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# Association Between Carbohydrate Intake During Golf Rounds and Its Related Factors in Japanese Elite Junior Golfers

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This study aims to determine the carbohydrate intake during a round of competition and its related factors in elite junior golfers. The participants included 64 Japanese elite junior golfers (32 male and 32 female) with an average age of  $14.6 \pm 1.6$  years old. The survey used recall methods. The survey items cover drinks and foods intake, purpose of intake, and basic demographics during official competitions in 2022. Carbohydrate intake was assessed according to whether they consumed the recommended 30 g per hour. In this study, for 18 holes constituted  $629 \pm 321$  kcal (mean  $\pm$  standard deviation) of energy and  $26.1 \pm 13.8$  g/h of carbohydrates. The percentage of players consuming the recommended amount of carbohydrates was 35.9%. Moreover, nutrition education was associated with consuming the recommended amount of carbohydrates during a golf round, regardless of age, sex, or BMI (odds ratio, 3.70;  $p = 0.039$ ).

### Introduction

Although the overall intensity of golf is much lower compared with other sports and the extended duration of 18 holes (a round) lasts anywhere from three to six hours while covering distances in excess of 10 km, golf is still considered an endurance sport (Ainsworth et al., 2011; Hayes et al., 2009; Luscombe et al., 2017; Stevenson et al., 2009). Especially when played competitively, golf involves critical shot-making decisions, multiple maximum effort swings, putting, and long-distance walking during the round, which can result in physical and mental fatigue (Smith, 2010; Smith et al., 2012). Mental fatigue affects the ability to select the correct club, shot type, and execution of the golf shot (Smith, 2010), whereas physical fatigue affects the mechanics of the golf swing (Higdon et al., 2012).

The American College of Sports Medicine (ACSM) has several recommendations for endurance athletes, which can be loosely applied to golfers during competition. As per the ACSM, when exercising longer than one hour, it is recommended that carbohydrates be ingested at a rate of 30–60 g/h to maintain the oxidation of carbohydrates and delay fatigue (Convertino et al., 2000). In previous studies, carbohydrate intake methods have been investigated in various endurance sports to prevent performance loss during competition (Fernandes, 2020; Jeukendrup, 2017; Reynolds et al., 2023). Previous studies have reported that during a competitive round of golf, blood glucose can significantly decrease by 10%–30% without nutritional intake, which can negatively impact focus, decision-making, and depth perception (Broman et al., 2004). Conversely, continuous feeding of carbohydrates can

help alleviate the decline in blood glucose concentrations and has a beneficial effect on the central nervous system, which can enhance exercise performance (Burke et al., 2011; Jeukendrup, 2014). Recently, we have found that during a competitive 18-hole event, 30 g/h of continuous carbohydrate intake with gummies may be effective in attenuating fatigue and maintaining the concentration of competitive golfers (Nagashima, Ehara, et al., 2023). These results then indicate the importance of systematic nutritional intake during competition. Additionally, in a recent study to determine the effect of feeding (30 g of carbohydrate or 15 g + 15 g protein and carbohydrate) during a simulated golf game, macronutrient food led to a significantly lower self-reported fatigue level, without affecting golf performance and alertness compared to control receive zero calories (Thompsett et al., 2022).

A professional golfer will play a competitive round of 18 holes with the assistance from a caddy against an elite amateur that may play 18 competitive holes of golf, while carrying their own bag, thus creating a larger energy expenditure during the competition (Berlin et al., 2023). A recent study by Kasper et al. assessed the energy expenditure of golfers in relation to the different means of transportation of clubs (carrying bag, manual trolley, and electronic trolley) (Kasper et al., 2023). Moreover, In Japan, junior golfers use push carts or carriers as a means of moving their golf bags. Considering this, the energy expenditure of junior golfers is likely to be higher than that of senior golfers. However, previous studies have not determined how elite junior golfers energized themselves during a round of golf. Thus, it would be necessary to conduct a survey on elite junior golfers to determine what they intake and drink during a competitive round of golf.

