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Original Article

Wellness reports in young soccer players: A within and between-weeks analysis

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Abstract
Monitoring a Soccer's load impact is essential for sporting performance. There are numerous methods of quantifying training load, both for internal and external loading is a key factor to improve the performance of soccer player. However, to the best of our knowledge, there are no previous studies investigating soccer wellness with questionnaires at least in young soccer player and in a championship of four continuous days. This study aimed to explore the wellness of young soccer players during the final phase of an autonomic championship. A total of 18 U14 young, male soccer players of Andalusian autonomic soccer team aged 13.11 ± 0.32 years old agreed to participate. All the players performed the wellness questionnaire three hours before the match during four continuous days. Repeated measures ANOVAs showed significant different during the championship in Sleep quality (p=0.01), stress (p=0.01), and Fatigue (p=0.04). Positive moderate correlations were found between percentage of change of Sleep Quality and percentage of change of Stress (r=.48, p=.047). In addition, multilinear regression analysis revealed that percentage of change of sleep quality was a predictor of the percentage of change of stress, F (1.15) = 4.69, p = 0.04, r = 0.48, r2 = 0.23, adjusted r = 0.18, SE= 0.22. Sleep quality, psychological stress, and fatigue are sensible variables to young players´ exposure to congested fixture calendars such as tournaments. In addition, sleep quality is useful to predict players´ stress. Therefore, coaches from teams in formation should use wellness questionnaire to take decisions in load progression previous to the tournaments, or team line up and substitutions during them.
Keywords: Wellness; Load impact; soccer; young soccer players; performance

Introduction

Load impact (LI) is a parameter that has been on the rise in recent decades (Impellizzeri et al., 2019) . The control, planning and periodisation of LI leads to an optimisation of sport performance, such as reduced risk of injury (Jaspers et al., 2019). Soccer is an intermittent sport that requires optimisation of all energy substrates, both anaerobic and aerobic (Fernandes, 2020). In addition, weekly competition is an added stress on the physiological and psychological levels. This leads to increased physiological fatigue. The relationship between performance and scores on psychological measures during competition, especially mood and competitive anxiety, have been the focus of an extensive and ongoing research effort in sports psychology and specifically in soccer (Prieto et al., 2020).

Players perform a number of high-intensity actions such as sprints, accelerations, decelerations, changes of direction, jumps, tackles and kicking during matches (de Hoyo et al., 2016). The succession of these actions induces alterations in the musculoskeletal, nervous, metabolic and immune systems leading to the fatigue of soccer players (Brownstein et al., 2017). It is known that the fatigue induced by soccer matches can decrease physical performance during several days after the competition (Roe et al., 2017). The current high exigence of the competitive, where elite soccer players can play two or three matches in the same week (Marqués Jiménez et al., 2017), and long trips performed in uncomfortable conditions, are situations that can also affect to the performance of soccer players (Fowler et al., 2015). To fully understand the stress experienced during one or several official soccer matches or tournaments, the physiological and psychological aspects must be considered (Haneishi et al., 2007). Furthermore, (Benitez-Jimenez et al., 2020), they indicated that the fatigue induced by

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matches played on consecutive days in young soccer players, who frequently play this type of competitive tournaments, has been little studied. The above mentioned could influence the well-being player.

It is known that monitoring a Soccer's LI is essential for sporting performance. There are numerous methods of quantifying LI, both for internal and external loading (Impellizzeri et al., 2019). Concerning internal LI, biomarkers are often used to analyse the fatigue state. These methods are usually measurement of hormones such as cortisol (Botelho et al., 2020), heart rate variability (Malagù et al., 2021) , red blood cells (Matos et al., 2020), lactate concentration (Zago et al., 2021), as well as erythrocyte iron concentration (Mariño et al., 2020) and markers of muscle damage (Hammouda et al., 2012). These tools are used to avoid overtraining syndrome. Nonetheless, overtraining could be multifactorial: 1) high- intensity training volume and 2) other stressors in the individual life such as travel, quality of sleep or occupation (Foster, 1998). In soccer, where there is competition every week, it is complicated to perform these measurements on a regular frequency, being a tool that can only be used by clubs with high financial resources, excluding categories in youth training. A recent review reported that further research on loading in youth soccer players is needed (Rico-González et al., 2022). Besides, this review highlighted those measurements tend to be over short periods of time, with the need for them to be more longitudinal. However, measuring biomarkers can be costly and inconvenient for players. Additionally, the stressors could scarcely be measured by the above-mentioned tools. Therefore, it could be interesting to assess the player well-being, through wellness questionnaires. These questionnaires also allow to assess the psychological intensity in a simple and cost-effective way. Hence, it could be a useful tool for coaches of players in formation.

