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A qualitative study on Norwegian esports students' sleep, nutritional and physical activity habits and the link to health and performance.

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Abstract

Aim: This study explored Norwegian esports students' lifestyle perspectives and habits concerning health and esports performance. *Methods and results*: Twenty participants between 17 and 21 years of age studying esports were recruited from high schools and folk high schools. The participants were interviewed through Zoom using a semi-structured interview guide, and the data were analyzed using a thematical analysis approach. The emerging themes were: 1) energy and focus, 2) factors influencing sleep, and 3) mental health and lifestyle factors. Proper nutrition, sleep, and reduced intake of energy drinks was considered essential factors for optimal energy and focus. Although this was the consensus, many participants reported skipping breakfast, sub-optimal sleep patterns, and habitual consumption of energy drinks. The participants also reported that sleep was negatively affected by playing right up until bedtime. However, esports matches did not impair sleep due to the time of the day matches were played. Finally, regular physical activity was considered vital for good mental health. *Conclusion*: The participants acknowledged that proper nutrition, enough sleep, and regular physical activity were essential for optimal health and esports performance. However, many participants reported sub-optimal lifestyle habits, such as skipping breakfast, using blue light-emitting devices before bedtime, and consuming energy drinks. Simple strategies that improve energy levels, mental health, and sleep are essential, such as improved nutritional habits and regular physical activity. Future research should consider investigating the previously mentioned lifestyle factors to help the esports population develop strategies for improving health and in-game performance.

Keywords: Nutrition, Sleep, Esports, Performance, Physical Activity, Health Highlights

- The esports students in the current study suggest that proper nutrition, getting enough sleep, and physical activity is essential for esports performance. However, it seems the students might not follow these suggestions themselves.
- The esports students' most common sub-optimal lifestyle habits were skipping breakfast, using blue light-emitting devices before bedtime, and consuming energy drinks.
- Intervention- and longitudinal studies are needed to assess how different lifestyle factors affect esports health and performance.

Introduction

Competitive gaming, known as esports, is growing at a rapid rate. While the term esports was introduced as early as the late 1990s, it was not defined until 2006 when Wagner proposed the following definition: "*esports is an area of sports activities in which people develop and train mental or physical abilities in the use of information and communication technologies*" (1). This definition may have some limitations, as the activity should meet other criteria such as having a form of organization, a structure, and institutionalization to be regarded as esports (2). There are also skill differences between players reflected in reaction time, accuracy, and executive control, as top-ranked esports athletes have been found to score better on all these parameters compared to lower-ranked players (3, 4).

It is reasonable to expect that an esports athlete's cognitive performance will be influenced by several factors, including the athletes' diet, sleep pattern, and fitness level. Low blood sugar levels can result in sub-optimal cognitive performance (5), caffeine intake can either have a positive or negative effect on cognitive performance depending on the dosage and individual tolerance (6, 7), and consuming breakfast might improve certain cognitive functions, such as memory (8-10). Sleep deprivation typically results in a severe decline in cognitive performance (11). Finally, physical fitness is closely related to several cognitive benefits, including improved memory and executive-control processes (12).

Even though esports athletes are likely to benefit from having a healthy diet, sleep, and fitness habits, several studies suggest that engagement in esports is associated with suboptimal health habits. Concerns regarding esports athletes' health have been raised partly due to the inactivity inherent in esports (13). Esports athletes are reported to sit between five and ten hours per day in the pre-competition phase, resulting in pain or fatigue in the back, neck, wrists, or eyes, or a combination of these (14). Inactivity, such as excessive sitting, is associated with an increased risk of all-cause mortality exceeding six to eight hours per day (15). Further, esports athletes' dietary habits have also raised concerns. One study reported that gamers and esports athletes' fruit and vegetable intake was less than half of the daily recommended intake (16). Low intake of fruit and vegetables has been linked to an increased risk of cancer, cardiovascular disease, and mortality (17).

Few studies currently investigate how esports athletes themselves think about diet, physical activity, and sleep habits. Therefore, the purpose of this study was to explore thoughts, opinions, and experiences concerning these factors in esports athletes using a qualitative approach.

