

The Relative Age Effect of Male and Female Japanese National Soccer Players

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The relative age effect (RAE) of Japanese national soccer players has not been examined to date. The purpose of this study was to examine the RAE of male and female Japanese national soccer players, targeting players who were called up to the Japanese national team from 2014 to 2020. The subjects were 241 national soccer players (143 male and 98 female). Even if they were called up to national team more than once, they were counted as one person. Among the Japanese male national soccer players, Q1 (January to March) was 31.5%, Q2 (April to June) was 22.4%, Q3 (July to September) was 20.3%, and Q4 (October to December) was 25.9%. As a result of the goodness-of-fit test, no significant difference was observed in the proportions of Q1 to Q4. Q1/Q4 was 1.22, and S1/S2 was 1.17. Among female national soccer players, Q1, Q2, Q3, and Q4 were 20.4%, 28.6%, 27.6%, and 23.5% respectively. No significant difference was observed in the proportions of Q1 to Q4. Q1/Q4 was 0.87, and S1/S2 was 0.96. We concluded that there is no RAE for Japanese national soccer players, whether men or women. Since the number of subjects is insufficient, it will be necessary to return to the analysis of the RAE of Japanese national soccer players in the future.

Keywords: birthday, football, Japan

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1. Background

Children born in months far from the cutoff date have been reported to be disadvantaged in academic and sports activities (Cobley et al., 2009; Smith et al., 2018; Katsumata et al., 2018; Delorme et al., 2011; Till et al., 2010; Müller et al., 2015), and this is called the “relative age effect.” The relative age effect of soccer players has also been investigated many times, and the analyses have been conducted from various aspects such as country, gender, position, and league (Musch and Hay, 1999; Sedano et al., 2015; Figueiredo et al., 2021; Yagüe et al., 2018; Brustio et al., 2018). Among the previous studies regarding the relative age effect of soccer players, the relative age effect of national representative players has also been investigated (Figueiredo et al., 2021; Götze and Hoppe, 2020). For example, no relative age effect was observed for either men or women in Portugal's national A team (2016/2017 season to 2019/2020) (Figueiredo et al., 2021). In contrast, among women, the percentage of soccer players who are close to the

cutoff date is as low as 10.5%. In addition, in a study that investigated Germany's representative soccer players, the odds ratio was high for men than for women, but no relative age effect was observed for both men and women (Götze and Hoppe, 2020). Since there are not many representative players from each country, there may be a limitation of the research that it is difficult to show statistical differences in each study. In addition, the relative age effect of soccer players who participated in the World Cup, in which national representative players participate, has been investigated (Pedersen et al., 2022). As a result, there was no relative age effect until 2010, but a relative age effect was observed in 2014 and 2018 World Cup players for men. For women, no relative age effect was observed consistently in the 2007–2019 World Cup. Judging from these results, it may be that the relative age effect is beginning to become clear for male national team players. In any case, it is thought that the trend in the relative age effect of national team players will also change, so the relative age effect of national team players will continue to be an

important theme in the future.

In Japan, the relative age effect has been investigated in professional male soccer players, youth players, and professional female soccer players (Nakata and Sakamoto, 2011; Sasano et al., 2020; Nakata and Sakamoto, 2012; Hirose, 2009; Matsuda and Ishigaki, 2023A, 2023B). The relative age effect of male professional soccer players has been observed for some time (Nakata and Sakamoto, 2011; Uchiyama, 1996), and a relative age effect has also been observed in male professional soccer players in recent years (Sasano et al., 2020; Matsuda and Ishigaki, 2023B). However, in women, although no relative age effect was observed in the top-level female soccer players in Japan in 2010 (Nakata and Sakamoto, 2012), a recent study did find a relative age effect (Matsuda and Ishigaki, 2023A). Thus, the relative age effect of Japan's top-level soccer players has been investigated, but the relative age effect of Japanese national soccer players has not been clarified. As mentioned above, the relative age effect of national soccer players has been studied in other countries, and to clarify the details of the relative age effect of Japanese soccer players, it is necessary to investigate the relative age effect of national soccer players in Japan as well. A slightly older study reported that the relative age effect of male professional soccer players in Japan was clearer than that of German, Brazilian, and Australian professional soccer players (Musch and Hay, 1999). Therefore, the tendency of the relative age effect of the Japanese national soccer players may differ from that of other countries. The elucidation of the relative age effect of Japanese national team players will provide useful information for soccer coaches, parents of young soccer players, and the players themselves, and will also result in a comprehensive understanding of the relative age effect and the development of research in this field.