Previous studies have monitored impact loading through perceived exertion (RPE). This tool has been shown to be useful for injury prevention. Previous studies have monitored impact loading through perceived exertion (RPE). This tool has been used mainly for injury prevention (de Dios-Álvarez et al., 2021; Impellizzeri et al., 2004; Marynowicz et al., 2020; Nobari et al., 2021). Nevertheless, a multidimensional approach is needed. In this sense, several recent studies have assessed physiological and psychological stress by means of wellness questionnaires for monitoring IL (Cullen et al., 2021; Gastin et al., 2013; Govus et al., 2018). These questionnaires are based on the player's perception of muscle damage (Montgomery & Hopkins, 2013), muscle fatigue (Gastin et al., 2013), sleep quality (Buchheit et al., 2013), subjective perception of effort (Govus et al., 2018) and psychological stress (Moalla et al., 2016).

However, limited studies have reported on pre-competition assessment of wellness (Ihsan et al., 2017). Coaches need a method to assess how the player is performing prior to competition. Furthermore, most studies have been conducted on senior players. Therefore, this study aimed to assess young soccer players before competition using a wellness questionnaire.

General Methods

Participants

A total of 18 U14 young, male soccer players of Andalusian autonomic soccer team (aged = 13.11 ± 0.32, body weight = 58.81 ± 8.06 kg, height =1.65 ± 6.75) from the region of Andalusia, Spain, were recruited from the province of Jaén, which has a population ranging from 500.000 to 650.000 inhabitants according to the National Institute of Statistics from the Spanish Government (http://www.ine.es/; accessed on 14 November 2021).

The participants' parents and responsible for the territorial federation, obtained information about the main aims of the investigation and signed informed consent forms. All the participants in this study were treated according to American Psychological Association (APA) guidelines, which ensured the anonymity of participants' responses. The study was conducted in accordance with the ethical principles of the 1964 Helsinki declaration for human research and was approved by the Research Ethics Committee of Comillas Pontifical University (2021/85). Inclusion criteria for the participants in this study were (i) reporting normal vision and no history of any neuropsychological impairments that could affect the results of the experiment, (ii) being an active player with federation license, (iii) not presenting any injuries during the previous two months, (iv) giving consent, and (v) participating in 85% of the match during the study period.

Usually, these players trained three times a week (90 min per session) and played one match a week with their respective teams. Generally, training sessions comprised a warm-up, main part, and cooldown. During the tournament, the training sessions were based on recovery strategies (50% of training time), technical and tactical content development (30% of training time), technical skill improvements (10% of training time) and general improvements in physical condition (10% of training time).

Materials

Wellness questionnaire

For our research, the (Hooper & Mackinnon, 1995) wellness questionnaire was used in its original version. The participants evaluated the following parameters from 1 to 10: (sleep, stress, fatigue and muscle soreness) See figure 1. They were told that 1 was the most negative rating and 10 was the most positive. All parameters were analyzed independently. All participants had become familiar with this tool in the 3 months

prior to the final phase of the championship, by using it daily both in training sessions and in competitions in its category.

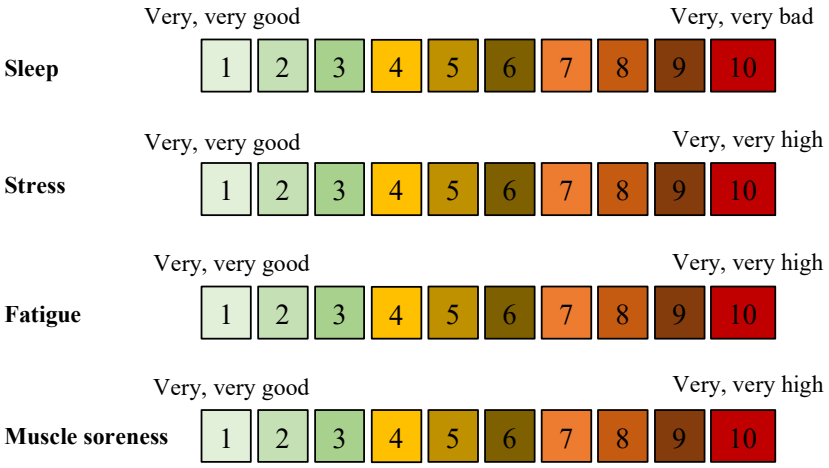

Figure 1. Wellness questionnaire (taken on Hooper & Mackinnon, 1995).