Method

Participants

Twenty participants were recruited from four different schools offering esports in Norway. Half of the participants were full-time esports students at folk high schools. Folk high schools have no rigid curriculum, grades, or exams, with most of the students between 18 and 25 years old. The students engaged in esports between 15 and 20 hours per week. The remaining school hours were split between exercise, electives, lectures, and chores. The other half were high school students with esports specialization as a part of their curriculum, with five hours of esports per week. Nineteen of the participants were male, and one was female. Age ranged from 17 to 21 years. None of the participants were professional esports athletes before or during the study, and their skills and experience varied greatly.

Study design

A semi-structured interview guide was created by the authors, who had expertise within esports, nutrition, physical activity, and sleep. The interviewers explained the procedure to the participants before the interviews. The interview guide focused on the participants' lifestyle, with questions concerning their nutrition-, physical activity-, and sleep routines. The interview began with a short talk about their primary game and what rank they were, followed by questions about their nutritional habits, such as how they eat prior to- and during matches, their consumption and perspective towards energy drinks and how it affects their esports performance, and how they perceived the dietary effects on their esports performance. Questions about physical activity- and sleep routines were structured similarly and queried how they perceived these topics concerning their esports performance. The interviews were conducted digitally using Zoom between March 2021 and June 2021 and were transcribed during the same period. All participants consented to the study before the interviews and signed a consent form before the interviews were initiated. The project was approved by the Regional Committee for Medical and Health Research Ethics, Western Norway (project id: 211304). Following the interviews, the participants received 500 NOK (~50 EURO) each as compensation for the time spent.

Data analysis

A thematical analysis approach (TA) was used for analyzing the data. The themes were generated based on codes deducted through interviewing the participants. Identification of the themes followed the method presented by Braun and Clarke (18), which translates to a six-step process. This process begins with 1) getting familiar with the data set, 2) idea generation and initial coding, 3) exploring potential main- and sub-themes, 4) re-reading and reviewing the themes and codes, 5) defining and refining the themes, and 6) finally writing the report. The analysis process for this study was based on an essentialist approach, which implies that the study data reflects the participants' experiences and meanings. Furthermore, the data analysis rested on an inductive approach as any specific theoretical point of view did not guide it. Finally, a semantic approach was used for the theme identification, focusing on the data material's explicit meanings (18).

Results

Table 1 presents the basic characteristics of the study participants. Seventeen male and one female participant (two did not answer) reported an average body weight of 72.3 kg, amounting to an average Body Mass Index (BMI) of 22.7 kg/m^2. Five of the participants were classified as overweight (BMI > 25 kg/m^2). Table 2 provides an overview of the games the participants played and their ranks from the lowest to the highest. The most popular game titles were "Counter-Strike: Global Offensive" and "League of Legends". The average reported playing time was 5.5 hours per day. The participants ate between three and four meals per day, excluding snack meals, and 55% believed dietary supplements could improve esports performance. On average, the participants engaged in physical activity three days per week, each session lasting between one and two hours. Almost all the participants were convinced that nutrition, physical activity, and sleep was essential for esports performance.

Table 1 - Baseline characteristics of the study subjects

	Total (n = 20)		Folk high school (n = 10)		High school (n = 10)	
Parameter	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age (years)	19	1.4	19.9	0.9	18.2	1.2
Weight (kg)	72.3	16.0	81.0	18.6	63.7	5.2

BMI (kg/m²)	22.7	3.7	24.6	4.4	20.9	1.1

Table 2 - The number of participants and their rank ranges for the respective esports titles

Esports title	Rank range	Participants
Counter-Strike: Global Offensive	Legendary Eagle to Global Elite	5
League of Legends	Silver to Diamond	7
Rainbow 6 Siege	Silver	2
Call of Duty	Unranked	2
Valorant	Top 5000	1
Apex Legends	Gold	1
Smite	Unranked	1

The following themes were identified from the data collected: 1) energy and focus, 2) factors affecting sleep, and 3) mental health and lifestyle factors.

Theme 1: Energy and focus

Almost all participants reported that having enough energy (e.g., feeling good) and having optimal focus was essential for their esports performance. The participants obtained enough energy from three factors: meals, where both the quantity and the quality of meals were thought to affect performance, enough sleep, and avoiding energy drinks. First, specific food items or meals were reported to impact their focus and energy levels negatively:

"*Well. I feel it [affecting the performance] after I've eaten fatty foods. Pizza or something like that. Some sort of junk-food, you know. You get very tired after you've eaten that. (…)*" (Bob, 21)

"*I feel that when I eat properly and have a good diet, I feel the energy and focus are much higher. And that I get less annoyed (…). Compared to when I just heat a pizza in the morning and eat a burger later, or don't eat at all, I feel that my focus is gone and that my energy isn't there, and that I feel my performance gets worse during the day (…)*" (Adam, 20).