Furthermore, this study aims to identify which factors influence how elite golfers achieve the recommended nutritional intake. Previous studies have reported that improved food skills have an impact on the eating behaviors of adolescents and children (Campbell et al., 2008; Contento et al., 2002; Horikawa, 2015; Nagashima, Horikawa, et al., 2023). However, to our knowledge, no studies have yet investigated the eating behaviors and nutrient intake of athletes during competitions. Thus, we conducted a survey on elite junior golfers to determine drinks and foods intake during a round of golf. The second objective of this study is to assess whether carbohydrate intake ( $\geq 30$  g/h) for over 18 holes is correlated with basic attributes and golf-related factors.

## **Materials and Methods**

### **Study Design**

This study was conducted using a cross-sectional study design in accordance with the guidelines stipulated in the Declaration of Helsinki, and all procedures were approved by the Ethics Committee of Musashigaoka Junior College, Japan (No. 23–3). Moreover, participants were informed about the experimental procedures and read and signed the informed consent form. Furthermore, if a participant was a minor, written informed consent and assent was obtained from their parents/guardians.

## Study Population

The study participants comprised a total of 64 male and female elite junior golfers certified by the Kanto Golf Association (The Kanto Golf Association, 2023). Kanto Golf Association selects and certifies junior golfers with excellent competitive performance, technique, and physical fitness, and trains them to become golfers that may play on national teams in the future. Furthermore, they offer junior golfers with an excellent training program. The Kanto Golf Association certifies 4–5 male and 4–5 female golfers in each age group (among 12–18 years old); up to approximately 64 players. In this study, we selected players certified by the Kanto Golf Association as a group of elite junior golfers who achieved a certain level of performance.

The selection criteria for the study were as follows: (1) August 2022, any change in diet for weight gain or weight loss, (2) in FY2022, if the highest result was below the local competition, not a national competitor, and (3) any bone or joint problems (e.g., back, knee or hip) that might limit your ability to play. If the participant answered “Yes” to any of the above questions, it was not included in this study. Overall, a total of 64 participants agreed to participate in this study (response rate, 100%) and were included in the analysis.

## Procedures

First, before this study was conducted, an explanatory meeting and prescreening were held at Musashigaoka Junior College in Yoshimi Town, Hiki-gun, Saitama Prefecture in November 2022. an explanatory meeting and prescreening were conducted in person. In this study, the study participants were required to attend an explanatory meeting and prescreening. During prescreening, we obtained data regarding participation competition results for FY2022, physical health, and existence of any dietary changes. Participants were evaluated for participation in the study before completing a basic demographic questionnaire, a food and golf questionnaire, and being subjected to anthropometrics measurements.

Next, the response methods of the dietary survey were explained to the study participants and their mothers by trained researchers. In December 2022, a dietary survey was conducted online.

## Dietary Survey

A dietary survey was conducted to determine the dietary intake during a round of golf, drinks and foods carried during golf rounds, and purpose of eating during a round of golf; all surveys were conducted online.

Regarding the dietary intake, drinks and food intake surveys and dietary intake surveys were conducted, and the drinks and foods intake during a round of golf was assessed using the recall method. The period covered was August 2022. In the present study, the study participants were required to recall all drinks and foods that they regularly consumed during 1 round of competitive golf. Participants were asked to record drink and food product names, quantities, and distributors. If a response was difficult, participants were asked

to respond with their parents. Recorded dietary surveys were submitted online. A registered dietitian was tasked to check the forms to ensure that they had been completed with no missing information.

All drinks and foods were categorized with reference to previous research as follows: liquids (sports drinks, etc.), gels, snacks and sweets (gummy, candy, chocolate, Japanese confectionery, etc.), rice products, fruits, and dietary supplements (Ishihara et al., 2020; Wardenaar et al., 2018). Nutritional values for the dietary surveys submitted were calculated using the Japanese Standard Tables of the Composition of Foods [Ministry of Education & Culture, Sports, Science and Technology, 2020]. Nutritional information provided by the manufacturer was also used to determine the nutritional value. Energy, protein, fat and carbohydrates were calculated based on the submitted dietary surveys.