Procedure

This study was designed to analyze the evolution of wellness state induced by four official matches played on consecutive days between February and April of 2019. It was a U14 category territorial team championship. The matches followed the official regulations (FIFA, 2020), with the exception that there was no limit on substitutions. (See Figure 2, for comprehension).

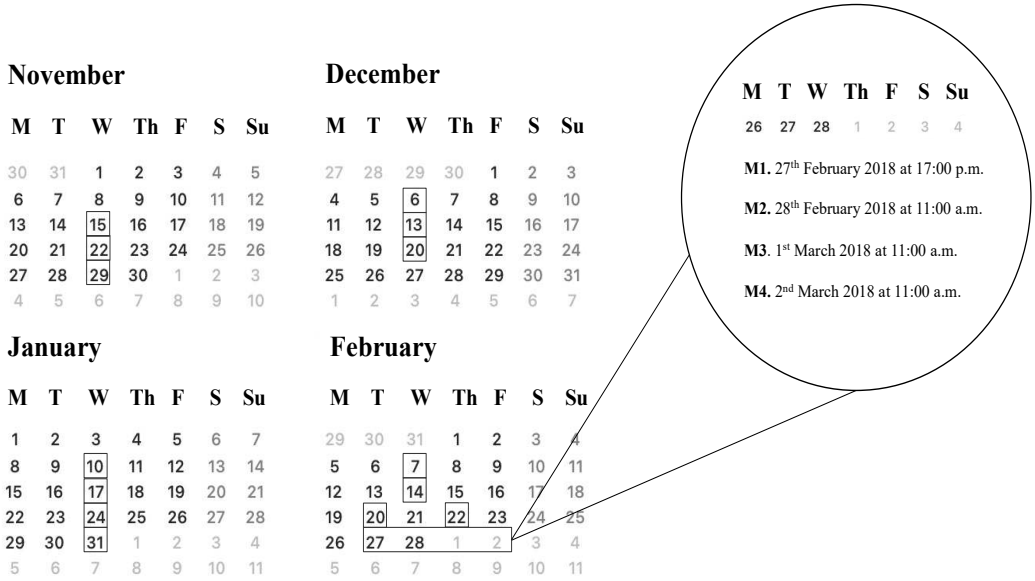

Figure 2. Schematic representation. Training and championship days.

Wellness questionnaire was determined 4 times, always 3 hours before the game. In the first game, the questionnaire was taken during lunch and in the rest of the games, during breakfast. The relation of schedules and results of the matches were: Match 1 (27/02/2018, 17:00 pm, won), Match 2 (28/02/2018, 11:00 am, tied), Match 3 (01/03/2018, 11:00 am, won) and Match 4 (02/03/2018, 11:00 am, lost). All matches were played under similar weather conditions (20ºC and 60% humidity). All the data to wellness questionnaire were collected in digital format by means of a google questionnaire with the players' mobile phones and later they were recorded in a spreadsheet in the Microsoft Windows Excel® program.

Statistical analysis

The statistical analyse were carried out by using the software Statistica (version 13.1; Statsoft, Inc., Tulsa, OK, USA). For all analyses, significance was accepted at $p < 0.05$. Descriptive statistics are represented as mean ± standard deviation (SD) with standard mean difference data. Before any parametric statistical analysis