Concerning the amount of food, eating large meals, or feeling full was associated with poor performance:

"*And I don't like to eat a lot of food before I play scrims [serious esports practice matches], for example. Because you can easily enter food coma, and that you feel drained after you've eaten a large meal. So, I don't eat a large meal prior to the scrims, I'd rather eat the large meal after I'm done playing*" (Joe, 20).

Some participants also emphasized the negative effects of sugar-rich carbohydrates as a cause for a varied performance:

"*(…) If it's very fast sugars, candy, sweet cornflakes for example, I noticed that I don't last as long if I'm playing for an extended period. While eating wholegrain bread and dinner will last much longer and will contribute to that I don't vary as much, or that my performance varies as much during my games. So, yeah.*" (William, 17)

Several participants also recognized the positive effect of eating breakfast instead of omitting it:

"*You will perform better if you eat healthily and frequently and eat breakfast and the regular meals. The breakfast is the most important meal, especially early during the day (…)*" (Oliver, 20).

"*For example, one time I skipped breakfast to see how it affected my in-game performance, and I noticed a huge difference [referring to the negative effect on performance]*" (Benjamin, 19.

The subjects also mentioned caffeine in energy drinks as a substance to improve energy and focus. However, the overwhelming majority reported that while it potentially gave them a temporary energy boost and ability to focus, they experienced it overall to be harmful to their performance:

"*I would say that energy drinks are something that, or I know many that drink energy drinks, and I've also drank a lot of energy drinks before, and I feel that now that I don't drink it anymore, I am much more consistent. My performance doesn't vary as much. Before it could've been that I was playing really well, then suddenly thirty to forty-five minutes later it got really hard to focus. I played poorer, and I noticed that I was like, that my energy was going up and down. It became quite the problem for me. And that's why I stopped drinking energy drinks*" (William, 17).

"*I noticed it a lot more when I drank energy drinks. I've tried to stay away from it more nowadays. I felt that it [energy drinks] didn't feel good for my gaming, because I couldn't focus and aim properly*" (Elijah, 18).

Although most participants felt that consuming energy drinks with caffeine had adverse effects, 75% of the subjects still consumed energy drinks regularly. Also, the participants ingested at least one unit (500 ml) when they chose to drink energy drinks. However, most participants reported that their motivation to drink energy drinks was not related to esports performance but was associated with the taste and its ability to help them stay awake:

"*Well, I only drink energy drinks because I think they taste good*" (Oliver, 20).

"*Usually, we have esports every day of the week, but I usually drink energy drinks when we are up all night. (…)*" (Benjamin, 19).

Finally, the last sub-theme related to energy and focus was sleep length, where too little sleep was reported to result in lower focus and energy levels, poorer reaction time and decision making, and impaired performance:

"*Lack of sleep affects me almost the same way as eating bad foods. I get very tired, I get very exhausted, I don't feel like myself at all. I can't communicate the way I want to; I lose focus quickly and yeah, I often make mistakes I otherwise wouldn't have done. I basically run on something I would call auto-pilot*" (Noah, 21).

"*I will get poorer reaction time [with too little sleep]. It can happen that my teammates order me to do something [in-game], but then I use much longer time than usual to get it done*" (Benjamin, 19).

"*Well, it's basically that I do a lot more bad choices [in-game], and that I don't react as quickly [with too little sleep]*" (Oliver, 20).

Interestingly, although almost all the subjects noted the importance of sleep for both health and performance, only three reported that they slept eight hours or more during the weekdays. Nearly one-third of the participants reported sleeping less than seven hours per day. The average sleep time during the weekdays was 6.8 hours. Some of the subjects reported

longer sleep duration on weekends. However, only half of the participants provided estimates of their sleep duration during weekends.

Theme 2: Factors affecting sleep

In general, competitive esports was not experienced to negatively affect their sleep at all since most esports matches were played several hours before their bedtimes:

"*No, I wouldn't say that [esports affects sleep]. That's very rare, especially during the weekdays, that I play at night. (…)*" (Jacob, 18).