In addition, to determine the contribution of each food to total carbohydrate intake, the carbohydrate contribution per food type was then calculated. Moreover, carbohydrate intake was assessed in accordance with the ACSM guidelines. ACSM has recommendations for golfers during competition. They recommended that carbohydrates be ingested at a rate of 30–60 g/h to delay fatigue (Convertino et al., 2000). In this study, we assumed that 18 holes would take 5 hours. This would require 150–300 g of carbohydrates. In this study, carbohydrate intake during a round of golf was evaluated based on whether or not the participants consumed 30 g/h, the lower limit of the 30–60 g/h recommended by the ACSM.

Regarding carrying drinks and foods during golf rounds, participants answer the question “Did you carry and drink a drink during a competitive round of golf in August 2022?” and “Did you carry and eat any food (including snacks and refreshments) during a competitive round of golf in August 2022?” with “Yes” or “No.”

Regarding the purpose of eating during a round of golf, participants were asked, “What was the purpose of eating during a round of golf in August 2022?” to which they chose the best applying answer: (1) Due to hunger, (2) change of mood, (3) to have something in the mouth, (4) to increase concentration, (5) for stimulation, (6) due to fatigue, or (7) to prevent sleepiness.

### **Variables Related to Food and Golf Competition**

In this study, we assessed the variables related to the food and golf competition. Previous studies have reported that improved food skills have an impact on the changes in eating behavior. Our previous studies with middle school soccer players have shown that the implementation of food education improves food knowledge, food skills, and eating behaviors (Campbell et al., 2008; Contento et al., 2002; Horikawa, 2015; Nagashima, Horikawa, et al., 2023). Therefore, in this study, information on the experience of attending nutrition education was obtained as a variable related to food. Furthermore,

an association was observed between food education, food knowledge, and athletic performance. Therefore, in this study, age, sex, and golf history details were obtained on variables related to competition performance.

All surveys were conducted online. Furthermore, regarding the experience with nutrition education, participants answer the question “Have you ever received nutritional guidance for golf from a sports nutritionist?” with “Yes” or “No.” Regarding their golfing career, the study participants were asked to indicate the period of time (in months) from when they started playing golf to the present period.

### **Other Variables**

Regarding the other variables in this study, data on anthropometrics was also obtained. Anthropometrics included body height, body mass, body fat percentage, body mass index (BMI), carrying drinks and foods during golf rounds, and the purpose to eat foods during a round of golf. Body height was measured using a stadiometer (YHS-200D, YAGAMI Inc., Nagoya, Japan). Body mass and body fat percentage were measured using bioelectrical impedance analysis (In Body 470, InBody Japan Inc., Tokyo, Japan). The body height (to the nearest 0.1 cm), body mass (to the nearest 0.1 kg), and body fat percentage (to the nearest 0.1%) of the study participants were measured, while wearing lightweight indoor clothes only without shoes. The BMI was calculated using the following formula: body mass [kg]/body height [m<sup>2</sup>].

### **Statistical Analyses**

All statistical analyses were performed using JMP version 14.3.0. (SAS Institute Inc., Cary, NC, USA). The continuous variables are expressed as the mean  $\pm$  standard deviation, whereas the categorical variables are assessed as counts and percentages. The normality of data was assessed using the Shapiro–Wilk test. In this study, descriptive statistics were first calculated to determine the current status of carrying and intended consumption of drinks and foods during a round of golf. The drinks and foods intake were expressed as total energy (kcal), protein, carbohydrates, and fat (in g). The carbohydrate intake was expressed by food group, and the contribution ratios were calculated.

Moreover, we investigated the factors associated with carbohydrate intake exceeding 30.0 g/h during a round of golf. Logistic regression analysis was performed with the objective variable being whether the carbohydrate intake exceeds 30.0 g/h and the independent variables being the variables related to the food and golf competition. Considering the effects of the confounding variables, the independent association between the related factors and carbohydrate intake exceeding 30.0 g/h was assessed, while the independent variable selection was calculated using a stepwise method. The confounding variables include sex, age, and BMI. In this study, we present unadjusted models (Model 1), a model adjusted for age, sex, and BMI (Model 2). The

Table 1. Basic characteristics of the study participants.