was performed, the assumption of normality was tested with the Kolmogorov–Smirnov test on each variable. The changes over the championship with participants' mean match load [sleep quality (SQ), stress (S), fatigue (F) and muscle soreness (MS)] were determined by a one-way ANOVA with repeated measures. Effect size is indicated with partial eta squared for Fs. To interpret the magnitude of the eta squared we adopted the following criteria: $\eta 2 = 0.02$, small; $\eta 2 = 0.06$, medium; and $\eta 2 = 0.14$ large. Pearson's correlation coefficient r was used to examine training load [sleep quality, mood, fatigue, and soreness [100-(post * 100)/pre]. To interpret the magnitude of these correlations, we adopted the following criteria: $r \leq 0.1$, trivial; $0.1 < r \leq 0.3$, small; $0.3 < r \leq 0.5$, moderate; $0.5 < r \leq 0.7$, large; $0.7 < r \leq 0.9$, very large; and $r > 0.9$, almost perfect. Multiple regression analysis was used to model the prediction of each variable of training load variables from remaining variables with positive correlation.

Results

Descriptive statistics were calculated for each variable.

Table 1. Training Load during the championship (mean ± SD).

	Match Load 1	**Match Load 2**	**Match Load 3**	**Match Load 4**
SQ	8.20 ± 1.32	8.07 ± 0.70	8.67 ± 0.49	9.00 ± 0.85
S	8.93 ± 1.16	9.47 ± 0.64	9.53 ± 0.52	9.67 ± 0.49
F	8.07 ± 0.88	7.47 ± 0.74	7.67 ± 0.62	7.67 ± 0.62
MS	8.27 ± 1.44	7.73 ± 0.96	7.80 ± 0.77	8.13 ± 0.92
%	8.74 ± 15.80	8.17 ± 9.51	-6.90 ± 15.28	-4.07 ± 15.70
A	0.01*	0.01*	0.04*	0.08
ES	0.29	0.28	0.19	0.15

SQ: Sleep quality; S: Stress; F: Fatigue; S: Soreness. * Denotes significance at $p<0.05$, and ** denotes significance at $p<0.01$.

Different repeated measures ANOVAs with participants' mean SQ, S and F revealed significant differences, $F(1.15) = 6.67$, $p = 0.01$, $\eta^2 = 0.29$, $F(1.15) = 6.11$, $p = 0.01$, $\eta^2 = 0.28$, $F(1.15) = 3.71$, $p = 0.04$, $\eta^2 = 0.19$, respectively. However, a new repeated measures ANOVA with participants' mean MS did not revealed significant differences, $F(1.17) = 2.89$, $p = 0.08$, $\eta^2 = 0.15$. (See table 1, for more information).

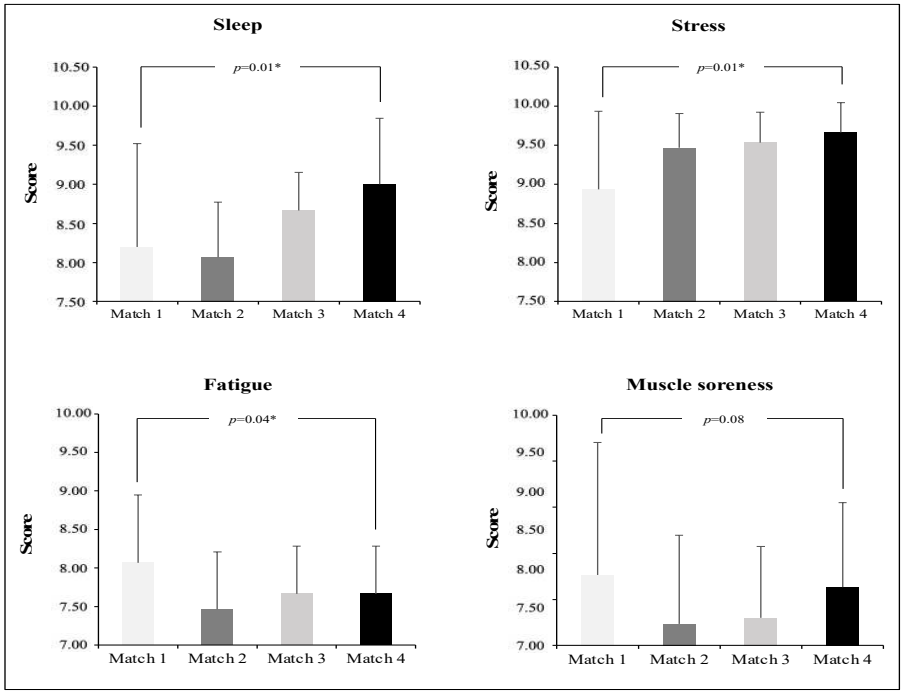

Figure 3. Wellness parameters (sleep, stress, fatigue and muscle soreness) in match 1, Match 2, Match 3 and Match 4.

