-113

Kohyama, K., Mioche, L., & Martin, JF. (2002). Chewing patterns of various texture foods studied by electromyography in young and elderly populations. Journal of Texture Studies, 33(4), 269-283

Kohyama, K., Nakayama, Y., Sasaki, T., Fukushima, F., & Hatakeyama, E. (2003). Mastication Quantities for Rice or Bread in Japanese- and Western-style Menus. Journal of Japanese Society for Mastication Science and Health Promotion, 12(2), 75-81

M, A, Peyron., A, Woda., P, Bourdiol., & M, Hennequin. (2017). Age-related changes in mastication. Journal of Oral Rehabilitation, 44(4), 299-312

Mathoniere, C., Mioche, L., Dransfield, E., & Culioli, J., (2000). Meat texture characterization: comparison of chewing patterns, sensory and mechanical measures. Journal of Texture Studies, 31(2), 183-203

Md, Saifuddin., K, Miyamoto., HM, Ueda., N, Shikata., & K, Tanne. (2001). A quantitative electromyographic analysis of masticatory muscle activity in usual daily life. Oral Diseases, 7(2), 94-100

Nakamura, T. (1987). Modulation of Jaw Movements and Jaw Muscle Activities in Human Mastication. Osaka University Knowledge Archive, 32, 36-55

Nakata, M. (1998). Masticatory function and its effects on general health. International Dental Journal, 48(1), 540-548

Ono, Y., Yamamoto,T., Kubo, K., & Onozuka, M. (2010). Occlusion and brain function: mastication as a prevention of cognitive dysfunction. Journal of Oral Rehabilitation, 37(8), 624-640

S, Paeratakul., D, P, Ferdinand., C, M, Champagne., D, H, Ryan., & George, A, Bray. (2003). Fast-food consumption among US adults and children: Dietary and nutrient intake profile. Journal of the American Dietetic Association, 103(10) 1332-1338

Sekiguchi, H., Machida, Y., & Omata, S. (1996). Evaluation of the Hardness of Foods measured by The New Tactile Sensor for Detecting Hardness. The Japanese Journal of Pediatric Dentistry, 34(1), 99-109

Shanthy, A, Bowman., & Bryan, T, Vinyard. (2004). Fast Food Consumption of U.S. Adults: Impact on Energy and Nutrient Intakes and Overweight Status. Journal of the American College of Nutrition, 23(2), 163-168

Shiono, K., Kai, S., Maruta, Y., Hinotsum, S., & Ogura, T. (1986). Study on the Standards for Evaluation of the Amount of Masticatory Function by the Kinds of Foods. Journal of dental health, 36(2), 179-188

T, Castroflorio., P, Bracco., & D, Farina. (2008). Surface electromyography in the assessment of jaw elevator muscles. Journal of Oral Rehabilitation, 35(8), 638-645

Teraoka, K., Shibata, H., Watanabe, S., Kumagai, S., & Okada, S. (1994). Interrelationships between Chewing Ability, Oral Condition and Dietary Attitudes among the Elderly. Journal of Dental Health, 44(5), 653-658

# Effect of oral communication through physical activity on a non-native language proficiency

国際社会系(渡邊ゼミ)

s116116

宮本葉月

Hazuki Miyamoto

**Abstract**

**Effect of oral communication through physical activity on a non-native language proficiency**

The purpose of the present study is to investigate the effect of oral communication through physical activity on non-native language proficiency and its difference depending on the type of activity. The results as shown below were observed by a questionnaire survey on non-native language proficiency and/or oral communication in the present study. In the non-native English speakers, student-athletes improved their English proficiency during their engagement in physical activity at the American university, while student non-athletes did not ($p < 0.05$) (Experiment 1). 86% of the international students who took a sport class answered that a sport class is effective for their proficiency in Japanese (Experiment 2). Japanese students who took a sport class were communicating more in a sport class than a conventional class ($p < 0.05$), especially in a team sport class and an individual sport class (Experiment 3). The present study suggested that communication through physical activity such as club activity and sport class can be an effective measure to learn a non-native language.

**身体活動を通した口頭でのコミュニケーションが非母国語習熟度に及ぼす影響**

本研究の目的は身体活動を通した口頭でのコミュニケーションが非母国語習熟度に及ぼす影響と、身体活動の種類によるその違いを明らかにすることである。非母国語習熟度・口頭コミュニケーションに関するアンケート調査から、以下のような結果が得られた。英語を母国語としないアメリカの大学に在籍する部活生は英語能力を向上させたが、非部活生には向上が見られなかった（$p < 0.05$）(実験 1)。体育の講義を履修した留学生の 86%が「体育の講義は日本語の習熟に有効である」と考えていることが分かった(実験 2)。体育の講義を履修した日本人学生が、座学の講義に比べ体育の講義、特にチームスポーツおよび個人スポーツで多くコミュニケーションをとっていることが分かった（$p < 0.05$）(実験 3)。結果から、本研究は部活動や体育の授業等の身体活動を通したコミュニケーションは非母国語の学習において有効な手段になりえることを示唆した。

**Efecto de la comunicación oral en el dominio de un idioma no nativo a través de la actividad física**

El propósito del presente estudio es investigar el efecto de la comunicación oral en el dominio de un idioma no nativo a través de la actividad física y su diferencia dependiendo del tipo de la actividad. Los resultados que se muestran a continuación fueron obtenidos mediante una encuesta tipo cuestionario sobre el dominio del idioma no nativo y/o la comunicación oral. En los hablantes no nativos de inglés, los estudiantes atletas mejoraron su dominio del inglés durante su participación en actividades físicas en la universidad estadounidense, mientras que los estudiantes no atletas no lo hicieron ($p <0.05$) (Experimento 1). El 86% de los estudiantes internacionales que tomaron una clase de deportes respondieron que la misma fue efectiva para su dominio del idioma japonés (Experimento 2). Los estudiantes japoneses que tomaron una clase de deportes se comunicaban más en una clase deportiva que en una clase convencional ($p <0.05$), especialmente en las clases deportivas de equipo y en las individuales. (Experimento 3). Los resultados del presente estudio sugieren que la comunicación oral a través de la actividad física, como las actividades de los clubes y las clases deportivas, pueden ser una medida efectiva para aprender un idioma no nativo.

This graduation thesis includes the conference abstract as shown below:

MIYAMOTO, H., WATANABE, K. (2019). Effect of Participation in Sports Team During Overseas Study Program on Non-native Language Proficiency. “24th Annual Congress of the European College of Sport Science”, Prague, Czech Republic, July 3-6, 2019.

**Introduction**

The number of people from overseas in Japan has been increasing in recent years (Ministry of Justice, 2018). Amendment of Immigration Control and Refugee Recognition Act in 1990 is considered to be one reason for that (Ministry of Education, Culture, Sports, Science and Technology-Japan, 2010), and in June 2018, their number has increased to the largest one: 2,637,251 (Ministry of Justice, 2018) (Fig. 1). The increase in their number has made Japanese government work on language training for those who do not speak Japanese, and the number of children/students who need any language training has been increasing; according to Ministry of Education, Culture, Sports, Science and Technology-Japan (2018), 34,335 children/students from overseas needs any language training (Ministry of Education, Culture, Sports, Science and Technology-Japan, 2018) (Fig. 2). However, many children and students who need the language training have not been able to take any training class; while the number of those who need any language training is 43,947, those who actually take it among them is only about 75% (Ministry of Education, Culture, Sports, Science and Technology-Japan, 2017). The lack of teachers who can teach Japanese and/or teaching materials contributes to the number of those who can actually take any language training. For example, 1,434 schools in Japan cannot teach Japanese to children from overseas because they do not know the method of teaching Japanese and/or they do not have any teaching materials for them (Ministry of Education, Culture, Sports, Science and Technology-Japan, 2018). In addition to that, Ministry of Education, Culture, Sports, Science and Technology-Japan (2006) reports that certain number of children from overseas do not attend school because they cannot understand Japanese, they cannot get used to Japanese culture, they cannot make any friends there, or they can be bullied at school (Ministry of Education, Culture, Sports,

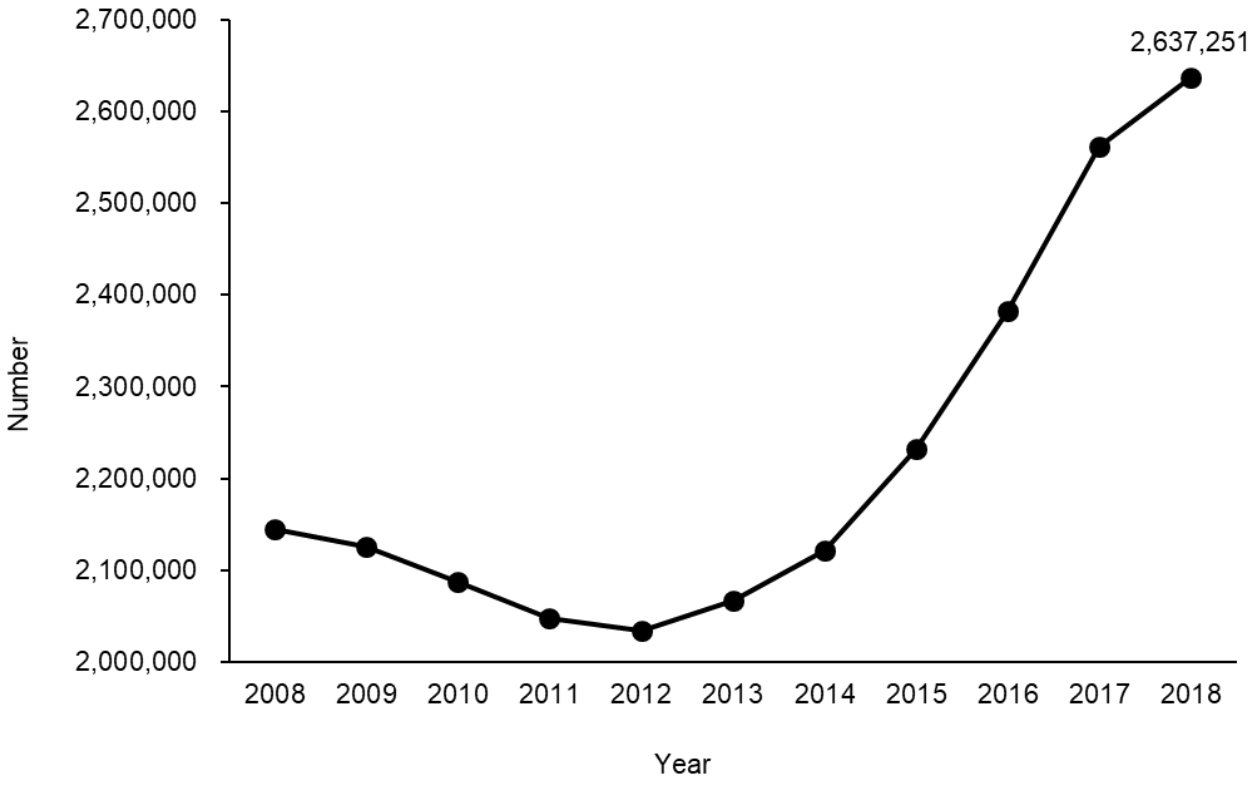



Fig. 1 The number of people from overseas in Japan

This was drawn by author based on a report from Ministry of Justice (2018).

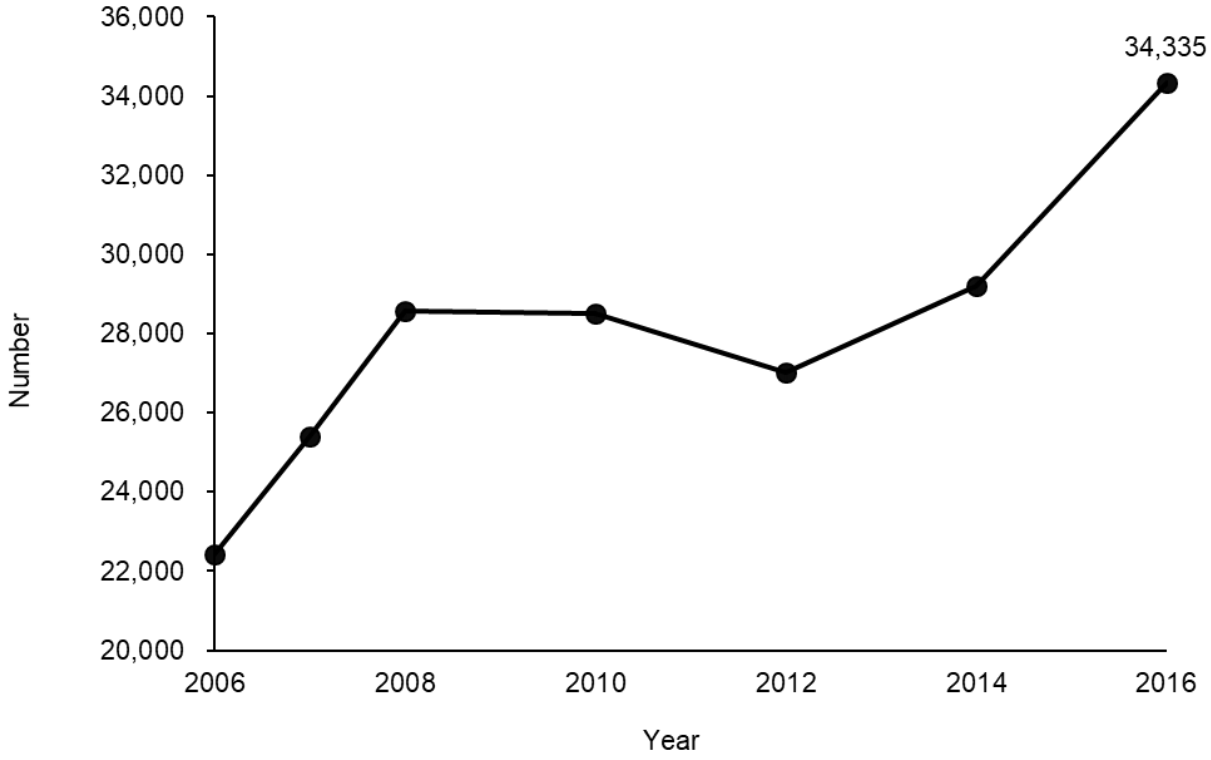



Fig. 2 The number of children/students from overseas who need to learn Japanese

This was drawn by author based on a report from Ministry of Education, Culture, Sports, Science and Technology-Japan (2018).

Science and Technology-Japan, 2006). As mentioned, sociocultural factors such as language, culture, and habit can be the obstacles for those children and students to attend school in Japan.

As previously mentioned, language is one of the crucial factors to attend school in Japan because all the class at school in Japan is offered in Japanese. To attend school and get used to it, acquiring Japanese is necessary for them; everyone includes those who have come from overseas is required to communicate in Japanese. Referring to the method of learning a non-native language, Hernández (2010) argues the importance of oral communication for the proficiency in a non-native language as follows.

> *It is often assumed that study abroad is superior to instruction at home because the study-abroad experience offers students greater access to NSs (native speakers) and more varied opportunities to use the target language as a tool for exchanging information and participating in social and interpersonal functions* (Hernández, 2010).

Indeed, his study to investigate how English speakers' proficiency in Spanish was affected by their motivation and interaction in Spanish has revealed that a student contact with the Spanish language has a significant effect on their speaking improvement (Hernández, 2010).

While many studies have been trying to find an effective way to learn a non-native language, some studies have revealed that physical activity can have a positive effect on learning. Recent animal studies showed that physical activity can have a positive impact on brain; according to Okamoto and co-workers (2012), mild exercise activates hippocampal neurons through the glutamatergic pathway, and also promotes adult hippocampal neurogenesis (Okamoto et al., 2012). Van der Borght and co-workers (2007) have revealed that 14 days of wheel

running promotes memory acquisition, memory retention, and reversal learning (Van der Borght et al., 2007). In human studies, one study has showed the impact of physical activity on learning a non-native language; Liu and colleagues (2017) have revealed that learning a foreign vocabulary while performing a concurrent physical activity yields better performance than learning the same vocabulary while being in a static situation (Liu et al., 2017). Their study showed that the participants in the experimental group, who were pedaling while learning non-native language vocabularies, responded faster in the word-picture verification task and had higher accuracy in the sentence semantic judgement task than the control group (Liu et al., 2017). As these studies have revealed, physical activity and learning have a positive correlation that makes learning more effective.

Although the two positive correlations, which refer to the relationship between physical activity and language learning and one between language learning and oral communication, have revealed by studies as mentioned above, studies of the relationship between physical activity and oral communication are sparse; most studies that referred to physical activity and learning have concentrated only on memory such as memorizing vocabulary. In addition to that, those studies have used personal activity for their experiments, which participants did not have to communicate with other participants and/or testers while conducting an experiment. While the relationship between physical activity and oral communication has not revealed yet, physical activity should go hand in hand with communication; study by Ishak (2017) argues that not only does interpersonal communication promote team success, but sports also offer a setting to improve communication efficacy (Ishak, 2017). If personal physical activity can have any positive impact on learning a non-native language, does interpersonal physical activity have more positive impact on it as well?

The purpose of the present study is to investigate the effect of oral communication through physical activity on non-native language proficiency and its difference depending on the type of physical activity such as personal activity and interpersonal one. In the United States, many universities regard collegiate sport as a crucial factor to decide their quality; NCAA, National Collegiate Athletic Association, governs collegiate sport in the United States. Therefore, many students from overseas enroll in a university in the United States, seeking a better environment for training and competing. According to NCAA, there are over 20,000 international student-athletes enrolled and competing at NCAA schools (National Collegiate Athletic Association). They are required to use English, a non-native language for them, to take classes and to engage in sport activity there. In Japan, a sport class is a compulsory subject in some universities; according to Japanese Association of University Physical Education and Sports (2017), in 2016, 27.5 percent of universities registered to the association have set a sport class as a compulsory subject for all students enrolled (Japanese Association of University Physical Education and Sports, 2017). Every student includes international students are required to take a sport class and thus they have an opportunity to communicate through physical activity. In addition to that, international students, whose first language is not Japanese, have also an opportunity to communicate in Japanese through physical activity. Based on the facts as mentioned above, three research questions were set to achieve the purpose of the present study.

i. Is there any difference between those who engage in sport activity and those who do not in their proficiency in a non-native language and in how they improve it?

ii. How do international exchange students think about a sport class's effectiveness for their proficiency in a non-native language?

iii. Is there any difference between a sport class and a conventional one in the amount of communication? Is there any difference in it depending on the type of sport class as well?

The hypotheses for each research questions were set as follows.

i. Those who engage in sport activity significantly improve their proficiency in a non-native language in comparison with those who do not engage in sport activity.

ii. International exchange students feel that a sport class is more effective for their proficiency in a non-native language than a conventional class is.

iii. Students communicate more in a sport class than they do in a conventional one, and they communicate more in interpersonal sport class than in personal sport class.

To verify the three hypotheses mentioned above, three experiments were conducted in this study.

**Materials and Methods**

Experiment 1

*Participants*

Twenty-five undergraduate international students including thirteen non-athletes (NATH) and twelve athletes (ATH) who attend a university in the United States participated. The participants were given the written informed consent for the study after receiving a detailed explanation of the purposes, potential benefits, and risks associated with participation in the study.

*Experimental design*

The participants were given an online survey. They were asked questions to ascertain their basic information such as nationality and first language, and then they were asked their English proficiency, which was divided into four categories: Reading, Listening, Speaking, and Writing. The participants retraced their English proficiency of before enrolling in the American university and then answered their proficiency at the time they answered the survey, which was during enrolling. "During enrolling" is referred to "Now" in the survey. ATH group was also asked questions to make sure what kind of sport team they join in the university and how long they have been in the team. The questions that participants were asked are shown in Fig. 3 for NATH group and Fig. 4 for ATH group.

*Statistics*

A part of data is provided as mean and SD. Before the analysis, the normal distribution of the data was confirmed using Shapio-Wilk test and the non-parametric analysis was used in Experiment 1 as a result. The understanding level of English for Reading, Speaking, Listening, and Writing were compared between before and during enrolling in the university in the United States by Wilcoxon test for NATH and ATH. The understanding level of English for Reading, Speaking, Listening, and Writing were compared between NATH and ATH by Man-Whitney test at before and during enrolling in the university in the United States. The level of statistical significance was set at $p < 0.05$. Statistical analyses were performed using SPSS software (version 21.0; SPSS, Tokyo, Japan).

Experiment 2

*Participants*

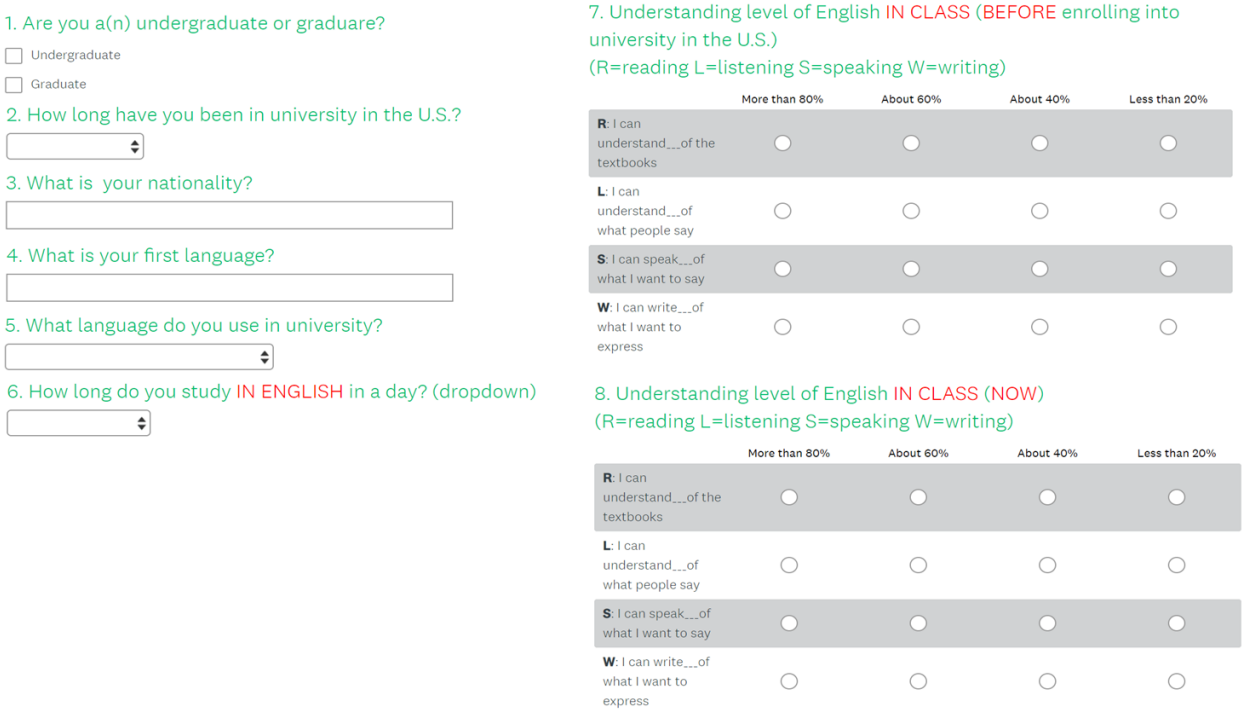



Fig. 3 Questionnaire survey used in Experiment 1 (for NATH)

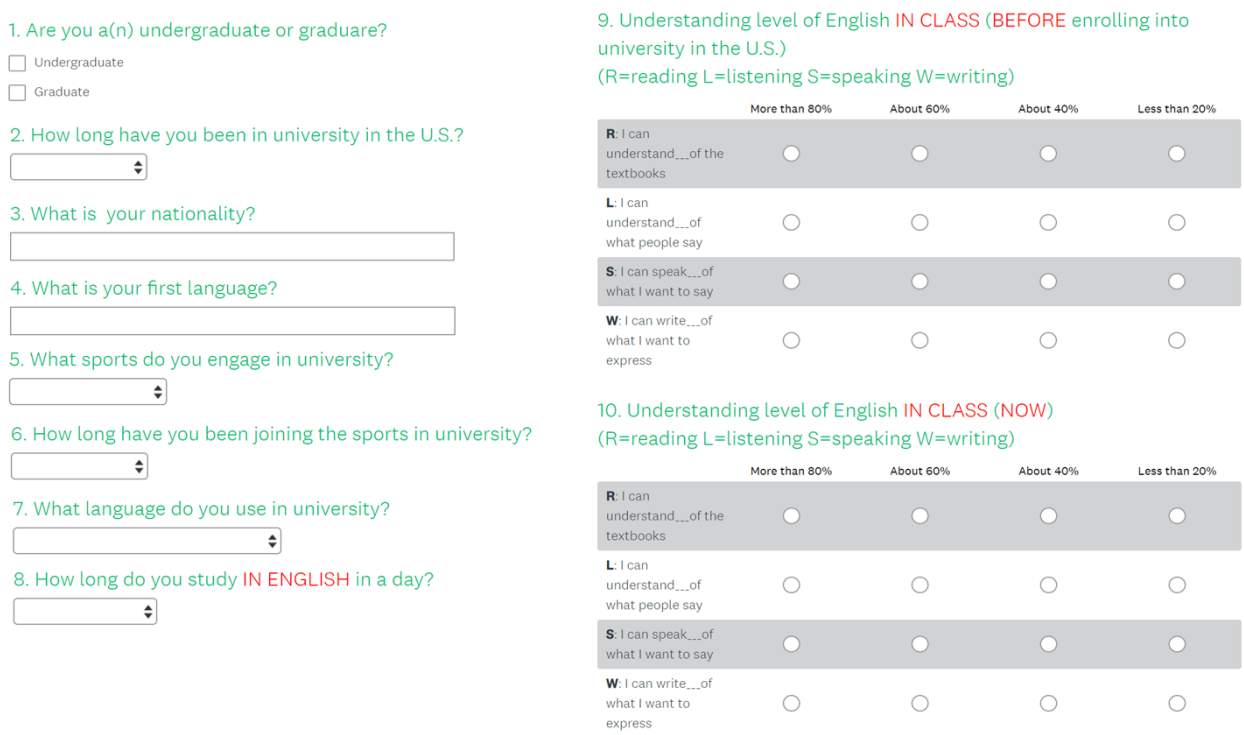



Fig. 4 Questionnaire survey used in Experiment 1 (for ATH)

Seven international exchange students who engaged in the exchange program at Chukyo University and took any sport class there participated. The participants were given the written informed consent for the study after receiving a detailed explanation of the purposes, potential benefits, and risks associated with participation in the study.

*Experimental design*

The participants were given an online survey. They were asked questions to ascertain how much they communicated with people in Japanese in a sport class, a conventional one, and outside of the classes. They were also asked what kind of sport class they took (fitness, individual sport, and team sport), and whether they think a sport class and a conventional one was effective for their proficiency in Japanese or not. The questions that participants were asked are shown in Fig. 5.

*Statistics*

Statistical analyzes could not be performed because the number of the data collected was for seven participants and all the questions were closed-ended questions. Therefore, percentages of answers were used to the quantify the results of Experiment 2.

Experiment 3

*Participants*

Eighty-eight Japanese students who took sport class (two-basketball classes, five-badminton classes, three-fitness classes, one-aerobics class, and one training class) at Chukyo University during fall semester 2019 participated. The participants were given the written informed consent for the study after receiving a detailed

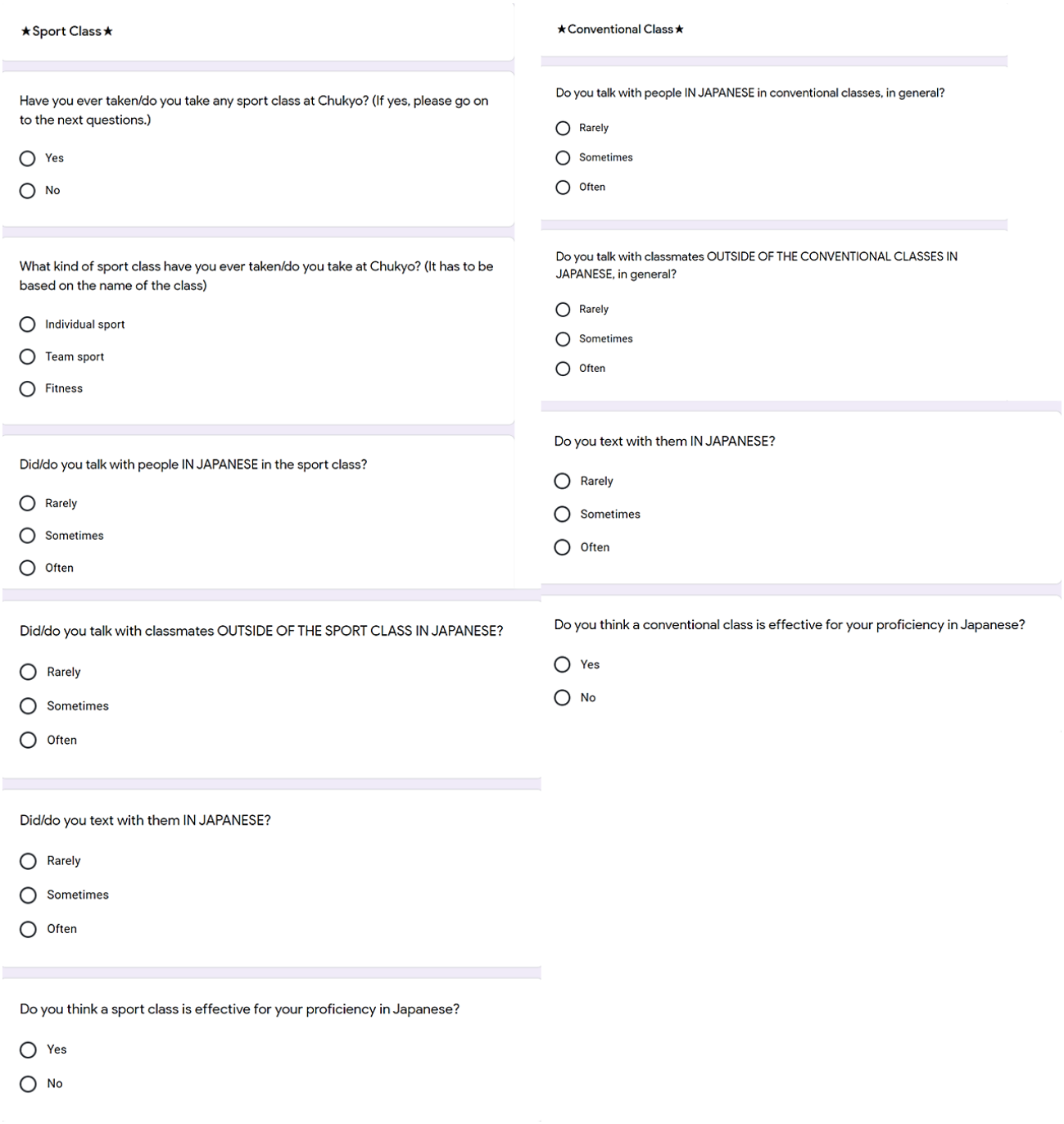



Fig. 5 Questionnaire survey used in Experiment 2

explanation of the purposes, potential benefits, and risks associated with participation in the study.

*Experimental design*

Experiment 3 was conducted to ascertain the tendency that has been shown in experiment 2. The participants were given either a printed survey or an online one at the last class of fall semester 2019. The participants were asked the questions to ascertain how much they communicated with people in a sport class, a conventional one, and the outside of the classes. They were also asked what kind of sport class they took (fitness, individual sport, and team sport). The questions that participants were asked are shown in Fig. 6 and 7.

*Statistics*

A part of data is provided as mean and SD. Before the analysis, the normal distribution of the data was confirmed using Shapio-Wilk test and the non-parametric analysis was used in Experiment 3 as a result. The amount of communication in a sport class was compared among fitness class (FT), individual sport class (IS), team sport class (TS) by Kruskal-Wallis test. The amount of communication was also compared between each groups and conventional class, and between the averaged values of three types of sport classes and that of conventional class by Wilcoxon test. The level of statistical significance was set at $p < 0.05$. Statistical analyses were performed using SPSS software (version 25.0; SPSS, Tokyo, Japan).

