

# Study on the Efficiency of Data Collection, Organization and Feedback Methods for Triathlon Races

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**Abstract** Considering the problems of data handling methods in the sports field, the use of smartphones, free tools, going online with the COVID-19 disaster, reducing the workload of data managers, creating graphs automatically, and building a system that can provide immediate feedback are considered to be useful. This study aims to improve data handling at sporting events by examining methods of enhancing data provision efficiency, such as collecting the athletes' physical condition and weather data, for the athletes, coach, and trainer. The data were collected using Google Forms and Google Sheets, and the study considered the problems associated with the data handling process. A questionnaire-based survey regarding data handling was conducted among seven athletes, one coach, and one trainer from a local triathlon team. The questions included collecting information on whether the (1) participants had viewed the Google Sheets, (2) data were useful for the race, (3) Google Sheets were easy to view, and (4) participants had any requests. In addition, eight university students were targeted as simulations for data organization. The results indicated that the use of Google Forms and Google Sheets was more efficient than the traditional paper-based method. In conclusion, this method is useful in collecting, organizing, and providing data at sporting events. The results of this study may lead to improvements in the way data are used in sports. In the future, it may be necessary to fine-tune the system to meet the needs of individual users.

**Keywords** Smartphone, Hot temperature, Automation

## 1. Introduction

Triathlon is a multi-sport endurance competition involving outdoor events in the following order: swimming, cycling, and running. Triathlon races are held intensively in Japan from May to September, sometimes in environments where the water and air temperatures are high [1]. Therefore, athletes must be conditioned to perform in a variety of environments. The factors necessary for an athlete to achieve peak performance can be categorized into physical, mental, environmental, and informational factors [2]. Thus, it is important for triathletes to accurately identify the physical and environmental factors that could affect their performance.

Seo [3] measured the specific gravity of urine, an indicator of dehydration, in triathletes from the training camp immediately before the Asian Games to immediately before the race day. Seo [3], who provided data to the supervisor and the coach, reported that the data were utilized effectively. In addition to triathletes, various methods have been used to measure athletes' physical conditions. In athletics-targeted studies, such methods included a system in which they fill out a form to

report their physical conditions, and a system in which they entered their conditions in Google Forms [4-7]. In soccer, conditions have been checked using a visual analog scale and applications [8]. Thus, the athletes' physical conditions are assessed in various ways at locations where sports are played.

Triathlons have the highest incidence of heatstroke among all sports [9]. The Wet Bulb Globe Temperature (WBGT) should be ascertained in hot environments [10]. Furthermore, it is also important to monitor the temperature and humidity to prevent heatstroke. Since weather conditions also significantly impact performance, acquiring a substantial amount of information about the weather conditions and preparing accordingly will help athletes achieve peak performance on the competition day [11]. In athletics, the air temperature, humidity, WBGT, wind direction and speed, and road surface temperature are measured on marathon courses [11,12]. Since triathlon events are held under hot and humid conditions, it is important to measure the above-mentioned weather data and use them for conditioning the athletes.

The condition of the triathlon team included in this study was monitored at previous training camps. The athletes noted down their body temperatures, weight, and other conditions after they woke up and when they finished their morning and afternoon training sessions. Next, they submitted the forms to their coach and trainer, who checked the forms to keep track of their physical condition. The purpose of examining this team was to check the physical condition of the athletes daily prior to the 22<sup>nd</sup> Japan U19 triathlon championship (2020/Nagaragawa) and the 10<sup>th</sup> Japan U23 triathlon championship (2020/Nagaragawa) held in October 2020. However, it became difficult for the athletes and staff to practice together owing to the spread of the COVID-19 disease. Numerous studies have reported on the impact of the COVID-19 on the sports world since 2020 [13-16]. Due to the spread of infectious diseases, players' physical conditions could not be exchanged face-to-face using paper media, and by going online, they were required to check their physical conditions from a distance. For this reason, several companies have released paid condition management software [17, 18]. In today's increasingly online world, Google Forms allows users to collect various information—substantial and small—free of cost [19]. Since Google Forms and Google Sheets are free to use, it would be an advantage for local sports teams with small budgets not to be charged for their use. It is used as a survey tool in various research [20-23]. The results of Google Forms surveys can be linked to the Google Sheets provided by Google, and the data can be viewed online [24]. In athletics, data on the physical condition of the athletes provided on Google Forms were compiled into Microsoft Excel (Microsoft's spreadsheet software) and shared with the medical staff [7]. Thus, data in the Google Sheets had to be rearranged for Excel. Therefore, to reduce the staff's workload at sporting events, it would be