Some even expressed that esports could potentially make them sleep better due to the mentally taxing efforts of playing esports:

"*If you consider post-matches and post-scrims and so on, my mind gets very tired. And then I get to sleep better, just because I'm so mentally exhausted and tired. (…)*" (Noah, 21).

"*(…) That you use so much brain capacity and energy when you're performing well when you play, and more serious since it's esports [matches]. So, it's easy to get more mentally fatigued at the end of the day. And maybe go to bed a bit earlier, so actually, I've gone to bed earlier due to esports. That's the only thing I guess*" (Bob, 21).

The consensus was that casual gaming (e.g., playing for fun with friends) in general could impair sleep quantity and quality due to the fact it interrupted regular bedtime, as they would stay up longer than usual:

"*It's bad if I play all the way till bedtime, and then just go straight to bed, that works really bad. I must have that cool-down period where my body, what can I say, relaxes and removes itself from the video games and so on. So, yes. If I play all the way until I go to bed to sleep, it affects my sleep*" (Michael, 17).

"*It [playing until bedtime] affects my sleep. I should really stop playing some time before I go to bed. It can feel good to stop playing a bit before bedtime, I've noticed that here on the school. You play first, stop playing, and hang out with those who live here [other fellow students]. We might hang out for half an hour or an hour post-match, then we go to bed*" (Benjamin, 19).

A few also mentioned that specific relaxation strategies were used as "cool-down" after playing, such as watching video clips or movies:

"*I usually have a little break where I watch YouTube or a TV-series before I go to bed. This way I get to relax a bit before I go to bed. I usually turn off one hour prior [going to sleep], the computer, so I can go to bed watching a TV-series (…)*" (Joe, 20).

Interestingly, some participants reported that they were aware of the adverse effects of blue light-emitting devices, but only one said to use night mode on the phone before bedtime.

Theme 3: Mental health and lifestyle factors

The participants brought up the topic of mental health and cognition several times during the interviews. When asked about physical activity habits, several participants elaborated on the importance of physical activity for mental health:

"*I always feel better after a walk outside. I don't know how much these walks impacts my health, but for my mental health it's definitely comfortable*" (Jacob, 18).

"*(…) Because if you, like I experience it, if you feel better, you perform better [in esports]. And if you feel bad, like being in bad shape, it's often that you let the negative thoughts take over, and suddenly you can't perform as well*" (James, 19).

When talking about the reason why physical activity would give the benefits mentioned above, it was related to physical activity in general and how it would make them feel about themselves, instead of the direct physiological impact of physical activity:

"*I don't think it matters strength-wise. I believe it has more to do with the mental advantage that you feel good about yourself. Makes you, your mind gets better, clearer, as I stated earlier. You don't need to be an athlete to move the computer mouse and push the buttons on the keyboard. I believe, you don't need any strength to do it. I believe it's the part that makes you feel good about yourself. I think that's the most important thing you get out of exercise. It makes you better mentally*" (Joe, 20).

Some of the participants also mentioned healthy foods and energy drinks as a factor that influenced mental health:

"*Nowadays my diet means a lot to me, because I have noticed how big changes it has made on me, both physically and mentally. Because, physically it's after I got a good diet and became more physically active that I lost body weight and got smaller. And mentally, it has helped me a lot in general, because I feel a lot better when I eat healthy foods. If I only eat unhealthy foods, I feel nasty and fat*" (James, 19).

"*I believe that, or for me when I got conscious that I drank a lot of energy drinks, thinking about it often made me kind of, how can I put it, it bothered me mentally, that I just couldn't stop drinking it. And I don't know if it was because I was addicted to it, it might be possible that I was addicted, but it bothered me a lot that I couldn't stop [drinking energy drinks]. Or that I didn't want to stop. (…)*" (William, 17).

The final sub-theme identified concerned the association between mental health and esports performance, including phenomena such as mental clarity, taking breaks and reflecting, all seemed important for their performance:

"*I think that… Along with the diet, I also believe that [physical activity] was a part of it, during the period I was on the diet, that helped me with it, but on a regular basis, I would've said it was to fortify my mental health: that I don't feel locked to the chair and that I don't sit for several hours… that I get some variation. But also, to make it more exciting to get back into the game again, that you're not locked up to the game for longer periods, but that a little break can help you get new perspectives. If I have a great game, it's something that I reflect on afterwards, and being able to take breaks to reflect on your game, I think that is nice*" (Logan, 19).