**Results**

*Experiment 1*

Before the analysis, three of all participants were excluded because their first language was English or


Fig. 6 Questionnaire survey used in Experiment 3 (online)

①日本人学生用

体育

1 現在履修している体育の授業は以下のうちどれに該当しますか。
個人スポーツ
チームスポーツ
フィットネス

2 一回の授業内で人との会話は平均して何分程度ありましたか。
約　　分

3 体育の授業内で出来た友人と授業外でも会話することはありますか。
はい
いいえ

4 体育の授業内で出来た友人とLINE等オンラインでのやり取りは一日何回しますか。
（メッセージ送信ー返信で1回とします）
約　　回

5 現在履修中の体育の授業には留学生はいますか。
はい
いいえ

6 （5で「はい」と答えた場合）一回の授業内で留学生との"日本語での"会話は平均して何分程度ありましたか。
約　　分

7 （5で「はい」と答えた場合）体育の授業内の留学生とLINE等"日本語での"オンラインでのやり取りは一日何回しますか。
（メッセージ送信ー返信で1回とします）
約　　回

座学

8 座学の授業：一回の授業内で人との会話は平均して何分程度ありましたか。
約　　分

9 座学の授業内で出来た友人と授業外でも会話することはありますか。
はい
いいえ

10 座学の授業内で出来た友人とLINE等オンラインでのやり取りは一日何回しますか。
（メッセージ送信ー返信で1回とします）
約　　回

11 現在履修中の座学の授業には留学生はいますか。
はい
いいえ

12 （10で「はい」と答えた場合）一回の授業内で留学生との"日本語での"会話は平均して何分程度ありましたか。
※複数の授業に留学生がいる場合、全ての授業の平均を回答してください。
約　　分

13 （10で「はい」と答えた場合）座学の授業内の留学生とLINE等"日本語での"オンラインでのやり取りは一日何回しますか。
（メッセージ送信ー返信で1回とします）
約　　回

Fig. 7 Questionnaire survey used in Experiment 3 (printed)

Translation of Figure. 6 and 7 is as follows:

Sport class

・What kind of sport class do you take this semester? [Individual sport/Team sport/Fitness]

・How much do you talk with people in one class of the sport class, on average? [About　minute(s)]

・Do you talk with classmates outside of the sport class? [Yes/No]

・How many times do you text with classmates online in a day [About　time(s)]?

・Is there any international student in the sport class? [Yes/No]

・If "Yes" in question 5, how much do you talk with them in Japanese in one class of the sport class, on average? [About　minute(s)]

・If "Yes" in question 5, how many times do you text with them in Japanese online in a day? [About　time(s)]

Conventional class

・How much do you talk with people in one class of a conventional class, on average? [About　minute(s)]

・Do you talk with classmates outside of the conventional classes? [Yes/No]

・How many times do you text with classmates online in a day? [About　time(s)]

・Is there any international student in the conventional class? [Yes/No]

・If "Yes" in question 11, how much do you talk with them in Japanese in one class of the conventional class, on average? [About　minute(s)]

*If there is an international student in several classes, please calculate its average.

・If "Yes" in question 11, how many times do you text with them in Japanese online in a day? [About　time(s)]

they were not categorized into international student. The participants were from Colombia, Kenya, Japan, China, France, Finland, Italy, Brazil, Spain, Austria, and Czech Republic (Table 1 and 3). Significant increase was found in the understanding level of English for Reading, Speaking, Listening, and Writing from before to during enrolling in the university in the United States for ATH ($p < 0.05$), while not for NATH ($p > 0.05$) (Table 6). There were significant differences in the understanding level of English in three of four skills: Reading, Listening, and Speaking between NATH group and ATH group at before enrolling in the university in the United States ($p < 0.05$) (Table 7). However, there was no significant differences in the understanding level of English in all four skills between NATH group and ATH group at during enrolling ($p > 0.05$) (Table 7).

*Experiment 2*

One participant took team sport class and five participants took individual sport class, and one correspondent took fitness class (Table 8). Regarding communication in sport class, one out of all participants answered “Rarely” (14%), and three of them answered “Sometimes” (43%) and “Often” (43%) (Table 8). For a question asking the effectiveness of a sport class for Japanese proficiency, six out of all participants answered “Yes” (86%), which means “I think a sport class is effective for my proficiency in Japanese.” (Table 8). Regarding communication in conventional class, one out of all participants answered “Rarely” (14%), four of them answered “Sometimes” (57%), and two of them answered “Often” (29%) (Table 9). For a question asking the effectiveness of a conventional class, all of the participants answered “Yes” (100%), which means “I think a conventional class is effective for my proficiency in Japanese.” (Table 9).

*Experiment 3*

Table. 1 The result of the questionnaire survey in Experiment 1 (NATH, n=11) (First half)

1. Are you a(n) undergraduate or graduate?

| | |
|---|---|
| Undergraduate | 11 |
| Graduate | 0 |

2. How long have you been in university in the U.S.?

| | |
|---|---|
| Less than one month | 3 |
| 1~3 month(s) | 3 |
| 4~6 months | 1 |
| 7~11 months | 1 |
| More than one year | 3 |

3. What is your nationality?

| | |
|---|---|
| Colombia | 1 |
| Kenya | 1 |
| Japan | 5 |
| China | 2 |
| France | 1 |
| Finland | 1 |

4. What is your first language?

| | |
|---|---|
| Spanish | 1 |
| Kiswahili | 1 |
| Japanese | 5 |
| Chinese | 2 |
| French | 1 |
| Finnish | 1 |

5. What language do you use in university?

| | |
|---|---|
| I always use English | 6 |
| I use both English and my first language | 5 |
| I always use my first language | 0 |

Table. 2 The result of the questionnaire survey in Experiment 1 (NATH, n=11) (Latter half)

6. How long do you study in English in a day?

| | |
|---|---|
| Less than one hour | 0 |
| 1~3 hour(s) | 2 |
| 4~6 hours | 8 |
| 7~9 hours | 1 |
| More than 10 hours | 0 |

7. Understanding level of English in class (before enrolling in university in the U.S.)

Reading

| | |
|---|---|
| More than 80% | 8 |
| About 60% | 3 |
| About 40% | 0 |
| Less than 20% | 0 |

Listening

| | |
|---|---|
| More than 80% | 9 |
| About 60% | 2 |
| About 40% | 0 |
| Less than 20% | 0 |

Speaking

| | |
|---|---|
| More than 80% | 6 |
| About 60% | 4 |
| About 40% | 1 |
| Less than 20% | 0 |

Writing

| | |
|---|---|
| More than 80% | 5 |
| About 60% | 6 |
| About 40% | 0 |
| Less than 20% | 0 |

8. Understanding level of English in class (now)

Reading

| | |
|---|---|
| More than 80% | 8 |
| About 60% | 3 |
| About 40% | 0 |
| Less than 20% | 0 |

Listening

| | |
|---|---|
| More than 80% | 10 |
| About 60% | 1 |
| About 40% | 0 |
| Less than 20% | 0 |

Speaking

| | |
|---|---|
| More than 80% | 8 |
| About 60% | 2 |
| About 40% | 1 |
| Less than 20% | 0 |

Writing

| | |
|---|---|
| More than 80% | 6 |
| About 60% | 5 |
| About 40% | 0 |
| Less than 20% | 0 |

Table. 3 The result of the questionnaire survey in Experiment 1 (ATH, n=11) (First part)

1. Are you a(n) undergraduate or graduate?

| | |
|---|---|
| Undergraduate | 11 |
| Graduate | 0 |

2. How long have you been in university in the U.S.?

| | |
|---|---|
| Less than one month | 0 |
| 1~3 month(s) | 2 |
| 4~6 months | 3 |
| 7~11 months | 2 |
| More than one year | 4 |

3. What is your nationality?

| | |
|---|---|
| Italy | 2 |
| Brazil | 3 |
| Spain | 2 |
| Austria | 1 |
| Czech Republic | 1 |
| Japan/United States | 1 |
| Germany | 1 |

4. What is your first language?

| | |
|---|---|
| Italian | 2 |
| Spanish | 1 |
| Catalan | 1 |
| Portuguese | 3 |
| Japanese | 1 |
| Czech | 1 |
| German | 2 |

Table. 4 The result of the questionnaire survey in Experiment 1 (ATH, n=11) (Second part)

5. What sports do you engage in university?

| | |
|---|---|
| Soccer | 5 |
| Track & Field | 3 |
| Basketball | 1 |
| Tennis | 2 |

6. How long have you been joining the sports in university?

| | |
|---|---|
| Less than one month | 0 |
| 1~3 month(s) | 3 |
| 4~6 months | 2 |
| 7~11 months | 2 |
| More than one year | 4 |

7. What language do you use in university?

| | |
|---|---|
| I always use English | 5 |
| I use both English and my first language | 6 |
| I always use my first language | 0 |

8. How long do you study in English in a day?

| | |
|---|---|
| Less than one hour | 1 |
| 1~3 hour(s) | 7 |
| 4~6 hours | 3 |
| 7~9 hours | 0 |
| More than 10 hours | 0 |

Table. 5 The result of the questionnaire survey in Experiment 1 (ATH, n=11) (Last part)

9. Understanding level of English in class (before enrolling in university in the U.S.)

Reading

| | |
|---|---|
| More than 80% | 3 |
| About 60% | 4 |
| About 40% | 3 |
| Less than 20% | 1 |

Listening

| | |
|---|---|
| More than 80% | 2 |
| About 60% | 4 |
| About 40% | 2 |
| Less than 20% | 3 |

Speaking

| | |
|---|---|
| More than 80% | 3 |
| About 60% | 1 |
| About 40% | 5 |
| Less than 20% | 2 |

Writing

| | |
|---|---|
| More than 80% | 4 |
| About 60% | 3 |
| About 40% | 2 |
| Less than 20% | 2 |

10. Understanding level of English in class (now)

Reading

| | |
|---|---|
| More than 80% | 10 |
| About 60% | 0 |
| About 40% | 1 |
| Less than 20% | 0 |

Listening

| | |
|---|---|
| More than 80% | 8 |
| About 60% | 3 |
| About 40% | 0 |
| Less than 20% | 0 |

Speaking

| | |
|---|---|
| More than 80% | 5 |
| About 60% | 5 |
| About 40% | 1 |
| Less than 20% | 0 |

Writing

| | |
|---|---|
| More than 80% | 8 |
| About 60% | 3 |
| About 40% | 0 |
| Less than 20% | 0 |

Table. 6 The understanding level of English (Before enrolling vs. During enrolling)

| | | NATH | | ATH | |
|---|---|---|---|---|---|
| Reading | Before enrolling | 74.5 ± 9.3 | | 56.4 ± 19.6 | |
| (%) | During enrolling | 74.5 ± 9.3 | $p$=1.000 | 76.4 ± 12.1 | *$p$=0.009 |
| Listening | Before enrolling | 76.4 ± 8.1 | | 49.1 ± 22.6 | |
| (%) | During enrolling | 78.2 ± 6.0 | $p$=0.317 | 74.5 ± 9.3 | *$p$=0.010 |
| Speaking | Before enrolling | 69.1 ± 13.8 | | 49.1 ± 22.6 | |
| (%) | During enrolling | 72.7 ± 13.5 | $p$=0.157 | 67.3 ± 13.5 | *$p$=0.014 |
| Writing | Before enrolling | 69.1 ± 10.4 | | 56.4 ± 23.4 | |
| (%) | During enrolling | 70.9 ± 10.4 | $p$=0.317 | 74.5 ± 9.3 | *$p$=0.026 |

*$p < 0.05$ Before enrolling vs. During enrolling (Wilcoxon test)

Table. 7 The understanding level of English (NATH vs. ATH)

| | | Before enrolling | | During enrolling | |
|---|---|---|---|---|---|
| Reading | NATH | 74.5 ± 9.3 | | 74.5 ± 9.3 | |
| (%) | ATH | 56.4 ± 19.6 | *$p$=0.017 | 76.4 ± 12.1 | $p$=0.353 |
| Listening | NATH | 76.4 ± 8.1 | | 78.2 ± 6.0 | |
| (%) | ATH | 49.1 ± 22.6 | *$p$=0.002 | 74.5 ± 9.3 | $p$=0.280 |
| Speaking | NATH | 69.1 ± 13.8 | | 72.7 ± 13.5 | |
| (%) | ATH | 49.1 ± 22.6 | *$p$=0.032 | 67.3 ± 13.5 | $p$=0.259 |
| Writing | NATH | 69.1 ± 10.4 | | 70.9 ± 10.4 | |
| (%) | ATH | 56.4 ± 23.4 | $p$=0.216 | 74.5 ± 9.3 | $p$=0.386 |

*$p < 0.05$ NATH vs. ATH (Man-Whitney test)

Table. 8 The result of the questionnaire survey in Experiment 2 (n=7) (First half)

1. Have you ever taken/do you take any sport class at Chukyo University?

| | |
|---|---|
| Yes | 7 (100%) |
| No | 0 (0%) |

2. If yes in question 1, what kind of class?

| | |
|---|---|
| Team sport | 1 (14%) |
| Individual sport | 5 (71%) |
| Fitness | 1 (14%) |

3. Did/do you talk with people in Japanese in the sport class?

| | |
|---|---|
| Rarely | 1 (14%) |
| Sometimes | 3 (43%) |
| Often | 3 (43%) |

4. Did/do you talk with classmates outside of the sport class in Japanese?

| | |
|---|---|
| Rarely | 3 (43%) |
| Sometimes | 2 (29%) |
| Often | 2 (29%) |

5. Did/do you text with them in Japanese?

| | |
|---|---|
| Rarely | 4 (57%) |
| Sometimes | 2 (29%) |
| Often | 1 (14%) |

6. Do you think a sport class is effective for your proficiency in Japanese?

| | |
|---|---|
| Yes | 6 (86%) |
| No | 1 (14%) |

Table. 9 The result of the questionnaire survey in Experiment 2 (n=7) (Latter half)

7. Do you talk with people in conventional classes, in general?

| | |
|---|---|
| Rarely | 1 (14%) |
| Sometimes | 4 (57%) |
| Often | 2 (29%) |

8. Do you talk with classmates outside of the conventional class in Japanese?

| | |
|---|---|
| Rarely | 1 (14%) |
| Sometimes | 5 (71%) |
| Often | 1 (14%) |

9. Do you text with them in Japanese?

| | |
|---|---|
| Rarely | 0 (0%) |
| Sometimes | 7 (100%) |
| Often | 0 (0%) |

10. Do you think a conventional class is effective for your proficiency in Japanese?

| | |
|---|---|
| Yes | 7 (100%) |
| No | 0 (0%) |

Twenty-two, thirty-six, and thirty students took TS, IS, and FT classes (Table 10 and 11). There was no significant effect of class in the amount of communication ($p > 0.05$). There were significant differences in the amount of communication between sport class and conventional class when compared in each group; the amount of communication was significantly lesser in conventional class when compared to TS, IS ($p < 0.05$) (Table 12). Furthermore, the amount of communication was significantly lesser in conventional class when compared to the averaged values of three groups ($p < 0.05$) (Table 13).

**Discussion**

*Experiment 1*

While ATH group significantly improved their English proficiency from before enrolling to during enrolling ($p < 0.05$), NATH group did not improve their English proficiency ($p > 0.05$) (Table 6); although ATH group was not proficient in English than NATH group before enrolling in a university in the United States, there was no significant difference between NATH group and ATH group at during enrolling in the American university ($p > 0.05$) (Table 7). Thus, engaging in physical activity have a potential to have any positive impact on learning a non-native language. Therefore, the hypothesis (i), "Those who engage in sport activity significantly improve their proficiency in a non-native language in comparison with those who do not engage in sport activity.", was supported by the results. However, this experiment should be more explored because the understanding level of English of the participants at before enrolling were varied; it should be the same in both NATH group and ATH group.

Table. 10 The result of the questionnaire survey in Experiment 3 (First half)

1. What kind of sport class do you take this semester?

| | |
|---|---|
| Individual sport | 36 |
| Team sport | 22 |
| Fitness | 30 |

2. How much do you talk with people in the sport class, on average?

| | IS (n=36) | TS (n=22) | FT (n=30) | Averaged |
|---|---|---|---|---|
| (minutes) | 45.7 ± 24.1 | 53.2 ± 29.2 | 30.8 ± 22.9 | 42.5 ± 26.3 |

3. Do you talk with classmates outside of the sport class?

| | IS (n=36) | TS (n=22) | FT (n=30) |
|---|---|---|---|
| Yes | 27 | 19 | 21 |
| No | 9 | 3 | 9 |

4. How many times do you text with classmates online in a day?

| | IS (n=36) | TS (n=22) | FT (n=30) | Averaged |
|---|---|---|---|---|
| (times) | 1.7 ± 3.9 | 0.4 ± 0.6 | 0.4 ± 0.7 | 0.9 ± 2.6 |

5. Is there any international student in the sport class?

| | IS (n=36) | TS (n=22) | FT (n=30) |
|---|---|---|---|
| Yes | 14 | 1 | 6 |
| No | 22 | 21 | 24 |

6. If “Yes” in question 5, how much do you talk with them in Japanese in one class of the sport class, on average?

| | IS (n=14) | TS (n=1) | FT (n=6) | Averaged |
|---|---|---|---|---|
| (minutes) | 11.4 ± 20.8 | 0.0 ± 0.0 | 0.5 ± 1.2 | 7.8 ± 17.6 |

7. If “Yes” in question 5, how many times do you text with them in Japanese online in a day?

| | IS (n=14) | TS (n=1) | FT (n=6) | Averaged |
|---|---|---|---|---|
| (minutes) | 0.0 ± 0.0 | 0.0 ± 0.0 | 0.0 ± 0.0 | 0.0 ± 0.0 |

Table. 11 The result of the questionnaire survey in Experiment 3 (Latter half)

8. How much do you talk with people in one class of a conventional class, on average?

| | IS (n=36) | TS (n=22) | FT (n=30) | Averaged |
|---|---|---|---|---|
| (minutes) | 22.7 ± 16.8 | 15.5 ± 16.7 | 22.0 ± 20.2 | 20.7 ± 18.1 |

9. Do you talk with classmates outside of the conventional classes?

| | IS (n=36) | TS (n=22) | FT (n=30) |
|---|---|---|---|
| Yes | 30 | 17 | 28 |
| No | 6 | 4 | 2 |
| N/A | 0 | 1 | 0 |

10. How many times do you text with classmates online in a day?

| | IS (n=36) | TS (n=22) | FT (n=30) | Averaged |
|---|---|---|---|---|
| (times) | 4.0 ± 6.2 | 2.0 ± 2.6 | 2.2 ± 2.5 | 2.9 ± 4.5 |

11. Is there any international student in the conventional class?

| | IS (n=36) | TS (n=22) | FT (n=30) |
|---|---|---|---|
| Yes | 14 | 5 | 7 |
| No | 22 | 17 | 23 |

12. If “Yes” in question 11, how much do you talk with them in Japanese in one class of the conventional class, on average?
    *If there is an international student in several classes, please calculate its average.

| | IS (n=14) | TS (n=1) | FT (n=6) | Averaged |
|---|---|---|---|---|
| (minutes) | 1.4 ± 3.6 | 0.3 ± 0.5 | 4.3 ± 11.3 | 2.0 ± 6.4 |

13. If “Yes” in question 11, how many times do you text with them in Japanese online in a day?

| | IS (n=14) | TS (n=1) | FT (n=6) | Averaged |
|---|---|---|---|---|
| (times) | 0.2 ± 0.4 | 0.0 ± 0.0 | 0.0 ± 0.0 | 0.1 ± 0.3 |

Table. 12 The amount of communication (each Sport class vs. Conventional class) (First half)

| | TS | | IS | | FT | |
|---|---|---|---|---|---|---|
| Sport class (minutes) | 53.2 ± 29.2 | | 45.7 ± 24.1 | | 30.8 ± 22.9 | |
| Conventional class (minutes) | 15.5 ± 16.7 | *$p$<0.001 | 22.7 ± 16.8 | *$p$<0.001 | 22.0 ± 20.2 | $p$=0.081 |

*$p < 0.05$ Sport class vs. Conventional class (Wilcoxon test)

Table. 13 The amount of communication (Sport class vs. Conventional class) (Latter half)

| | Averaged Value | |
|---|---|---|
| Sport class (minutes) | 42.5 ± 26.2 | |
| Conventional class (minutes) | 20.7 ± 18.1 | *$p$<0.001 |

*$p$ < 0.05 Sport class vs. Conventional class (Wilcoxon test)

*Experiment 2*

86% of the participants were communicating in Japanese both in a sport class and in a conventional class (Table 8 and 9); that could be the reason why almost all of them answered "Yes" for question "Do you think a sport class/a conventional class is effective for your proficiency in Japanese?" (Table 8 and 9). On the other hand, contrary to the hypothesis (ii), more participants answered "Sometimes" or "Often" in questions regarding communication with classmates of a conventional class in comparison with a sport class (Table 9). This could be because they are required to communicate with classmates of a conventional class, unlike they just have an opportunity to communicate with them; for example, they might have to communicate with classmates of a conventional class to work on a group project. For the results mentioned and the reasons presumed above, the hypothesis (ii), "International exchange students feel that a sport class is more effective for their proficiency in a non-native language than a conventional class is.", could not be supported by the results. In Experiment 2, the number of data collected was for seven participants; this experiment needs a further research by collecting a greater number of data.

*Experiment 3*

The participants of all groups were communicating more in a sport class than in a conventional class ($p < 0.05$) (Table 13). However, there was no significant difference in the amount of communication between a sport class and a conventional class in FT group ($p > 0.05$) (Table 12). That could be because of a characteristic of a fitness class: it mainly concentrates on physical activities that can be performed without communicating with others such as running on a treadmill, pedaling an aero bike, and resistance training using a machine. On the other hand,

there were significant differences in the amount of communication between a sport class and a conventional class in both TS group and IS group ($p < 0.05$) (Table 12); that could be because a team sport class and an individual sport class involve communication with others by forming a team to practice/compete and by making a pair to throw a ball to each other. Indeed, communication is crucial for those who engage in interpersonal physical activity; according to the article from Arkansas State University (2018), players who know how to effectively interact with each other will work together better, forming a stronger overall team (Arkansas State University, 2018). In addition to that, communication is one of the important factors to acquire a non-native language; Gass and Mackey (2015) argues that interaction, which means conversations that learners participate in, is important because it is in this context that learners receive information about correctness and incorrectness of their utterances (Gass & Mackey, 2015). For the result mentioned and reasons presumed above, the hypothesis (iii), "Students communicate more in a sport class than they do in a conventional one, and they communicate more in interpersonal sport class than in personal sport class.", was supported by the results.

*Conclusion*

We explored how oral communication through physical activity can affect the proficiency in a non-native language using questionnaire surveys that referred to language proficiency and/or communication, dividing the study into three experiments. The results of the study are as follows.

i. While proficiency in English was improved during enrolling in a university in the United States in international student-athletes ($p < 0.05$), there was no significant improvement in it in international student non-athletes ($p > 0.05$) (Table 6).

ii. 86% of international students at Chukyo University who participated in the study think that a sport class is effective for their proficiency in Japanese (Table 8).

iii. Students communicate more in a sport class than in a conventional class ($p < 0.05$) (Table 13), especially in a team sport class and in an individual sport class ($p < 0.05$) (Table 12).

The results showed that engagement in physical activity enabled participants to communicate more. Based on the results above and the fact that oral communication is important for the proficiency in a non-native language (Hernández, 2010), we concluded that communication through club activity contributed to the improvement in the proficiency in English in international student-athletes. This study suggests that communication through physical activity such as club activity and sport class can be an effective measure to learn a non-native language. This finding would be one of the crucial factors to develop a more effective program to learn/acquire a non-native language, which will contribute to people from overseas including children and students who need to learn Japanese. In addition to that, this finding would also contribute to Japanese children/students as well; 9,612 children/students whose nationality is Japan also need to learn Japanese in 2016 (Ministry of Education, Culture, Sports, Science and Technology-Japan, 2018). The program to learn a non-native language would also be applied to other countries which have been working on language training for those who have come there as immigrants.

**Acknowledgement**

The author is sincerely grateful to Prof. Kohei Watanabe for helpful suggestions and the support in the use of SPSS software.

**References**


Arkansas State University. (2018). The Importance of Communication in Sports. 2019, https://degree.astate.edu/articles/sport-administration/communication-in-sports.aspx

Gass, S.M. & Mackey, A. (2015). Input, Interaction, and Output in Second Language Learning. In VanPatten, B. & Williams, J. (Eds.), *Theories in Second Language Acquisition: An Introduction* (2nd ed., pp. 180-206). New York, the United States: Routledge.

Hernández, T.A. (2010). The Relationship Among Motivation, Interaction, and Development of Second Language Oral Proficiency in a Study-Abroad Context. The Modern Language Journal, vol.94 (4), 600-617

Ishak, A.W. (2017). Communication in Sports Teams: A Review. Communication Research Trends, vol.36 (4), 4-38

Japanese Association of University Physical Education and Sports. (2017). 2016 年度大学・短期大学保健体育教育実態調査結果ダイジェスト. http://daitairen.or.jp/2013/wp-content/uploads/2016_HealthAndPhysicalEducation_SurveyReport_digest.pdf

Liu, F., Sulpizio, S., Kornpetpanee, S., & Job, R. (2017). It takes biking to learn: Physical activity improves learning a second language. PLOS ONE, https://doi.org/10.1371/journal.pone.0177624

Ministry of Education, Culture, Sports, Science and Technology-Japan. (2018). 外国人児童生徒等教育の現状と課題. http://www.bunka.go.jp/seisaku/kokugo_nihongo/kyoiku/todofuken_kenshu/h30_hokoku/pdf/r1408310_04.pdf

Ministry of Education, Culture, Sports, Science and Technology-Japan. (2010). 帰国・外国人児童生徒等の状況

について. 2019, http://www.mext.go.jp/a_menu/shotou/clarinet/genjyou/1295897.htm

Ministry of Education, Culture, Sports, Science and Technology-Japan. (2017). 「日本語指導が必要な児童生徒の受け入れ状況等に関する調査（平成 28 年度)」の結果について.

http://www.mext.go.jp/b_menu/houdou/29/06/__icsFiles/afieldfile/2017/06/21/1386753.pdf

Ministry of Education, Culture, Sports, Science and Technology-Japan. (2006). 外国人の子どもの不就学実態調査の結果について. 2019,

http://www.mext.go.jp/a_menu/shotou/clarinet/003/001/012.htm

Ministry of Justice. (2018). 平成 30 年 6 月末現在における在留外国人数について（速報値）. 2019,

http://www.moj.go.jp/nyuukokukanri/kouhou/nyuukokukanri04_00076.html

http://www.moj.go.jp/content/001269620.pdf

National Collegiate Athletic Association. International Student-Athletes. 2019,

http://www.ncaa.org/student-athletes/future/international-student-athletes

Okamoto, M., Hojo, Y., Inoue, K., Matsui, T., Kawato, S., McEwen, B.S., & Soya, H. (2012). Mild exercise increases dihydrotestosterone in hippocampus providing evidence for androgenic mediation of neurogenesis. Proceedings of the National Academy of Sciences of the United States of America, vol.109 (32), 13100-13015

Van der Borght, K., Havekes, R., Bos, T., Eggen, B.J.L., & Van der Zee, E.A. (2007). Exercise Improves Memory Acquisition and Retrieval in the Y-Maze Task: Relationship with Hippocampal Neurogenesis. Behavioral Neuroscience, vol.121 (2), 324-334

# Kendo vocalization by Japanese and Chinese

国際社会系(渡邊ゼミ)

S116121

森松滉平

Kohei Morimatsu

**Abstract**

**Kendo vocalization by Japanese and Chinese**

**Aim** The purpose of the present study is to investigate the accuracy of Japanese and Chinese kendo vocalization. **Methods** Sixteen healthy Japanese (21.9±0.8 (21–23) ys) and Chinese (21.9±0.8 (15–33) ys) participated in this study. Five of the word, including the designation of a strike part of Kendo, was carried out speech recognition using the application for voice recognition. Evaluation was made based on whether the recognized word was accurate, and the correct answer rate of each word was calculated from five trials for each word. **Results** Significant greater answer rates were shown in Japanese compared with Chinese ($p < 0.05$). Comparing five words among Japanese, there was a significant difference between "MEN" and "KOTE" ($p < 0.05$). Comparing five words among Chinese, there was a significant difference between the "MEN" and "KOTE" pair and the "MEN" and "TSUKI" pair ($p < 0.05$). **Conclusion** It was suggested that Chinese could not vocalize the designation of a strike part of kendo naturally, and that there was a difference with Japanese in the part of Ki(mind) that is the condition of become Ippon.

**日本人と中国人による剣道の発声**

**目的** 本研究の目的は、日本人と中国人による剣道の発声の正確性を調査することである。**方法** 16 人の健康な日本人(21.9±0.8 (21–23) 歳)と中国人(21.9±0.8 (15–33) 歳)がこの研究に参加しました。剣道の打突部位呼称を含む 5 つのワードを、音声認識アプリを用いて音声認識を行った。認識されたワードが正確であるか否かで評価し、正答率を計算した。**結果** 日本人の正答率が「メン」「コテ」「ドウ」「ツキ」において、中国人と比較して有意に高かった($p<0.05$)。日本人の中での 5 つの言葉では「メン」と「コテ」に有意差が見られた($p<0.05$)。中国人の中での 5 つの言葉では「メン」と「コテ」のペアと「メン」と「ツキ」のペアに有意差が見られた($p<0.05$)。**結論** 中国人は剣道の打突部位呼称を自然に発声することができず、有効打突の条件である「気」の部分に日本人との差があることを示唆した。

**日本人和中国人的剑道发声**

**目标** 本研究的目的是研究日语和中国剑道发声的准确性。**方法** 参加这项研究的有 16 名健康的日本人(21.9±0.8(21–23) 岁 )和中国人(21.9±0.8(15–33) 岁 )。使用该语音识别应用，其中五个词（包括剑道的罢工部分的指定）得以实现。根据识别出的单词是否正确进行评估，并计算出每个单词的正确答案率。**结果** 与中国人相比，"MEN"，"KOTE，"DOU"和"TSUKI"对日本人的正确回答率明显更高（$p<0.05$）。比较日本人中的五个单词，"MEN"和"KOTE"之间存在显着差异($p<0.05$)。比较中国人中的五个单词，"MEN"和"KOTE"对与"MEN"和"TSUKI"对之间存在显着差异（$p<0.05$）。**结论** 有人认为中国人不能自然地发出剑道罢工部分的名称，而在日本人的气（mind）方面，与日本人有所不同，这就是成为有效攻击的条件。

**Introduction**

In 1970, the International Kendo Federation (FIK) was established, and initially 17 countries / regions joined, but as of September 2018, 59 countries / regions have joined (International Kendo Federation, 2019). In recent years, the world kendo championships have seen excitement in countries other than Japan, and the internationalization of kendo has developed. Although it is not an Olympic competition, there is the fact that Japanese athletes are overwhelmingly stronger than foreign athletes in the competition "Kendo". Looking at the result of the world championship, Japanese men's team have won 16 times out of 17 times, Japanese women's team have won all eight times. In men's individual match the Japanese won all the tournaments and in girls' individual match Japanese won all time (FIK, 2019). When it was held in Chinese Taipei in 2006, the Japanese male organization was third prize. It was only one time that Japan could not win (FIK, 2019). Although the strength of Japan is clear as mentioned above, it is not clear what kind of Japanese kendo skill is the secret of strength.

According to the All Japan Kendo Federation, Ippon means *' with fulfilling mind and proper posture, a strike with the proper part of blade of a bamboo sword and has zan-shin '* (All Japan Kendo Federation, 2019). Fulfilling mind is vocalization and spirit, and zan-shin is the posture and mental attitude after stroke. Therefore, it is necessary to match the KI (mind), KEN (sword), (TAI) body, and zan-shin to the requirement Ippon.

According to the research on the quality, frequency and length of vocalization in a kendo game, it is said that 88.4% of the strike motions vocalized the designation of a strike part (Hashizume, K., Katsuki, T., Sasaki, H, 1992). It is studied that when it became Ippon, the designation of a strike part was always vocalized. Because Kendo has the background that it is a budo (martial arts) originated in Japan (All Japan Kendo Federation, 2018), the

face guard (MEN), the gauntlet (KOTE), the plastron (DOU) and the throat (TUSKI) of the strike part of the kendo are Japanese language. Therefore, those who are not native speakers of Japanese must play kendo while they speak the language that are not familiarized. Here, it can be seen that Japanese and people from countries other than Japan players are greatly involved in their native language from the viewpoint of vocalization. After all, for those who are native speakers of Japanese, there is a sense of incongruity in vocalizing kendo by people from countries other than Japan. So far, there has been no research focusing on pronunciation in research on vocalization of kendo.