In this study, based on the data of players who were called up to the Japanese national team from 2014 to 2020, we will clarify the relative age effect of male and female Japanese national soccer players. In addition, to clarify the details of the relative age effect, we will also examine the gender and positional differences in the relative age effect.

2. Method

2.1. Subjects

The subjects were 241 Japanese national soccer players (143 male and 98 female) who were called up to international tournaments and official matches from 2014 to 2020. Even if a player is called up to national team more than once, they are counted as one player. By position, there were 11 GK (Goalkeeper), 52 DF (Defender), 43 MF (Midfielder), and 37 FW (Forward) among the men and 10 GK, 32 DF, 36 MF, and 21 FW among the women.

2.2. Data Collection

The date of birth of the subjects was obtained from the official website of the Japan Football Association (<https://www.jfa.jp/>). As these data are a matter of public record, there was no need for informed consent from subjects. The data-collection period was from August 2021 to September 2021.

2.3. Statistical analysis

We calculated the number and percentage of subjects for each month based on their date of birth. As in the previous study (Musch and Hay, 1999), we calculated the Spearman rank correlation coefficient and determined the significance of establishing the relationship between the frequency of each birth month and the number of participants born in each month. Because the school year begins in April in Japan, April was taken as month 1 in this analysis.

Following previous studies (Nakata and Sakamoto, 2011; Sasano et al., 2020), the date of birth of the subjects was classified into 4 groups: the first quarter (April–June; Q1), the second quarter (July–September; Q2), the third quarter (October–December; Q3), and the 4th quarter (January–March; Q4), and we calculated the frequency and ratio in each quarter. Additionally, we tested the goodness of fit to examine the difference in the proportions of Q1 to Q4. The expected value was calculated based on the birth month distribution of Japanese people at birth from a demographic survey conducted by the Ministry of Health, Labour and Welfare of Japan. Since the subjects' dates of birth ranged from 1978 to 2003, the birth months of children born between 1978 and 2003 were referenced. As a result, Q1 was 24.2%,

Q2 was 24.8%, Q3 was 26.3%, and Q4 was 24.7%. ω was calculated as the effect size. Effect sizes ω are considered to be small, moderate, and large, when ω is 0.10, 0.30, and 0.50, respectively (Cohen, 1988). Following previous research (Sasano et al., 2020), we calculated Q1/Q4 to examine the difference between the ratios of Q1 and Q4. In addition, S1/S2 was calculated to examine the difference between the sum of the proportions of Q1 and Q2 (S1) and the sum of the proportions of Q3 and Q4 (S2). A χ^2 test was performed to examine gender differences and playing positional differences in the proportions of Q1–Q4.

We used the Statistical Package for the Social Sciences (SPSS, Version 27, IBM Corp.) and js-STAR for statistical analysis, and we set the statistical significance at 5%.

3. Results

No significant correlation was observed between

the birth months of the Japanese national male soccer players and the frequency of each month (**Table 1**), and **Figure 1** shows this result. Among Japanese male soccer players (overall), 31.5% in Q1, 22.4% in Q2, 20.3% in Q3, and 25.9% in Q4 (**Figure 2**). As a result of the goodness-of-fit test, no significant difference was observed in the ratios of Q1 to Q4 (**Figure 2**, **Table 2**). Q1/Q4 was 1.22 and S1/S2 was 1.17 (**Table 2**). As a result of testing the goodness of fit for each position, no significant difference was observed for any position (**Table 2**).