desirable to establish a system whereby the athletes' data are automatically converted to a graph in Google Sheets and provided to the staff immediately after the athletes input their data. This would reduce the amount of time spent by the staff managing the data, and thus reduce their workload. Furthermore, 81.4% of Japanese aged 13-19 use smartphones to access the Internet [25]. Therefore, it is practical to consider how to access Google Sheets and Google Sheets using a smartphone instead of a computer.

Thus, in the field of sports, the use of smartphones, the use of free tools, going online with the COVID-19 disaster, reducing the workload of data managers, creating graphs automatically, and building systems that can provide immediate feedback are considered necessary. Therefore, it can be said that examining a method that can solve all these issues in this research will lead to the improvement of data utilization methods in sports. This study—including athletes in a triathlon team, one coach, and one trainer—used Google Forms and Google Sheets to collect, organize, and feedback information on the condition of the athletes and the weather. Furthermore, this data was provided to the athletes, coach, and trainer to enable them to make this process more efficient and identify any problems.

## 2. Materials and Methods

### 2.1. Subjects

The study included a total of nine participants with seven triathletes (average age:  $18.9 \pm 2.0$  years) belonging to a triathlon team, one coach, and one trainer. Since the subjects were Japanese, the Japanese version of Figures 1-5 was used for the subjects. This triathlon team has been participating in the Japan U23 and U19 triathlon championships every year. The athletes participated in the 22<sup>nd</sup> Japan U19 triathlon championship (2020/Nagaragawa) and the 10<sup>th</sup> Japan U23 triathlon championship (2020/Nagaragawa) held in October 2020 and were accompanied by the coach and the trainer to the above events. These two competitions were to determine the best in Japan for each generation. The trainers are certified athletic trainers by the Japan Sport Association and assist with conditioning and health management [26]. The objective, content, and data-handling method of this study were explained to all the participants in advance, and they provided their consent to participate. This study was approved by Waseda University's academic research ethical review committee regarding procedures concerning research with human subjects (Approval Number: 2020-244).

### 2.2. Data on Athletes' Physical Conditions

To collect data on the athletes' physical conditions, the author created a Google Form for the participants to enter

information about their physical condition at least six days prior to the race (Fig. 1). The author sent the Google form's response page uniform resource locator (URL) to each athlete's LINE (LINE Corporation) messenger account. Tsuzuki et al. (2019) conducted a survey on which social networking service (SNS) Japanese university students usually use, and reported that all the subjects used LINE [27]. Therefore, it can be said that LINE is a familiar SNS to Japanese people. The athletes clicked on the URL and entered their subjective conditions for the day by 9 am every morning, starting five days before the race. Data entered by the athletes were automatically sent to the Google Sheets (Fig. 2).

To organize the data on the athletes' physical conditions, the author created tables and graphs on a Google Sheets at least six days before the race (Fig. 2). For example, regarding the range of values for the heart rate when they

woke up in the morning (beats/minute) represented in Figure 2, the ranges of the vertical and horizontal axes were from cells D3–D8 and B3–B8, respectively. This allowed the data to be sent to the Google Sheets and the numbers to be reflected in the graph simultaneously. This method was a new way of using Google Sheets that had not been reported before. In Figure 2, the first line shows the Google Forms questions without any modifications. Consequently, it uses many characters and takes up significant space. Therefore, the author hid the first line and entered a second line six days before the race, as shown in line 2 of Figure 2.

Moreover, the author sent the URLs of the athletes' Google Sheets to the personal LINE messenger accounts of the coach and trainer at least six days before the race. All study participants could click on the URL at any given time to view the tables and graphs of their conditions.