Discussion

This study aimed to explore Norwegian esports students' lifestyle strategies and perspectives at folk high school and high school about how they perceived these factors to affect health and in-game performance. One of the main findings was that the participants reported energy levels and focus as the main drivers for their performance and well-being. Proper nutrition and sleep were the two primary components for having sufficient energy levels and focus. Avoiding large amounts of unhealthy meals were consistently reported to be associated with improved focus and energy. The participants' experience regarding the negative effect of large, unhealthy meals on focus and energy is probably related to blood glucose levels. Large meals containing unhealthy food items can negatively affect blood glucose regulation. A solution can be to increase the meal frequency, e.g., eat every three to four hours (19). Since a well-

regulated blood sugar level is essential for optimal cognitive performance (20), this is vital for individuals competing in cognitive sports, such as esports (3, 21). The participants also reported a decline in performance when skipping breakfast, which is also in line with other studies showing that certain cognitive abilities can be negatively affected by not consuming breakfast (8-10). Finally, the reported acute positive performance effects of ingesting energy drinks most likely reflect that caffeine, the primary psychoactive substance of such beverages, has cognitive benefits such as reduced reaction time and improved alertness and attention (7, 22-24). The participants reported an intake of energy drinks, ingesting at least 150mg of caffeine per serving, corresponding to about 2.1mg of caffeine per kilogram of body weight. This should be sufficient to notice a cognitive effect, as caffeine dosages with observed positive performance-enhancing effect begin at 0.5mg per kilogram of body weight (24). However, in a recent study on professional League of Legends players, the players did not report any performance-enhancing effect after ingesting an energy drink containing 150 mg caffeine, which is about the same caffeine dose typically ingested by the participants in this study (25). Most of the subjects reported an overall negative effect on long-term esports performance when consuming energy drinks, which might be related to the carbohydrate content in the beverages. Simple sugars such as sucrose, glucose or high fructose corn syrup are found in many energy drinks (26). These carbohydrates can profoundly impact blood sugar levels, which can negatively affect cognitive performance (19, 20, 27). The potential adverse effect of energy drinks may also be related to abstinence reactions occurring when users are caffeine-deprived (28).

Finally, concerning energy levels and focus, lack of sleep was reported to negatively affect the participants' performance. Sleep deprivation, either due to acute or chronic sleep deprivation, has detrimental effects on cognitive performance (29, 30). Although the subjects were aware of the pitfalls of not obtaining enough sleep, the estimated average sleep duration of the participants was 6.8 hours during the weekdays. This result is similar to what is reported in one multi-national study on esports athletes, where the mean total sleep time between the different athletes ranged from 6.8 to 6.9 hours per day (31). However, the present results contrast some previous studies on esports athletes, where the athletes reported at least seven hours of total sleep time per day (16, 25, 32). The recommended sleep duration for adolescents and young adults is between 7 and 10 hours per day (33), which our study participants, with some exceptions, did not achieve during weekdays. This might be due to various sleep incompatible pre-sleep habits, such as gaming, watching YouTube or engaging in social media. Playing with friends (e.g., social gaming) seemed to extend the participants' waketime and interfere with an optimal sleep pattern.

The second main theme concerned the impact of the components affecting sleep quantity and quality and pre-sleep routines. Most participants did not experience a negative impact on sleep in conjunction with esports, as their matches were scheduled during the daytime. However, participants in the present study who played right up until bedtime reported that this caused problems falling asleep and poor sleep quality. These sleep problems were attributed to being aroused and extending bedtime, which might be because of the increased physiological activation, such as elevated heart rate and arousal typically following such activity (34-36). The participants reported that activities such as browsing social media or watching YouTube or TV series on their phones improved their sleep, functioning as a tool for unwinding after gaming. However, using such devices, which usually are blue light-emitting, prior to bedtime is known to impair sleep (37-39) and might not be an optimal sleep promoting strategy. A few participants reported that they went to bed earlier due to playing taxing esports matches and that their sleep quality was better after playing esports, which might be due to the taxing mental stress of such activity. Viable strategies to improve sleep might include activities that do not imply blue light exposure, avoiding caffeine, and not

participating in strenuous physical activity that raises the body's core temperature late in the evening (40). It might also be beneficial to stop playing unnecessary games before bedtime and instead engage in, e.g., relaxation techniques.