Posteriorly, associations between percentage of change of match load were performed (Table 2). Crucially, we found positive moderate correlations were found between percentage of change of SQ and percentage of change of S (r=.48, p=.047).

Table 2. Associations between percentage of change of match load.

	SQ	S	F	MS
SQ	r=1.00	r=0.48 | *p*=0.04*	r=0.14 | *p*=0.57	r=-0.65 | *p*=0.80
S	r=0.48 | *p*=0.04*	r=1.00	r=0.35 | *p*=0.16	r=0.24 | *p*=0.35
F	r=0.14 | *p*=0.57	r=0.35 | *p*=0.16	r=1.00	r=0.25 | *p*=0.31
MS	r=-0.65 | *p*=0.80	r=0.24 | *p*=0.35	r=0.25 | *p*=0.31	r=1.00

SQ: Sleep quality; S: Stress; F: Fatigue; S: Soreness. * Denotes significance at p<0.05, and ** denotes significance at p<0.01

Finally, a multilinear regression analysis was performed to verify which variable of percentage of change of match load (agreement with the correlation analysis) could be used to better explain the percentage of change of other variables. The percentage of change of SQ was a predictor of the percentage of change of S, F (1.15) = 4.69, p = 0.04, r = 0.48, r^2 = 0.23, adjusted r = 0.18, SE= 0.22.

Discussion

To the best of our knowledge, it is no previous study investigating soccer match load with questionnaires, at least, in young soccer player and in a championship of four continuous days. Therefore, this study, aimed to explore the match load of young soccer players during the final phase of an autonomic championship which involved four matches in four days, will try to better bridge the research practice gap. The main findings were: (i) significant differences were found during the championship in sleep quality, stress, and fatigue; (ii) positive moderate correlations were found between percentage of change of Sleep Quality and percentage of change of Stress; and, (iii) multilinear regression analysis revealed that percentage of change of sleep quality was a predictor of the percentage of change of stress.

Match load quantification through wellness questionnaire during a congested fixture

Fatigue detecting induced by post-match inflammatory and performance measures has been highlighted as one of the main topics in football community (Rabbani et al., 2019; Rico-González et al., 2021), where congested calendars such as tournaments suppose a challenge for coaches to avoid fatigue and its consequences (Lago-Peñas et al., 2011). This idea is supported by some articles that have shown how a congested calendar induces negative effects in players´ (Moreira et al., 2016; Mortatti et al., 2012), even highlighting a progressive negative consequence as matches are played (Mortatti et al., 2012). In this scenario, the necessity of match load quantification tools is well-known, where questionnaires have been demonstrated their value as one of the most interesting tools for its application in formation teams due to their characteristics as an easy-to-use, no cost, and non-invasive tools (Jaspers et al., 2019). However, to the best of the authors´ knowledge, no previous studies have looked for the fatigue induced by young soccer match load during four-day consecutive match schedule and analyzed by a wellness questionnaire (i.e., Hooper index). In the near future, this study may be a frame of reference for young soccer community in the first post pandemic year derivate by the COVID-19, where the tournaments will return (Rico-González et al., 2021).

To date, it is assumed that changes in perceived wellness status (measured by perception of muscle damage, fatigue, sleep quality, and psychological stress) influences players´ performance and in the possibility of suffering an injury (Laux et al., 2015). It seems that wellness indexes are modified after a match load, likely derivate from the high-intensity load during competition, suggesting the necessity to use recovery strategies, or at least, a sufficient rest period from a match to the following intensive session (or the following match). In this sense, the use of rest days or active rest sessions are usually used strategies in after competition (Rico-González et al., 2020), together with the suggestion that, at least, 48-72 h should be programmed between two competition matches (Rico-González et al., 2021). These strategies are usually respected during the in-season period where one-match-day microcycles are the most common (Rico-González et al., 2020). However, the appearance of congested calendars during or after in-season period is a challenge to the coaches. For example, (Clemente et al., 2017) analyzed professional soccer players´ fatigue during one-day and two-day macrocycles through wellness indexes. The results of this study found that greater fatigue, muscle soreness, and stress was significantly more