The image shows a Google Form interface for data entry. The form is titled "Please enter the conditions for this morning." and is divided into several sections:

- Today's date \***: A date input field with the format YYYY / MM / DD.
- Today's schedule \***: Three radio button options: Training, Race, and OFF.
- Waking up heart rate (Example->50)**: A text input field with the label "Your answer".
- Body temperature (°C) (Example->35.0) \***: A text input field with the label "Your answer".
- Sleep time (h) \***: A vertical list of radio button options ranging from 3.0 to 12.0 in increments of 0.5.
- Sleep quality (1=The worst, 10=The best) \***: A vertical list of radio button options ranging from 1 to 10.
- Mental fatigue (1=Fatigued to the max, 10=Not fatigued at all) \***: A vertical list of radio button options ranging from 1 to 10.
- Physical fatigue (1=Fatigued to the max, 10=Not fatigued at all) \***: A vertical list of radio button options ranging from 1 to 10.
- Motivation to train and race (1=Not the best, 10=The best) \***: A vertical list of radio button options ranging from 1 to 10.

Figure 1. Google forms for entering condition data

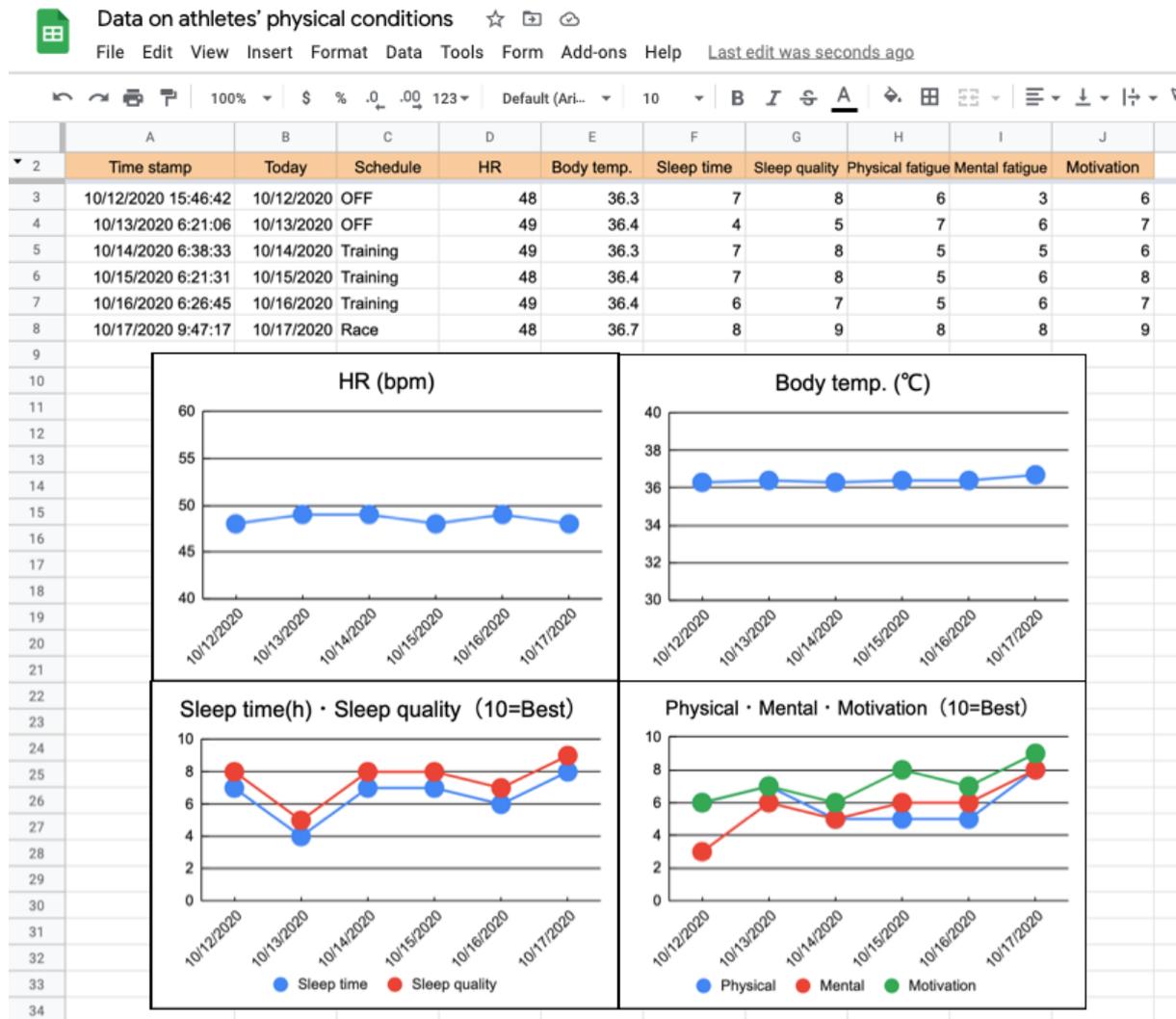


Figure 2. Google Sheets for condition data

2.3. Weather Data

The author obtained the weather data at 11 am, 12 noon, 1 pm, and 2 pm every day, starting five days before the race until the day prior to it. The temperature, humidity, and WBGT were measured using a WBGT meter (SATO, SK-150GT), and the wind speed and direction were measured using an anemometer (Kestrel, 3500) on the biking course of the triathlon race. Water temperatures were measured at the start line using a thermometer (Tanita, TT-508N). The author entered the data obtained into the Google form for recording the weather data (Fig. 3).

The author prepared tables and graphs in advance to organize the data collected for 5 days (up until 1 day before the race) (Fig. 4). Regarding the October 13 data range in the “Air Temp. (°C)” graph represented in Figure 4, the vertical and horizontal axes ranges were from cells E2–E5

and C2–C5, respectively (Fig. 4). This allowed the weather data to be sent to the Google Sheets and the numbers to be reflected in the graph simultaneously. This method was a new way of using Google Sheets that had not been reported before.

To provide the weather data, the author posted the URL of the Google Sheets on LINE Notes—a notice board, which included all the participants and the author—at least 6 days before the race. The Note function allows saved messages to be kept on the bulletin board, and registered members can view them immediately. A URL could be missed if sent to a regular chatroom that has numerous chats. Therefore, the author used the Notes function so that the participants could access the sent URL quickly at any time. All participants clicked on the URL, as needed, to view the weather data tables and graphs in the Google Sheets.

19:50  
Gmail docs.google.com

**Weather data**

Day  
YYYY MM DD  
/ /

**Measurement time**

Time  
:

**Weather**

- Cloudlessness
- Clear sky
- Clouding
- Rain

**Air temperature (°C)**  
Short answer text

**Humidity (%)**  
Short answer text

**WBGT (°C)**  
Short answer text

**Water temperature (°C)**  
Short answer text

**Maximum wind speed (m/s)**  
Short answer text

**Average wind speed (m/s)**  
Short answer text

**Wind direction (X→★)**  
Short answer text

Figure 3. Google forms for entering weather data

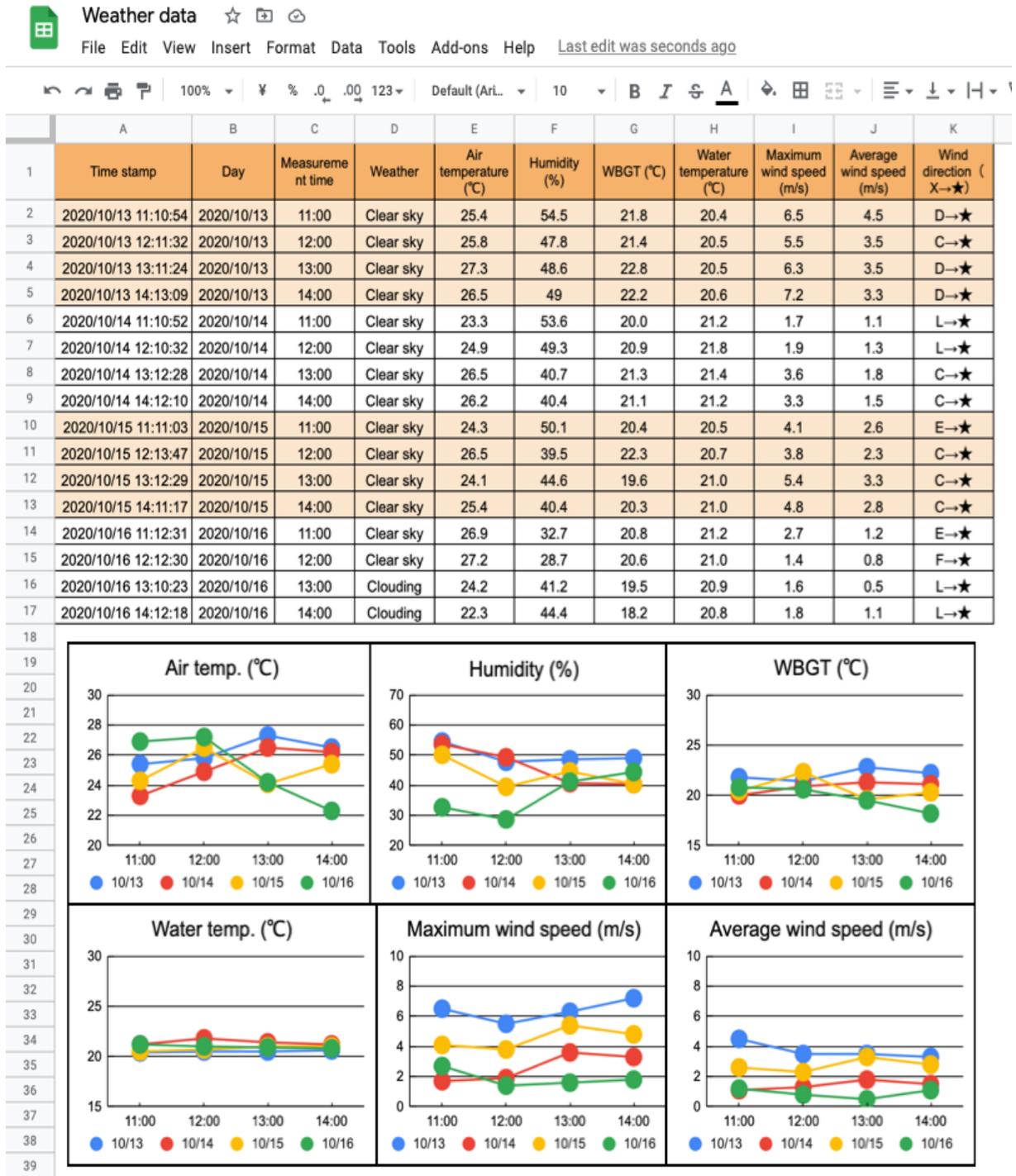


Figure 4. Google Sheets for weather data

10:27 4 docs.google.com

## Questionnaire survey

(1) Was it easy to input condition data? \*

Very easy  
 Fairly easy  
 Cannot say either way  
 Somewhat difficult  
 Difficult

(2) Please enter any requests or suggestions you have for the input method so that athletes can input condition data better in the future. If there are none, please enter "none." \*

Short answer text

(3) Did you go through the results table and graphs in the condition data? \*

Yes  
 No

(4) Did you go through the results tables and graphs in the condition data carefully? \*

Yes  
 No

(5) Were the condition data results helpful in conditioning you for the race? \*

Very useful  
 Fairly useful  
 Cannot say either way  
 Not very useful  
 Not useful

(6) Why did you think that way about the answer in (5)? Please enter. \*

Short answer text

(7) Were the results tables and graphs in the condition data easy to read? \*

Very easy to view  
 Fairly easy to view  
 Cannot say either way  
 Somewhat difficult to view  
 Difficult to view

(8) Regarding your answer to (7), which part of the results in the condition data was difficult to see? Please enter the answer. If no, please enter "none." \*

Short answer text