Take Chinese as an example of countries other than Japan. The Chinese team lost 5-0 to Japan in the first round of the World Championship final tournament held in September 2018 (All Japan Kendo Federation, 2018). Each other is fighting on behalf of the country in the world convention, but such a difference in power is manifested. In terms of language, kanji notation is common to both Japanese and Chinese, but there are major differences between Japanese and Chinese in terms of pronunciation.

The purpose of this study is to investigate the accuracy of Japanese and Chinese kendo vocalization. In Japanese pronunciation, there are vowels and consonants that people in countries other than Japan are not good at (Jin, 2017). In addition, unique pronunciation such as special morae (long vowels, double consonant, syllabic nasal) must be careful when learn Japanese (Toda, 2003). For example, there is a phenomenon of vowel devoicing among the features of Japanese speech, and this phenomenon is related to Japanese speech rhythm and naturalness (Yasuda, Hayashi, 2011). Japanese can speak natural Japanese by devoicing vowels, and people outside of Japan struggle with Japanese by this law. From the law of this phenomenon, the “TSUKI” of the striking part applies to the devoiced words. It is estimated that Japanese speakers can naturally vocalize “TSUKI”, and Chinese speakers

cannot naturally vocalize “TSUKI”. Therefore, it is assumed that it will affect the vocalize of “TSUKI” by Chinese.

**Materials and Methods**

*Participants*

Eight Japanese (21.9±0.8 (21–23) ys, 5 males and 3 females) and Chinese (21.9±0.8 (15–33) ys, 4 males and 4 females) participated in this study. Japanese were targeted for those whose native language was Japanese, and Chinese were intended for those whose native language was Mandarin (Putonghua). The Japanese level of the Chinese was set to a level where conversation in Japanese including the contents of the experiment was not possible. The participants in both groups were informed that the purpose of participating in the study and the data on the experiment were used only for this study.

*Experimental design*

By using the speech recognition application, the participants were vocalized “MEN” “KOTE” “DOU” “TSUKI” and to two letter Japanese words based on the hypothesis. “SUSHI” was selected as the two-letter word based on the hypothesis. “SUSHI” is a Japanese language that is well-recognized and is easy for Chinese people to speak as Japanese. Because of the difference in language sense, Romaji notation is suitable for letting Chinese speak the correct pronunciation of Japanese, and all the paper was presented to the participants in Romaji notation. Romaji was written as “MEN”, “KOTE”, “DOU”, “TUKI”, and “SUSHI”, and “TUKI” was used for “TSUKI” to simplify Chinese pronunciation. Mandarin speakers cannot speak Japanese just by showing Roman letters because they speak based on Pinyin. Therefore, before the actual performance, I listened to the correct Japanese

pronunciation of each word and practiced it several times. The same procedure was followed when it has a native Japanese speaker vocalized. In the actual performance, each word was given 5 times, and a total of 25 times word were presented to the participants at random, and the words that came out were vocalized by the participants. In addition, the words that were vocalized and recognized were recorded each time. The procedure was after bringing the device close to the participant's mouth and starting the recording function, the procedure was to show the participants the word written in the sketchbook and let the participants vocalize. The experiment was conducted in a quiet room without noise.

*Measurement*

We used the application for voice recognition (Dragon Search, NUANCE, Massachusetts, The United States of America) on iPhone5 to evaluate the voices (Fig. 1). The speech recognition software (Dragon NaturallySpeaking, NUANCE, Massachusetts, The United States of America), the base of Dragon Search, can automatically and accurately deliver speech developed for personal, home, professional and business use (Jaehwang, Kyung-Whan, 2005). In addition, the application for voice recognition (Dragon Dictation, NUANCE, Massachusetts, The United States of America), based on Dragon NaturallySpeaking, is also used in the practice and verification of pronunciation in German, which recognizes and clearly texts the clear pronunciation of native speakers (Iwai, 2012). The distance between the iPhone 5 and the subject was set within 5 cm from the mouth. The recognition language is set to Japanese, and search results are displayed in Japanese. We investigated whether the search results were accurately searched in Japanese for “MEN”, “KOTE”, “DOU”, “TUKI” and “SUSHI” (Fig. 2). Evaluation was made based on whether the recognized word was accurate, and the correct answer rate of


A. Press the center button to start recording.


B. Vocalize when “Recording” appears.

Fig. 1 The actual voice recording screen of the Dragon Search application.

Fig. 2 The actual recorded results are displayed in Japanese.

each word was calculated from five trials for each word.

*Statistics*

All data are provided as mean and SD. In this study, nonparametric analysis was used for non-normal distribution data. The five words “MEN”, “KOTE”, “DOU”, “TUKI” and “SUSHI” were compared between groups using the Mann-Whitney U test. In addition, the Friedman test was used to compare the five words between the Japanese people and the five words between the Chinese people, followed by each pairwise comparison. The level of statistical significance was set at $p < 0.05$. Statistical analyses were performed using SPSS software (version 25.0; SPSS, Tokyo, Japan).

**Results**

Comparison between groups by Mann-Whitney U test showed the following results.

Significant differences between groups were observed for “MEN” vocalize ($p < 0.05$). Both groups had very high correct answer rates, but it was confirmed that the rate of correct answers was slightly higher in Japanese (100%) and Chinese (85%) (Fig. 3).

In the “KOTE” vocalize, a significant difference was observed between the groups ($p < 0.05$), and there was a considerable difference in the correct answer rate between Japanese (65%) and Chinese (2.50%) (Fig. 3).

In the “DOU” vocalize, a significant difference was observed between groups ($p < 0.05$), and a slight difference in correct answer rate was seen between Japanese (97.50%) and Chinese (65%) (Fig. 3).

In the “TUKI” vocalize, a significant difference was observed between Japanese (90%) and Chinese (15%)

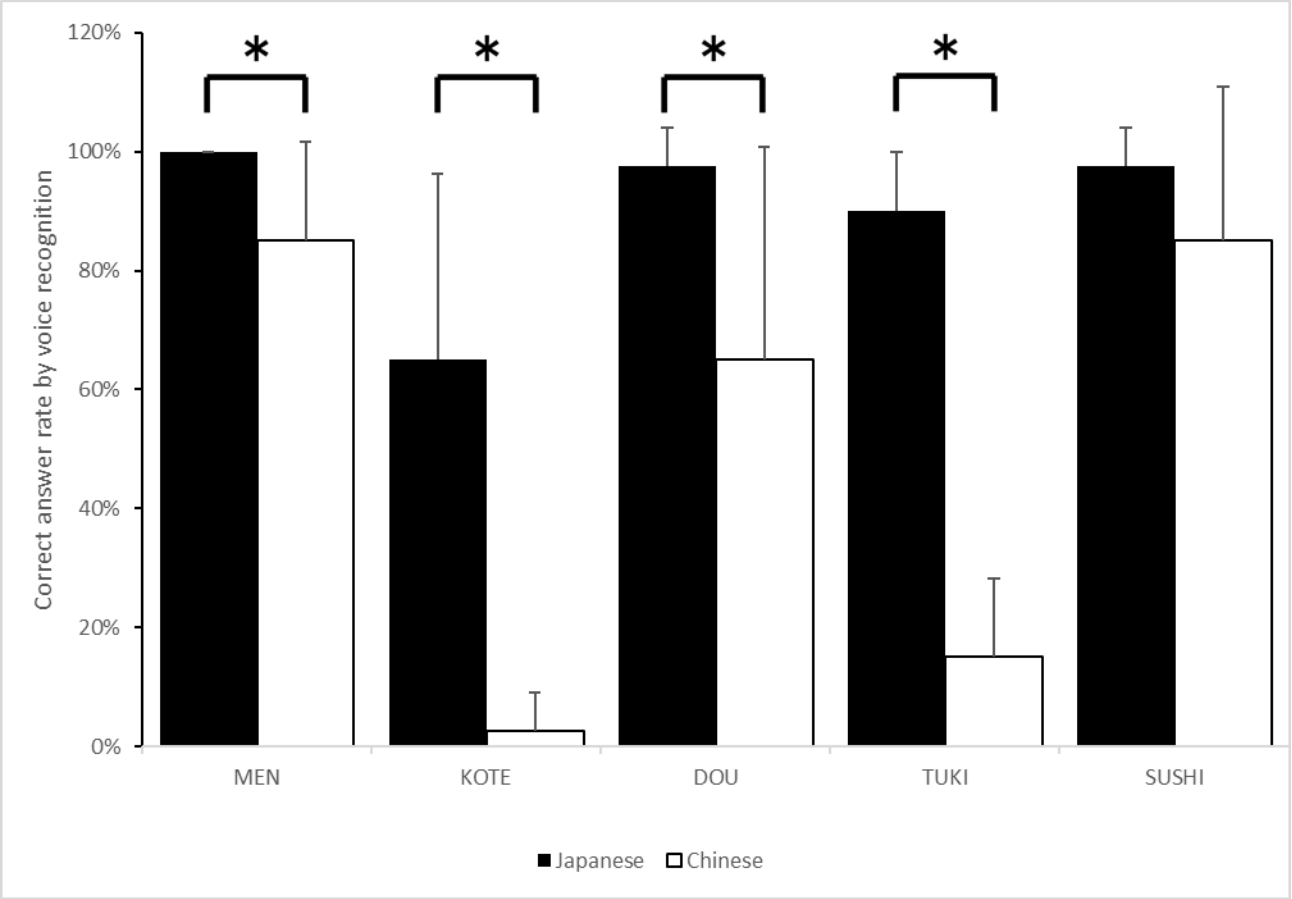



Fig. 3 Correct answer rate of vocalize of "MEN", "KOTE", "DOU", "TUKI" and "SUSHI" by Japanese and Chinese.
*$p < 0.05$ between Japanese and Chinese

($p < 0.05$), and a considerable difference in correct answer rate was observed between groups (Fig. 3).

There was no significant difference between Japanese (97.50%) and Chinese (85%) in the "SUSHI" vocalize ($p > 0.05$).

"MEN", "KOTE", "DOU", and "TUKI", which are the designation of a strike part of kendo, show significant differences between groupings ($p < 0.05$), and "SUSHI" shows no significant difference between groups. ($p > 0.05$).

A comparison of the five words in the Japanese people by the Friedman test and the five words in the Chinese people showed the following results.

In the case of Japanese, there was a significant difference between "MEN" and "KOTE" ($p < 0.05$). In the case of Chinese, there was a significant difference between the pair of "MEN" and "KOTE" and the pair of "MEN" and "TUKI" ($p < 0.05$).

**Discussion**

In this study, as a result of focusing on the vocalize of "TSUKI", the vocalize of "TUKI" was significantly different between groups ($p < 0.05$). In addition, the correct answer rate of "TUKI" was low overall for Chinese (Fig. 3). In Chinese, "TSUKI" is pronounced "cì", which is thought to have led to a low correct answer rate due to the dissimilarity of pronunciation. However, the word "SUSHI" based on the hypothesis was not significantly different between groups ($p > 0.05$) (Fig. 3). This indicates that the correct answer rate by voice recognition was not significantly different between the two groups. During the experiment, it was confirmed that the Japanese word

“sushi” was highly recognized by the Chinese. In Chinese, “SUSHI” is pronounced as “shoùsī”. Because the Japanese word “SUSHI” is recognized all over the world, there may be no difference. And it has been reported that the vowels devoicing of Japanese learners is affected by speech rate, accent type, and surrounding consonant environments (Yasuda, Hayashi, 2011). Since the occurrence rates of devoicing is higher at the sentence level than at the word level (Yasuda, Hayashi, 2011), it is possible that the devoicing could not be observed in this study. In order to conduct detailed experiments to confirm devoicing, it is necessary to incorporate acoustic analysis of speech and obtain the occurrence rates of devoicing. In this result, it is necessary to investigate the cause of whether the vowel devoicing did not affect the word. When conducting more detailed experiments, it is necessary to consider more various parts.

Regarding the vocalize of “MEN” and “DOU”, the same significant difference was observed between the groups ($p < 0.05$). The correct answer rate of Japanese “MEN” is 100%, and that of Chinese is 85%. It can be assumed that both groups are able to vocalize very accurately (Fig. 3). As for “DOU”, the correct answer rate for Japanese was 97.5% and that for Chinese was 65% (Fig. 3). In Chinese, “MEN” is pronounced “miàn”, and “DOU” is pronounced “dòng”. Similarities are seen, which may have led to a high correct answer rate. The correct answer rate of “MEN” and “DOU” have high results, but it can be seen that there is a difference between groups because a significant difference can be confirmed.

In the “KOTE” vocalize, a significant difference was observed between the groups ($p < 0.05$), and the correct answer rate was low in both groups (Fig. 3). In Chinese, “KOTE” is pronounced “Lóngshǒu”. There is a possibility that the pronunciation of “KOTE” also has non-similarity with Chinese. Regarding the low correct

answer rate of Japanese people, in experiments, the Japanese vocalize was often recognized as “kote i”. In the evaluation in this experiment, since the data was sorted depending on whether or not the vocalized word was correctly recognized, also small vocalize mistakes were recorded as inaccurate. It has been reported that the consonant part “t”, which is the “te” part of “kote”, has a short duration and is one tenth of the duration of the vowel part “e” (Nakao, Kishimoto, & Hamada, 2005). From this, it can be assumed that “KOTE” could not be clearly vocalize.

Significant differences between groups in the vocalize of “MEN”, “KOTE”, “DOU”, and “TUKI” ($p < 0.05$) revealed that Japanese people had a higher percentage of correct answers than Chinese people. And since there was no significant difference between the groups for the word “SUSHI” ($p > 0.05$), it can be assumed the level of recognition of the word “SUSHI” in Japanese significantly affects the correct answer rate.

Comparing five words among the Japanese, there was a significant difference between “MEN” and “KOTE” ($p < 0.05$), it can be assumed that the Japanese could not vocalize “KOTE” most naturally. In the case of Chinese, there was a significant difference between the pair of “MEN” and “KOTE” and the pair of “MEN” and “TUKI” ($p < 0.05$). It can be assumed that the word “KOTE” and “TUKI” could not be vocalize naturally compared to other words. Furthermore, there was no significant difference in “MEN” and “TUKI” among the Japanese, and there was a significant difference in the correct answer rate of “MEN” and “TUKI” between the groups. Based on these facts, it is considered that the Chinese could not vocalize the word “TSUKI” most naturally compared to the Japanese.

In conclusion, we compared the accuracy of Japanese and Chinese kendo vocalize using a speech recognition application. It was confirmed that the accuracy of Kendo vocalization was different between Japanese and Chinese in all words. Furthermore, the vocalize of “TSUKI” was the most different between Japanese and

Chinese. From these results, it was suggested that the Chinese could not vocalize the designation of a strike part of kendo naturally, and that there was a difference with the Japanese in the part of “KI” (mind) that is the condition of become Ippon.

Based on this research, the future task will be to calculate the ratio of Japanese and Chinese scores in actual games and to see the relationship with vocalization. I hope that the results of this study will be used to study in detail the differences in pronunciation between Japanese and people from other countries in Kendo vocalize. And, as Kendo is becoming more internationalized, I would like to share the greatness of Japanese Kendo further and return it to strengthen the world standard.

**Acknowledgement**

The authors are sincerely grateful to all the Chinese visitors to Japan and Chukyo University for providing data for this study. Further, in the writing of this article, the authors thank from the bottom of my heart to kindness gave me politely guidance Prof. Watanabe.

**References**

All Japan Kendo Federation. (2019/4/1). Kendo game umpire rule, Kendo game umpire detailed rule. 2019/11/1. https://www.kendo.or.jp/wp/wp-content/themes/kendo/assets/library/pdf/kendo-shiai_regulations.pdf

All Japan Kendo Federation. (2018/9/16). The 17th World Kendo Championship. 2019/11/1 https://www.kendo.or.jp/event/wkc-17th/

All Japan Kendo Federation. (2019). View of All Japan Kendo Federation. 2019/11/1, https://www.kendo.or.jp/en/knowledge/kendo-origin/

FIK. (2019). Organization. 2019/11/1, , https://www.kendo-fik.org/organization

Hashizume, K., Katsuki, T., & Sasaki, H. (1992). According to a research on the quality, frequency and length of vocalization in a kendo game. Martial arts studies, 25(1), 50-56.

International Kendo Federation. (2019). World Kendo Championships (PAST RESULTS). 2019/11/1, https://www.kendo-fik.org/wkc/past-results

Iwai, H. (2012). Active Learning with iPads in a German Class for Beginners. Bulletin of Osaka University Research Center for Educational Practice, 8(2011), 1-8.

Jaehwang, S., Kyung-Whan, C. (2005). Dragon NaturallySpeaking. 2019/11/1, http://kmjournal.bada.cc/wp-content/uploads/2013/05/8-1-11Shim.pdf

Jin, J. (2017). Actual Situation of Acquisition of Single Vowels in Chinese Japanese Learners. Linguistic arguments, 10, 16-27.

Nakao, M., Kishimoto, M., & Hamada, K. (2005). Speech Synthesis of Japanese Language having Consonant /t/. Memoirs of Akashi National Colllege of Technology, 48, 11-18.

Toda, T. (2003). Acquisition of Special Morae in Japanese as a Second Language. Journal of the Phonetic Society of Japan, 7(2), 70-83.

Yasuda, R., Hayashi, R. (2011). Acquisition of vowel devoicing in Japanese as a second language by Taiwanese learners of Japanese. Journal of the Phonetic Society of Japan, 15(2), 1-10.

# The effect of shoe sole thickness on body sway and heart rate during walking with platform shoes

国際社会系(渡邊ゼミ)

S116023

大根田輝

Akira Ohneda

**Abstract**

**The effect of shoe sole thickness on body sway and heart rate during walking with platform shoes**

The purpose of this study was to investigate the effect of shoe ole thickness on body sway and heart rate during walking with platform shoes. Eight male and female college students walked on a treadmill while wearing 5 types of sneakers with different thicknesses, i.e., 11-45mm at 5 km / h and simultaneously measured heart rate as indicator of whole body physiological burden. There was no significant effects of shoe sole thickness on the average acceleration and heart rate. The result of this study suggested that body sway and physiological burden are not influenced by different sole thickness of platform shoes, ranging from 11mm to 45mm, during walking.

**厚底靴による身体動揺や心拍数との関連性**

本研究の目的は、厚底靴を用いたソールの厚さが身体動揺や心拍数へ与える影響を調査することであった。若年男女 8 名の大学生が時速 5km/h で 5 種類のソールの厚さが異なる(11-45mm)スニーカーを着用してトレッドミル上を歩行し、同時に全身性の生理学的負担して心拍数も計測した。シューズのソール厚の違いは、上下方向、左右方向、および前後方向の平均加速度と心拍数に有意な影響を及ぼしていなかった($p>0.05$)。得られた結果から、歩行中の重心動揺や生体負荷は、シューズのソール厚が 11mm から 45mm の範囲で大きく異なっていても影響を受けていなかったと考えられた。

**厚底运动鞋与姿势运动和心率的相关性**

这项研究的目的是调查在穿厚底鞋行走过程中鞋的鞋垫厚度对身体摇摆和心率的影响。 八名男女大学生在跑步机上行走时，穿着 5 种厚度不同的运动鞋，即 5 km ／ h 的运动鞋厚度为 11-45mm，并同时测量了心率，作为全身生理负担的指标。 鞋底厚度对平均加速度和心率没有显着影响。 研究结果表明，在步行过程中，不同的厚底鞋的鞋底厚度（11mm 至 45mm）不会影响身体的摇摆和生理负担。

**Introduction**

In recent years, various shapes of sneakers have been developed in the market. Looking at the collections of each brand held each year, especially many shoes with thick soles were sold this year, for example, 5 type shoes for forefoot 5cm, heel 8cm, 5 types shoes for forefoot 3cm, heel 5cm from Maison Margiela (maisonmargiela, 2019), 15 type shoes with 5cm sole from Louis Vuitton (louisvuitton, 2019), 2 types shoes with 8cm sole from COMME des GARÇONS (comme-des-garcons, 2019), 1 type shoes for forefoot 2.1cm, heel 3.1cm from NIKE (nike, 2019) and 5 typed shoes with 5cm sole from Alexander McQueen (alexandermcqueen, 2019) are sold in the official online store. Although the danger of platform shoes has been suggested for several year reference, platform shoes have become popular among young women. According to the National Consumer Affairs Center of Japan, more than 20 accidents with platform shoes occurred in 1998, accounting for 39% of the total of women's shoes, with examples of falls and falls on steps and stairs mainly (National Consumer Affairs Center of Japan, 1999). Highest number of age group for its accidents is twenties (32, 40%), followed by thirties (18, 23%) (National Consumer Affairs Center of Japan, 1999). Around 20's (10's to 30's) alone will occupy 76% (National Consumer Affairs Center of Japan, 1999). In addition, it is pointed out that platform shoes neglect the functions necessary for walking, and furthermore, lack of stability tends to lead to sprains and toppling (National Consumer affairs Center of Japan, 1999). This higher foot position can be associated with some concern as it takes a longer time to adjust to a weight bearing surface change because of its greater distance. In other words, while wearing a thicker shoe sole, joint position sense may be altered by eliminating the adaptability of the joint to the change in surface. This condition may predispose the body to become more unstable because the center of gravity has been raised, and because the plantar surface of the

foot is removed more from the contact surface.

In previous study, several other characteristics, including factors thought to be related to foot position sense (sole thickness and flexibility and heel-collar height), bore little apparent relation to risk of a fall (Tencer et al., 2004). Besides, other styles with relatively stiff soles included athletic shoes, sandals, and lace-up oxfords, all of which also had relatively thick fore-soles. These shoes characteristics were found to have little association with risk of a fall (Tencer et al., 2004). There have been some reports dealing with heart rate about its usefulness as a risk assessment for falls and physiological burden of whole body movement (Howcroft et al., 2013, Kavanagh et al., 2008, Menz et al., 2003, Doi, et al., 2013). However, these experiments were not use platform shoes.

Nowadays, number of young people wearing thick soles are increasing. Although it seemed that platform shoes associate with fall risk, no studies have investigated the relationship between fall risk and platform shoes. The purpose of this study is to examine the effect of shoe sole thickness on body sway and heart rate during walking with platform shoes. I hypothesized that body sway and heart rate are not influenced by difference in sole thickness of platform shoes.

## Materials and Methods

### *Participants*

Eight University students with no abnormalities in the lower limbs participated in this study. The subject gave informed consent for the study after receiving a detailed explanation of the purpose, potential benefits, and risk associated with participation in the study. In the case of female subjects, the method of attaching the equipment

used was fully explained and attached in the correct position.

*Experimental design*

In the experiment, subjects walked on treadmill (WELL ROAD 200E, TAKEI, Niigata, Japan) with wearing five different (23cm, 24cm, 25cm, 26cm, 27cm, 28cm) custom-made shoes (MIZUNO corporation, Osaka, Japan). These custom-made shoes have different sole thickness (Forefoot-Heel: 11mm - 15mm, 21mm - 25mm, 31mm - 35mm, 41mm - 45mm, 25mm - 35mm). Before the experiment began, we asked to subjects about their height and the size of shoes they normally wear. In order to adjust the walking conditions, the subject walked on the treadmill. Walking speed was set at 5 km/h and walked for 2 minutes for each sole. According to Adachi et al. (2014), the average walking speed of the entire Japanese was 1.364m/s. Since this is about 5 km/h, the walking speed was set at 5 km/h. We used a three-axis accelerometer (FA-DL-111A, 4 assist, Tokyo, Japan) for estimating body sway in this experiment, and the sensor was attached to the subject's tailbone. The calibration values of the three-axis acceleration sensor were 1.97V in the vertical direction, 1.99V in the horizontal direction, and 1.97V in the longitudinal direction for 19.6m/s/s. Previous studies have shown that gait assessment using a three-axis accelerometer is effective in a clinical environment (Sakurai et al., 2010). Therefore, we used a three-axis accelerometer in this experiment. The accelerometer can evaluate the stationarity of the center of gravity in the walking motion, and the failure of the stationarity means an increase in the body sway (Koda et al., 2016). The foot switch was attached to the heel of the right foot to detect gait cycle. Electrodes (CMT-01MTH-0.8D, FUKUDA DENSHI, Niigata, Japan) were placed on the right sternal and left ribs between the bones, electrodes were placed on the right ribs of the bones, and the electrocardiogram / respiration transmitter was LX-8100 (FUKUDA DENSHI, To

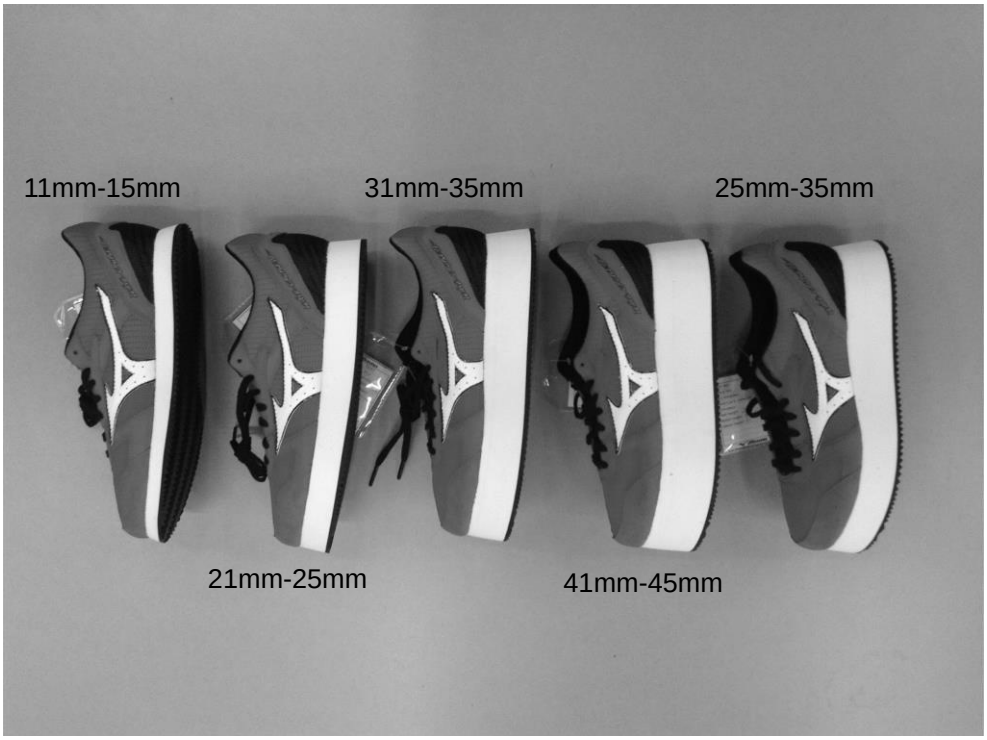



Fig. 1 Five type of sneaker used in this experiment (Forefoot-Heel: 11mm-15mm, 21mm-25mm, 31mm-35mm, 41mm-45mm, 25mm-35mm).

kyo, Japan). Data sent from LX-8100 was received by DYNASCOPE DS-8600 system (FUKUDA DENSHI, Tokyo, Japan). Time was measured with a stopwatch and the heart rate displayed on the DYNASCOPE DS-8600 system was recorded in a notebook every 10 seconds. During walking, a mark was hung at the tip of the subject's line of sight to prevent the line of sight from shifting, and the height of the mark was adjusted each time the shoe changed. While walking, used a lifting device to prevent the subject from falling. After wiping the three parts of the body with alcohol, we attached electrodes.

The data obtained at the time of walking measurement was synchronized with the acceleration data on a personal computer using Lab Chart 8 software (ADInstruments, Melbourne, Australia). One minute in the second half of the calculated acceleration data for 8 persons was extracted, and an average value and a standard deviation were calculated for each thickness of the sole. The walking cycle and the number of steps were calculated from the measured foot switch data. From the calculated cadence data, 1 minute in the second half was extract and the coefficient of variation was calculated to determine the variation in the walking cycle. Average heart rate was calculated for 1 minute of latter half of trial.

*Statistics*

The parametric analysis was used for normally distributed data and the non-parametric analysis was used for non-normally distributed data. The effect of different shoe sole thickness on vertical acceleration, lateral acceleration, longitudinal acceleration, and heart rate were tested the Friedman test. The level of statistical significance was set at $p < 0.05$. Statistical analyses were performed using SPSS software (version 25; SPSS, Tokyo, Japan).

**Result**

There were no significant effects of shoe sole thickness on the average acceleration and heart rate ($p>0.05$) (Figures 2 and 3). Figure. 4 and Figure. 5 show the average number of steps per minute and the average coefficient of variation of the walking cycle for each sole thickness obtained in this experiment. Figure 4. and Figure 5. did not perform statistical processing, but were graphed as obtained data. There was no significant effect of shoe sole thickness on the average coefficient of variation of walking cycle and steps ($p>0.05$).

**Discussion**

In this study, we investigated the effect of shoe sole thickness on body sway and heart rate during walking with platform shoes. There were no significant effects of shoe sole thickness on the average acceleration for vertical, lateral, and longitudinal directions and heart rate ($p>0.05$). These result supports the hypothesis. In the previous study, it was considered possible to evaluate the center of gravity sway using a three-axial accelerometer (Hiiragi, 2004).

The increase in up-and-down sway has been shown to be related to falling (Koda et al., 2016). Even when the sole was thick, the average acceleration in the vertical direction was almost flat. Therefore, there is no danger of falling in the front-rear direction of the platform shoes. It has been reported that the average fluctuation width of the left and right sides of the body's center of gravity depends on walking speed and decreases significantly with increasing walking speed under stable walking conditions (Shinoda et al., 2008). Other researchers have reported the speed dependence of the left and right swing width of the body center of gravity (Shinoda et al., 2008).

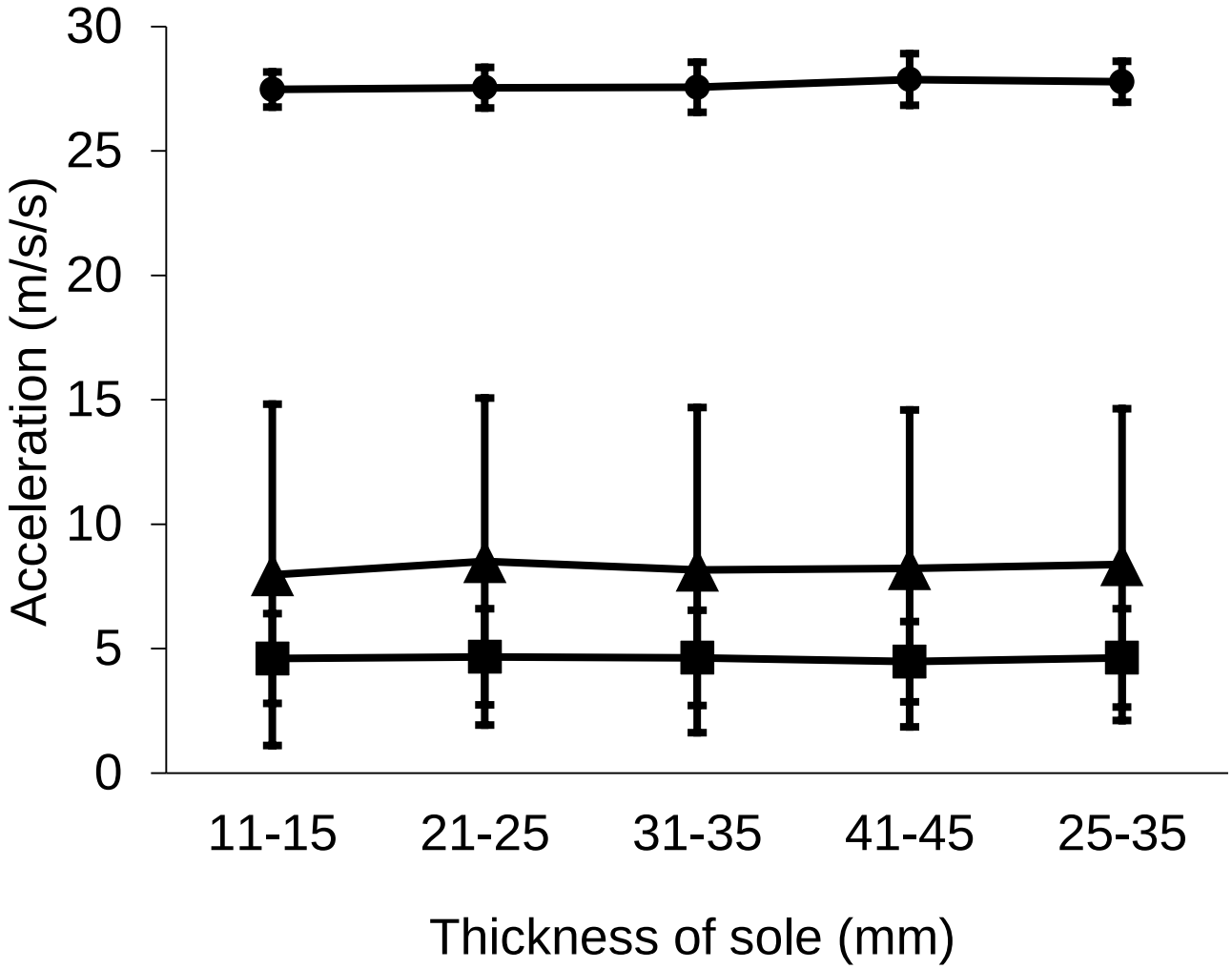



Fig. 2 Mean (SD±) transition of average acceleration for each sole for 1 minute ($p > 0.05$).