	All (n = 64)		Male (n = 32)		Female (n = 32)	
	Mean	SD	Mean	SD	Mean	SD
Age, years	14.6	1.7	14.5	1.7	14.6	1.6
Body height, cm	164.0	8.5	164.7	9.4	163.3	7.5
Body mass, kg	57.2	9.9	58.2	10.4	56.3	9.4
BMI, kg/m <sup>2</sup>	21.2	2.6	21.3	2.3	21.1	2.9
Golf career, month	103.2	29.2	107.1	30.7	99.3	27.6
Experience in nutritional education*						
Yes	36	(56.3)	19	(59.4)	17	(53.1)
No	28	(43.7)	13	(40.6)	15	(46.9)
Carrying drinks and foods during golf rounds*						
Drinks	64	(100)	32	(100)	32	(100)
Foods	58	(90.6)	28	(87.5)	30	(93.8)
The nutritional value of drinks and foods						
Energy, kcal	629	321	565	303	698	330
Protein, g	7.3	7.2	5.8	6.2	8.9	7.9
Fat, g	8.5	10.8	5.9	7.2	11.0	13.1
Carbohydrate, g/h	26.1	13.8	24.1	13.9	28.2	13.6
Achievement recommended carbohydrates intake <sup>†</sup>	23	(35.9)	10	(31.2)	13	(40.6)

BMI, body mass index; SD, standard deviation; ACSM, American College of Sports Medicine

<sup>†</sup>Carbohydrate intake during a round of golf was evaluated based on whether or not the study participants consumed 30 g/h, the lower limit of as per the ideal amount of carbohydrates recommended by the ACSM (30–60 g/h).

odds ratio and 95% confidence interval corresponding to the p-values were presented. All reported p-values were two-tailed, and statistical significance was set at p-values of <0.05.

## Result

### General Results

[Table 1](#) shows the basic characteristics of the study participants with the following mean values: age, 14.6 ± 1.7 years; BMI, 21.2 ± 2.6 kg/m<sup>2</sup>; and golf career, 103.2 ± 29.2 month. Moreover, 56.3% of the participants had experience in nutrition education.

### Status of Drinks and Foods During a Golf Round

[Table 1](#) shows the percentage of players who carried drinks was 100% and those who carried foods was 90.6% across the board. The total energy intake during a round of golf was 629 ± 321 kcal. The mean carbohydrate intake of all study participants during an estimated 5-hour round of golf was 26.1 ± 13.8 g/h, while 35.9% of them had more than the recommended amount of carbohydrates.

[Table 2](#) shows carbohydrate intake and contribution per product type. Based on the results, overall, the mean total carbohydrate intake based on gels was the highest. This was followed by sports drink and gummy with a combined contribution rate of 68.8% for these three. By sex, for the male study participants, sports drinks were the most important source of energy of the

Table 2. Carbohydrate intake and contribution per product type\*

Variable	All (n = 64)		Male (n = 32)		Female (n = 32)	
	Mean	(CC %)	Mean	(CC %)	Mean	(CC %)
<b>Liquids</b>						
Sports drink, g	30.6	(23.2)	40.3	(32.8)	20.9	(14.8)
Others, g	9.8	(7.4)	5.9	(4.8)	13.7	(9.7)
Gels, g	38.4	(29.1)	37.4	(30.5)	39.4	(28.0)
<b>Snacks and sweets</b>						
Gummy, g	21.7	(16.5)	21.4	(17.4)	22.0	(15.6)
Candy, g	4.7	(3.6)	3.7	(3.0)	5.7	(4.0)
Baked sweets, g	8.8	(6.7)	6.2	(5.0)	11.5	(8.2)
Chocolates (and snacks), g	5.5	(4.2)	3.2	(2.6)	7.8	(5.5)
Japanese confectionery, g	2.8	(2.1)	0.8	(0.7)	4.7	(3.3)
Others, g	2.5	(1.9)	2.3	(1.9)	2.6	(1.8)
Rice product (rice ball), g	5.5	(4.2)	0.0	(0.0)	11.1	(7.9)
Fruits (banana), g	1.4	(1.1)	1.4	(1.1)	1.4	(1.0)
Dietary supplement, g	0.1	(0.0)	0.2	(0.2)	0.1	(0.1)
Carbohydrate, g	131.8	(100.0)	122.8	(100.0)	140.8	(100.0)

CC, carbohydrate contribution

\*Carbohydrate contribution to total carbohydrate intake from each food.