(9) Please enter any requests or suggestions that would make it easier for athletes to check condition data results in the future. If you have no requests or suggestions, please enter "none." \*

(10) Have you gone through at the weather data? \*

Yes  
 No

(11) Did you go through the weather data carefully? \*

Yes  
 No

(12) Did the weather data help you prepare for the race? \*

Very useful  
 Fairly useful  
 Cannot say either way  
 Not very useful  
 Not useful

(13) Regarding your answer to (12), if it was helpful, how was it helpful? If not, why was it not helpful? Please enter. \*

Short answer text

(14) Were the weather data tables and graphs easy to read? \*

Very easy to view  
 Fairly easy to view  
 Cannot say either way  
 Somewhat difficult to view  
 Difficult to view

(15) Regarding your answer to (14), which parts of the weather data were difficult to read? Please enter. If no, please enter "none." \*

Short answer text

(16) Please enter any requests or suggestions you have to make it easier for athletes to check weather data in the future. If you have no requests or suggestions, please enter "none." \*

Short answer text

Figure 5. Google forms for doing surveys

## 2.4. Questionnaire-Based Survey

In the questionnaire-based survey, the participants were asked about the handling of the data on athletes' physical conditions and the weather. The questions assessed whether they had viewed the Google Sheets, whether the data were useful for the race, whether the Google Sheets were easy to view, and whether they had any requests. For this survey, each question was created using Google Forms, based on the questionnaire-based survey by Tsuno et al. [28] (Fig. 5). The author sent the Google form URL to a LINE group that included all the participants and the author. The response rate was 100%, with participants filling the survey from two to eight days after the race.