Black circle, vertical direction

Black triangle, horizontal direction

Black square, longitudinal direction

Forefoot-Heel: 11mm-15mm, 21mm-25mm, 31mm-35mm, 41mm-45mm, 25mm-35mm

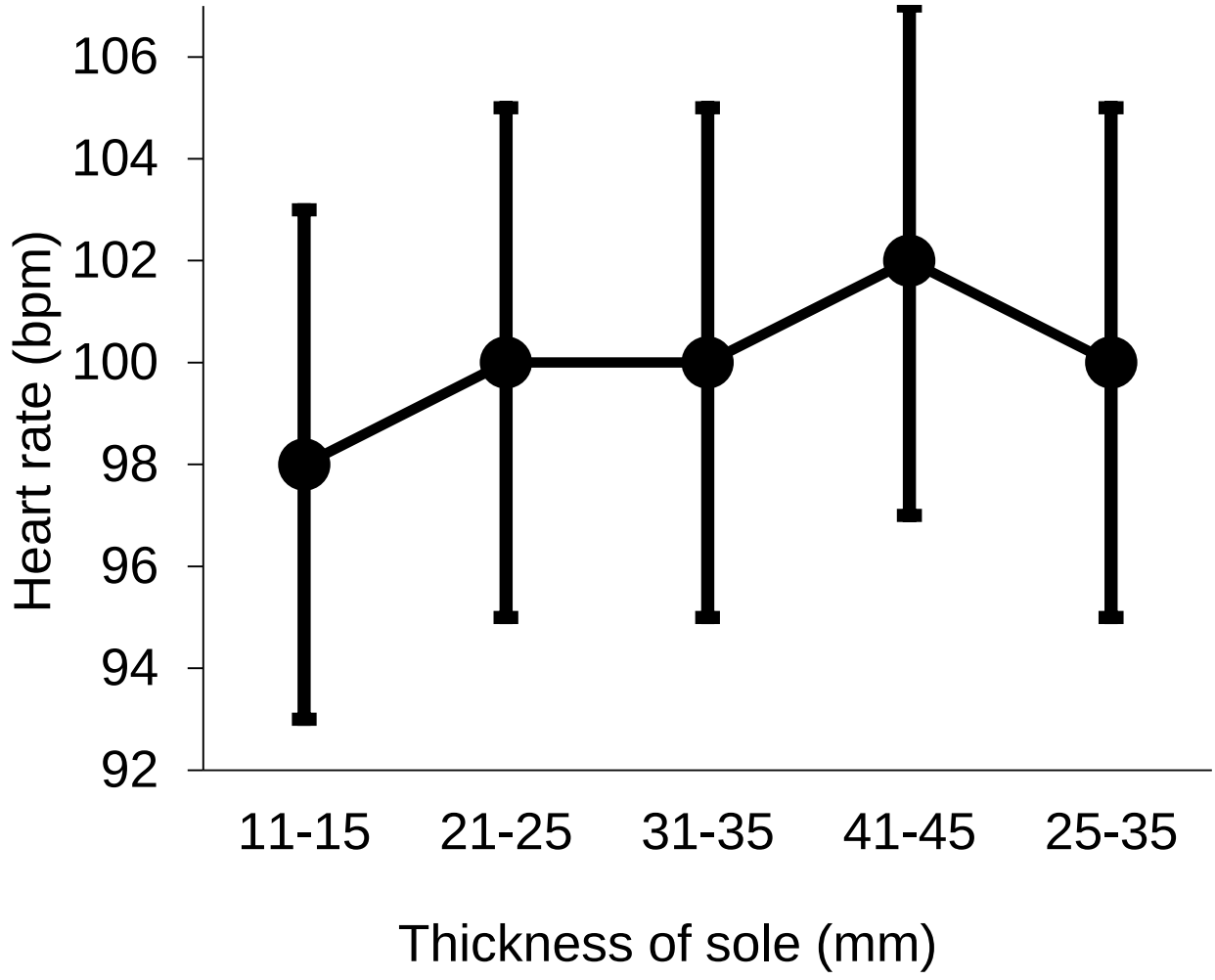



Fig. 3 Mean (SD±) average heart rate per minute recorded every 10 seconds on each sole ($p>0.05$).

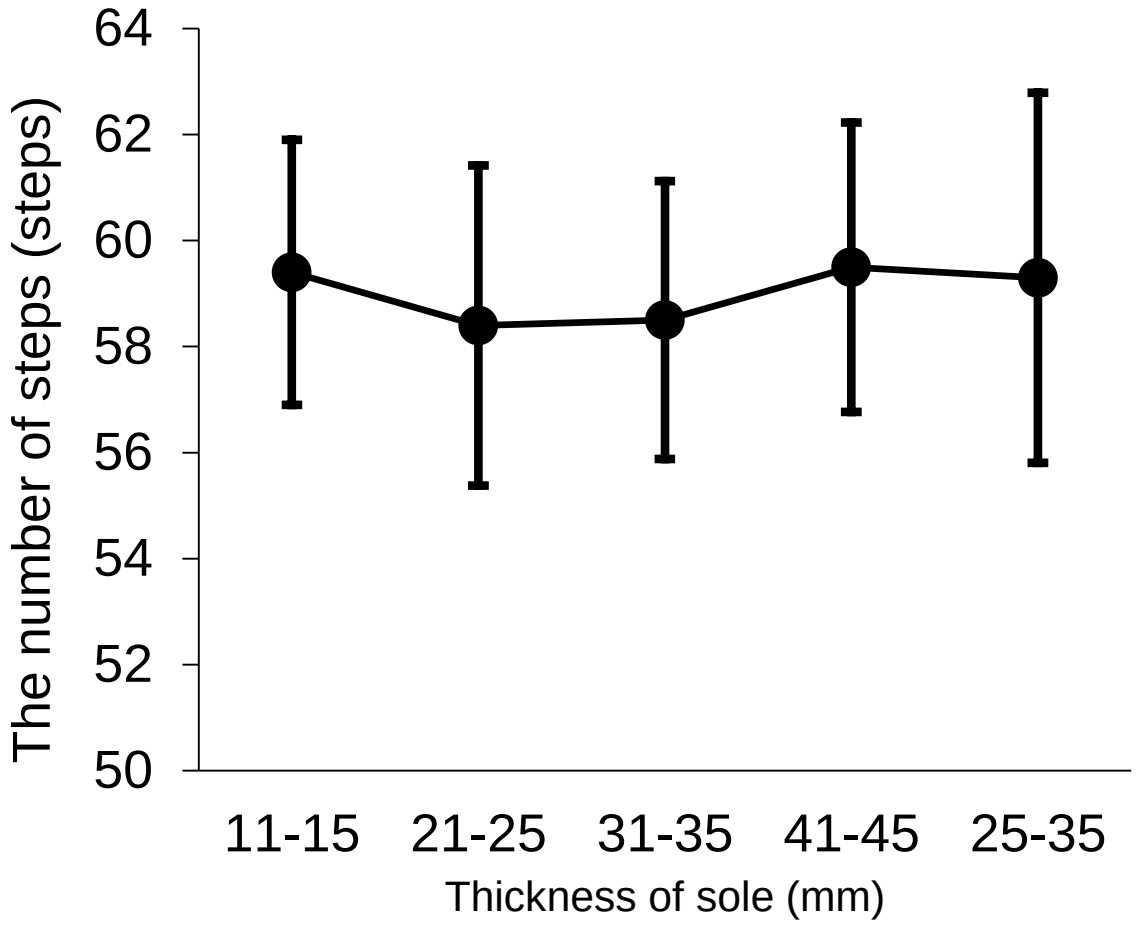



Fig. 4 Mean (SD±) average steps per minute in each sole ($p>0.05$).

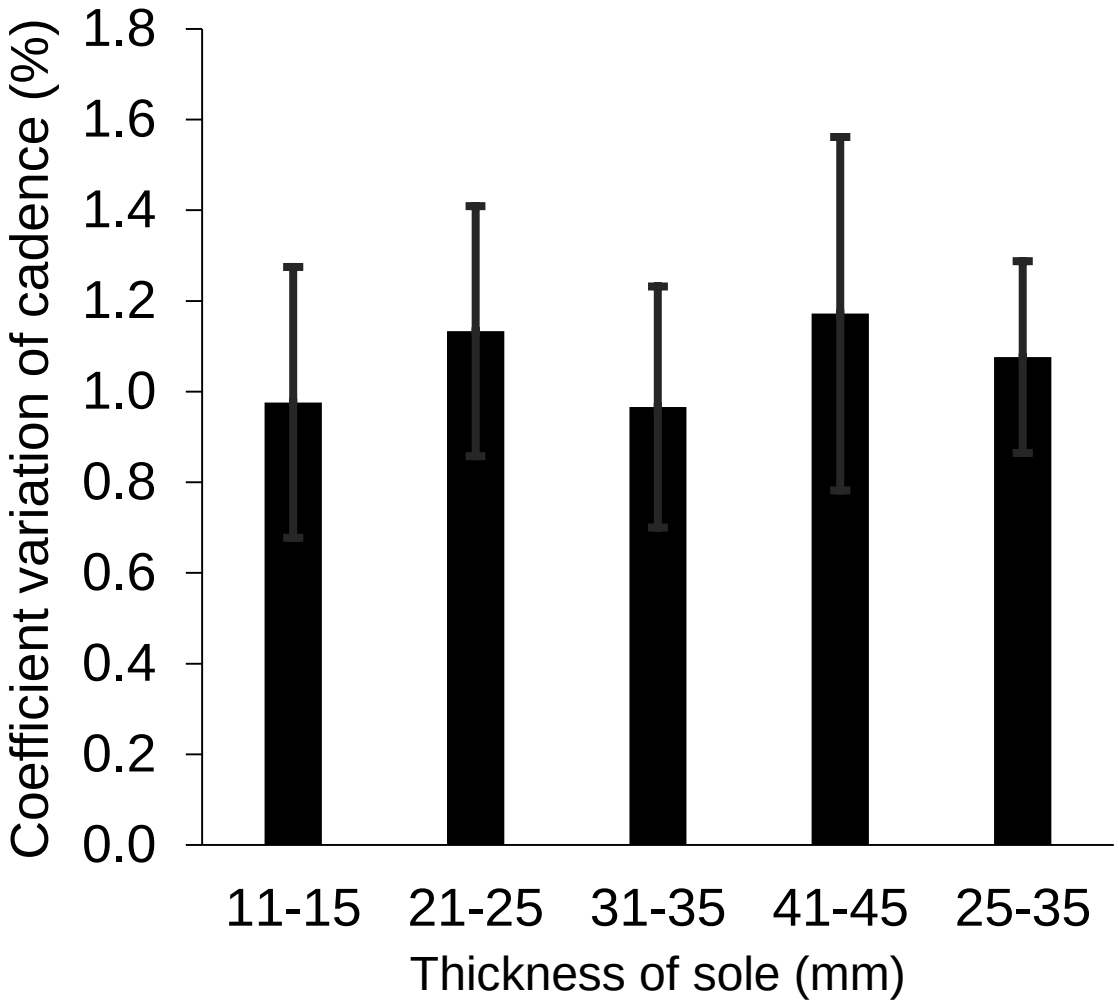



Fig. 5 Mean (SD±) 1 minute average walking cycle for each sole ($p>0.05$).

Orendurff et al. (2004) showed that the lateral variation of the center of gravity decreased with increasing walking speed (Orendurff et al., 2004). Compared with walking at low speed (1 km / h), walking at high speed (5 km / h) decreased the body sway of the center of gravity (Shinoda et al., 2008). In our study, we did not use the left and right sway width as an index, but because the treadmill speed (5km/h) was fixed as in the previous study, this experiment can be said to be stable walking depending on walking speed. As a result, there was no significant effects of shoe sole thickness on the average horizontal acceleration (Fig. 2). Therefore, it is considered that there is no risk of falling in the left-right direction with the shoe sole thickness used in our experiments.

There were reports that the sway in the front-rear direction becomes very large when the walking speed is not constant (Koda et al., 2016). In our study, the participants walked at a constant speed on a treadmill. As shown in Fig. 2, in this experiment, the average acceleration in the front-rear direction was generally flat even when the sole was thickened. Therefore, when walking at a constant speed, it is considered that there is no risk of falling in the back-and-forth direction for platform shoes.

In our experiments, there was no significant difference between the shoe sole thickness and the heart rate. According to Fig. 3, the lowest heart rate was 98 bpm and the highest heart rate was 102 bpm. This is equivalent to the data from the Ministry of Health, Labor and Welfare. In other words, it is considered that there is no risk of falling at any sole thickness used in this study.

The gait cycle variation (%) of 87 elderly people (76.7 ± 2.2) was 2.3 ± 1.0 (Arai et al., 2011). In this experiment, the walking cycle fluctuation was around 1%. Participants in this experiment were 8 young men and women, and stable walking with a fixed speed on the treadmill was considered, so the walking cycle variation was

considered to be low.

In conclusion, there were no significant effects of shoe sole thickness on the body sway and heart rate. By further increasing the number of subjects in the future and clarifying the relationship with other factors such as walking cycle, muscle factor during walking, and trajectory length of shaking, the relationship between platform shoes and fall risk will become clearer right. As a result, the shape of the sole will be greatly affected. The shoes used in this experiment were thinnest 11mm-15mm and thickest 41mm-45mm. From the results of this experiment, it is considered that the thickness of the sole within this range has little influence on the fall risk and the biological load. We thought that an experiment using shoes with a thicker sole may have an effect on the risk of falls and the load on the body.

**Acknowledgement**

The shoes used in this study were designed by Prof. Watanabe for the purpose of this study and provided and supported by MIZUNO corporation, Osaka, Japan. The equipment used for the experiment was supported by the Watanabe laboratory. The authors are sincerely grateful to Prof. Watanabe and Dr. Tomita for helpful suggestions and the support in the use of three-axis accelerometer.

**References**

Adachi, K., Endo, B., & Kawada, J. (2014). Comparison of Walking Parameters between Japanese and Malians. Bull. Facul. Health & Sci., Univ. of Tsukuba, 37, 73-83.

Arai, T., Shiba, Y., Watanabe, S., & Shibata, H. (2011). The Relationship Between the Stride Time Variability, Motor Ability and Fall in Community-Dwelling Elderly People. Journal of the Japanese Physical Therapy Association, 38(3), 165-172.

Brodie, M., Menz, H. B., Smith, S. T., Delbaere, K., & Lord, S. R. (2015). Good lateral harmonic stability combined with adequate gait speed is required for low fall risk in older people. Gerontology, 61(1), 69-78.

COMME des GARCONS. (2019/11/25). COMME des GARCONS. 2019/6/4, https://comme-des-garcons-online.com/cdg-cortez/

Doi, T., Hirata, S., Ono, R., Tsutsumoto, K., Misu, S., & Ando, H. (2013). The harmonic ratio of trunk acceleration predicts falling among older people: results of a 1-year prospective study. J Neuroeng Rehabil, 10, 7.

Hiiragi, Y. (2004). Evaluation of Postural Sway Using a Triaxial Accelerometer. Rigakuryoho Kagaku, 19(1), 305-309.

Howcroft, J., Kofman, J., & Lemaire, E. D. (2013). Review of fall risk assessment in geriatric populations using inertial sensors. J Neuroeng Rehabil, 10(1), 91.

Kamide, N., Obuchi, S., Shiba, Y., & Kakurai, S. (2002). BODDY REACTION PATTERN TO PERTURBATION DURING WALKING. Journal of the Society of Biomechanisms, 16, 27-35.

Kavanagh, J. J., Menz, H. B. (2008). Accelerometry: a technique for quantifying movement patterns during walking. Gait Posture, 28(1), 1-15.

Kering. (2019/11/25). Alexander McQueen | Designer Fashion and Luxury Clothing. 2019/6/5, https://www.alexandermcqueen.com/jp

Koda, H., Kai, Y., Ohsugi, H., Fukumoto, T., & Murata, S. (2016). Relationship between the Body Sway of Fast Walking and Muscle Strength in Elderly People. Japanese Journal of Health Promotion and Physical Therapy, 5(4), 161-165.

LVMH. (2019/11/25). LOUIS VUITTON. 2019/6/5, https://jp.louisvuitton.com/jpn-jp/homepage

Menz, H. B., Lord, S. F., & Fitzpatrick, R. C. (2003). Acceleration patterns of the head and pelvis when walking are associated with risk of falling in community-dwelling older people. J Gerontol A Biol Sci Med Sci, 58(5), 446-452.

Ministry of Health, Labour and Welfare (2019/11/25). e-healthnet. 2019/10/25, https://www.e-healthnet.mhlw.go.jp/information/dictionary/exercise/ys-032.html

Murata, S., Kutsuna, T., & Kitayama, C. (2004). Difference in Optimal Walk and Fastest Walk: Analysis by GAITRite. Rigakuryoho Kagaku, 19(3), 217-222.

National Consumer Affairs Center of Japan. (2019/11/26). A sudden increase in accidents of “platform shoes”, 2019/3/1, http://www.kokusen.go.jp/pdf/n-19990709.pdf

Nike, Inc. (2019/11/25). Nike Just Do it. 2019/6/5, https://www.nike.com/jp/

Nishida, Y., Higuchi, K., & Keiri, H. (1998). Differences in Treadmill and Indoor Walking on Level Ground: Investigation of Physiological Responses and Rating of Perceived Exertion. Rigakuryoho Kagaku, 13(4), 199-204.

Ono, N. (2019, 11/25). Health & Fitness Information. 2019/6/5, http://www.yspc-ysmc.jp/ysmc/column/health-fitness/walking-2.html

OTB. (2019/11/25). Maison Margiela PARIS. 2019/10/20,

https://www.maisonmargiela.com/jp

Orendurff, M. S., Segal, A. D., Klute, G. K., Berge, J. S., Rorh, E. S., & Kadel, N. J. (2004). The effect of walking speed on center of mass displacement. Journal of Rehabilitation Research & Development, 41(6), 829-834.

Patterson, S. M., Krantz, D. S., Montgomery, L. C., Deuster, P. A., Hedges, S. M., & Nebel, L. E. (1993). Automated Physical Activity Monitoring: Validation and Comparison with Physiological and Self-Repot Measures. Psychophysiology, 30(3), 269-305.

Sakurai, S., Sakamoto, M., Nakazawa, R., Kawagoe, M., & Kato, K. (2010). Investigation of the Reproducibility of a 3D Accelerometer-Based Gait Analysis of the Tibia. Rigakuryoho Kagaku, 25(1), 7-12.

Shinoda, H., Sato, H., & Suzuki, Y. (2008). Evaluation of Gait Stability Based on Variability of Medio-Lateral Motion of the Center of Mass. Rigakuryoho Kagaku, 23(1), 55-60.

Tencer, A. F., Koepsell, T. D., Wolf, M. E., Frankenfeld, C. L., Buchner, D. M., Kukull, W. A., LaCroix, A. Z., Larson, E. B., & Tautvydas, M. (2008). Biomechanical Properties of Shoes and Risk of Falls in Older Adults. Milda Tautvydas. MFA J Am Geriatr Soc, 52(11), 1840-1846.

# Effect of coffee temperature on the physical performance during exercise

国際社会系(渡邊ゼミ)

S116102

ベントシーヤバネッサ

Vanessa Ventocilla

**Abstract**

**Effect of coffee temperature on the physical performance during exercise**

**Aim** The purpose of the present study is to investigate the effect of temperature of coffee on endurance performance and lipolysis. **Methods** Four healthy college student over 20 years old performed a light exercise with a bicycle ergometer before and after drinking coffee. Between the first exercise (EX1) and second exercise (EX2), they intake 125cc of water and 160cc of hot coffee or ice coffee. We compared oxygen consumption (VO2), heart rate (HR) and rate of perceived exertion (RPE) to see these changes. **Results** In EX2, HR of the placebo group was significantly higher than EX1, whereas the coffee group was significantly lower. On the other hand, HR was a slightly lower for iced coffee than for hot coffee ($p < 0.05$). Regarding VO2, there was no difference between the two groups after drinking ($p > 0.05$). Individual RPE showed no difference between hot coffee group and ice coffee group ($p > 0.05$). **Conclusion** We suggested that drinking coffee before exercise can increase the endurance ability and energy metabolism, and also, both hot coffee and iced coffee are effective.

**コーヒーの温度差が運動中の身体能力に与える効果**

本研究の目的は、コーヒーの温度差が持久性運動能力の向上と脂肪燃焼効果に及ぼす影響の有無を調査することである。20 歳以上の健康な大学生 4 名が自転車エルゴメーターによる軽運動を行った。被検者は 1 回目(EX1)と 2 日目(EX2)の運動の間に、125cc の水と 160cc のホットコーヒーまたはアイスコーヒーを飲用した。各運動時の酸素摂取量(VO2)、心拍数(HR)、および自覚的運動強度(RPE)を比較し、変化の有無を確認した。EX2 の HR において、対照飲料摂取群の数値は EX1 よりも有意に高かった。それに対し、コーヒー摂取群は EX1 よりも有意に低下した。コーヒーの温度差別の変化率は、アイスコーヒー摂取群がホットコーヒー摂取群よりもわずかに低かった( $p < 0.05$)。VO2 に関しては飲料摂取後の両群の違いは認められなかった( $p > 0.05$)。個人の RPE は、コーヒー摂取の前後で両群の変化に差は見られなかった( $p > 0.05$)。これらの結果から、運動前のコーヒー飲用は、アイスコーヒー、ホットコーヒーのどちらも持久性運動能力と脂肪燃焼効果の向上に繋がることが示唆される。

**Efecto de la temperatura del café sobre la capacidad de resistencia fisica.**

El propósito de este estudio es investigar si la diferencia de la temperatura del café afecta o no la capacidad de resistencia fisica y el efecto de quema de grasa. Cuatro estudiantes universitarios varones sanos mayores de 20 años realizaron un ejercicio ligero con un ergómetro de bicicleta antes y después de tomar café. Los participantes tomaron 125cc de agua y 160cc de café caliente y/o frío entre el primer y el segudo ejercicio. La ingesta de oxígeno (VO2), la frecuencia cardíaca (HR) y la tasa de esfuerzo percibido (RPE) se compararon para confirmar si hay un cambio. El HR para el grupo que tomó café frío fue menor ($p < 0.05$) a comparacion con el grupo que tomó café caliente ($p < 0.05$) aunque la diferencia no es significativamente grande. El VO2 no difirió entre los dos grupos después de beber ($p > 0.05$). El RPE individual no mostró diferencias entre los dos grupos ($p > 0.05$). Como resultado, tomar café frío o caliente antes del ejercicio conduce a una mejora en la capacidad de resistencia fisica y al efecto de quema de grasa.

Abbreviations:

VO2: oxygen consumption, HR: heart rate, RPE: rate of perceived exertion.

**Introduction**

According to National Coffee Association of United States of America (NCA), the proportion of Americans drinking coffee increase. In Europe, viewing a survey conducted by Centre for Economics and Business Research (CEBR), their coffee consumption has jumped 35% in the 10 years from 2008 to 2018. In China, the annual consumption of coffee per person is still relatively low, but the statistics show an average annual growth of 16% over the past 10 years (Alizila, 2018). In this way, opportunity to drink coffee are increasing year by year in the world. On the other hand, in fact, Japan is the major coffee-consuming country next to European Union (EU) and United States of America (USA) (ICO, 2018). According to All Japan Coffee Association, the quantity of the coffee which one drinks a week is 11.09 cups on man and woman average (AJCA, 2016). The consumption of the youth is less than average, but it gradually increases from 18 years old. Woman aged 40 to 59 years old consumes 14.40 cups per week in average so they consume the most. Consequently, coffee is required not only for workers but also for a wide range of age groups from students to seniors.

Coffee consumption in Japan has increased by nearly 1.5 times in 20 years from 1996(AJCA, 2018), and it is presumptive that this trend will continue in the future. For instance, AJINOMOTO AGF INC. has developed stick-type coffee for the first time in 2003 (AJINOMOTO AGF, INC. 2019). Using this product, we can make and drink easily without measuring the quantity for the cupful, and they have been trying to improve the quality to now (AJINOMOTO AGF, INC. 2019). On the other hand, the demand for coffee of convenience store such as Seven-Eleven, Lawson, and Family Mart is also expanding. At these stores, it became possible to purchase a cup of coffee at low price of 100 to 150 yen. It means we became able to enjoy the freshly brewed coffee anytime. Furthermore,

in recent years, coffee shop and cafe are receiving attention mainly on young people. The following points can give as reasons. First, photo sharing service "Instagram" announced that Monthly Active User (MAU) of the whole world broke through 1 billion people in 2018 (Statista. 2019). In the whole world, 41 percent of users are 24 years of age or younger (Statista. 2019). The number of hashtags people put on photos posted to Instagram has increased endlessly. So I used the Instagram service (Top-HashTags.com) to find out the hashtags and the number of posts. As of the statistics of 2016, #Coffee ranks 112 and is used for 8.148 million articles. Furthermore, #cafe ranks 416 and is used for 3,184 million articles. This indicates that the number of coffee and cafe postings is overwhelmingly different from the 1.8 billion #restaurant and 2.2 billion #tea, and that coffee and cafe are more interesting. Second, the total sales of 1180 cafe owners in 2017 increased 4.6% from the previous year to 64,532 million yen (TDB, 2018), and the expansion trend continues. As these reasons, it may be associated with the expansion of the cafe that is particular about the interior, and the trend of young people to publish photographs on SNS. In addition, specialty coffee shops by baristas who are particular about coffee increase little by little. In a word, interest in coffee is gradually changing.

A number of studies indicate that there is a relationship between coffee and health, and that is the other reason for increased consumption. For example, it is investigated the metabolic effects of caffeine on recovery. This study concluded that by taking about 1.5 to 2 cups of caffeine in coffee after light exercise, endurance ability is restored, and heart rate and respiratory exchange ratio at the time of light exercise again decrease significantly (Sasagawa et al, 2015). Similarly, in experiments using caffeine, caffeine consumption resulted in a 3% reduction in Rating of perceived exertion (RPE) (Gregory, 2002). From this, it became evident that caffeine

intake an hour ago is ideal for during cycling within 60 minutes (Gregory, 2002). According to an interview with some cyclists by the road bike channel Global Cycling Network (GCN), they drink 1 to 4 cups of coffee before the competition (GCN, 2017). Many of them say that coffee has an impact on performance. It assumed that caffeine contained in coffee expected to improve the ability of endurance sports. Alternatively, caffeine has the effect of breaking down fat. By promoting the breakdown of fat, it increases activated sweat gland density (ASGD) and free fatty acids (FFA) (Tae-Wook Kim et al, 2010). Therefore, it usually takes time to burn the fat, but it can burn efficiently. As a result, it can predict that diet effect can expect by combining caffeine intake and exercise.

In summary, research has shown that caffeine intake by coffee as well as anhydrous caffeine such as tablets leads to improved endurance exercise performance and fat burning effect. However, little attention has been paid to the effect of temperature in the coffee. Previous studies have used caffeine diluted in water, but specific temperature is not indicated (Sasagawa et al, 2015). Another study used hot water at 92-96 ℃, but they did not compare it with iced coffee (Hudgson et al, 2013). Therefore, I estimated that temperature is not important in foreign country because they have less opportunity to drink iced coffee. A survey of major coffee shops and cafes in Japan showed that 100% of stores had ice coffee on the menu. However, 15% of them offer cold brew, i.e., Soak coffee beans directly in water and slowly extract for a long time. It made in American coffee shops, as iced coffee. In terms of this, those stores based on American or other countries coffee culture concepts do not tend to sell iced coffee dripped like hot coffee. Similarly, for comparison I investigated major coffee shops in France, Italy, Spain, UK and USA. Thirty-five percent of the surveyed shops have iced coffee on the menu.

However, 83% of them offer cold brew or Americano i.e., a coffee prepared by diluting espresso with water. Based on my field survey in Spain, Torch Coffee Roasters do not list iced coffee. Nevertheless, when customers asked about it, the cafe staff provided cold coffee. Iced coffee is not on the menu at 65% of the stores in foreign countries. In those stores, it is normal that they give a glass of ice with hot coffee or espresso as iced coffee. Moreover, stores targeted at tourists tend to have cold drinks such as iced coffee. Hence, it is presumed that there are few people who have a habit of drinking iced coffee in foreign countries. It indicated that hot coffee is the mainstream in most countries, while the majority of Japanese prefer iced coffee in summer. Therefore, for those who like iced coffee, it is interesting to see if the same effect can obtain.

The purpose of the present study is to reveal the effect of temperature of coffee on endurance performance and lipolysis. Caffeine has sublimation property and the sublimation point is said to be 178℃ (Mohammad Uppal Zubair, 1986). The appropriate temperature for hot coffee is around 68-70℃, and 92-96℃ when extracting. In view of the fact that the sublimation point of caffeine is not be reached even at the time of extraction, it is considered that the amount of caffeine does not change with temperature change. Based on this, it is assumed that the same effect can obtain even if the temperature is change.

**Materials and Methods**

*Participants*

The participants are 4 healthy men aged 20 and over (Mean±SD: Age 21±1y, Weight 66±6kg). In order to eliminate the error due to the tolerance to caffeine, take a questionnaire on their habit of drinking coffee in

advance. In addition, those without extreme exercise experience, smokers, and those with cardiovascular disease were exclude.

*Experimental design*

An exercise had conducted using a bicycle ergometer (KONAMI SPORTS CLUB Exercise Bike 75 XL III, Kanagawa, Japan). The participants had prohibited from alcohol intake, caffeine intake, and intense exercise on the day before the experiment, and the wake-up time on the day was standardized. In order to avoid hunger and satiety, they had instructed to take an appropriate amount of breakfast or lunch 1 hours before test. Since the load was constant according to the weight of the participants, the weight of the participants was measure before the experiment (TANITA Body composition meter with automatic height scale DC-250, Tokyo, Japan).

The experimental protocol is shown in Fig. 1. First, participants performed a light exercise with a bicycle ergometer for 10 minutes(EX1). The amount of load was set to 6 Mets, which corresponds to light jogging for each participants (National Institute of Health and Nutrition, 2012). This workload is estimated from the individual body weight. That is corresponded with physical activity intensity. Cadence of pedal is set at 60 rpm. After the exercise, the participants drink 125cc of water within 5 minutes for hydration. Five minutes after, they intake coffee within 10 minutes. Since the amount of caffeine contained in coffee is 90 mg per 100 ml, they should drink a cup of coffee (160 cc). The reason is that, according to Spriet (2014), although there are individual differences in the intake at which the effect of caffeine can obtain, it indicates to be about more than 2 mg per kg body weight. Rest for 60 minutes, including time to drink coffee (Laura et al, 2004). After that, performed the same level of bicycle exercise for 30 minutes(EX2).