The third and final main theme evolved around the topic of mental health. The participants reported that physical activity supported good mental health, which is attested to by other studies (41-43). Interestingly, almost all the participants believed it was important for performance. This is somewhat in contrast to the findings in another study on esports athletes, where physical fitness was rated as the area with the least effect on performance (44). Therefore, a proposed strategy for maintaining a habit of regular physical activity might be to find an enjoyable means of doing so. However, there is currently little evidence on specific physical activity types that promote esports performance. As such, a general recommendation is to reach the weekly recommended goal of 150 minutes per week of physical activity (45). Also, if the participants knew they ate healthily, it would reflect how they perceived themselves and their self-esteem. Eating healthy and having regular physical activity have been shown to improve self-esteem (46, 47). In addition, there are some indications that self-confidence, in general, is essential for performance across several esports (44). Taking breaks was experienced to be important as well, as the participants believed it helped them to reflect on their gameplay and, as such, learn and improve their performance. In addition, by taking breaks, the participants also appreciated and enjoyed the game more. Table 3 summarizes our recommended lifestyle strategies for improved esports performance based on our findings in the present study and the existing literature.

Table 3 - Recommendations for improving health and esports performance based on the current study and existing literature

Reported performance and/or health variable(s)	Component	Recommendations
Energy levels and ability to focus	Nutrition	Avoid large meals before a competition Increase the meal frequency, consuming a meal every three to four hours Eat breakfast, especially if practice/competition is in proximity Only use caffeine within recommended ranges for cognitive performance Avoid going to bed hungry
	Sleep	Achieve 7 to 8 hours of sleep per day Avoid blue light-emitting devices and electronic media before sleep Avoid caffeine and nicotine in the evening The bedroom should be quiet, dark, and temperate (e.g., 16-20 Celsius)
Sleep quantity and quality	Gaming, esports and electronic devices	Avoid games that increase heart rate and arousal before bedtime
	Waketime	Avoid extending waketime Avoid playing unnecessary games at the cost of sleep Rise at approximately the same time every day (maximum 1-2 hours later during weekends)

	Relaxation strategies	Use sleep rituals before bedtime (e.g., listen to calming music, take a bath)
Mental health and lifestyle factors	Exercise	Participate in enjoyable exercise that helps maintain a physically active lifestyle Achieving 75-150 minutes of exercise with vigorous-intensity OR 150-300 minutes of moderate-intensity
	Self-esteem	Eat balanced and exercise regularly
	Regular breaks	Take breaks from playing (e.g., every hour)

To the best of our knowledge, this study is the first that explores esports students' habits on nutrition, physical activity, and sleep using a qualitative approach. The study identified several lifestyle patterns in the study population that can influence esports performance. Verification of these results by larger samples and by quantitative data collection is needed. One apparent limitation of the present study is that all data were self-reported, which may result in an under- or overestimation of body weight, BMI, average gaming time, and meal frequency due to social desirability (48) and recall bias (49). Another limitation might be undiscovered themes during the process of analyzing the data.

Conclusions

Lifestyle factors play an essential role in health and performance for esports athletes. In the current study, the participants considered eating healthy, being physically active, and sleeping enough to be essential for optimal health and esports performance. Although it was a consensus that these factors were vital for esports performance, many subjects still reported a habitual intake of energy drinks, sub-optimal sleep patterns, and skipping breakfast. Based on the current study, implementing strategies for improving sleep might improve health and esports performance. This entails simple strategies such as avoiding blue light-emitting devices and caffeine in the evening and ceasing to play games a sufficient time (e.g., one hour) before bedtime. In addition, having a healthy diet is advised, focusing on avoiding large meals pre-competition, eating breakfast, and consuming regular meals. Finally, regular physical activity and breaks from playing esports are essential for improved mental health, as this may improve the confidence and self-esteem of the players. Based on the present study's findings, future studies should consider exploring the general lifestyle habits of esports athletes that can help develop specific intervention strategies for the esports population.

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