apparent within a 2-game microcycles (Clemente et al., 2017). The main reason is the accumulative fatigue effects, which seems to be aggravated in players with lower competitive level (Rampinini et al., 2011). These arguments support the results found in the present study, which showed a significant change in sleep quality ($F(1.15) = 6.67$, $p = 0.01$, $\eta 2 = 0.29$), psychological stress ($F(1.15) = 6.11$, $p = 0.01$, $\eta 2 = 0.28$), and fatigue as the tournament advances ($F(1.15) = 3.71$, $p = 0.04$, $\eta 2 = 0.19$).

In this scenario, it is encouraged to formation team´s coaches to enhance practical solutions to avoid fatigue during congested calendars. In this sense, further to nutritional (Patton-Lopez et al., 2018), lifestyle (Clemente et al., 2021), or other recovery strategies (Keaney et al., 2018; Vitale et al., 2019) between matches, and considering that pre-session wellness status influence players performance (De Beéck et al., 2019a), team staffs should use this tool to individualize time to exposure to match load. Beyond, the results of the present article found positive moderate correlations were found between percentage of change of Sleep Quality and percentage of change of Stress, and since the quality of sleep and the stress seems to be sensible to load´s volume (Moalla et al., 2016), coaches should programme a progressive moderate increment in competitive matches during the previous weeks leading up to the tournament, not only in the previous week as was programmed in this study.

Sleep quality as a predictor of psychological stress during a congested fixture

To date, the use of new algorithms such as random forest, support vector machines, decision trees, or regression models (Herold et al., 2019) have allowed take advantage with the possibility to take decisions predicting dose-response relationship. To the best of the author´s knowledge, only three studies have used the results extracted from wellness questionnaires to predict load values. (De Beéck et al., 2019a) have found through Gradient boosted, regression tree, and Naïve baseline that a combination of internal and external load quantification, together with wellness questionnaire may predict players´ performance (De Beéck et al., 2019a). (Perri et al., 2021) found through a supervised regression model that wellness status can be predicted using the load performed the day before, suggestion the high relationship between load and wellness questionnaires. Finally, (Campbell et al., 2021) demonstrated how through classification tree, regression tree, and random forest algorithms the fluctuations in wellness status responses (e.g., due to the load modifications) can lead to predicting an influence in athlete´s performance. However, no study has highlighted the prediction capacity of sleep quality in stress. Interestingly, the results of the present study demonstrated through a multilinear regression analysis how the percentage of change of sleep quality is a predictor of the percentage of change of stress ($F(1.15) = 4.69$, $p = 0.04$, $r = 0.48$, $r2 = 0.23$, adjusted $r = 0.18$, $SE = 0.22$). This founding may be supported by the idea summarized in a recent systematic review whose authors highlighted how the low sleep quality may induce additional stress, leading to performance reduction and greater injury risk (Manuel Clemente et al., 2021). It may be useful for head and physical fitness and conditioning coaches who, together with the previously commented idea about the influence of the pre-session wellness status in match players performance (De Beéck et al., 2019b), may take decisions in team line up or to make substitutions during the competition based on sleep quality measured through a wellness questionnaire (i.e., Hoop index), maintaining young soccer players´ healthcare.

Conclusions

Congested fixtures such as tournaments may suppose a challenge to head and physical fitness and conditioning coaches managing load and avoiding fatigue. Wellness questionnaires such as Hoop index (based on fatigue, stress, muscle damage, and sleep quality) may suppose an interesting and available tool for teams in formation to manage IL to avoid fatigue in young players, and above all, in young athletes' healthcare (i.e., injury prevention). Furthermore, this tool performs a multidimensional approach, reporting valid information about the player's internal load.

In this sense, coaches should distribute the exposure time to the high-intensity stimuli that arise during competitions to avoid, at least to a certain extent, the accumulation of sleep quality, stress, and fatigue. In addition, they may program a slow progression of match load exposure time as the tournament date approaches. On the other hand, and regarding to the capacity to predict stress using the perception of sleep quality, coaches should use this tool to take advantage making decisions in team line up of substitutions during a match, and beyond, as the tournament progresses. In addition, it should be noted that this tool is easy to use and does not affect the player's daily life.

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