Table 3. Purpose of Foods intake during a round of golf

Variable	All (n = 64)		Male (n = 32)		Female (n = 32)	
	n	(%)	n	(%)	n	(%)
Due to hunger	22	(34.4)	12	(37.5)	10	(31.2)
Change of mood	21	(32.8)	9	(28.1)	12	(37.5)
To crave something in your mouth	5	(7.8)	3	(9.4)	2	(6.3)
To increase concentration	9	(14.1)	4	(12.5)	5	(15.6)
To stimulate	0	(0.0)	0	(0.0)	0	(0.0)
Due to fatigue	1	(1.6)	0	(0.0)	1	(3.1)
To prevent sleepiness	0	(0.0)	0	(0.0)	0	(0.0)
No answer	6	(9.4)	4	(12.5)	2	(6.3)

male study participants. For the female study participants, the carbohydrate contribution from snacks and sweets was 38.5%, which is higher than that of the male study participants (30.6%).

[Table 3](#) shows the purpose of foods intake during a round of golf. In general, the most common answer for consuming a light meal was “because I am hungry.” By sex, the most common answer for the male study participant was “because I get hungry,” while that for the female study participants was “I need a change of scenery.” In this study, it was revealed that the purpose of consuming a light meal differed between males and females.

Table 4. Associations between variables related to foods and golf competition and carbohydrate intake more than the recommended amount during a round of golf

Variable	Model 1			Model 2		
	Odds ratio	95% CI	p-values	Odds ratio	95% CI	p-values
Golf career	1.00	0.98-1.02	0.767			
Experience in nutritional education						
Yes	3.28	1.08-10.00	0.037	3.70	1.07-12.83	0.039
No	1.00			1.00		
Gender						
Male	0.66	0.23-1.86	0.435			
Female	1.00					
Age	0.88	0.64-1.20	0.404			
BMI	1.13	0.93-1.37	0.228			

BMI, body mass index; CI, confidence interval; ACSM, American College of Sports Medicine

The dependent variable was variables related to the food and golf competition. The independent variable was the consumption of more carbohydrates than the recommended amount guessed during the golf round. In creating Model 2, sex, age, and BMI were forced in, and a stepwise method was used to select variables for nutrition education experience (p-values of <0.20) in Model 1.

Model 1, unadjusted model; Model 2, a model adjusted for sex, age, and BMI.

\*Carbohydrate intake during a round of golf was evaluated based on whether or not the study participants consumed 30 g/h, which is the minimum amount of carbohydrates recommended by the ACSM (30-60 g/h).

## Associations between Variables Related to Drinks, Foods, and Golf Competition and Intakes More than the Recommended Amount of Carbohydrates During a Round of Golf

Table 4 shows the logistic regression analysis model of the consumption of more carbohydrates than the recommended amount. Experience in nutritional education was significantly positively associated with the consumption of more carbohydrates than the recommended amount based on the univariate logistic regression analysis (Model 1). These variables were added for adjustments of age, sex, and BMI, and their associations were evaluated (Model 2). After adjustment, experience in nutritional education was still associated with the consumption of more carbohydrates than the recommended amount in the adjusted model.

### Discussion

The findings of this study revealed that the main sources of carbohydrates during the competition were gels, sports drinks, and gummy among Japanese elite junior golfers. It was noted that many elite junior golfers in Japan do not consume the recommended amount of carbohydrates for every golf round. Moreover, our results revealed that golf players receiving nutrition education were 3.7 times more likely to consume the recommended amount of carbohydrates during a round of golf in junior golfers than those not reporting receiving education, independent of age, sex, and BMI. To our knowledge, no studies have produced similar results based on the perspectives of competitive golfers. Therefore, the present study is the first to determine the carrying status of drinks and foods of junior golfers during competitions.