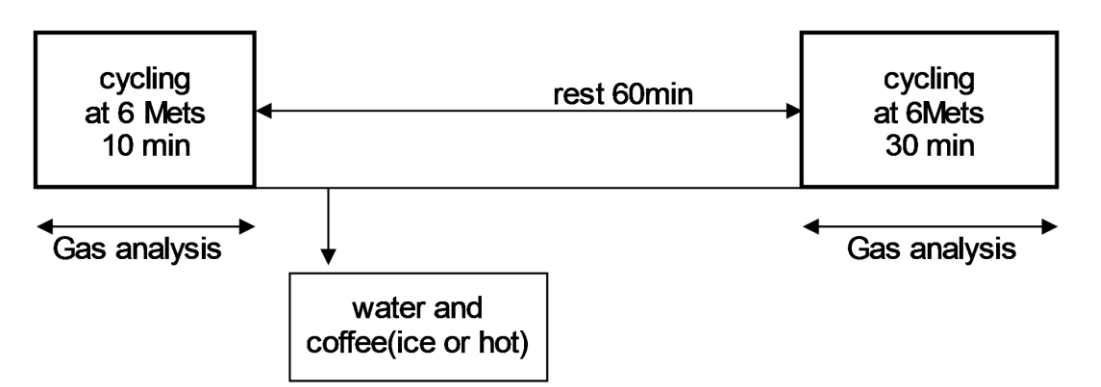



Fig. 1 Mean experimental protocol. In Borg Scale, 6 Mets corresponds to light jogging. EX1: cycling exercise before drink coffee or placebo. EX2: cycling exercise after drink coffee or placebo.

*Measuring methods*

During exercise with a bicycle ergometer, the participant's heart rate (HR) was measured using a bicycle ergometer clip-type heart rate monitor (KONAMI SPORTS CLUB Exercise Bike 75 XL III, Kanagawa, Japan) every 5 minutes, and oxygen intake (VO2) were measured using expired gas analyzer (Nippon photoelectric aero monitor AE-310S, Minato Medical Science CO., LTD, Tokyo, Japan). The participants had been asked to conduct four experiments including drinking hot coffee, iced coffee, hot water and cold water. In this experiment, two comparisons were made: placebo vs coffee (Measurement A), hot coffee vs iced coffee (Measurement B). Placebo in Measurement A shows both cold and hot water, and two people were targeted. In Measurement B, 4 people were targeted. The time for half of caffeine in the body is said to be about 4 hours (Knutti R et al, 1981), but there is an individual difference of 2 to 8 hours, so those experiments was separate by 1 day or more. The order of the trials with hot coffee and iced coffee were random. The coffee used for the experiment is MAXIM. of AJINOMOTO AGF INC. The temperature of hot water was 92 to 96℃. On the other hand, iced coffee unified to 4 to 6℃.

*Statistics*

We compared HR and VO2 before and after each coffee intake to see if there was any change. VO2 calculated using AT analysis software and the mean value excluding 2 minutes after the start of exercise. The data was compared using Wilcoxon test. With this, VO2, HR and RPE were compared between coffee and placebo. Likewise, these were compared between iced coffee and hot coffee. Thereby, it clarified whether there is a difference in the magnitude of change due to the difference in temperature of coffee.

**Results**

In EX2, HR increased with placebo but significantly decreased with hot coffee (Participant A water: hot water: hot coffee =143.7:116.2:129.5, Participant B water: hot water: hot coffee =108.0:107.3:104.0) (Table 1). There were individual differences in iced coffee (Table 1). Regarding VO2, there was no significant difference between these drinks (Table 2).

Next, changes in VO2 are shown in Fig. 2. Looking at the rate of changes of VO2 between with placebo and coffee, with coffee is lower than placebo, still the difference is small (Participant A water: hot water: ice coffee: hot coffee=1.05:1.03:1.02:1, Participant B water: hot water: ice coffee: hot coffee=1:1.02:1.01:1). The rate of changes in HR is illustrated in Fig. 3. With hot coffee decreased (Participant A:0.98, Participant B:0.95), while with placebo has increased (Participant A water: hot water=1.1:1.0, Participant B water: hot water=1.01:1.09). There were individual differences in iced coffee.

Additionally, the coffee group was divided into ice group and hot group. The results of HR and VO2 during exercise are shown in Table 3. The decrease in HR from EX1 to EX2 were seen in both groups. Regarding VO2, there was no significant difference between both groups in EX1 and EX2. Fig. 4 illustrated the changes in HR, and Fig. 5 illustrated the changes in VO2. As regards HR, the decrease in ice coffee group is larger than that in hot coffee group (hot coffee: ice coffee = $0.974 \pm 0.02$: $0.955 \pm 0.04$) ($P < 0.05$). As for VO2, the rate of change in both groups was almost the same (hot coffee: ice coffee = $1.016 \pm 0.02$: $1.016 \pm 0.01$) ($p > 0.05$).

RPE during exercise is expressed in Borg Scale. In EX1, the ice coffee group was $10.4 \pm 2.4$ and the hot coffee group was $10.5 \pm 2.8$ (Table4). In EX2, the ice coffee group showed $9.5 \pm 1.9$ and the hot coffee group

showed 9.8 ± 2.6, namely, both of which decreased after taking caffeine ($p < 0.05$) (Table4). Borg Scale 9-10 showed “very light”, “fairly light” and there was no significant difference between the two groups.

Table. 1 Mean HR during exercise with coffee and placebo. EX1: cycling exercise before drink coffee or placebo. EX2: cycling exercise after drink coffee or placebo. In EX2, HR increased with placebo but significantly decreased with hot coffee (Participant A water: hot water: hot coffee =143.7:116.2:129.5, Participant B water: hot water: hot coffee =108.0:107.3:104.0).

| | Hot coffee | | Ice coffee | | Hot water | | Water | |
|---|---|---|---|---|---|---|---|---|
| | EX1 | EX2 | EX1 | EX2 | EX1 | EX2 | EX1 | EX2 |
| Participant A | 131.5 | 129.5 | 126.5 | 115.5 | 116.5 | 116.2 | 130.0 | 143.7 |
| Participant B | 109.0 | 104.0 | 114.5 | 116.0 | 98.5 | 107.3 | 107.0 | 108.0 |

Table. 2 Mean VO2 during exercise with coffee and placebo. EX1: cycling exercise before drink coffee or placebo. EX2: cycling exercise after drink coffee or placebo.

| | Hot coffee | | Ice coffee | | Hot water | | Water | |
|---|---|---|---|---|---|---|---|---|
| | EX1 | EX2 | EX1 | EX2 | EX1 | EX2 | EX1 | EX2 |
| Participant A | 20.8 | 20.9 | 20.8 | 21.3 | 21.0 | 21.6 | 21.7 | 22.8 |
| Participant B | 20.5 | 20.5 | 20.8 | 21.0 | 19.6 | 20.0 | 21.3 | 21.3 |

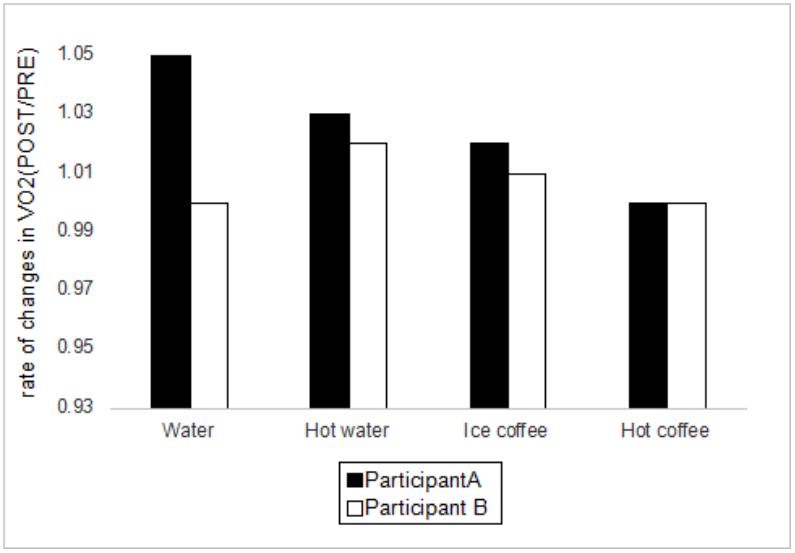



Fig. 2 Mean the changes in VO2 between with water, hot water, ice coffee and hot coffee. With coffee is lower than placebo, still the difference is small (Participant A water: hot water: ice coffee: hot coffee=1.05:1.03:1.02:1.0, Participant B water: hot water: ice coffee: hot coffee=1.0:1.02:1.01:1.0).

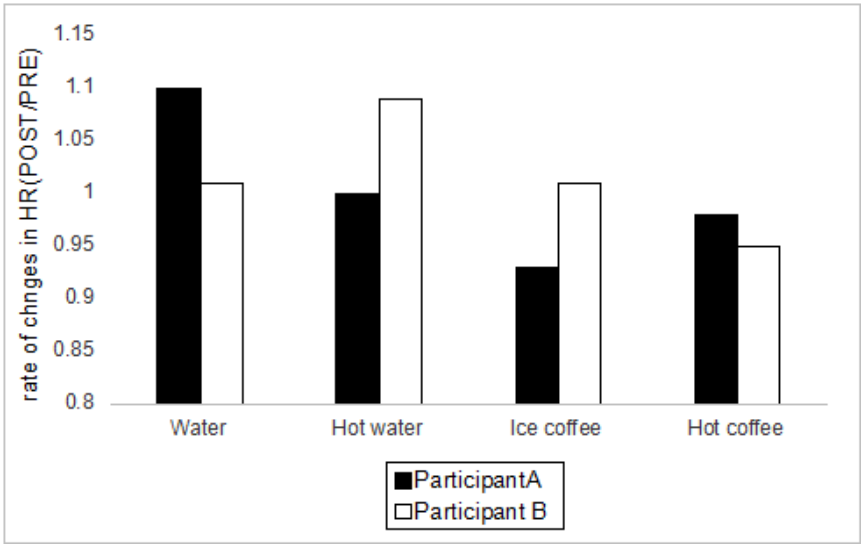
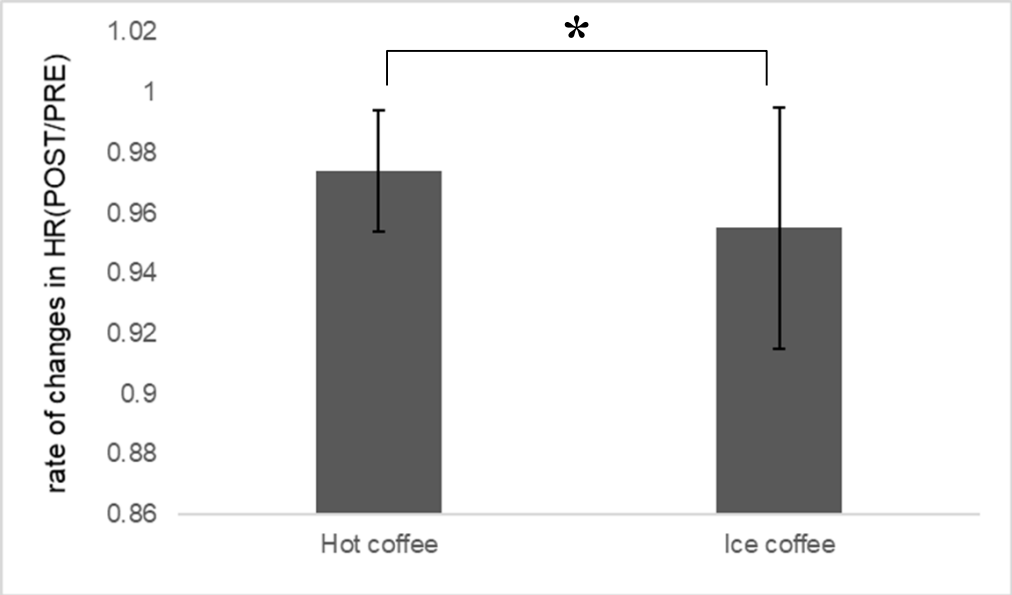



Fig. 3 Mean the changes in HR between with water, hot water, ice coffee and hot coffee. With hot coffee decreased (Participant A:0.98, Participant B:0.95), while with placebo has increased (Participant A water: hot water=1.1:1.0, Participant B water: hot water=1.01:1.09).

Table. 3 Mean (± SD) HR and VO2 during exercise with the ice coffee group and the hot coffee group. EX1: cycling exercise before drink coffee or placebo. EX2: cycling exercise after drink coffee.

| | Hot coffee | | Ice coffee | |
|---|---|---|---|---|
| | EX1 | EX2 | EX1 | EX2 |
| HR(beat/min) | 121.1±9.6 | 118±10.6 | 126.6±16.9 | 120.5±12.9 |
| VO2(ml/kg/min) | 21.2±1.8 | 21.5±1.9 | 20.7±0.3 | 21±0.3 |




*p < 0.05 between Hot and Ice coffee

Fig. 4 Mean the changes in HR between the ice coffee group and the hot coffee group. The decrease in ice coffee group is larger than that in hot coffee group (hot coffee: ice coffee = 0.974±0.02: 0.955±0.04) (P < 0.05).

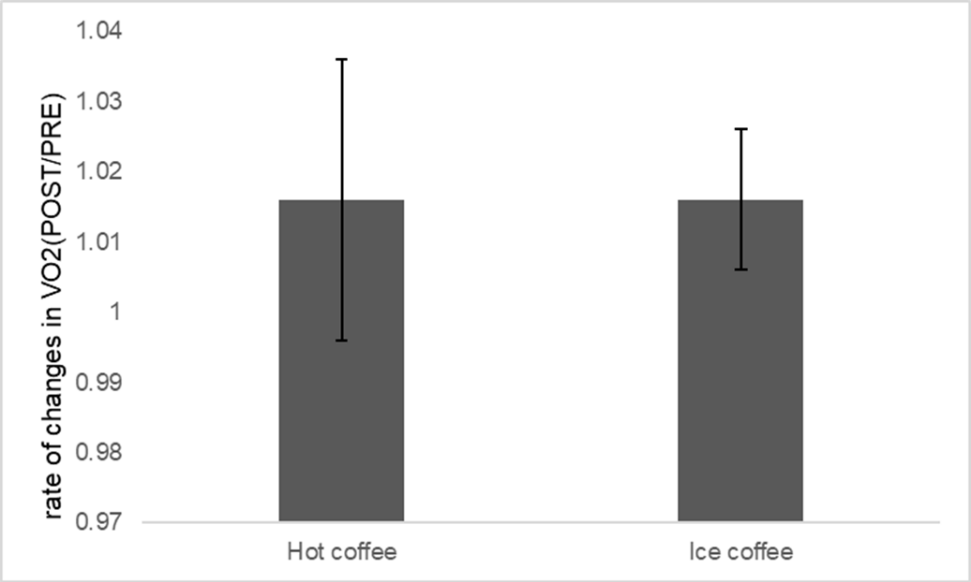



Fig. 5 Mean the changes in VO2 between the ice coffee group and the hot coffee group.

Table. 4 Mean (± SD) RPE during exercise with the ice coffee group and the hot coffee group. EX1: cycling exercise before drink coffee or placebo. EX2: cycling exercise after drink coffee. Both groups are significantly decreased ($p<0.05$).

| | Hot coffee | | Ice coffee | |
|---|---|---|---|---|
| | EX1 | EX2 | EX1 | EX2 |
| RPE | 10.5 ± 2.8 | 9.8 ± 2.6 | 10.4 ± 2.4 | 9.5 ± 1.9 |

**Discussion**

The purpose of this study was to examine the effects of ice and hot coffee consumption on the endurance ability during the second exercise after a light exercise with a bicycle ergometer. In this study, HR, RPE, and VO2 during exercise were calculated for healthy men. According to the previous study, exercise after drinking coffee and resting for 60 minutes showed a decrease in heart rate and an increase in oxygen intake, both of which were significant changes compared to before drinking coffee (Suzuki, 2010). However, they used only hot water and hot coffee. We focused on the temperature of the coffee and conducted an experiment to determine whether there was a change between hot coffee and iced coffee.

There was no significant difference between coffee and placebo regarding VO2. In previous studies, the amount of caffeine used was equivalent to about 2 cups of coffee, and an increase in oxygen intake after caffeine consumption was observed (Suzuki, 2010). Meanwhile, in this study, it was set to about 1 cup (160cc). That is, it is thought that VO2 does not increase with about a cup of coffee.

Each RPE decreased in both groups with exercise after consuming coffee (Table4). The exercise intensity set in this experiment is as low as 6 Mets, which corresponds to light jogging. Regarding the participants who felt slightly tight, it was considered that the temperature on the day was slightly high (22℃), the HR was higher than the average, and the amount of sweating was large. RPE was between 9 and 11 for most participants, no participants responded “tight”, and was appropriate for light exercise.

The participants of this study were a male university student. Considering that men have higher endurance than women (Japan Foundation for Aging and Health, 2019), it is unclear whether it can be applied to

women and ordinary people who are not accustomed to daily exercise. In addition, we excluded those who were caffeine resistant. Therefore, it is unclear whether a person with caffeine resistance can obtain the same result.

The coffee used in this study does not contain sugar or milk. Therefore, it is unknown whether it is effective other than black coffee. However, if you are focused on energy consumption for diet, coffee without sugar or milk is appropriate considering the ingredients contained in these. For the reason, sugar, milk and coffee whiteners have higher calories than coffee, and dairy products have higher fat (Ministry of Education, Culture, Sports, Science and Technology, 2015). In addition, since excessive drinking of coffee may adversely affect the body, it is desirable to utilize coffee intake and exercise on the premise that excessive intake is not performed (Health Canada, 2010).

In this study, HR was a slightly lower for iced coffee than for hot coffee (hot coffee: ice coffee = 0.974±0.02: 0.955±0.04) ($P < 0.05$). Knutti et al, 1981 showed that the half-life of caffeine in the body is about 4 hours. In this study, the time from caffeine intake to the second exercise was 60 minutes. Therefore, the effect was obtained without halving caffeine. However, as mentioned earlier, it is thought that VO2 does not increase with about a cup of coffee (Suzuki, 2010). According to Midoh et al, 2012, the amount of change in HR 60 minutes after drinking hot soup was larger than that of cold soup. Based on this, the reason why hot coffee has a higher HR value is presumed that the increase in body temperature due to a hot drink is related to the individual's sense of temperature and HR. Kondo et al, 2005 said that athletic performance decreases with increasing body temperature. Therefore, it is considered that the suppression of the rise in body temperature by drinking iced coffee influenced HR. That means iced coffee is suitable for obtaining a more effective in aerobic exercise. On the other hand, since both hot

coffee and iced coffee showed a reduction in HR, it can interpret that both are effective.

For this result, by improving endurance ability, it became possible to increase the exercise intensity of each participant. Therefore, it is estimated that free fatty acid can be consumed more as energy by exercising more. In conclusion, this study confirmed that iced coffee can suppress HR more than hot coffee and making it possible to increase exercise intensity or extend exercise time. It turned out that iced coffee is more effective in endurance and fat burning.

**Acknowledgement**

This research was supported in part by Watanabe Laboratory. The authors are sincerely grateful to Prof. Kohei Watanabe, Prof. Aya Tomita and the students of the seminar for the support in this experimental.

**References**

The All Japan Coffee Association (AJCA). (2016). The drinking present conditions of the coffee in Japan. http://coffee.ajca.or.jp/wp-content/uploads/2017/06/data04_2017-06b.pdf

AJINOMOTO AGF, INC.. (2019). History of AGF®. https://www.agf.co.jp/english/history.html

Alizila for Alibaba Group. (2018). https://www.alizila.com/china-coffee-consumption-coffee-drinking-nation/

Cappelletti S, Piacentino D, Fineschi V, Frati P, Cipolloni L and Aromatario M. (2018). Caffeine-Related Deaths: Manner of Deaths and Categories at Risk. Nutrients 10(5):611.

Centre for Economics and Business Research (CEBR). (2018). The Independent – Brits now drinking 95 million cups of coffee per day. https://cebr.com/reports/the-independent-brits-now-drinking-95-million-cups-of-coffee-per-day/.

Global Cycling Network (GCN). (2017). How many coffee's before the start? https://www.youtube.com/watch?v=p2AZFDVQhRg.

Gregory R. Cox, Ben Desbrow, Paul G. Montgomery, Megan E. Anderson, Clinton R. Bruce, Theodore A. Macrides, David T. Martin, Angela Moquin, Alan Roberts, John A. Hawley and Louise M. Burke. (2002). Effect of different protocols of caffeine intake on metabolism and endurance performance. Journal of Applied Physiology, 93, 990–999.

Health Canada. (2010). Caffeine in Food Health Canada. http://www.hc-sc.gc.ca/fn-an/securit/addit/caf/food-caf-aliments-eng.php.

Hodgson AB, Randell RK, Jeukendrup AE. (2013). The metabolic and performance effects of caffeine compared to

coffee during endurance exercise. PLoS One, volume 8, issue 4.

Japan Foundation for Aging and Health. (2019). Healthy longevity net, Average maximum oxygen uptake. https://www.tyojyu.or.jp/net/kenkou-tyoju/tairyoku-kiki/sanso.html.

International Coffee Organization (ICO). (2018). World coffee consumption. http://www.ico.org/prices/new-consumption-table.pdf.

Laura M Juliano and Roland R Griffiths. (2004). A critical review of caffeine withdrawal: empirical validation of symptoms and signs, incidence, severity, and associated features. Psychopharmacology, 176(1), 1-29.

Lawrence L. Spriet. (2014). Exercise and Sport Performance with Low Doses of Caffeine. Sports Med 2014, 44(Suppl 2), 175‑184.

Masato Suzuki. (2010). Additional effects of drinking coffee and exercise therapy. http://dm-rg.net/contents/guidance/024.html.

Ministry of Education, Culture, Sports, Science and Technology (MEXT). (2015). Japanese food standard ingredient table, 2-3,13,17.

Mohammad Uppal Zubair, Mahmoud M.A. Hassan, Ibrahim A. Al-Meshal. (1986). Caffeine. Analytical Profiles of Drug Substances and Excipients, 15, 71-150

Narihiko Kondo and Kazuyuki Kanosue. (2005). Functional link between body temperature and exercise. Physical fitness, 54, 19-20.

Naoki Midoh, Miki Tokunaga, Takashi Isomura and Takanori Noguchi. (2012). Effect of soup temperature on body thermal sensation, body temperature and heart rate. Journal of Japan Society for Food Science and Technology, 59(6),

262-267.

National Institute of Health and Nutrition (NIHN). (2012). Revised “METs table of physical activity”.

National Coffee Association (NCA). (2019). The Behaviors and Perceptions of U.S. Coffee Drinkers. http://www.ncausa.org/Industry-Resources/Market-Research/National-Coffee-Drinking-Trends-Report.

R. Knutti, H. Rothweiler, Ch. Schlatter. (1981). Effect of pregnancy on the pharmacokinetics of caffeine. European Journal of Clinical Pharmacology, volume21, issue2, 121‑126

Sasagawa tomoyuki, Takayo KAIHO, Takaaki MATSUMOTO and Yuko NAITO. (2015). The Metabolic Effects of Caffeine on Recovery Immediately After Endurance Exercise. Journal of physical education and sports science, 15, 55-61.

Statista. (2019). Number of monthly active Instagram users from January 2013 to June 2018 (in millions). https://www.statista.com/statistics/253577/number-of-monthly-active-instagram-users/

Tae-Wook Kim, Young-Oh Shin, Jeong-Beom Lee, Young-Ki Min, and Hun-Mo Yang. (2010). Effect of Caffeine on the Metabolic Responses of Lipolysis and Activated Sweat Gland Density in Human during Physical Activity. Food Science and Biotechnology, volume19, issue4, 1077–1081.

TEIKOKU DATABANK, LTD. (2018). Business condition survey of 1180 companies of coffee shops and cafes. https://www.tdb.co.jp/report/watching/press/pdf/p180801.pdf.

# Differences of the dietary intake between chopsticks and a spoon from the features of chewing

国際社会系(渡邊ゼミ)

S116128

吉田貴洋

Takahiro Yoshida

**Abstract**

**Differences of the dietary intake between chopsticks and a spoon from the features of chewing**

Aim: The purpose of this experiment was to reveal difference of the dietary intake between different eating tools, such as chopsticks and spoon. Methods: Participants participated two experiments in separated days. On first day, each participant ate rice (200g) with chopsticks or spoons. We used wearable device to record feature of chewing and participants were recorded with video camera. Participants were not allowed to speak and to drink during the eating. After the eating, satiety level was measured with visual analogue scale between one and ten. On second day, participants performed same procedure using remaining eating tools, i.e., spoons or chopsticks. Result: There were no significant differences between chopsticks and a spoon in satiety level, total time, total number of chewing, speed of chewing and number of chewing for each picked up rice ($p>0.05$). A significant difference between chopsticks and a spoon in amount of rice for each picked up as expected ($p < 0.05$). Conclusion: From these results, we suggested that a spoon helps increase amount of rice for each picked up.

**咀嚼の特徴から考える箸とスプーンの食事摂取量の違い**

目的：本研究の目的は、箸とスプーンの食事摂取量の違いを明らかにすることである。方法：中京大学の学生１０名を対象に実験を行った。実験は１人２回行った。１日目、対象者は箸もしくはスプーンの一方を使用し米飯２００ｇを完食した。我々は咀嚼を記録する為に、ビデオカメラとウェアラブルデバイスを使用した。対象者は咀嚼している間飲み物を飲むことや、喋る事を禁止された。対象者は完食して直ぐに満腹度を１から１０の間で示した。２日目、同じ方法でもう一方を使用しご飯を完食した。結果：箸とスプーン間に満腹感、総食事時間、総咀嚼回数、咀嚼速度、一口毎の咀嚼回数の有意な差は無かった（ｐ＜０．０５）。一口の量には有意な差があった（ｐ＜０．０５）。結論：これらの結果から、スプーンは一口の量を増やす助けとなる事を示唆した。

**Diferencias de la ingesta dietética entre palillos y una cuchara de las características de masticar**

Objetivo: El participante de este experimento fue revelar la diferencia de la ingesta dietética entre palillos y cuchara. Métodos: Los participantes participaron en dos experimentos en días separados. El primer día, cada participante comió arroz (200 g) con palillos o cucharas. Utilizamos un dispositivo portátil llamado Bitescan para grabar la característica de masticar y los sujetos se grabaron con una cámara de video. No se permitió que los participantes hablaran y bebieran durante la comida. Después de comer, a los participantes se les indicó un nivel de sensación de plenitud. Primer día, los sujetos realizaron el mismo procedimiento con palillos o cucharas. Resultado: No hubo diferencias significativas entre palillos y una cuchara en el tiempo total, el número total de masticación, la velocidad de masticación y el número de masticación por bocado ($p> 0.05$). Se observó una diferencia significativa entre los palillos y una cuchara en la cantidad de una mordida como se esperaba ($p <0.05$). Conclusión: A partir de estos resultados, sugerimos que una cuchara ayuda a aumentar la cantidad de una mordida.

**Introduction**

Recent years in Japan, aging population has been remarkable, and it predicts that will progress in the feature (Cabinet Office, Government of Japan, 2018). Currently, Japan has a total population of 126.71 million, of which 35.15 million are elderly people (Over 65 years old). In other words, elderly people actually account for 27.7% of the population. Accordingly, elderly people who account for a large proportion of the population are considered to affect various markets because it bears the responsibility in consuming society. In addition, the health of them is related to productivity (Nakata, T., 2008). In Japan, the percentage of people with low BMI is high in over the 70s. Undernutrition which one of the causes of low BMI is a problem in older adults (Men: 24%, Women: 37%, BMI standard value: 21.5-24.9) (Ministry of Health, Labor and Welfare, 2018). However, Japan is not the only country with the problem of undernourishment among the elderly. This problem is common in many developed countries. As one ages, several physiological processes may contribute towards the development of protein energy malnutrition. Protein energy malnutrition in elderly people comes at a significant cost to the individual, families, communities and the healthcare system. Failure to address this syndrome is not only unethical and unhealthy, but also costly (Visvanathan, R., 2003). Furthermore, undernutrition also is related to sarcopenia, flail, underweight and depression (Jeejeebhoy, K., 2012). The main cause of sarcopenia is a decrease in skeletal muscle mass, which is suppressed by moderate protein intake and strength training (Morley, J., et al., 2010). Underweight is especially due to lower food intake. Sarcopenia and flail will lead to a decrease in going out and a decline in quality of life.

Also, percentage of female underweight people (BMI＜18.5 kg/m$^2$) from their 20's to 50's age group exceeded 10 % in all age groups. Especially in young women (21.7% in 20's group), low protein intake is problem

(Ministry of Health, Labor and Welfare, 2018).

In addition, the problem of undernutrition in young athlete is clear in survey of each of competitions (Ishizaki, Y., 2013; Omi, N., et al., 2005; Simooka, R., et al., 2017; Adachi, T., Yamamoto, M., Saito, A., & Hotta, N., 2004). International Olympic Committee showed the risk of relative energy deficiency in sports and American Dietetic Association described importance of optimal nutrition to enhance physical activity, athletic performance, and recovery from exercise (Margo, M., et al., 2014; Nancy, R., Nancy, D., & Susie, L., 2009). Moreover, student athletes and their advisors often are misinformed or have misconceptions about sports nutrition. Nutritional needs for peak athletic performance include sufficient calorie intake, adequate hydration, and attention to timing of meals. Moreover, proper nutrition for young athletes is critical not only to their athletic success, but more importantly to their growth, development, and overall health (Nancy, C., Connie E, V., & Sheldon, M., 2005).

Recent studies of regarding chewing and a mouthful amounts of foods have shown that when various gels are used, if a mouthful amounts of foods is halved, the chewing time becomes 0.7 times (range is 3g-24g) (Kohyama, K., et al., 2014). Fukuda and Hirakawa (2009) discovered that in the case of rice, if a mouthful amounts of foods increases, both total chewing frequency and total chewing time increase linearly. However, even if a mouthful increased to two times and three times, the chewing frequency and the time including food in mouth did not increase to two times and three times. When rice was chewed well, the postprandial blood glucose level was always higher from 15 min to 150 min than when it was not chewing well and there was a significant difference between chewing well and not chewing well (Fukuda, H., & Hirakawa, T., 2009). Not chewing well is good way to increase the amount of intake because of feeling full when blood glucose level increases (AF, Debons., I, Krimsky., & A, From.,

1970). In fact, there also is a report that mastication helps digestion and absorption, improves cognitive function, and improves blood flow (Kiwako, S., Hiroki, N., & Ryusuke, K., 2008; AM, Pedersen., et al., 2002; Y, Hasegawa., et al., 2007). However, about digestion, there is also a report that the mastication seems to be crucial for gastrointestinal absorption of a number of essential foods like meat and vegetables, but not to others such as bread, cheese, rice, fish, and egg (AM, Pedersen., et al., 2002). There are various positive effects to chewing well but increase the amount of meal may be more important to get the nutrition.

Spoons were used all over the world before chopsticks spread and spoons are still mainly used in many countries. In addition, in also countries where chopsticks are widespread, spoons are used for serving dishes. For these reasons, a spoon is easy to use and suitable to pick up a lot of food at once (Yamamoto, N., 2016; Tsubame shinko Industrial Co., Ltd. 2013). Chopsticks are widely used mainly in Asia and previously were used mainly when grabbing soup ingredients. Namely, chopsticks are suitable to grab a solid that not too small (Yamamoto, N., 2016; Tsubame shinko Industrial Co., Ltd. 2013).

The purpose of this experiment was to reveal difference between the dietary intake of chopsticks and spoon from the satiety level and features of chewing. The results from this study would be useful to improve undernutrition of elderly people and underweight people (BMI＜18.5 kg/m2). Since increasing the amount of meals is essential to improve undernutrition of elderly people and underweight people and young athlete is assisted improving undernutrition and weight control. Improving underweight reduces the risk of death (Shizuka, S., et al., 2011) and also improving undernutrition leads to restraint of the cost of care.

We hypothesized that when eating with a spoon, food intake increases more than when using chopsticks

because when using a spoon, the percentage of chewing frequency and chewing time in a mouthful is less than using chopsticks results in inhibiting increase in postprandial blood glucose level, and hence inhibiting the stimulation of satiety center (AF, Debons., I, Krimsky., & A, From., 1970).

**Materials and Methods**

*Participants*

Ten healthy students in Chukyo University participated in this study (Age: 21.8±0.4, Weight: 56.7±10.1, BMI: 20.4 ± 2.4). The participants gave written informed consent for the study after receiving a detailed explanation of the purposes, potential benefits, and risks associated with participation in the study. All participants were fasted three hours before the experiment to match a condition among the participants.