No significant correlation was observed between the birth month of the Japanese national female soccer players and the frequency of each month (**Table 1**), and **Figure 1** shows this result. Female national soccer players (overall) were 20.4% in Q1, 28.6% in Q2, 27.6% in Q3, and 23.5% in Q4 (**Figure 3**). As a result of the goodness-of-fit test, no significant difference was observed in the ratios of Q1 to Q4 (**Table 2**). Q1/Q4 was 0.87 and S1/S2 was 0.96

Table 1 Distributions of players' birth months and the results of correlation analysis

	April	May	June	July	August	September	October	November	December	January	February	March	Sum	r	p
Male n	13	17	16	13	12	7	10	11	8	12	12	12	143	-0.56	0.06
Male %	9.1	11.9	11.2	9.1	8.4	4.9	7.0	7.7	5.6	8.4	8.4	8.4	100.0		
Female n	6	10	4	13	5	10	10	8	9	12	2	9	98	-0.01	0.97
Female %	6.1	10.2	4.1	13.3	5.1	10.2	10.2	8.2	9.2	12.2	2.0	9.2	100.0		

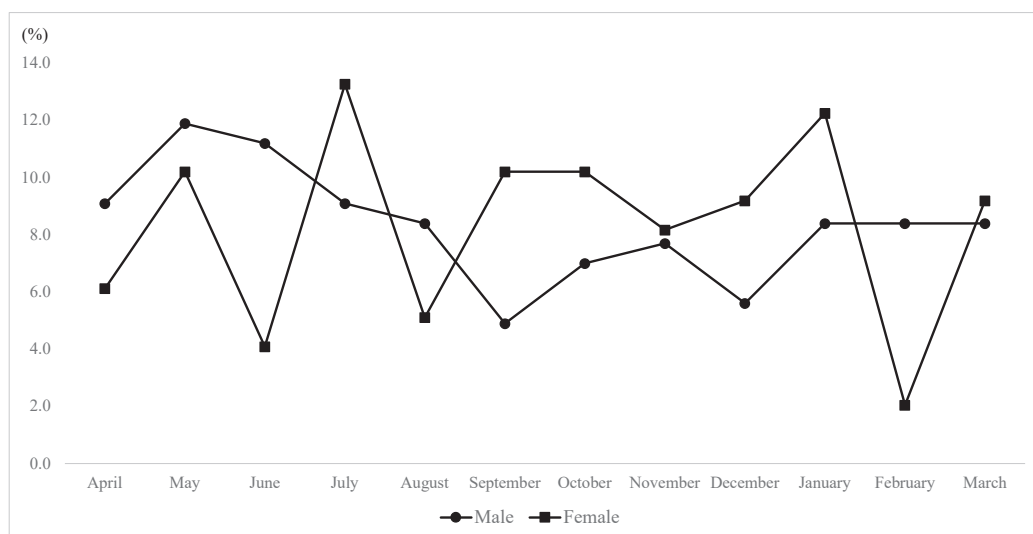


Figure 1 Ratio of players' birth months in each month

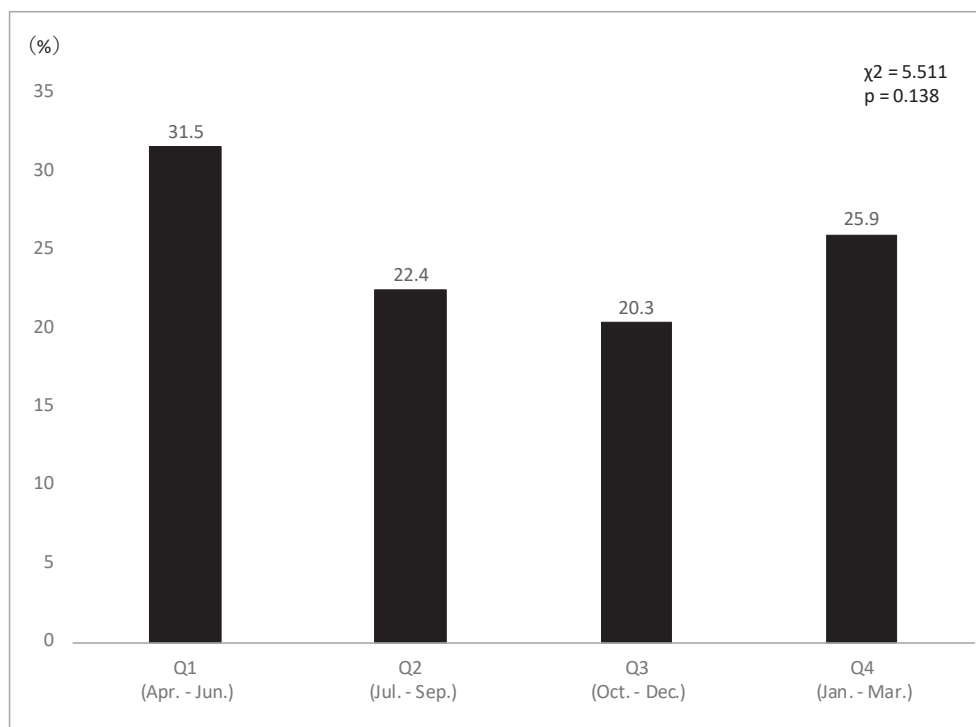


Figure 2 Ratio of players' birth months in each quarter (Q1–Q4) in Japanese male national soccer players

(**Table 2**). As a result of testing the goodness of fit for each position, no significant difference was observed for any position (**Table 2**).

Regarding the ratio of Q1–Q4, we tested the positional and gender differences, but no significant differences were observed (sex difference: $\chi^2 = 4.992$, $p = 0.172$, positional difference: male $\chi^2 = 8.132$, $p = 0.521$, female $\chi^2 = 10.000$, $p = 0.350$).

4. Discussion

Overall, no relative age effect was observed in the Japanese national soccer players for either men or women. In comparison, no relative age effect was observed for either men or women in Portugal's national team players (2016/2017 season–2019/2020 national team players) (Figueiredo et al., 2021). In this study (Figueiredo et al., 2021), players' birthdays were divided into four periods (Q1: January to March, Q2: April to June, Q3: July to September, and Q4: October to December). For women, the number of players who are close to the cutoff date (i.e. Q1) is low at 10.5% in this previous study (Figueiredo et al., 2021). In addition, in a study that investigated Germany's national team (players registered for the World Cup and Champions League since 2015), no relative age effect was observed for either men