## 2.5. Data-Handling Simulation

The form used to record athletes' physical conditions in the previous triathlon training camps was similar to the one used by Taniguchi and Sugita [29]. Thus, the author simulated the form-filling and data entry in Excel to find out how long it would take to complete the entire process, as a pilot study. Sixteen athletes participated in the triathlon U-23 training camp. Eight university students who had experience in using Excel recorded the data of these athletes from their forms and entered them into Excel. The author measured how long it took for them to complete the process.

### 3. Results

#### 3.1. Data on Athletes' Physical Conditions

In the questionnaire-based survey, three out of the seven athletes answered that it was “very easy” to enter their physical condition, while four said that the process was “fairly easy.”

After the data collection, all participants repeatedly viewed the Google Sheets that described their physical conditions before the race. When asked if the results were useful for their conditioning, six out of the nine participants said that they were “very useful,” two said that they were “fairly useful,” and one said “cannot say either way.” Regarding requests or suggestions about the conditioning check, one athlete said that the results table on the smartphone screen had to be viewed by scrolling to the left and right as well as up and down, and that it should be redesigned such that it could be viewed by only scrolling vertically. The coach responded that irregular physical conditions should also be considered. The trainer said that the coach would benefit if there was a page that showed tables for each athlete and the physical condition of all athletes at once.

#### 3.2. Weather Data

The results of the survey indicated that all the participants had repeatedly viewed the weather data Google Sheets before the race. Regarding the viewability of the Google Sheets, six out of the nine participants said that the Google Sheets was “very easy to view,” and three participants answered that it was “fairly easy to view.” When asked if the results were useful to prepare for the race, five out of the nine participants said that they were “very useful,” three said that they were “fairly useful,” and one said “cannot say either way.” When asked if they had any requests or suggestions about the weather data, one athlete replied: “It was sunny until the day before the race, but the day of the race was rainy. Therefore, the weather data were completely different.” One coach stated, “If data are available for the morning and the evening, I could follow weather changes for the entire day.”

#### 3.3. Data-Handling Simulation

The pilot study participants—the eight university students who simulated the data-processing work—took on an average 14 min and  $7 \text{ s} \pm 43 \text{ s}$  (average  $\pm$  standard deviation) to simulate the data.

### 4. Discussion

This study, which targeted a triathlon team, used Google Forms and Google Sheets to collect and organize athletes' physical conditions and weather data. It provided these

data back to the participants to enable them to create a more efficient process and identify any problems. The use of Google Forms and Google Sheets made it possible to automate the graphs and share the data with the participants, improving the data handling efficiency. Therefore, this study allowed us to examine the use of smartphones, the use of free tools, going online with the COVID-19 disaster, and the construction of a system that can reduce the burden on data administrators, automatically generate graphs, and provide immediate feedback. The consideration of a system that solves all of these problems is a new finding in the field of conditioning. However, the results of the survey indicated that there were some areas for improvement.

The survey results revealed that data on physical conditions were easy to enter, and that the participants repeatedly viewed the Google Sheets before the race. Many participants said that Google Sheets were useful in preparing for the race. Thus, the subjective evaluation of the participants was generally favorable. In a previous study, athletes responded to Google Forms and their recorded answers were compiled into Excel; this information was then shared among the medical staff [7]. However, in this study, the athletes entered their data into Google Forms, and these data were automatically converted into graphs and shared with staff, which reduced the staff's work in comparison with the method by Tabata et al. [7]. As a result, the conversion of data collection to data provision became more efficient. This pilot study reported that the average time required to enter the athletes' physical condition into Excel was about 14 minutes. In contrast, the method proposed in this study does not require any time to enter the data into Excel. Thus, about 14 minutes could be saved daily. Hence, this method improves the overall efficiency of the data handling process. In actual triathlon training camps, training often starts at 7:00 a.m., and the medical staff needs to enter condition data by then. However, by reducing the time by about 14 minutes, the medical staff can use that time to analyze the condition data and consider the results. However, in athletics settings, internet connection is not always available to check the physical condition of athletes when they play overseas. Therefore, in order to allow direct communication between athletes and medical staff, the survey was conducted on a paper basis rather than electronically [4,5]. Thus, it is necessary to choose an appropriate method after considering the objective of the process and the availability of the internet. In addition, given that paratriathlon is now a Paralympic sport, the interest in reporting on paratriathlon, and the impact of such reporting on disabled people, increase [30]. This study was conducted on athletes with no vision problems, but since there are athletes with visual impairment in paratriathlon, it is necessary to find the best data collection and feedback methods for athletes with visual impairment in the future. In the questionnaire, one athlete replied that the results table on the smartphone screen had to be scrolled from left and right as well as up and down, and that it should be redesigned such that it