*Experimental design*

Participants participated two experiments in separated days. First day, each participant ate rice (200 g) with chopsticks or spoons. During the eating, we used wearable device called Bitescan (Sharp corporation, Osaka, Japan) to record feature of chewing and video camera recorded participants, the meter and smartphone simultaneously. From rice on weighing scale between eating, amount of rice for each picked up was measured. Participants were not allowed to speak and to drink during the eating. After just the eating, participants were indicated satiety level with visual analogue scale between one and ten (One is hunger, ten is full). Second day, participants performed same procedure using remaining eating tools, i.e., chopsticks or spoons. The order to using chopsticks and spoons was decided at random. Spoons was 17 cm in length, 4 mm in depth and chopsticks was 22 cm in length (Figure1).

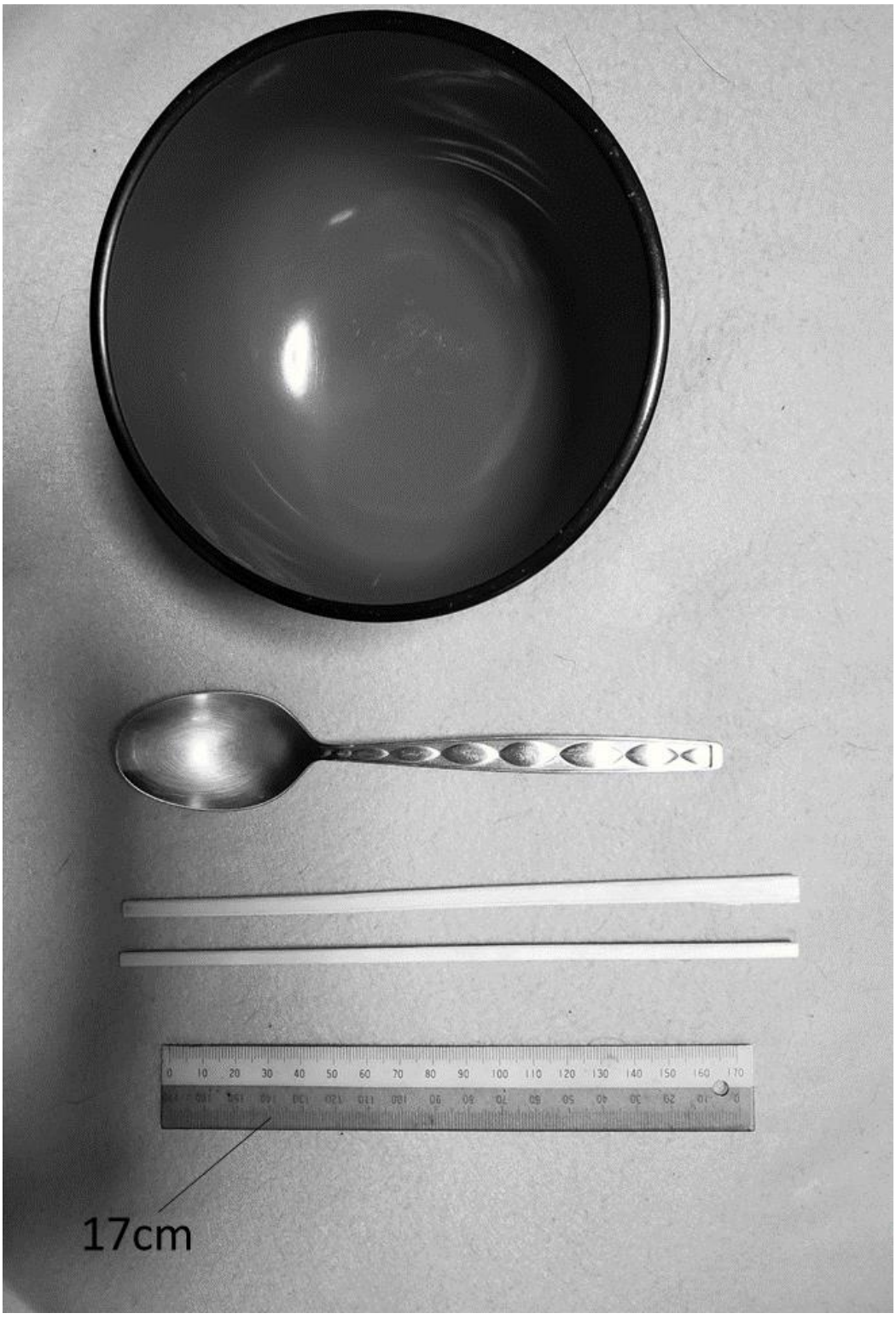



Fig.1 a bowl, chopsticks and a spoon

*Measurements of bite features*

Bitescan is a machine to record. Participants wore the device (Figure 2, 3). This device constructs the algorithm which identifies the amount of mastication by extraction difference between the features of wavelength and amplitude of mastication and other movements from the obtained waveform from an optical sensor and a triaxle acceleration sensor. Mastication that is recorded includes the following factor: Total time, total number of chewing, number of chewing for each picked up rice and speed of chewing. The device is connected to the smartphone via Bluetooth. Times of chewing is indicated immediately on smartphone. Total time, total number of chewing, number of chewing for each picked up rice and speed of chewing are checked on smartphone after measurement (Yoshio, Y., et al., 2018).

*Food*

Rice was used in this study because it is staple food in Japan and easy to eat with chopsticks and spoons (Ministry of Agriculture, Forestry and Fisheries, 2018). One of the microwave meals Sato-no-gohan which is Koshihikari from Niigata was used as rice. This study used one packs (200 g per pack). The amount of rice was referred to the meal balance guide issued by the Ministry of Health, Labor and Welfare. The standard for the amount of carbohydrates in one meal was equivalent to 200 g of rice. Pack of rice was warmed for two minutes with five hundred watts of power and the rice was kept for two minutes with the lid open to cool just before eating. All the rice was transferred from the pack to the bowl (Figure 1).

Fig. 2 Wearable device Bitescan


Fig. 3　Wearing Bitescan

*Statistics*

All data are provided as mean and SD. The non-parametric analysis was used for non-normally distributed data. Satiety level, total time, total number of chewing, speed of chewing, amount of rice for each picked up and number of chewing for each picked up rice were compared between when using chopsticks and a spoon using Wilcoxon signed-rank test. The level of statistical significance was set at $p < 0.05$. Statistical analyses were performed using SPSS software (version 25.0; SPSS, Tokyo, Japan).

**Results**

The average of satiety level were 6.2±1.7 and 6.3±1.9 for chopsticks and spoon, respectively. There was no significant difference in average of satiety level between chopsticks and spoon ($p > 0.05$) (Figure 4). The average of total number of chewing were 309.9 ± 133.9 and 319 ± 115.1 for chopsticks and spoon, respectively. There was no significant difference in average of total number of chewing between chopsticks and spoon ($p > 0.05$) (Figure 5). The average of number of chewing for each picked up were 23.8 ± 10.1 and 28 ± 10.7 for chopsticks and spoon, respectively. There was no significant difference in average of chewing for each picked up between chopsticks and spoon ($p > 0.05$) (Figure 6). The average of speed of chewing were 73.7 ± 8.8 and 76.7 ± 12.0 for chopsticks and spoon, respectively. There was no significant difference in average of speed of chewing between chopsticks and spoon ($p > 0.05$) (Figure 7). The average of total time were 5.8 ± 2.1 and 5.8 ± 1.7 for chopsticks and spoon, respectively. There was no significant difference in average of total time between chopsticks and spoon ($p > 0.05$) (Figure 8). The average of amount of rice for each picked up were 17.0 ± 7.4 and 18.9 ± 8.3 for chopsticks and

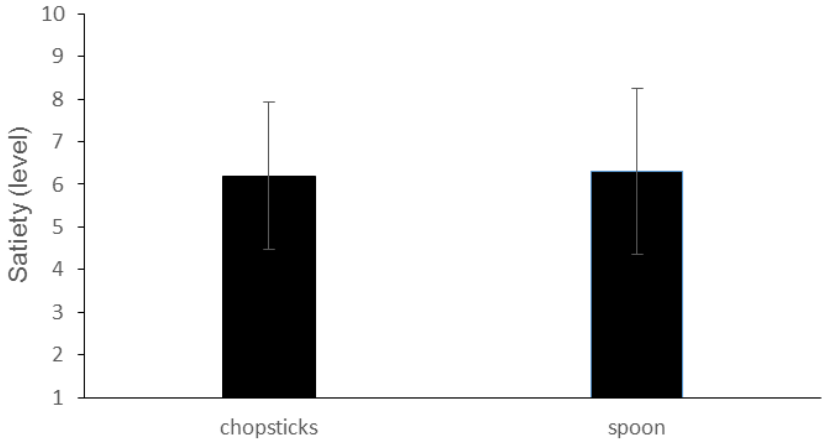



Fig. 4 The differences of satiety between chopsticks and a spoon. ($p > 0.05$)

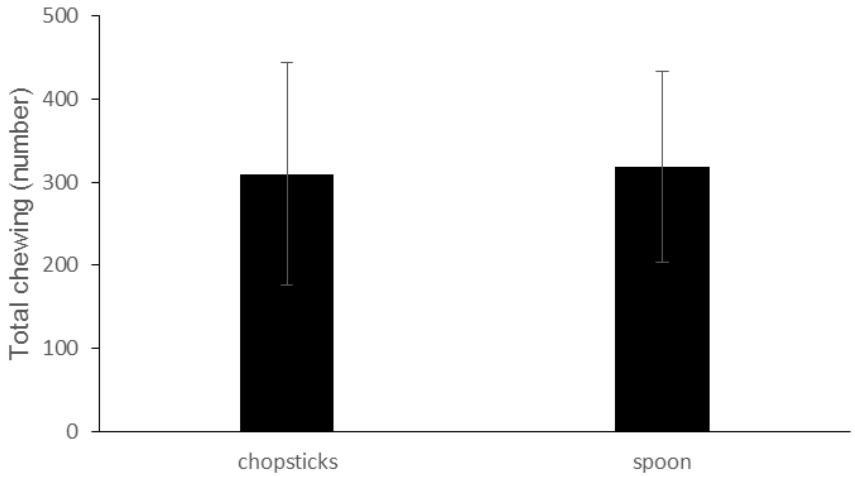



Fig. 5 The differences of total number of chewing between chopsticks and a spoon. ($p > 0.05$)

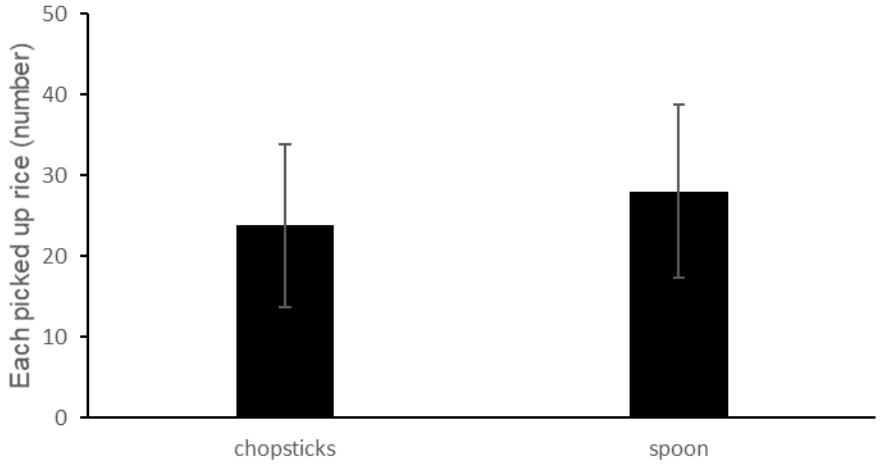



Fig. 6　The differences of number of chewing for each picked up rice between chopsticks and a spoon. ($p > 0.05$)

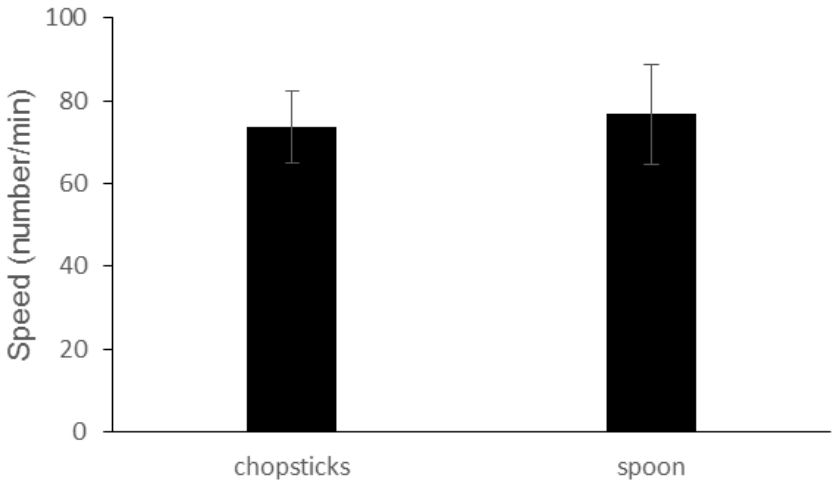



Fig. 7　The differences of speed of chewing between chopsticks and a spoon. ($p > 0.05$)

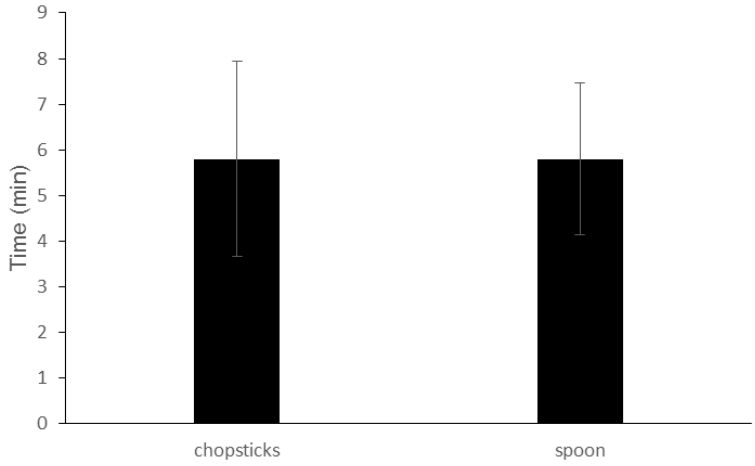



Fig. 8 The differences of total time between chopsticks and a spoon. ($p > 0.05$)

spoon, respectively. There was significant difference in average of amount of rice for each picked up between chopsticks and spoon ($p < 0.05$) (Figure 9).

**Discussion**

In the present study, a significant difference between chopsticks and a spoon was observed in amount of one bite as expected ($p < 0.05$). However, there were no significant differences in total time, total times of chewing, speed of chewing and number of chewing for each picked up rice between chopsticks and a spoon ($p > 0.05$). We consider that the reason why there was no significant difference in satiety is that there was no significant difference in the total number of chewing and total time because when chewing well, blood glucose level is increased then feel full (Fukuda, H., & Hirakawa, T., 2009; AF, Debons., I, Krimsky., & A, From., 1970). From previous studies, we predicted that there will be a difference in the number of chewing for each picked up rice when there is a difference in the amount of rice for each picked up (Kohyama, K., et al., 2014; Fukuda, H., & Hirakawa, T., 2009). However, this experiment suggests that there is no significant difference in number of chewing for each picked up rice when the difference in amount of rice for each picked up is small. This is because that the amount of food for each picked up is controlled to be doubled to tripled in previous studies (Kohyama, K., et al., 2014; Fukuda, H., & Hirakawa, T., 2009). When there is a significant difference in the amount of rice for each picked up and there is no significant difference in the total number of chewing, it is predicted that the number of chewing for each picked up rice is significantly higher with a spoon. The result of this study showed that there was no significant difference in the

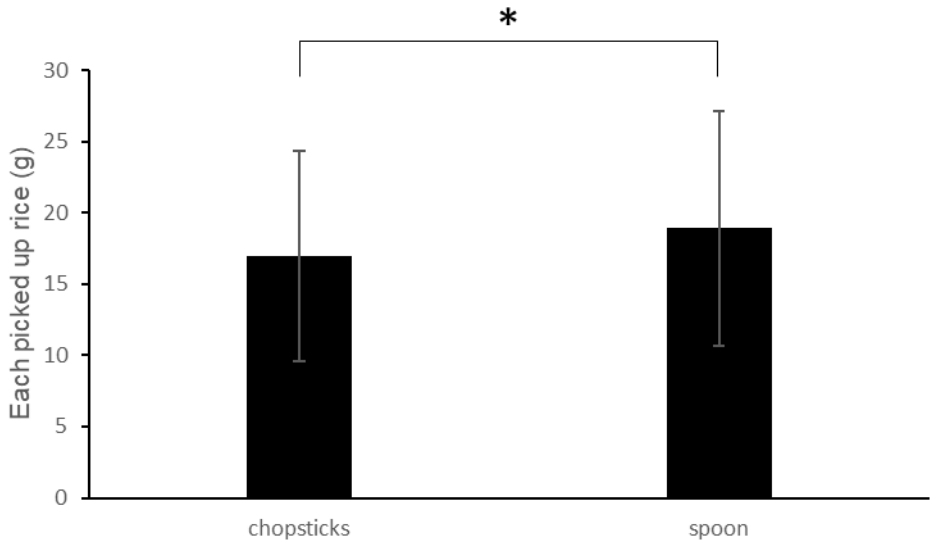



Fig. 9 The differences of amount of rice for each picked up between chopsticks and a spoon. (*$p < 0.05$)

number of chewing for each picked up rice as total number of chewing was very scattering data (Standard deviation, chopsticks: 309.9±133.9, spoons: 319±115.1).

In item of total number of chewing and number of chewing for each picked up, there was one participant who showed outlier. The average of total number of chewing when using a spoon was 1.1 times that when using chopsticks, whereas this participant showed 0.5 times. The average of number of chewing for each picked up when using a spoon was 1.2 times that when using chopsticks, whereas this participant showed 0.6 times. From these results, I determined that there was some abnormality in the measurement of this participant. Excepting one participant who showed outlier, total number of chewing, amount of rice for each picked up and number of chewing for each picked up were compared between when using chopsticks and a spoon by Wilcoxon signed-rank test as additional analysis. The average of total number of chewing were 289±124.7 and 324.3±120.1 for chopsticks and spoon, respectively. There was no significant difference in average of total number of chewing between chopsticks and spoon ($p > 0.05$). The average of amount of rice for each picked up were 17.3±7.7 and 19.3±8.6 for chopsticks and spoon, respectively. There was significant difference in average of amount of rice for each picked up between chopsticks and spoon ($p < 0.05$). The average of number of chewing for each picked up were 23.8±10.1 and 28±10.7 for chopsticks and spoon, respectively. There was significant difference in average of chewing per one between chopsticks and spoon ($p < 0.05$). These results suggest that the number of chewing for each picked up increases in direct proportion to the amount of rice for each picked up however, total number of chewing is unchanged. On other words, the difference in the amount of rice for each picked up between chopsticks and spoon is not enough to affect in satiety level and total number of chewing.

As mentioned above, the undernutrition for the elderly people is a problem, but the awareness of eating habits is high. Awareness about eating habits increases with age, and 77% (Men: 69%, Women: 85%) of elderly people over the 60's answers that they care the healthy meal (Ministry of Agriculture, Forestry and Fisheries, 2019). Hence, elderly people can expect to increase more the amount of food for each picked up by incorporating a spoon into their daily lives.

In conclusion, we compared the differences of the dietary intake between chopsticks and a spoon from the features of chewing. A significant difference between chopsticks and a spoon was observed in amount of one bite as expected. However, there were no significant differences between chopsticks and a spoon in total time, total number of chewing, speed of chewing and number of chewing per bite. From these results, we suggested that a spoon help increase amount of rice for each picked up.

**Acknowledgement**

This research was supported by the full support of Watanabe Lab. The authors are sincerely grateful to associate professor Watanabe Kohei (Chukyo University).

**References**

Adachi, T., Yamamoto, M., Saito, A., & Hotta, N. (2004). Dietary Intakes of University Handball players. Journal of Health Science, Kyushu University, 26：49－53.

AF, Debons., I, Krimsky., & A, From. (1970). A direct action of insulin on the hypothalamic satiety center. American Journal of Physiology. Vol. 219, No. 4

AM, Pedersen., A, Bardow., SB, Jensen., & B, Nauntofte. (2002). Saliva and gastrointestinal functions of taste, mastication, swallowing and digestion. Oral Diseases 8, 117–129

Cabinet office, Government of Japan. (2018). Annual Report on the Aging Society: 2018. https://www8.cao.go.jp/kourei/whitepaper/w-2018/gaiyou/pdf/1s1s.pdf

Fukuda, H., & Hirakawa, T. (2009). Effects of size and mouthful amount of foods on chewing. Annual review of human sciences

Ishizaki, Y. (2013). Nutritional management of high school football players. Annu. Rep. Fac. Life Sci. Biotechnol. Fukuyama Univ. (12), 17-42.

Jeejeebhoy, K. (2012). Malnutrition, fatigue, frailty, vulnerability, sarcopenia and cachexia: overlap of clinical features. Curr Opin Clin Nutr Metab Care. 2012 May;15(3):213-9

Kiwako, S., Hiroki, N., & Ryusuke, K. (2008). The effect of mastication on human cognitive processing: A study using event-related potentials. Clinical Neurophysiology 120 (2009) 41–50

Kohyama, K., Hayakawa, F., Gao, Z., & Ihara, S., et al.（2014）. Mouthful Size Effects on Mastication Effort of

Various Hydrocolloid Gels Used as Food Models. Food Science and Technology Research, 20 (6), 1121_1130

Morley, J., Argiles J., Evans W., & Bhasin S., et al. (2010). Nutritional recommendations for the management of sarcopenia. J Am Med Dir Assoc. 2010 Jul;11(6):391-6.

Nakata, T. (2008). The Relationship between Worsening Health and Retirement Process among Elderly Japanese People. Sociological Theory and Methods, vol.23, No1:57-72.

Nancy, C., Connie E, V., & Sheldon, M. (2005). Sports Nutrition for Young Athletes. The Journal of School Nursing Volume 21, Number 6.

Margo, M., Jorunn, S., Louise, B., & Susan, C., et al. (2014). The IOC consensus statement: beyond the Female Athlete Triad—Relative Energy Deficiency in Sport (RED-S). British Journal of Sports Medicine 2014; 48: 491–497.

Ministry of Agriculture, Forestry & Fisheries. (2019). Attitude survey report on food education Japan, 2019. http://www.maff.go.jp/j/syokuiku/ishiki/h31/pdf_index.html.

Ministry of Agriculture, Forestry and Fisheries. (2018). Related document over rice: 2018. http://www.maff.go.jp/j/seisan/kikaku/attach/pdf/kome_siryou-252.pdf

Ministry of Health, Labor and Welfare. (2018). Summary Results of the National Health and Nutrition Survey Japan, 2017. https://www.mhlw.go.jp/stf/houdou/0000177189_00001.html.

Nancy, R., Nancy, D., & Susie, L. (2009). Nutrition and Athletic Performance. Medicine and science in sports and exercise 41(3):709-31

Omi, N., Soga, H., Matsumoto, T., Kawamura, T., et al. (2005). The study of nutritional intake for male university athletes. Bull. Inst. Health & Sport Sci., Univ. of Tsukuba 28：67－72.

Shizuka, S., Manami, I., Ichiro, T., & Yumi, S., et al. (2011). Body mass index and mortality from all causes and major causes in Japanese: results of a pooled analysis of 7 large-scale cohort studies. J Epidemiol. 2011; 21(6):417-30. Epub 2011 Sep 10.

Simooka, R., Ayukawa, M., Kimachi, Y., & Iwami, M., et al. (2017). A Survey of Nutritional Status on High School Runners and an Examination of Nutrition Education Methods. Journal of the Faculty of Human Life Studies Hiroshima Jogakuin University 5: 17–25.

Tsubame shinko Industrial Co., Ltd. (2013, 4.25). History of cutlery "Spoon". Tsubame Shinko Cutlery Shop. 2019, https://www.sunao-tsubame.com/html/page16.html

Usui, T., Suruga, M., & Kurihara, S. (2003). Occlusal force and relevance to maxillofacial configuration-with Occlusal Force Meter-. The Journal of the Matsumoto Dental College Society

Visvanathan, R. (2003). Under-Nutrition in Older People: A Serious and Growing Global Problem. J Postgrad Med 2003;49: 352-360

Yamamoto, N. (2016, 8.5). How “chopsticks” dismissed candy and spread to 1.4 billion people in Asia. DIAMOND online. 2019, https://diamond.jp/articles/-/97935

Y, Hasegawa., T, Ono., K, Hori., & T, Nokubi. (2007). Influence of Human Jaw Movement on Cerebral Blood Flow. J Dent Res 86(1):64-68

Yoshio, Y., Kazuhiro, H., Fumiko, U., Motoki, T., Isao, S., & Takahiro, O. (2018). The monitoring of mastication using wearable device. The Journal of Japanese Society of Stomatognathic Function.

# Differences of Characteristics of Informing with Using SNS to Fans from Professional Football Clubs between Japan and Germany

国際社会系(渡邊ゼミ)

S116131

吉永翠

Midori Yoshinaga

**Abstract**

**Differences of Characteristics of Informing with Using SNS to Fans from Professional Football Clubs between Japan and Germany**

This study is intended as an investigation of difference of information contents via Twitter from professional football leagues in Japan (J1, 18 clubs) and Germany (1. Bundesliga, 18 clubs). The all gathered Tweets from clubs of both leagues in a year were classified into two categories. The Tweets which referred to football itself belonged to Category 1, and the other Tweets, which were not mentioned football were come under Category 2. To compare the Tweets from both leagues, Mann-Whitney test and Friedman test were performed. 1. Bundesliga clubs and J1 clubs posted totally 51,202 and 75,573 tweets, respectively. 1. Bundesliga clubs made greater level of the total Tweets, the amounts and the ratio of Tweets of Category 1 than J1 clubs significantly ($p < 0.05$), and in Category 2 it resulted in opposite situation ($p < 0.05$). Moreover, 1. Bundesliga clubs released Tweets in the larger amounts and in the higher ratio in off-season than J1 clubs ($p < 0.05$). In conclusion, 1. Bundesliga clubs tended to put stronger emphasis on informing to fans via Twitter, expressly relating to football, than J1 clubs.

**日本とドイツのプロサッカークラブの、SNS を利用したファンへの情報発信の特徴の違い**

本研究では、J1 リーグ（18 クラブ）とブンデスリーガ 1 部（18 クラブ）の全クラブにおける 1 年間の Twitter の投稿内容を分析した。収集された両リーグクラブのツイートは、サッカー競技自体に言及したツイート（カテゴリー 1）と、それ以外の競技に関係のないツイート（カテゴリー 2）に分離した。2 つのリーグのツイートを比べるため、Mann-Whitney 検定と Friedman 検定を用いた。J1 クラブとブンデスリーガ 1 部クラブの投稿数はそれぞれ 51,202、75,573 ツイートだった。ブンデスリーガ 1 部は合計ツイート数とカテゴリー 1 のツイート数・割合が J1 より有意に高く（$p$ <0.05）、カテゴリー 2 は逆の結果となった（$p$ <0.05）。さらにブンデスリーガ 1 部クラブは、J1 クラブと比べオフシーズンのツイート数・割合も有意に高かった ($p < 0.05$)。結論として、ブンデスリーガ 1 部クラブは、J1 クラブよりも Twitter を通したファンへの情報発信、特に競技に関連する情報を重視する傾向がみられる。

**Untersuchung zur Verschiedenheit der Informierung durch Fußballvereine mittels sozialer Medien in Japan und Deutschland**

Diese Untersuchung wurde ausgeführt, um die Verschiedenheit der Informationen zu Fans mittels Twitter zwischen japanischen und deutschen professionellen Fußballvereinen zu erforschen. Alle innerhalb eines Jahres gemachten Tweets beider Vereine wurden gesammelt und in zwei Kategorien unterteilt. Tweets welche einen Zusammenhang zu Fußball aufwiesen, wurden der Kategorie 1 zugeordnet, die restlichen Tweets der Kategorie 2. Die Daten (J1 51,202 Tweets und 1. Bundesliga 75,573 Tweets) wurden mittels des Mann-Whitney Tests sowie des Friedman Tests analysiert. Die Vereine der 1. Bundesliga machten bezüglich Kategorie 1 signifikant mehr Tweets, in absoluter und relativer Menge als Vereine der J1 und die Tweets der Kategorie 2 wiesen ein umgekehrtes Ergebnis auf ($p$ <0.05). Außerdem, war die absolute und relative Anzahl an Tweets außerhalb der Spielsaison von Vereinen der 1. Bundesliga bedeutende höher, als diejenigen der Vereine der J1 ($p$ <0.05). Folglich lag der Schwerpunkt der Informierung durch Twitter bei der 1. Bundesliga tendeziell stärker auf dem Thema Fußball.

**Introduction**

Germany has a professional football league called Bundesliga, which is one of the largest and the most famous leagues in the world. In 2017/18 season, the Financial Report in 2019 from Germany Football Association (DFL) reported that the league of first category of Bundesliga (1. Bundesliga) profited about €4 billion (€ 3,813,486,000) in all and the number is maximum revenue in the past the league. It is worthy of mention that the revenue exceeded former season for fourteenth consecutive season. On the other hand, the Club Financial Data List from J. LEAGUE in 2019 showed that Japanese professional football league of first category (J1) made a total profit of about ￥86 billion (￥85,597,000,000) in 2018 season. It was equivalent to about €719 million (€ 719,302,000) (EUR/JPY = 119) and accounted for 18% of 1. Bundesliga's total revenue in one season (Fig. 1). Moreover, the report by DFL emphasized that in 2017/18 season 17 of all 18 clubs belonging to 1. Bundesliga achieved €100 million of the proceeds respectively, and the case which 17 clubs got such results was for the first time in the history of Bundesliga. From the data list from J. LEAGUE the average of the proceeds by 18 clubs belonging to J1 in 2018 season was about ￥5 billion (￥4,755,000,000) and it can be converted into €39.95 million, and there was no club which reached to €100 million in all J1 clubs. From the perspective on the spectators, DFL reported that the total number of them in 2017/18 season was 13,426,855 for all 306 matches of 1. Bundesliga, and J. LEAGUE presented that in 2018 season J1 had 5,833,538 spectators for all 306 matches (Fig. 2). Bundesliga had an average of 43,879 spectators on one match, and J1 had 19,064 on it. Each Matchweek there are 9 matches in both leagues, so the data above could be calculated that every weekend 0.475% of German people visited stadium to watch professional football of their national first league and 0.136% of Japanese did so in

average (the Ministry of Public Management of Japan, 2018; the Ministry of Foreign Affairs of Japan, 2018). DFL also stated in Financial Report 2019 that in recent years Bundesliga acquired the most spectators in the world. Furthermore, in not only world football, Bundesliga is but also one of the most attractive professional sports leagues in the other world sports. Bundesliga is in third place of number of average attendances in the all sports leagues, and only two leagues, US National Football League and Indian cricket's Premier League have more average attendances than that of Bundesliga (Peter Kennedy &David Kennedy, 2012). It follows from what has been said that there is a great difference between the situation of these leagues of two countries.

It is completely clear that Japan stands higher level in aspects of the economy than Germany. Gross domestic product (GDP) of Japan is about $5 million ($4,970,915.56) and of Germany is about $4 million ($3,996,759.29) in 2018 (THE World Bank, 2019), whereas it is at quite opposite end when it comes to football. There are several reasons for this situation. One must be the length of history as culture or custom in each country. The population of playing football is the largest of all local sports clubs in Germany and long culture has been developed around local sports clubs (Tsuboi & Hagi, 2015). Another reason may be that the existence of the competitive sports. There is no doubt about the large-scale popularity, long history and great public culture of baseball in Japan. In the Meiji Era the concept of sport was imported from Western countries to Japan. Baseball and boat race were the first imported sports at the time, and football, tennis and track-and-field followed them (Kusaka, 1996), so baseball has a longer history than football in Japan, and Germany is in the opposite situation. Moreover, with the background of history of corporate sports, deep-seated amateurism still exists in Japan and media tend to use sports teams or athletes to get more audience rating, thus the situation in Japanese professional

sports is different from it in Germany to some extent (Nagata, 2011). However, another factor dealing with in this paper is the contents of Information given by clubs to fans through social media in both countries.