or women (although the odds ratio was higher for men than for women) (Götze and Hoppe, 2020). The number of subjects in both studies was small; therefore, a simple interpretation is not possible, but our results were found to be consistent with these previous studies. However, in the Spanish women's national team (2010–2013), a relative age effect was observed, and the percentage of players near the cutoff date (Q1) was high at 34.5%. However, since this previous study included not only seniors but also U17, U19, and U21 players, it cannot be said that it is the result of the representative players (Sedano et al., 2015). A previous study (Pedersen et al., 2022) that analyzed players who participated in the 2006–2018 World Cup did not show a relative age effect until 2014 in men, but a relative age effect was found in 2014 and 2018. For women, no relative age effect was observed between 2007 and 2019. Pedersen et al. (2022) assessed several players who participated in the World Cup. In Pedersen et al.'s (2022) study, the number of participants was approximately 730 men and 330–550 women in each World Cup, and the large number of participants increased the possibility of detecting statistical differences. However, the number of participants in the present study was small, with 143 men and 98 women. Previous studies that included few participants did not show a clear relative

Table 2 Distribution of players in Q1–Q4, the result of χ^2 test, Q1/Q4, and S1/S2

		Q1 (Apr. - Jun.)	Q2 (Jul. - Sep.)	Q3 (Oct. - Dec.)	Q4 (Jan. - Mar.)	Sum	χ^2	p	ω	Q1vsQ4	S1vsS2
Male	FW	n 11 (%) 29.7	8 21.6	9 24.3	9 24.3	37 100.0	0.675	0.879	0.14	1.22	1.06
	MF	n 16 (%) 37.2	9 20.9	10 23.3	8 18.6	43 100.0	4.065	0.255	0.31	2.00	1.39
	DF	n 15 (%) 28.8	13 25.0	10 19.2	14 26.9	52 100.0	1.557	0.669	0.17	1.07	1.17
	GK	n 3 (%) 27.3	2 18.2	0 0.0	6 54.5	11 100.0	7.097	0.069	0.80	0.50	0.83
	Total	n 45 (%) 31.5	32 22.4	29 20.3	37 25.9	143 100.0	5.511	0.138	0.20	1.22	1.17
Female	FW	n 3 (%) 14.3	8 38.1	6 28.6	4 19.0	21 100.0	2.663	0.447	0.36	0.75	1.10
	MF	n 8 (%) 22.2	12 33.3	6 16.7	10 27.8	36 100.0	2.524	0.471	0.26	0.80	1.25
	DF	n 7 (%) 21.9	4 12.5	11 34.4	10 31.3	32 100.0	3.373	0.338	0.32	0.70	0.52
	GK	n 2 (%) 20.0	4 40.0	4 40.0	0 0.0	10 100.0	4.188	0.242	0.65	-	1.50
	Total	n 20 (%) 20.4	28 28.6	27 27.6	23 23.5	98 100.0	1.263	0.738	0.11	0.87	0.96