As per a survey report on drinks and foods intake during ultramarathons among Japanese participants (mean age: male 41.5 years, female 42.6 years) (Ishihara et al., 2020), the drinks and foods that contributed the most to the carbohydrate intake was jelly (37.2%), followed by rice products (18.9 %) and sports drinks (11.8%). By comparing the contribution rates of the previous study and the present study, gels (29.1%) and rice products (4.2%) had a lower contribution to the carbohydrate intake of the elite junior golfers in present study, while snacks and sweets (34.9%) and sports drinks (23.2%) had a higher contribution to their carbohydrate intake than the previous study. This result suggests that the difference in activity intensity between golf and ultramarathon may have increased the intake of snacks and sweets. The physical activity of an ultramarathon is equal to 11 METs, which is higher than golf (4.8 METs) (Ainsworth et al., 2011). Furthermore, golf is due to the waiting time for others to play, golfer can intakes the solid food. snacks for golf. Thus, junior golfer is believed to have carried, and intake snacks and sweets during competition.

By sex, 40.6% and 31.2% of the female and male study participants met the recommended amount of carbohydrates. This was likely due to the fact that the purpose of eating a light meal during a round of golf differed between male and female. The most common reason for female to snack during golfing was to refresh (37.5%), while for male, the most common reason was hunger (37.5%). Furthermore, based on the energy intake, the female study participants consumed 698 kcal, which is more than the amount consumed by the male study participants (565 kcal). These findings revealed that for junior golfers, the consumption of a light meal during competition not only prevents hunger but may also provide an opportunity for players to improve their mood. Competitive golf involves high cognitive loads, critical shot-making decisions, and high-level motor and biomechanical skills. This combination of critical shot-making decisions, multiple maximum effort swings, putting, and long-distance walking during a round can lead to physical and mental fatigue and golf-specific fatigue (Doan et al., 2007; Smith, 2010; Smith et al., 2012). Australian Institute of Sport states the following about confectionery consumed during competition: sports confectionery provide a highly concentrated source of carbohydrate in a chewy jelly bean/jube form that is easily consumed and rapidly digested (Australian Institute of Sport, 2021). They are typically provided in packets or pouches that are suited for situations where consumption of smaller servings of carbohydrate can be managed at frequent intervals. Moreover, carbohydrates consumed during exercise can support or enhance performance via two different mechanisms. First, they provide fuel for the muscle. Second, they provide benefits to the brain and central nervous system. Thus, they are commonly consumed by junior golfers as snacks as they not only provide energy but also relieve them from stress of the competition.

Some previous studies reported that the experience in nutritional education was dietary intake (Fahlman et al., 2008; Parmer et al., 2009) and eating behaviors (Horikawa, 2015; Murai et al., 2015; Nishinakagawa et al., 2018) among adolescents and children. The acquisition of knowledge in health education is known to promote changes in behavior (Lawrence, 2005). Therefore, the study participants in the present study were considered to be motivated to change their behavior due to the food knowledge they acquired from nutrient education. Based on these findings, we considered that our results were reasonable. Alternatively, no association was observed between the factors related to golf competition and carbohydrate intake. Taken together, the results revealed that the amount of carbohydrates in competition was not affected by a longer golf career, indicating that junior golfers need nutritional education to increase the amount of carbohydrates they consume to prevent fatigue. However, the study participants in this study did not receive a detailed information on the content of nutrition education, and future research should determine what type of nutrition education influences behavioral changes in golf players. Furthermore, the findings of this study may be applicable not only to junior golfers but also to adult golfers. Therefore, it is necessary to conduct further research on junior athletes in other sports events.

This finding of this study revealed that nutrition education has the potential to increase the carbohydrate intake among players. It has been suggested that promoting nutrition education will increase the carbohydrate intake among golf players and prevent fatigue and decreased performance. Through the application of the findings of this study, preventing any potential decline in cognitive function associated with low blood glucose levels may help elite golfers perform more consistently on course and dictate fueling strategies (Nagashima, Ehara, et al., 2023). Further, in the future, nutrition education focusing on the types of carbohydrates needs to be encouraged, as it is possible that education aiming to increase intake of higher quality, slow-release carbohydrates may have a positive effect on energy levels and performance. Furthermore, recently a study reported that macronutrient consumption (consuming 30 g of carbohydrate, 15 g + 15 g protein and carbohydrate) led to a significantly lower level of self-reported fatigue without affecting golf performance and alertness compared to a control (Thompsett et al., 2022). Therefore, future studies should not only examine the effects of consuming carbohydrates but a combination of carbohydrates and proteins.