According to the official fan-survey of J. LEAGUE (2018), 87.9% of fans who watched football games in stadiums got information about J-league from the Internet, 39.8% of them from TV, 27.9% of them from daily newspapers and 9.3% from match programs they could get in stadiums (Fig. 3). It was likely that fans were much or less influenced by Web media surroundings, and they could decide their consumptive actions and form their disposition as fans. Recently with the increase of users of SNS, social networking service on Web aimed to communicate others, especially the micro blog has been paid attention by companies and corporations. The micro blog is the service which users can both inform like web blog and real-time communicate like web chat. Twitter is popular micro blog service, in December 2012 it had over 500 million user accounts (Yamamoto et al., 2013), and in October 2017 Twitter Japan reported it had over 45 million users in a month. Thus, Twitter is the social media to have very wide spread usage all over the world, and professional football clubs also follow this trend. At the present time every big club utilizes Twitter for marketing. It can allow clubs to build fan participation, heighten access to their website, and even develop sponsor programs to increase revenue (Kuzma et al., 2014). Twitter users can send a short sentence (Tweet) to the stream of other user's Tweet called Time-Line and watch real-time-posted Tweet to know other user or gather information about their interesting subjects or just have a fun. It is free, easy to use, very convenient and there are tremendous users all over the world, so in recent years some surveys which analyze trend of Tweets to clarify user's interest or attribute were conducted (Kobayashi et al., 2011). In February 2019 Vegalta Sendai established official Twitter account and it completed all J1 club official accounts.

All clubs of Bundesliga have already entered Twitter and made use of each official account. They use Twitter for marketing for tickets or goods, to keep up live commentary during a game, to show player's snapshots and videos, to inform events or new comers to team, to paste link for their Web site to raise access, and so on. Everyone can watch club's Tweets every time and everywhere, therefore now club's account has a great influence on consciousness of football fans. For example, FC Bayern München, the champion of Bundesliga for the seventh consecutive season, was followed by over 4 million users and made about 60,000 Tweets in October 2019. In other words, it could be assumed that what club informed through Twitter controlled fans and Twitter affected the professional football league market of their own countries. Sales staffs of clubs can easily target at specific fans and formulate a more effective marketing strategy in order to increase sales of tickets and attendance at stadiums (Pacheco et al., 2016).

The purpose of this study was to clarify the characteristics of information to fan via Twitter from Japanese and German professional football clubs. The information was divided into two patterns of characteristics in this paper, to relate to football or not. As stated above, German people live surrounded football culture as both a game sport and an entertainment. However, it seems that marketing target of J. LEAGUE and interest of many Japanese fans are a little different. Study by Nakazawa et al. (2000) said that ways for marketing of J. LEAGUE, especially targeting for female fans, tended to regard players as entertainers, and the ways seemed to be effective. That means many Japanese female fans prefer personal charm of football players. From J. LEAGUE PUB REPORT (2018), 37.9% of spectators were female fans, so clubs cannot disregard them as targets, and it is natural to depend on such marketing. The study aimed to show that there were differences of the amounts

and the ratio of the Tweets relating football between Japan and Germany leagues, which had different backgrounds. In this paper I hypothesized that Bundesliga clubs make larger amount and higher ratio of Tweets relating football than J. LEAGUE clubs, and J. LEAGUE clubs released larger amount and higher ratio of Tweets non-relating football than Bundesliga clubs. I estimated that J. LEAGUE clubs also released the more total amount of Tweets, and the reason was that Japanese was in 5th in the rank of language by number of Twitter users worldwide, and German was in 6th (Mocanu et al., 2013). Although it seemed that in off-season clubs of both leagues made fewer Tweets totally than in season, even it may be assumed that Bundesliga clubs also keep more Tweets relating football than J. LEAGUE clubs.

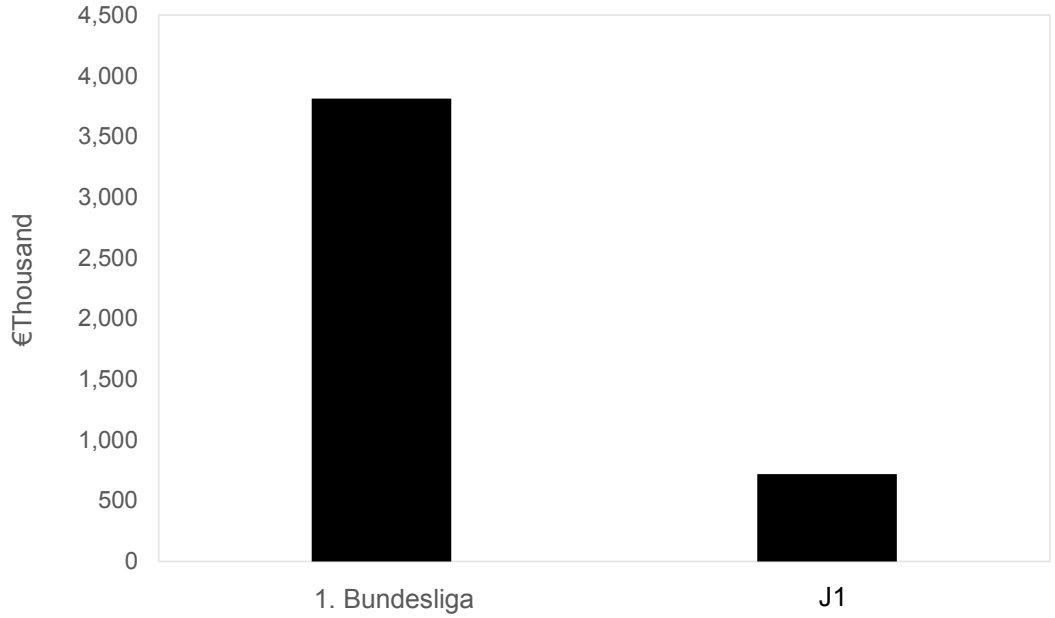



Fig. 1: The avenue of J1 (season 2018) and 1. Bundesliga (season 2017/18) made by author based on data from the Financial Report in 2019 from DFL and the Club Financial Data List from J. LEAGUE.

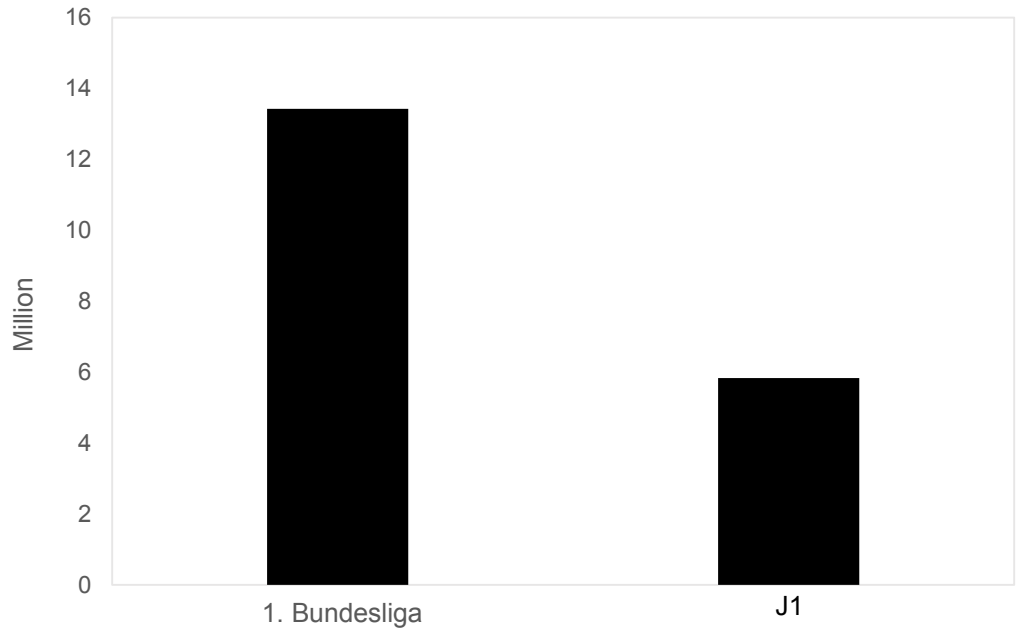



Fig. 2: The total spectators in one season of J1 (season 2018) and 1. Bundesliga (season 2017/18) made by author based on data from the Financial Report in 2019 from DFL and J. LEAGUE Data Site.

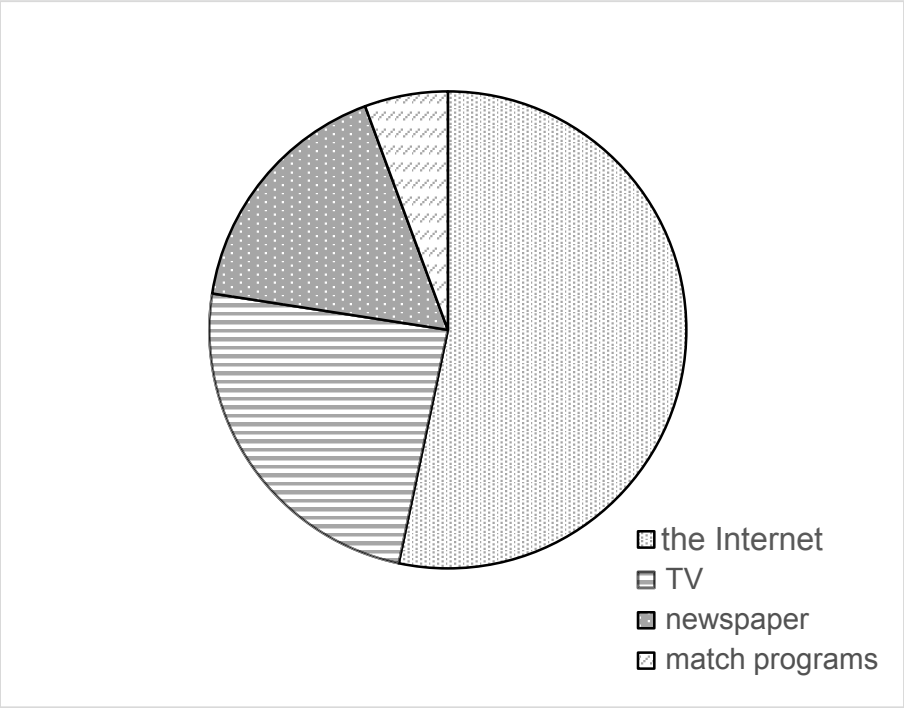



Fig. 3: The rate of how fans get information about J.LEAGUE games made by author based on data from J. LEAGUE FAN SURVEY 2018 SUMMARY REPORT.

**Methods**

*Experimental design*

Tweets from all official accounts of professional football clubs in first league both in Japan (J1) and in Germany (1. Bundesliga) were gathered and categorized into two types of contents (Details are shown below) (Table 1). The term of this survey was fixed on one a year, from 1. October 2018 to 30. September 2019. The reason to settle this term was that until February 2019 Vegalta Sendai had no official account of Twitter, and World Cup held in Russia which lasted until July 2019 changed match plans of both leagues and the contents of club's Tweets became unusually. Therefore, this term was used in order to catch all club's usual Tweets as much as possible.

*Data analysis*

Tweets were classified into two categories according to their contents, mention, and theme. Category 1 called in this paper was for information about football itself as a game sport (Fig 4, 5). Tweets with sentences, videos, pictures or URLs of result, live commentary, match highlight, match preview and statistics of games and so on were sorted into Category 1. When main contents were referred to game, press conference and coach's or player's interview were applied to Category 1, too. The other information, which meant contents excluding about football itself as a game sport, namely, off the pitch information, were classified into Category 2 (Fig 6, 7). For example, gratitude or communicating with fans, marketing of merchandise like goods, tickets, tours and foods in stadium, snapshots of players, event information, show the club mascot, and the others like an anniversary, someone's birthday, news of birth and death were applicable to Category 2. ReTweet, the function of Twitter

which user can show other user's Tweets on his or her own account was not countable in both categories because it was just information from another account. However, quotation ReTweet, which user can take own comments on other user's Tweets, was included in count. Reply, the function which user can send messages to other user' s Tweets was countable when it was sent to another official accounts like players of the club, other clubs, or sponsoring companies, for every user can watch the exchange of comments easily. Of course, Reply to non-official accounts was uncountable on this survey. A Tweet which mentioned both categories, was judged on which contents of category were focused on mainly. Attached videos, pictures or URLs could help these judgments. When it came to Tweets with URLs which only pay members could entry, lead sentences and thumb nail pictures could also help to categorize. Gathered Tweets were classified into two categories according to main contents, and were classified simultaneously by clubs, by the timings (in season or in off-season), and by months. During the research term (from 1. October 2018 to 30. September 2019), season of J1 lasted from 1. October 2018 to 1. December 2018, from 22. February 2019 to 30. September and of 1. Bundesliga lasted from 1. October 2018 to 18. May 2109, 16. August to 30. September 2019.

*Statistics*

In this study total 126,775 Tweets were gathered and they were classified into (ⅰ) the amounts of Tweets of Category 1 and 2 from J1 and 1. Bundesliga clubs, (ⅱ) the amounts of Tweets in season and off-season from J1 and 1. Bundesliga clubs. These data were computed (ⅲ) the ratio of Tweets of Category 1 and 2 from J1 and 1. Bundesliga clubs and (ⅳ) the ratio of Tweets in season and off-season from J1 and 1. Bundesliga clubs. In addition to that, (ⅴ) the monthly total amounts of Tweets, (ⅵ) the monthly amounts of Category 1 and 2, and (ⅶ)

the monthly ratio of Category 1 and 2 from J1 and 1. Bundesliga clubs were classified. From the results of Shapiro-Wilk test, detected data were not normally distributed in this study. Therefore, this study used non-parametric analysis. The total amounts of Tweets, (ⅰ) the amounts of Tweets of Category 1 and 2, (ⅱ) the amounts of Tweets in season and off-season, (ⅲ) the ratio of Tweets of Category 1 and 2, (ⅳ) the ratio of Tweets in season and off-season were compared by Mann-Whitney test. (ⅴ) The monthly total amounts of Tweets, (ⅵ) the monthly amounts of Category 1 and 2 and (ⅶ) the monthly ratio of Category 1 and 2 were analyzed by Friedmann test to detect differences in each month of J1 and 1. Bundesliga clubs respectively. These statistical analyses were performed with SPSS software (version 15.0; SPSS, Tokyo, Japan).

| Club (J1) | Official Twitter account | Club (1. Bundesliga) | Official Twitter account |
|---|---|---|---|
| Hokkaido Consadole Sapporo | @consaofficial | SV Werder Bremen | @werderbremen |
| Vegalta Sendai | @vega_official_ | VfL Wolfsburg | @VfL_Wolfsburg |
| Kashima Antlers | @antlrs_official | Hertha BSC | @HerthaBSC |
| Urawa Reds | @REDSOFFICIAL | 1. FC Union Berlin | @fcunion |
| FC Tokyo | @fctokyooficial | SC Parderborn 07 | @SCParderborn07 |
| Kawasaki Frontale | @frontale_staff | RB Leipzig | @DieRotenBullen |
| Yokohama F. Marinos | @prompt_fmarinos | FC Schalke 04 | @s04 |
| Shonan Bellmare | @bellmare_staff | Borussia Dortmund | @BVB |
| Shimizu S-pulse | @spulse_official | Borussia Mönchengladbach | @borussia |
| Jubilo Iwata | @Jubiloiwata_YFC | Bayer 04 Leverkusen | @bayer04official |
| Matsumoto Yamaga FC | @yamagafc | Fortuna Düsseldorf | @f95 |
| Nagoya Grampus | @nge_official | 1. FC Köln | @fckoeln |
| Gamba Osaka | @GAMBA_OFFICIAL | Eintracht Frankfurt | @Eintracht |
| Cerezo Osaka | @crz_official | 1. FSV Mainz 05 | @1FSVMainz05 |
| Vissel Kobe | @visselkobe | TSG Hoffenheim | @tsghoffenheim |
| Sanfrecce Hiroshima | @sanfrecce_SFC | FC Augsburg | @FCAugsburg |
| Sagan Tosu | @saganofficial17 | FC Bayern München | @FCBayern |
| Oita Torinita | @TRINITAofficial | SC Freiburg | @scfreiburg |

Table 1: J1 and 1. Bundesliga Clubs, and their Twitter official accounts used in this survey.


Fig.4: Examples for Tweets of Category1 from J1 clubs.

Left: Live commentary of a game.　Right: A column of match review and explanation for team tactics.


Fig.5: Examples for Tweets of Category1 from 1. Bundesliga clubs.

Left: Data and statistics on next games.  Right: Comments on a previous game from coach in press conference.


Fig.6: Examples for Tweets of Category2 from J1 clubs.

Left: The sales promotion of goods in stadium.  Right: The sales promotion of original foods in stadium.


Fig.7: Examples for Tweets of Category2 from 1. Bundesliga clubs.

Left: A celebration of a player's birthday. Right: Information on an event of a club mascot.

**Results**

( ⅰ ) The amounts of Tweets of Category 1 and 2 from J1 and 1. Bundesliga clubs are showed in Table 2, ( ⅱ ) the amounts of Tweets in season and off-season from J1 and 1. Bundesliga clubs are showed in Table 3. ( ⅲ ) The ratio of Tweets of Category 1 and 2 from J1 and 1. Bundesliga clubs are explained in Table 4, and in Table 5 ( ⅳ ) the ratio of Tweets in season and off-season from J1 and 1. Bundesliga clubs are displayed. ( ⅴ ) The monthly amounts of Tweets are described in Table 6, 7, ( ⅵ ) the ratio of Category 1 and 2 in each month from J1 clubs are showed in Table 8, 9, and 1. Bundesliga clubs are showed in Table 10, 11.

A significant difference was seen in the total amounts of Tweets between J1 and 1. Bundesliga clubs ($p < 0.05$) (Table 12), the amounts of Tweets of Category 1 between J1 and 1. Bundesliga clubs ($p < 0.05$) (Table 13), and both amounts of Tweets from 1. Bundesliga clubs were larger than J1's. However, in Category 2 there was no significant difference between these two leagues ($p > 0.05$) (Table 13). In the ratio of Tweets of Category 1 and 2 between J1 and 1. Bundesliga clubs, a significant difference was noted ($p < 0.05$) and in the ratio of Tweets of Category 1, 1. Bundesliga clubs were noted higher degree (Table 13). On the whole, J1 clubs made less Tweets but the ratio of Tweets of Category 2 was higher than 1. Bundesliga clubs. Both in season and off-season, significant differences were noted in the amounts and the ratio of Tweets between J1 and 1. Bundesliga clubs ($p < 0.05$) (Table 14). These data pointed out that more amounts of Tweets both in season and off-season were made by 1. Bundesliga clubs than J1 clubs, and in season the difference was smaller than in off-season (Table 14). The ratio of Tweets in season of a year made by J1 clubs were higher than of 1. Bundesliga clubs (Table 14). Comparing the groups of Tweets made in each month, I set a standard group of a month to judge differences of the

amounts and the ratio of Category 1 and 2 of Tweets from other months in J1 and 1. Bundesliga clubs respectively. The group of Tweets released in August from J1 clubs was set as a standard group (after six months from season beginning), and the total amounts of Tweets of this group differed significantly from the groups of November and December 2018, January, February and September 2019. *(p* < 0.05) (Table 15). These all groups were lower level of the amounts of total Tweets than the standard group. From the groups of January and February 2019 of J1 significant increases were noted in the ratio of Category 2 and significant decreases of the ratio in Category 1 followed *(p* < 0.05) (Table 15). In February the group of Tweets made from 1. Bundesliga clubs was fixed a standard group (after six months from season beginning). Comparing with this group, the total amounts of Tweets were significantly decreased in group of June 2019 *(p* < 0.05) (Table 16). Significantly differences were also noted in the groups of January, May and July 2019 in the ratio of Category 1 and 2 of Tweets from 1. Bundesliga *(p* < 0.05) (Table 16). The ratio of these groups in Category 2 were higher than the standard group. Thus, these monthly data represented that in off-season (J1: 2. December 2018 to 21. February 2019, 1. Bundesliga: 19. May to 15. August 2019) clubs of both leagues tend to make less Tweets than in season, as we can also recognize with Table 14. Moreover, J1 clubs released fewer Tweets in early and at the end of season besides in off-season (Table 15).

| | Category 1 | Category 2 | Total | | Category 1 | Category 2 | Total |
|---|---|---|---|---|---|---|---|
| Sapporo | 980 | 1007 | 1987 | SVW | 4721 | 1660 | 6381 |
| Sendai | 377 | 468 | 845 | WOB | 2107 | 806 | 2913 |
| Kashima | 1956 | 1564 | 3520 | BSC | 3011 | 1177 | 4188 |
| Urawa | 801 | 1539 | 2340 | FCU | 1256 | 591 | 1847 |
| FC.Tokyo | 2005 | 2028 | 4033 | SCP | 1370 | 397 | 1767 |
| Kawasaki | 488 | 2844 | 3332 | RBL | 2967 | 1424 | 4391 |
| F.Marinos | 758 | 590 | 1348 | S04 | 3890 | 2037 | 5927 |
| Shonan | 795 | 1406 | 2201 | BVB | 3736 | 1614 | 5350 |
| Shimizu | 1273 | 1440 | 2713 | BMG | 2583 | 1181 | 3764 |
| Iwata | 783 | 687 | 1470 | B04 | 4231 | 1791 | 6022 |
| Matsumoto | 1462 | 2616 | 4078 | F95 | 2769 | 1318 | 4087 |
| Nagoya | 1566 | 1649 | 3215 | KOE | 2482 | 954 | 3436 |
| G.Osaka | 4282 | 2255 | 6537 | SGE | 5222 | 1927 | 7149 |
| C.Osaka | 1887 | 2108 | 3995 | M05 | 1841 | 637 | 2478 |
| Kobe | 1149 | 753 | 1902 | TSG | 2867 | 1124 | 3991 |
| Hiroshima | 779 | 1521 | 2300 | FCA | 3001 | 761 | 3762 |
| Tosu | 1300 | 849 | 2149 | FCB | 3900 | 1633 | 5533 |
| Oita | 2034 | 1203 | 3237 | SCF | 2018 | 569 | 2587 |

Table 2: The amounts of Tweets of Category 1 and 2 from J1 and 1. Bundesliga clubs.

| | Season | Off-season | Total | | Season | Off-season | Total |
|---|---|---|---|---|---|---|---|
| Sapporo | 1690 | 297 | 1987 | SVW | 5287 | 1094 | 6381 |
| Sendai | 845 | | 845 | WOB | 2335 | 578 | 2913 |
| Kashima | 2981 | 539 | 3520 | BSC | 3386 | 802 | 4188 |
| Urawa | 1963 | 377 | 2340 | FCU | 1392 | 455 | 1847 |
| FC.Tokyo | 3381 | 652 | 4033 | SCP | 1370 | 397 | 1767 |
| Kawasaki | 2531 | 801 | 3332 | RBL | 3536 | 855 | 4391 |
| F.Marinos | 1092 | 256 | 1348 | S04 | 4772 | 1155 | 5927 |
| Shonan | 1804 | 397 | 2201 | BVB | 4317 | 1033 | 5350 |
| Shimizu | 2269 | 444 | 2713 | BMG | 3066 | 698 | 3764 |
| Iwata | 1330 | 140 | 1470 | B04 | 4903 | 1119 | 6022 |
| Matsumoto | 3282 | 796 | 4078 | F95 | 3293 | 794 | 4087 |
| Nagoya | 2805 | 410 | 3215 | KOE | 2702 | 734 | 3436 |
| G.Osaka | 5812 | 725 | 6537 | SGE | 5785 | 1364 | 7149 |
| C.Osaka | 3510 | 485 | 3995 | M05 | 2086 | 392 | 2478 |
| Kobe | 1623 | 279 | 1902 | TSG | 3366 | 625 | 3991 |
| Hiroshima | 1926 | 374 | 2300 | FCA | 3149 | 613 | 3762 |
| Tosu | 1902 | 247 | 2149 | FCB | 4320 | 1213 | 5533 |
| Oita | 2897 | 340 | 3237 | SCF | 2179 | 408 | 2587 |

Table 3: The amounts of Tweets in season and off-season from J1 and 1. Bundesliga clubs.

| | Category 1 | Category 2 | | Category 1 | Category 2 |
|---|---|---|---|---|---|
| Sapporo | 49.32 | 50.68 | SVW | 73.99 | 26.01 |
| Sendai | 44.62 | 55.38 | WOB | 72.33 | 27.67 |
| Kashima | 55.57 | 44.43 | BSC | 71.90 | 28.10 |
| Urawa | 34.23 | 65.77 | FCU | 68.00 | 32.00 |
| FC.Tokyo | 49.71 | 50.29 | SCP | 77.53 | 22.47 |
| Kawasaki | 14.65 | 85.35 | RBL | 67.57 | 32.43 |
| F.Marinos | 56.23 | 43.77 | S04 | 65.63 | 34.37 |
| Shonan | 36.12 | 63.88 | BVB | 69.83 | 30.17 |
| Shimizu | 46.92 | 53.08 | BMG | 68.62 | 31.38 |
| Iwata | 53.27 | 46.73 | B04 | 70.26 | 29.74 |
| Matsumoto | 35.85 | 64.15 | F95 | 67.75 | 32.25 |
| Nagoya | 48.71 | 51.29 | KOE | 72.24 | 27.76 |
| G.Osaka | 65.50 | 34.50 | SGE | 73.05 | 26.95 |
| C.Osaka | 47.23 | 52.77 | M05 | 74.29 | 25.71 |
| Kobe | 60.41 | 39.59 | TSG | 71.84 | 28.16 |
| Hiroshima | 33.87 | 66.13 | FCA | 79.77 | 20.23 |
| Tosu | 60.49 | 39.51 | FCB | 70.49 | 29.51 |
| Oita | 62.84 | 37.16 | SCF | 78.01 | 21.99 |

Table 4: The ratio of Tweets of Category 1 and 2 from J1 and 1. Bundesliga clubs.

| | Season | Off-season | | Season | Off-season |
|---|---|---|---|---|---|
| Sapporo | 85.05 | 14.95 | SVW | 82.86 | 17.14 |
| Sendai | | | WOB | 80.16 | 19.84 |
| Kashima | 84.69 | 15.31 | BSC | 80.85 | 19.15 |
| Urawa | 83.89 | 16.11 | FCU | 75.37 | 24.63 |
| FC.Tokyo | 83.83 | 16.17 | SCP | 77.53 | 22.47 |
| Kawasaki | 75.96 | 24.04 | RBL | 80.53 | 19.47 |
| F.Marinos | 81.01 | 18.99 | S04 | 80.51 | 19.49 |
| Shonan | 81.96 | 18.04 | BVB | 80.69 | 19.31 |
| Shimizu | 83.63 | 16.37 | BMG | 81.46 | 18.54 |
| Iwata | 90.48 | 9.52 | B04 | 81.42 | 18.58 |
| Matsumoto | 80.48 | 19.52 | F95 | 80.57 | 19.43 |
| Nagoya | 87.25 | 12.75 | KOE | 78.64 | 21.36 |
| G.Osaka | 88.91 | 11.09 | SGE | 80.92 | 19.08 |
| C.Osaka | 87.86 | 12.14 | M05 | 84.18 | 15.82 |
| Kobe | 85.33 | 14.67 | TSG | 84.34 | 15.66 |
| Hiroshima | 83.74 | 16.26 | FCA | 83.71 | 16.29 |
| Tosu | 88.51 | 11.49 | FCB | 78.08 | 21.92 |
| Oita | 89.50 | 10.50 | SCF | 84.23 | 15.77 |

Table 5: The ratio of Tweets in season and off-season from J1 and 1. Bundesliga clubs.