age effect (Figueiredo et al., 2021; Götze and Hoppe, 2020). For example, Figueiredo et al. (2021) analyzed the relative age effect in Portugal among 61 men and 57 women. Similarly, Götze and Hoppe (2020) evaluated this effect among 46 men and women in Germany's national team. Studies focusing on national players from a single country, such as this study, tend to have fewer participants; therefore, the results of this study differ from those of Pedersen et al.'s (2022) research on players who participated in the World Cup.

A relative age effect for Japanese professional male soccer players was found in 1993 season data (Uchiyama, 1996) and also in a recent study analyzing the 2018 season (Sasano et al., 2020). The value of Q1/Q4 has also been investigated in a

previous study and it was 2.2 in the 1993 data and 2.1 in 2018 (Sasano et al., 2020). Since the Q1/Q4 ratio of this result was 1.22, it can be inferred that the tendency of the birth month distribution of the representative players is somewhat different from that of the male professional soccer players as a whole. A representative player is an excellent player chosen from the pool of professional soccer players. As for the percentage of professional soccer players, the number of players whose birth month is far from the cutoff date (Q4) is small, but many excellent players are thought to be among them. A study analyzing English professional football club players found that few academy players had birthdays far from the cutoff date, but the probability of becoming a professional soccer player is reported to be higher for players

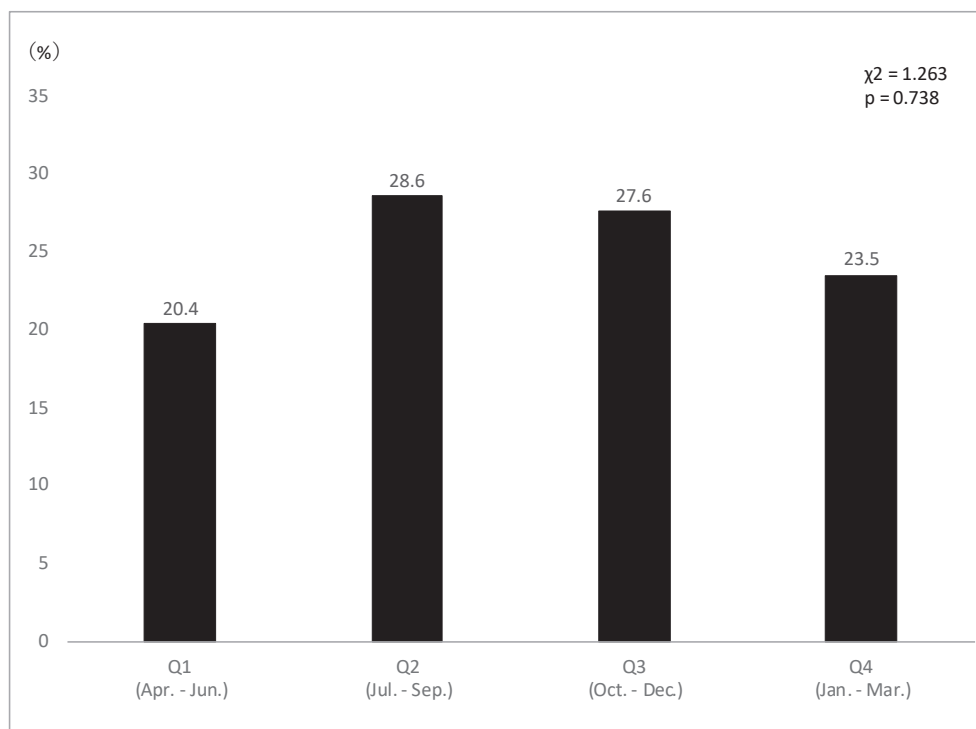


Figure 3 Ratio of players' birth months in each quarter (Q1–Q4) in Japanese female national soccer players