The findings of this study may be expected to contribute to the further improvement of the quality of nutritional support in elite junior golfers. Japan's elite junior golfers play matches every week during August, which is considered a peak season of the sport. In junior golf, matches usually last three or four days, and there are hardly any days off during the week if designated practice days and travel days are included. Furthermore, the energy expenditure of junior golfers is high. Junior golfers need energy not only for competition but also for growth. If inadequate energy is consumed, this can lead to low energy availability, which has been shown to induce endocrine and metabolic

alterations affecting health and performance (Loucks, 2013; Mountjoy et al., 2018). Therefore, adequate energy supplementation during competition would not only reduce fatigue but also promote a healthy development of junior golfers. Thus, we believe that the findings of this study may be used to improve nutrition education for junior golfers to promote energy supplementation methods during competition.

Furthermore, it is possible that adult golfers are not consuming enough carbohydrates, as there does not appear to be a difference in carbohydrate intake between adults and children. Therefore, increasing carbohydrate intake might be beneficial for adult golfers. However, considering differences in preferences between adults and children, to find the best carbohydrate supplementation method for adult golfers, a drinks and food study should be conducted on such a demographic.

The strength of this study is the large sample size of 64 study participants, which is a relatively middle sample size of children and adolescent elite golfers. However, this study has several limitations. First, since it is a cross-sectional study, it did not permit the assessment of causality. In the future, intervention studies are needed to determine whether nutrition education will increase the carbohydrate intake of athletes. Second, this study was not conducted using a conditioned match. Moreover, the length of a round of golf, average walking distance, and average completion time were not measured. Third, participants were not selected at random, potentially introducing selection bias. Fourth, we found a difference with the time of year of interest. The previous study was conducted in April, while the present study was conducted in August as the target time period (Ishihara et al., 2000). According to the Japan Meteorological Agency, August in Japan is hot with an average temperature of 27.1°C. Conversely, the average temperature in April is 8.7°C. Therefore, we believe that these differences in temperature negatively affected the contribution of carbohydrates (Ministry of Land, Infrastructure, Transport and Tourism, n.d.). Therefore, it was thought that rice products, which have the potential to spoil, were less likely to be chosen. Moreover, the higher consumption of sports drinks to prevent dehydration was thought to have increased their carbohydrate contribution. Fifth, this study did not directly assess the eating skills of the study participants. Therefore, future studies are needed to assess the eating skills of athletes and test whether improvement in the eating skills of athletes can increase the number of people meeting the recommended carbohydrate intake. Sixth, this study assumed that 18 holes would take 5 h and require  $\geq 150$  g of CHO. However, we did not obtain actual data on the duration of play in this study population. Moreover, some rounds may have taken longer or less than 5 h. Thus, future research needs to consider the duration of play. Seventh, although the recall method was used for the dietary survey, it is possible that omissions or errors in the approximate amount of drinks and foods may occur. Furthermore, the study calculated the nutritional value of all drinks and foods carried; however, it is possible that some people may have and left some of the drinks and foods they carried. It

is also possible that he could not recall the food he carried. Therefore, future studies should allow researchers to record all drink and foods intake. Eight, it is possible that limiting the nutrition education instructors in this study to sports dietitians may have decreased the number of nutrition education participants. Thus, future research should consider if the participants have ever received nutrition education from anyone/where instead of just a sports nutritionist. Furthermore, this study left many unanswered questions on the type of counseling received, its duration, and intensity; thus, the present results should be interpreted with caution.

### **Conclusions**

This study found that the main sources of carbohydrates during the competition were gels, sports drinks, and gummy among Japanese elite junior golfers. It was noted that many elite junior golfers in Japan do not consume the recommended amount of carbohydrates for every golf round. Moreover, our results revealed that nutrition education was associated with a higher carbohydrate consumption matching existing recommendations during a round of golf in junior golfers, independent of age, sex, and BMI.

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## Supplementary Materials

### Appendix

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