Table 6: The monthly amounts of Tweets from J1 clubs.

| | Oct, 2018 | Nov, 2018 | Dec, 2018 | Jan, 2019 | Feb, 2019 | Mar, 2019 | Apr, 2019 | May, 2019 | Jun, 2019 | Jul, 2019 | Aug, 2019 | Sep, 2019 | 1 season |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sapporo** | 131 | 157 | 118 | 132 | 106 | 200 | 190 | 160 | 171 | 194 | 246 | 182 | 1987 |
| **Sendai** | | | | | 18 | 99 | 129 | 111 | 136 | 117 | 135 | 100 | 845 |
| **Kashima** | 342 | 287 | 266 | 166 | 206 | 289 | 321 | 310 | 302 | 346 | 351 | 334 | 3520 |
| **Urawa** | 175 | 172 | 164 | 95 | 186 | 237 | 218 | 254 | 203 | 213 | 225 | 198 | 2340 |
| **FC.Tokyo** | 284 | 273 | 245 | 266 | 207 | 409 | 457 | 381 | 414 | 394 | 412 | 291 | 4033 |
| **Kawasaki** | 271 | 244 | 242 | 381 | 240 | 282 | 249 | 310 | 183 | 399 | 288 | 243 | 3332 |
| **F.Marinos** | 99 | 101 | 78 | 104 | 116 | 136 | 148 | 137 | 119 | 116 | 130 | 64 | 1348 |
| **Shonan** | 256 | 144 | 149 | 148 | 163 | 209 | 202 | 242 | 163 | 175 | 205 | 145 | 2201 |
| **Shimizu** | 251 | 262 | 147 | 186 | 198 | 197 | 238 | 222 | 259 | 243 | 264 | 246 | 2713 |
| **Iwata** | 77 | 66 | 55 | 44 | 61 | 156 | 168 | 165 | 228 | 167 | 180 | 103 | 1470 |
| **Matsumotc** | 379 | 360 | 258 | 250 | 340 | 326 | 365 | 418 | 354 | 388 | 333 | 307 | 4078 |
| **Nagoya** | 256 | 236 | 160 | 156 | 201 | 357 | 349 | 359 | 314 | 277 | 337 | 213 | 3215 |
| **G.Osaka** | 503 | 588 | 311 | 267 | 349 | 706 | 660 | 670 | 674 | 571 | 700 | 538 | 6537 |
| **C.Osaka** | 234 | 289 | 165 | 164 | 263 | 367 | 427 | 436 | 376 | 509 | 381 | 384 | 3995 |
| **Kobe** | 111 | 109 | 101 | 111 | 113 | 208 | 169 | 170 | 192 | 205 | 254 | 159 | 1902 |
| **Hiroshima** | 122 | 164 | 114 | 127 | 208 | 211 | 265 | 217 | 172 | 255 | 210 | 235 | 2300 |
| **Tosu** | 189 | 174 | 88 | 76 | 151 | 210 | 237 | 256 | 191 | 185 | 263 | 129 | 2149 |
| **Oita** | 277 | 248 | 119 | 140 | 135 | 358 | 302 | 350 | 421 | 291 | 326 | 270 | 3237 |
| **avarage** | 232.76 | 227.88 | 163.53 | 165.47 | 181.11 | 275.39 | 283.00 | 287.11 | 270.67 | 280.28 | 291.11 | 230.06 | 2844.56 |

Table 7: The monthly amounts of Tweets from 1. Bundesliga clubs.

| | Oct, 2018 | Nov, 2018 | Dec, 2018 | Jan, 2019 | Feb, 2019 | Mar, 2019 | Apr, 2019 | May, 2019 | Jun, 2019 | Jul, 2019 | Aug, 2019 | Sep, 2019 | 1 season |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SVW** | 561 | 521 | 553 | 597 | 667 | 552 | 698 | 437 | 167 | 480 | 626 | 522 | 6381 |
| **WOB** | 176 | 225 | 273 | 213 | 253 | 277 | 256 | 280 | 122 | 224 | 338 | 276 | 2913 |
| **BSC** | 343 | 362 | 336 | 368 | 410 | 372 | 338 | 408 | 110 | 386 | 405 | 350 | 4188 |
| **FCU** | 181 | 147 | 148 | 113 | 136 | 141 | 153 | 220 | 83 | 180 | 202 | 143 | 1847 |
| **SCP** | 143 | 138 | 93 | 116 | 185 | 147 | 159 | 156 | 72 | 190 | 213 | 155 | 1767 |
| **RBL** | 457 | 362 | 394 | 271 | 293 | 330 | 567 | 478 | 157 | 326 | 394 | 362 | 4391 |
| **S04** | 533 | 617 | 536 | 427 | 537 | 534 | 522 | 444 | 346 | 455 | 510 | 466 | 5927 |
| **BVB** | 546 | 546 | 489 | 374 | 496 | 499 | 415 | 403 | 251 | 354 | 511 | 466 | 5350 |
| **BMG** | 398 | 320 | 339 | 303 | 277 | 298 | 356 | 339 | 162 | 232 | 400 | 340 | 3764 |
| **B04** | 622 | 515 | 518 | 377 | 696 | 564 | 443 | 403 | 224 | 580 | 587 | 493 | 6022 |
| **F95** | 339 | 356 | 314 | 403 | 347 | 336 | 352 | 337 | 158 | 369 | 417 | 359 | 4087 |
| **KOE** | 292 | 258 | 286 | 228 | 310 | 275 | 319 | 336 | 175 | 300 | 361 | 296 | 3436 |
| **SGE** | 630 | 540 | 622 | 474 | 570 | 688 | 680 | 743 | 250 | 591 | 763 | 598 | 7149 |
| **M05** | 259 | 232 | 232 | 313 | 246 | 186 | 193 | 189 | 96 | 168 | 201 | 163 | 2478 |
| **TSG** | 445 | 400 | 393 | 315 | 338 | 373 | 386 | 283 | 121 | 294 | 395 | 248 | 3991 |
| **FCA** | 401 | 265 | 325 | 272 | 357 | 342 | 435 | 259 | 127 | 257 | 353 | 369 | 3762 |
| **FCB** | 477 | 472 | 464 | 355 | 451 | 488 | 466 | 673 | 162 | 456 | 604 | 465 | 5533 |
| **SCF** | 223 | 214 | 236 | 209 | 226 | 278 | 236 | 202 | 70 | 197 | 300 | 196 | 2587 |
| **avarage** | 390.33 | 360.56 | 363.94 | 318.22 | 377.50 | 371.11 | 387.44 | 366.11 | 158.50 | 335.50 | 421.11 | 348.17 | 349.88 |

Table 8: The monthly ratio of Category 1 from J1 clubs.

| | Oct, 2018 | Nov, 2018 | Dec, 2018 | Jan, 2019 | Feb, 2019 | Mar, 2019 | Apr, 2019 | May, 2019 | Jun, 2019 | Jul, 2019 | Aug, 2019 | Sep, 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sapporo** | 48.85 | 41.40 | 33.90 | 40.15 | 19.81 | 50.00 | 61.58 | 58.75 | 69.59 | 45.88 | 53.25 | 47.80 |
| **Sendai** | | | | | 22.22 | 44.44 | 41.86 | 46.85 | 48.53 | 48.72 | 42.96 | 42.00 |
| **Kashima** | 64.33 | 66.20 | 67.67 | 47.59 | 49.51 | 57.09 | 56.39 | 57.42 | 53.31 | 40.46 | 47.01 | 58.38 |
| **Urawa** | 29.71 | 34.88 | 35.98 | 16.84 | 16.13 | 36.29 | 38.99 | 29.92 | 40.39 | 40.38 | 38.22 | 41.92 |
| **FC.Tokyo** | 43.66 | 47.62 | 33.06 | 22.18 | 37.20 | 60.88 | 48.36 | 60.63 | 56.76 | 55.58 | 49.03 | 60.82 |
| **Kawasaki** | 8.86 | 13.52 | 20.66 | 10.24 | 8.75 | 17.38 | 22.09 | 20.65 | 18.03 | 13.78 | 10.76 | 13.99 |
| **F.Marinos** | 52.53 | 56.44 | 46.15 | 45.19 | 49.14 | 56.62 | 64.86 | 61.31 | 52.94 | 56.90 | 61.54 | 67.19 |
| **Shonan** | 33.59 | 26.39 | 30.87 | 21.62 | 15.95 | 38.28 | 42.57 | 38.02 | 36.20 | 49.14 | 52.68 | 38.62 |
| **Shimizu** | 32.67 | 51.91 | 25.17 | 17.20 | 39.90 | 60.91 | 62.18 | 61.26 | 57.53 | 45.68 | 48.86 | 46.34 |
| **Iwata** | 68.83 | 46.97 | 47.27 | 45.45 | 52.46 | 64.74 | 52.38 | 50.30 | 43.42 | 61.08 | 44.44 | 66.02 |
| **Matsumoto** | 32.45 | 33.33 | 21.71 | 40.40 | 31.47 | 43.25 | 47.95 | 40.19 | 34.46 | 35.31 | 38.44 | 27.36 |
| **Nagoya** | 40.63 | 50.00 | 49.38 | 39.74 | 35.32 | 47.34 | 52.72 | 51.81 | 53.82 | 47.65 | 51.04 | 56.34 |
| **G.Osaka** | 59.84 | 65.48 | 56.91 | 34.46 | 36.96 | 71.67 | 72.73 | 72.09 | 76.85 | 68.13 | 67.00 | 65.61 |
| **C.Osaka** | 46.58 | 36.33 | 56.36 | 54.88 | 34.60 | 59.40 | 43.79 | 50.92 | 54.52 | 39.10 | 45.93 | 50.26 |
| **Kobe** | 55.86 | 56.88 | 56.44 | 33.33 | 43.36 | 65.38 | 76.33 | 70.00 | 66.15 | 54.15 | 65.35 | 59.12 |
| **Hiroshima** | 18.03 | 15.24 | 36.84 | 31.50 | 25.96 | 38.86 | 35.09 | 41.47 | 38.37 | 54.15 | 40.48 | 39.57 |
| **Tosu** | 47.62 | 45.98 | 51.14 | 52.63 | 53.64 | 69.05 | 65.40 | 61.33 | 60.21 | 54.15 | 69.96 | 66.67 |
| **Oita** | 58.12 | 56.45 | 46.22 | 41.43 | 54.07 | 63.41 | 72.52 | 64.86 | 67.93 | 54.15 | 68.10 | 67.04 |

| | Oct, 2018 | Nov, 2018 | Dec, 2018 | Jan, 2019 | Feb, 2019 | Mar, 2019 | Apr, 2019 | May, 2019 | Jun, 2019 | Jul, 2019 | Aug, 2019 | Sep, 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sapporo** | 51.15 | 58.60 | 66.10 | 59.85 | 80.19 | 50.00 | 38.42 | 41.25 | 30.41 | 54.12 | 46.75 | 52.20 |
| **Sendai** | | | | | 77.78 | 55.56 | 58.14 | 53.15 | 51.47 | 51.28 | 57.04 | 58.00 |
| **Kashima** | 35.67 | 33.80 | 32.33 | 52.41 | 50.49 | 42.91 | 43.61 | 42.58 | 46.69 | 59.54 | 52.99 | 41.62 |
| **Urawa** | 70.29 | 65.12 | 64.02 | 83.16 | 83.87 | 63.71 | 61.01 | 70.08 | 59.61 | 59.62 | 61.78 | 58.08 |
| **FC.Tokyo** | 56.34 | 52.38 | 66.94 | 77.82 | 62.80 | 39.12 | 51.64 | 39.37 | 43.24 | 44.42 | 50.97 | 39.18 |
| **Kawasaki** | 91.14 | 86.48 | 79.34 | 89.76 | 91.25 | 82.62 | 77.91 | 79.35 | 81.97 | 86.22 | 89.24 | 86.01 |
| **F.Marinos** | 47.47 | 43.56 | 53.85 | 54.81 | 50.86 | 43.38 | 35.14 | 38.69 | 47.06 | 43.10 | 38.46 | 32.81 |
| **Shonan** | 66.41 | 73.61 | 69.13 | 78.38 | 84.05 | 61.72 | 57.43 | 61.98 | 63.80 | 50.86 | 47.32 | 61.38 |
| **Shimizu** | 67.33 | 48.09 | 74.83 | 82.80 | 60.10 | 39.09 | 37.82 | 38.74 | 42.47 | 54.32 | 51.14 | 53.66 |
| **Iwata** | 31.17 | 53.03 | 52.73 | 54.55 | 47.54 | 35.26 | 47.62 | 49.70 | 56.58 | 38.92 | 55.56 | 33.98 |
| **Matsumoto** | 67.55 | 66.67 | 78.29 | 59.60 | 68.53 | 56.75 | 52.05 | 59.81 | 65.54 | 64.69 | 61.56 | 72.64 |
| **Nagoya** | 59.38 | 50.00 | 50.63 | 60.26 | 64.68 | 52.66 | 47.28 | 48.19 | 46.18 | 52.35 | 48.96 | 43.66 |
| **G.Osaka** | 40.16 | 34.52 | 43.09 | 65.54 | 63.04 | 28.33 | 27.27 | 27.91 | 23.15 | 31.87 | 33.00 | 34.39 |
| **C.Osaka** | 53.42 | 63.67 | 43.64 | 45.12 | 65.40 | 40.60 | 56.21 | 49.08 | 45.48 | 60.90 | 54.07 | 49.74 |
| **Kobe** | 44.14 | 43.12 | 43.56 | 66.67 | 56.64 | 34.62 | 23.67 | 30.00 | 33.85 | 45.85 | 34.65 | 40.88 |
| **Hiroshima** | 81.97 | 84.76 | 63.16 | 68.50 | 74.04 | 61.14 | 64.91 | 58.53 | 61.63 | 65.88 | 59.52 | 60.43 |
| **Tosu** | 52.38 | 54.02 | 48.86 | 47.37 | 46.36 | 30.95 | 34.60 | 38.67 | 39.79 | 34.05 | 30.04 | 33.33 |
| **Oita** | 41.88 | 43.55 | 53.78 | 58.57 | 45.93 | 36.59 | 27.48 | 35.14 | 32.07 | 36.43 | 31.90 | 32.96 |

Table 9: The monthly ratio of Category 2 from J1 clubs.

| | Oct, 2018 | Nov, 2018 | Dec, 2018 | Jan, 2019 | Feb, 2019 | Mar, 2019 | Apr, 2019 | May, 2019 | Jun, 2019 | Jul, 2019 | Aug, 2019 | Sep, 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SVW** | 77.01 | 71.40 | 78.66 | 68.68 | 70.31 | 79.17 | 79.80 | 75.97 | 62.28 | 58.33 | 79.23 | 76.05 |
| **WOB** | 68.75 | 68.44 | 73.99 | 66.67 | 80.24 | 76.17 | 75.39 | 71.79 | 60.66 | 75.45 | 69.53 | 73.19 |
| **BSC** | 77.84 | 70.72 | 74.40 | 72.28 | 77.07 | 80.38 | 73.37 | 57.60 | 55.45 | 70.47 | 73.83 | 69.14 |
| **FCU** | 74.59 | 69.39 | 56.76 | 72.57 | 75.74 | 72.34 | 69.28 | 60.45 | 60.24 | 66.67 | 74.26 | 62.24 |
| **SCP** | 75.52 | 84.06 | 77.42 | 75.86 | 79.46 | 83.67 | 78.62 | 66.67 | 43.06 | 87.37 | 77.46 | 80.65 |
| **RBL** | 74.62 | 70.44 | 72.84 | 69.37 | 70.65 | 74.55 | 73.02 | 56.07 | 47.77 | 46.32 | 70.56 | 70.99 |
| **S04** | 72.80 | 68.23 | 68.84 | 62.53 | 69.27 | 72.66 | 69.35 | 58.33 | 46.24 | 64.84 | 60.39 | 64.59 |
| **BVB** | 78.21 | 73.26 | 72.80 | 65.24 | 79.84 | 78.96 | 68.43 | 67.74 | 63.35 | 49.15 | 62.23 | 66.74 |
| **BMG** | 76.38 | 78.13 | 76.40 | 62.05 | 76.90 | 74.50 | 59.55 | 59.29 | 62.96 | 54.74 | 67.00 | 69.71 |
| **B04** | 79.42 | 79.03 | 75.87 | 60.48 | 73.28 | 78.19 | 70.43 | 65.76 | 62.50 | 44.66 | 67.97 | 77.69 |
| **F95** | 68.14 | 69.38 | 68.47 | 61.54 | 77.52 | 72.02 | 75.57 | 68.84 | 37.34 | 53.39 | 72.66 | 72.42 |
| **KOE** | 79.79 | 71.71 | 79.02 | 64.91 | 79.35 | 78.55 | 78.37 | 70.83 | 65.14 | 61.00 | 67.31 | 67.57 |
| **SGE** | 82.38 | 83.52 | 67.52 | 67.30 | 79.12 | 80.81 | 76.91 | 70.26 | 38.40 | 66.50 | 70.77 | 72.24 |
| **M05** | 79.92 | 81.90 | 75.86 | 73.16 | 81.30 | 77.96 | 74.09 | 68.78 | 59.38 | 61.31 | 78.11 | 63.80 |
| **TSG** | 75.28 | 79.75 | 65.39 | 67.94 | 69.23 | 78.82 | 71.76 | 67.49 | 55.37 | 65.65 | 77.72 | 72.18 |
| **FCA** | 79.80 | 81.51 | 77.85 | 73.16 | 89.64 | 88.60 | 87.59 | 80.69 | 59.06 | 66.93 | 81.02 | 72.36 |
| **FCB** | 81.97 | 78.18 | 61.21 | 71.55 | 79.38 | 74.18 | 81.12 | 67.46 | 45.06 | 54.82 | 70.53 | 64.73 |
| **SCF** | 72.20 | 78.50 | 74.58 | 69.86 | 80.97 | 83.09 | 85.59 | 80.69 | 68.57 | 75.63 | 79.67 | 77.55 |

Table 10: The monthly ratio of Category 1 from 1. Bundesliga clubs.

| | Oct, 2018 | Nov, 2018 | Dec, 2018 | Jan, 2019 | Feb, 2019 | Mar, 2019 | Apr, 2019 | May, 2019 | Jun, 2019 | Jul, 2019 | Aug, 2019 | Sep, 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SVW** | 22.99 | 28.60 | 21.34 | 31.32 | 29.69 | 20.83 | 20.20 | 24.03 | 37.72 | 41.67 | 20.77 | 23.95 |
| **WOB** | 31.25 | 31.56 | 26.01 | 33.33 | 19.76 | 23.83 | 24.61 | 28.21 | 39.34 | 24.55 | 30.47 | 26.81 |
| **BSC** | 22.16 | 29.28 | 25.60 | 27.72 | 22.93 | 19.62 | 26.63 | 42.40 | 44.55 | 29.53 | 26.17 | 30.86 |
| **FCU** | 25.41 | 30.61 | 43.24 | 27.43 | 24.26 | 27.66 | 30.72 | 39.55 | 39.76 | 33.33 | 25.74 | 37.76 |
| **SCP** | 24.48 | 15.94 | 22.58 | 24.14 | 20.54 | 16.33 | 21.38 | 33.33 | 56.94 | 12.63 | 22.54 | 19.35 |
| **RBL** | 25.38 | 29.56 | 27.16 | 30.63 | 29.35 | 25.45 | 26.98 | 43.93 | 52.23 | 53.68 | 29.44 | 29.01 |
| **S04** | 27.20 | 31.77 | 31.16 | 37.47 | 30.73 | 27.34 | 30.65 | 41.67 | 53.76 | 35.16 | 39.61 | 35.41 |
| **BVB** | 21.79 | 26.74 | 27.20 | 34.76 | 20.16 | 21.04 | 31.57 | 32.26 | 36.65 | 50.85 | 37.77 | 33.26 |
| **BMG** | 23.62 | 21.88 | 23.60 | 37.95 | 23.10 | 25.50 | 40.45 | 40.71 | 37.04 | 45.26 | 33.00 | 30.29 |
| **B04** | 20.58 | 20.97 | 24.13 | 39.52 | 26.72 | 21.81 | 29.57 | 34.24 | 37.50 | 55.34 | 32.03 | 22.31 |
| **F95** | 31.86 | 30.62 | 31.53 | 38.46 | 22.48 | 27.98 | 24.43 | 31.16 | 62.66 | 46.61 | 27.34 | 27.58 |
| **KOE** | 20.21 | 28.29 | 20.98 | 35.09 | 20.65 | 21.45 | 21.63 | 29.17 | 34.86 | 39.00 | 32.69 | 32.43 |
| **SGE** | 17.62 | 16.48 | 32.48 | 32.70 | 20.88 | 19.19 | 23.09 | 29.74 | 61.60 | 33.50 | 29.23 | 27.76 |
| **M05** | 20.08 | 18.10 | 24.14 | 26.84 | 18.70 | 22.04 | 25.91 | 31.22 | 40.63 | 38.69 | 21.89 | 36.20 |
| **TSG** | 24.72 | 20.25 | 34.61 | 32.06 | 30.77 | 21.18 | 28.24 | 32.51 | 44.63 | 34.35 | 22.28 | 27.82 |
| **FCA** | 20.20 | 18.49 | 22.15 | 26.84 | 10.36 | 11.40 | 12.41 | 19.31 | 40.94 | 33.07 | 18.98 | 27.64 |
| **FCB** | 18.03 | 21.82 | 38.79 | 28.45 | 20.62 | 25.82 | 18.88 | 32.54 | 54.94 | 45.18 | 29.47 | 35.27 |
| **SCF** | 27.80 | 21.50 | 25.42 | 30.14 | 19.03 | 16.91 | 14.41 | 19.31 | 31.43 | 24.37 | 20.33 | 22.45 |

Table 11: The monthly ratio of Category 2 from 1. Bundesliga clubs.

| | Total amounts |
|---|---|
| J1 clubs | 2844.56 ± 1330.50 |
| 1. Bundesliga clubs | 4198.50 ± 1582.87 |
| | $p$=0.01 between J1 and 1. Bundesliga clubs |

Table 12: The averages and the standard deviations of the total amounts of Tweets from J1 and 1. Bundesliga clubs.

| | Amounts of Category 1 | Amounts of Category 2 | Ratio of Category 1 | Ratio of Category 2 |
|---|---|---|---|---|
| J1 clubs | 1370.83 ± 897.17 | 1473.72 ± 693.06 | 47.53 ± 12.82 | 52.47 ± 12.82 |
| 1. Bundesliga clubs | 2998.44 ± 1108.16 | 1200.06 ± 506.37 | 71.84 ± 3.86 | 28.16 ± 3.86 |
| | $p<0.0001$* | $p=0.293$ | $p<0.0001$* | $p<0.0001$* |

*$p<0.05$ between J1 and 1. Bundesliga clubs

Table 13: The averages and the standard deviations of the amounts and the ratio of Tweets of Category 1 and 2, from J1 and 1. Bundesliga clubs.

| | Amounts in season | Amounts in off-season | Ratio in season | Ratio in off-season |
|---|---|---|---|---|
| J1 clubs | 2424.61 ± 1157.75 | 444.65 ± 197.37 | 84.83 ± 3.74 | 15.17 ± 3.74 |
| 1. Bundesliga clubs | 3402.44 ± 305.94 | 796.06 ± 305.94 | 80.89 ± 2.45 | 19.11 ± 2.45 |
| | $p$ =0.016* | $p$ < 0.0001* | $p$ =0.001* | $p$ =0.001* |

*$p$ <0.05 between J1 and 1. Bundesliga clubs

Table 14: The averages and the standard deviations of the amounts and the ratio of Tweets in season and off-season, from J1 and 1. Bundesliga clubs.

| | Total amounts | Ratio of Category 1 | Ratio of Category 2 |
|---|---|---|---|
| October, 2018 | 232.76 ± 111.43 | 43.66 ± 16.26 | 56.34 ± 16.26 |
| November, 2018 | 227.88 ± 121.68 * | 43.83 ± 15.58 | 56.17 ± 15.58 |
| December, 2018 | 163.53 ± 74.87 * | 42.10 ± 13.65 | 57.90 ± 13.65 |
| January, 2019 | 165.47 ± 83.87 * | 34.99 ± 13.27 * | 65.01 ± 13.27 * |
| February, 2019 | 181.11 ± 85.83 * | 34.80 ± 14.19 * | 65.20 ± 14.19 * |
| March, 2019 | 275.39 ± 137.93 | 52.50 ± 14.08 | 47.50 ± 14.08 |
| April, 2019 | 283.00 ± 132.67 | 53.21 ± 14.58 | 46.79 ± 14.58 |
| May, 2019 | 287.11 ± 136.44 | 52.10 ± 13.82 | 47.90 ± 13.82 |
| June, 2019 | 270.67 ± 138.45 | 51.61 ± 14.61 | 48.39 ± 14.61 |
| July, 2019 | 280.28 ± 129.75 | 48.02 ± 11.89 | 51.91 ± 13.38 |
| August, 2019 | 291.11 ± 129.37 | 49.73 ± 14.17 | 50.27 ± 14.17 |
| September, 2019 | 230.06 ± 115.75 * | 50.84 ± 15.06 | 49.16 ± 15.06 |

*$p$ <0.05 vs August 2019

Table 15: The averages and the standard deviations of the total amounts, the ratio of Category 1 and 2 of Tweets in each month, from J1 clubs (group in August 2019 was set as a standard).

| | Total amounts | Ratio of Category 1 | Ratio of Category 2 |
|---|---|---|---|
| October, 2018 | 390.33 ± 155.42 | 76.37 ± 4.08 | 23.63 ± 4.08 |
| November, 2018 | 360.56 ± 147.28 | 75.42 ± 5.58 | 24.58 ± 5.58 |
| December, 2018 | 363.94 ± 144.84 | 72.11 ± 6.23 | 27.89 ± 6.23 |
| January, 2019 | 318.22 ± 121.31 | 68.06 ± 4.57 * | 31.94 ± 4.57 * |
| February, 2019 | 377.50 ± 161.62 | 77.18 ± 5.17 | 22.82 ± 5.17 |
| March, 2019 | 371.11 ± 153.44 | 78.03 ± 4.38 | 21.97 ± 4.38 |
| April, 2019 | 387.44 ± 160.73 | 74.90 ± 6.62 | 25.10 ± 6.62 |
| May, 2019 | 366.11 ± 156.50 | 67.48 ± 7.25 * | 32.52 ± 7.25 * |
| June, 2019 | 158.50 ± 71.85 * | 55.16 ± 9.65 | 44.84 ± 9.65 |
| July, 2019 | 335.50 ± 133.66 | 62.40 ± 11.04 * | 37.60 ± 11.04 * |
| August, 2019 | 421.11 ± 154.83 | 72.24 ± 5.97 | 27.76 ± 5.97 |
| September, 2019 | 348.17 ± 135.18 | 70.77 ± 5.21 | 29.23 ± 5.21 |

*$p$ <0.05 vs February 2019

Table 16: The averages and the standard deviations of the total amounts, the ratio of Category 1 and 2 of Tweets in each month, from 1. Bundesliga clubs (group in February 2019 was set as a standard).

.

**Discussion**

In this study I investigated into the differences of characteristics of informing from Japanese and German professional football leagues via Twitter, the popular social media in present-day. The main findings of this study were that Bundesliga clubs used Twitter so actively, especially to inform about football, and in contrast, J.LEAGUE clubs made more Tweets which were not related to football. 1. Bundesliga clubs released the significantly larger amounts of Tweets totally and of Category 1 ($p < 0.05$) (Table 12 and 13), and the higher ratio of Category 1 ($p < 0.05$) (Table 13) than J1 clubs, which made the significantly more amounts and the higher ratio of Tweets of Category 2 ($p < 0.05$) (Table 13). These results supported the hypotheses that Bundesliga clubs made the larger amounts and the higher ratio of Tweets relating football and J.LEAGUE clubs made more Tweets of Category 2, but the hypothesis that J.LEAGUE clubs made a larger number of Tweets totally was not supported. The hypotheses that in off-season clubs of both leagues made fewer Tweets than in season, and more Tweets were made by Bundesliga clubs than J.LEAGUE clubs even in off-season were also supported. With the great amounts of total Tweets and Tweets of Category 1 from 1. Bundesliga, it was likely that Bundesliga clubs made use of Twitter to supply details of games, trainings or statistics like live commentary Tweets or press conference Tweets before and after every game with fans. On the contrary, J.LEAGUE clubs may consider Twitter as a tool of promoting products, events or the appeal of player's personality. Based in these reasons, it seemed reasonable to assume that even in off-season Bundesliga clubs made lots of Tweets to report test matches or training camp, but J.LEAGUE clubs did not make so many Tweets (Table 14). Although the heat became the liveliest, in early and climax of season J.LEAGUE clubs also made fewer Tweets (Table 15), and it could be also regarded that they did not

emphasize so much on informing via Twitter.

In this paper Twitter was used to compare contents of real-time information released by two professional football leagues. However, in this method it seems somewhat vague to classify whether category 1 or 2. As stated in chapter of Methods, the Tweets were sorted out according to contents which mentioned mainly, but it still depended on researcher's subjectivity. All parts of gathering and distinguishing Tweets on this survey conducted by hand-operated, so it is necessary for more efficient way with objective like expression abstracting algorithm system used in study by Kobayashi et al. (2011). In addition to that, it will make this study more correct to examine not only first leagues but also second leagues of both countries called J2 and 2. Bundesliga, and not only Twitter but also other social media like Instagram or Facebook. Moreover, it needs further investigation of the reaction from fans like Retweet or Favorite functions to Tweets from clubs in both leagues. This study was examination only for club side actions, so we need to more examine how fans behave to club's informing and difference between J.LEAGUE and Bundesliga.

J.LEAGUE reported that the average age of spectators in 2018 season was 36.4 years old, which was increasing consecutive three seasons, and study by Nagata (2011), described that the rate of young generation (12 to 29 years of age) who come to stadium became fewer in Japan. This researcher explained that the reason was the change of lifestyle of young people, for they had to prioritize many things of daily lives over watching sports and there were large varieties of amusements recently, thus to watch sports was just one of many choices, and it was more difficult to get them into the habit of watching football in the stadium. Moreover, Nakazawa et al. (2000) revealed in their study that female fans in Japan had less interest and less connection to football itself as a

sport game. They showed their interest toward player's personality or characters. Therefore, their understanding of football rules was less than that of male fans. In the study they insisted that in order to make stable market it was necessary to deepen female fan's understanding on rules, to raise their interest in football games, and to build stronger identity of football as itself in their lives. To make stronger identity of football in Japanese fans is especially essential to make stable market. I would like to emphasize that many fans have already had the demand for broadcasting of football with deeper contents like a technical live commentary, not focusing only entertainment contents and player's personality. One of the examples of this was in October 2018 live broadcasting of international match with profound tactical commentary by former professional football player, Kazuyuki Toda. Although this was a first trial held by commentator in person without terrestrial broadcasting and was not free, over 700 fans payed audience fee and joined the program. This project continues still as of November 2019. Another example is: on the same game of Toda's project, Skyperfectv broadcasted free tactical commentary on YouTube and it got 20,000 views in only a day. On the other hand, in recent years the situation of Japanese sports market is changing. Many sports show growths, for example, in 2019 Rugby World Cup and Volleyball World Cup were held and these games broadcasted across Japan. These competitions became current topics and Japanese professional rugby league (TOP LEAGUE) and volleyball league (V-League) got chances to make people pay more attention to these leagues. As stated earlier in study by Kusaka (1996), baseball also has a strong influence on Japanese sports culture. Thus J.LEAGUE and clubs must increase the number of fans who are attracted to football itself to make its market larger and more stable.

In conclusion, the survey on this paper revealed that Bundesliga clubs gave their fans much information

both in season and off-season, especially relating football via Twitter than J.LEAGUE clubs, and J.LEAGUE clubs offer information referred to off-the-pitch to their fans. These findings suggest that to establish fan's interest with information from clubs become important factor to enlarge football market.

As I stated above, in Japan the culture and history of football are still not so huge like Germany. To build great identity of football in J.LEAGUE fans is needed in order to ensure market against other professional sports. Plenty of Japanese people access Twitter every day, so clubs can make use of this great social media more efficiently not only to promote products or events, but also to spread the pleasure of watching and thinking about football games. Real-time tracking date technology is available in recent seasons, so it is possible to display what happened on the pitch more easily in one's smartphone. In the future I expect a lot of fans who have a purpose to watch football game primarily fill the stadiums up, and they also enjoy various events, foods and other entertainments. I am sure that this scene become Japanese own football culture.

**Acknowledgement**

I would like to express the deepest appreciation to Mr. Kohei Watanabe for generous support and lots of valuable comments, and to Ms. Megumi Higuchi for correcting German sentences.

**References**

DFL Deutsche Fußball Liga GmbH. (2019. 2. 13).

DFL WIRTSCHAFTSREPORT 2019 DIE ÖKONOMISCHE SITUATION IM LIZENZFUßBALL. 2019, file:///C:/Users/MIDORI/AppData/Local/Packages/Microsoft.MicrosoftEdge_8wekyb3d8bbwe/TempState/Downloads/DFL_Wirtschaftsreport_2019_DE_S-1%20(1).pdf

JAPAN PROFESSIONAL FOOTBALL LEAGUE. (2019. 10. 31). J. LEAGUE Data Site. 2019, https://data.j-league.or.jp/SFTD12/

JAPAN PROFESSIONAL FOOTBALL LEAGUE. (2019. 7. 23). The Club Financial Data List. 2019, https://www.jleague.jp/docs/aboutj/club-h30kaiji_3.pdf

JAPAN PROFESSIONAL FOOTBALL LEAGUE. (2019. 1. 31). J. LEAGUE FAN SURVEY 2018 SUMMARY REPORT. 2019, https://www.jleague.jp/docs/aboutj/funsurvey-2018.pdf

JAPAN PROFESSIONAL FOOTBALL LEAGUE. (2018. 12. 17). J. LEAGUE PUB REPORT 2018. 2019, https://jlib.j-league.or.jp/-site_media/media/content/48/1/html5.html

GDP (Current US$). (2019. 10.28). THE WORLD BANK. 2019, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD

Kennedy, P., & Kennedy, D. (2012). Football Supporters and the Commercialisation of Football: Comparative Responses across Europe. Soccer & Society, 13 (3), 327-340.

Kobayashi, T., Noda M., Deguchi D., Takahashi T., Ide I., & Murase H. (2011). Summarizing sports video by on-the-spot comments on Twitter. TECHNICAL REPORT OF IEICE, MVE, Multimedia, Virtual Environment, 110(457), 165-169.

Kusaka, Y. (1996). A Cultura1-Sociological Study on the Roots of Sport Culture in Japan. Bulletin of Ibaraki

University, 30, 195-223.

Kuzma J., Bell V., Logue C. (2014). A Study of the Use of Social Media Marketing in the Football Industry. Journal of Emerging Trends in Computing and Information Sciences, 5(10), 728-738.

Mocanu D., Baronchelli A., Perra N., Gonçalves B., Zhang Q., Vespignani A. (2013). The Twitter of Babel: Mapping World Languages through Microblogging Platforms. PLoS ONE 8(4): e61981.1-9.

Nagata, Y. The Particularity of Sport Management in Japan: Present Conditions and the Problems. (2011). Journal of Hiroshima University of Economics, 33 (4), 89-99.

Nakazawa, M., Hirakawa, S., Mahony, D., Hums, M., Tokari, J., & Nakatsuka, Y. (2000). Female Spectators in J.League. Japan Journal of Sports Industry, 10 (1), 45-57.

Pacheco Diego F., Diego Pinheiro, Fernando B. de Lima-Neto, Eraldo Ribeiro and Ronaldo Menezes. (2016). Characterization of Football Supporters from Twitter Conversations. IEEE/WIC/ACM International Conference on Web Intelligence, 169-176.

Skyperfectv. (2019). Japan×Uruguay. 2018, https://www.youtube.com/watch?v=_U29vnEmsYU

Statistics Bureau, Ministry of Internal Affairs and Communications of Japan. (2019). Population Estimates. https://www.stat.go.jp/data/jinsui/new.html

The Ministry of Foreign Affairs of Japan. (2019). The Basic Data of Federal Republic of Germany. https://www.mofa.go.jp/mofaj/area/germany/data.html

Toda Kazuyuki. (2018). Urakaisetsu. 2019, https://ameblo.jp/todakazuyuki/entry-12404020451.html

Tsuboi, K., & Hagi, Y. (2015). A study of management of football league: Focusing Bundesliga in Germany. Japan

Journal of Living Sports, 11 (2), 1-12.

Twitter Japan. (2017.10.27). 2019, https://twitter.com/TwitterJP/status/923671036758958080?s=20

Yamamoto, Y., Asai, H., Ueda, T., Akioka, S., & Yamana, H. (2013) Real-time Detection of Twitter user with opinion of TV programs. Forum on Data Engineering and Information Management 2013.