whose birth months are farther from the cutoff (Kelly et al., 2020). In other words, there are thought to be excellent athletes among those whose birth month is far from the cutoff date, so it is thought that the tendency of the relative age effect will be smaller in the case of representative soccer players. However, looking at the results for the Japanese male national soccer players, the rank correlation coefficient was -0.56 (Table 1). Looking at Table 2, Q1/Q4 was 1.22 and S1/S2 was 1.17, so there may be a slight trend toward relative age effects. Due to the small number of subjects, no statistical difference may have been observed. Previous studies (Figueiredo et al., 2021; Götze and Hoppe, 2020) had the same problem and this is a limitation of this research because the number of national soccer players is very small compared to the pool of professional soccer players. As mentioned above, since the relative age effect is observed in the male soccer players who participated in the World Cup (Pedersen et al., 2022), there may be a slight trend of the relative age effect in the Japanese male national team players. A study comparing the relative age effect of two seasons (the 2000/01 season and the 2010/11 season) about 10 years apart of professional soccer players in Europe found that the relative age effect tended to increase slightly (Helsen et al., 2012). As mentioned above, no relative age effect

was observed by for male players who participated in the World Cup until 2014, but a relative age effect was observed in 2014 and 2018 (Pedersen et al., 2022). Similarly, although no relative age effect was observed among female players in the World Cup from 2007 to 2019, a relative age effect was observed for the U-20s in 2018 for the first time since 2002 (Pedersen et al., 2022). These findings indicate a notable shift in the relative age effect trend in recent years. Hence, since the relative age effect of Japanese national team players may change over time, it will be important to accumulate data in the future. In addition, by position, although there is no significant difference, MF is 2.00 for Q1/Q4 and 1.39 for S1/S2, which are higher than other positions. A study that examined the positional difference in the relative age effect also reported a tendency more likely to be seen in goalkeepers and defenders who are required to be tall and physically strong (Sedano et al., 2015). The results of this study seem to be different from the trend of the previous study (Sedano et al., 2015). Due to the small number of subjects, a clear interpretation is difficult, but this result may be unique to the Japanese national team. A detailed analysis of each position will be necessary in the future.

Among top-level Japanese female soccer players, the 2010 data did not show a relative age effect

(Nakata and Sakamoto, 2012), but a recent study (from the 2016 season to the 2020 season) did find a relative age effect (Matsuda and Ishigaki, 2023). In this study, since no relative age effect was observed in female Japanese national soccer players, it was clarified that the appearance of the relative age effect is different between professional soccer players and national soccer players in female as well as in male Japanese soccer players. Because the correlation coefficient is -0.01 , $Q1/Q4$ is 0.87 , and $S1/S2$ is 0.96 in female Japanese national soccer players, the effect of relative age is thought to be negligible, unlike male Japanese national soccer players. Because Japanese women's soccer won the FIFA Women's World Cup in 2011, the 2012 Olympic Games, and the 2015 FIFA World Cup runner-up title, the competitiveness of Japanese female soccer has increased and developed remarkably. As mentioned above, the relative age effect of female professional soccer players in Japan has recently been observed, which is different from the past. The relative age effect of female national soccer players may also change in the future due to intensifying competition from younger generations. It will be necessary to consider this further in the future.

5. Conclusion

As a result of analyzing the relative age effect of Japanese national soccer players who were called up to the national team from 2014 to 2020, no relative age effect was observed for either male or female Japanese national soccer players. No gender or positional differences were observed in the ratio of $Q1$ to $Q4$. Since the number of subjects in this study is not sufficient, it will be necessary to continue the analysis of the relative age effect of Japanese national soccer players in the future.

Declaration of conflicting interests

There is no conflict of interest.

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