could be viewed using vertical strokes only. In a study by Tsuno et al. [28], which examined support methods video data handling, many people commented that the method being proposed was convenient because it allowed them to browse easily on their smartphones. On the other hand, 91.6% of the Internet users were worried about their personal information being leaked to the outside world [25]. Because of this, it may be necessary to design Google Sheets with security in mind in the future. The coach responded that irregular physical conditions should also be considered. For this study, Google questionnaire forms were created by referring to the condition-recording sheet used by Murakami et al. [4]. It may be beneficial to include freeform answers in the Google form to handle atypical answers, which are not covered in the given options. The trainer stated that the coach would benefit if there was a page that showed tables for each athlete and the physical condition of all athletes together. In this study, a Google Sheets was created for each athlete to provide data to the participants. In the future, it may be necessary to collaborate with the team members in advance and design Google Sheet in accordance with their needs.

Sports weather is the concept that athletes should make effective use of weather information to improve their preparation skills, which will lead to improved athletic performance [12]. It is important to collect and utilize weather data at the location where sports are played. The method of handling the weather data used in this study allowed for the data to be converted into a graph as soon as they were entered, as in the case of the athletes' physical conditions, so that they could be instantly provided to the participants. Therefore, this system could be used in sports wherein the weather conditions have a significant impact on the performance. In the questionnaire-based survey, all the participants reported that they had repeatedly viewed the weather data Google Sheets before the race and that it was easy to view. Many participants responded that the Google Sheets was useful in preparing for the race, indicating that the subjective evaluation of this method by the participants was generally favorable. An athlete responded that "It was sunny until the day before the race, but the day of the race was rainy. Therefore, the weather data were completely different." Moreover, in the future, weather forecasts could be fed to Google Forms and used to predict weather conditions.

This study did not consider whether the use of Google Forms was the best method for collecting the athletes' physical condition and the weather data. Therefore, it is not clear whether the use of Google Forms is the best method in this context. Moreover, various other online survey creation programs are available for free on the internet that may enable better data handling. In the future, it may be necessary to use other online questionnaire services and examine their usefulness. In addition, the number of subjects in this study was small because nine athletes, coaches, and trainers of one triathlon team were included in the study. Therefore, in the future, it is necessary to

increase the number of target teams and conduct further studies after resolving the issues identified in this study.

This study streamlined data collection and organization of the weather and athletes' physical condition and shared the data with the participants using free programs, such as Google Forms and Google Sheets. Based on our results, it may be necessary to customize the system to meet the needs of individual users in the future. This method may allow regional triathlon teams with limited budgets to collect, organize, and provide data on the athletes' physical condition and weather easily, efficiently, and for free. The results of the present study may provide a methodology that can be implemented in the field of sports right now, as the spread of the COVID-19 disaster continues. It also suggests that this study may be of great value in improving the handling of data in the field of conditioning involving athletes, coaches, and trainers.

## 5. Conclusions

This study, which included triathlon athletes, a coach, and a trainer, used Google Forms and Google Sheets to collect, organize, and provide data on athletes' physical condition and the weather to improve the efficiency of the data handling process and identify any problems. We found that this method was more efficient than the conventional method of using paper-based forms to collect, organize, and provide data, organizing, and providing data. The results of this study that may lead to improvements in the way data are used in sports. In the future, it may be necessary to customize the method to meet the needs of individual users better.

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## Conflicts of Interest

We affirm that we have no financial affiliation or involvement with any commercial organization that has a direct financial interest in any matter included in this manuscript.

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