Body Mass Index in eSports: A Systematic Literature Review

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Abstract

The purpose of this review is to synthesize all the observational studies that studied the effects of eSports on Body Mass Index (BMI). In addition, it has systematically brought together all peer-reviewed observational studies related to the BMI of eSports gamers to draw the attention of field academicians and researchers to the issue related to eSports and promote observational studies on future in the field of sports sciences. Playing eSports games or competing in these games can have significant consequences for players' health. As the popularity of eSports continues to grow rapidly around the world, studies focusing on understanding the health risks and benefits associated with eSports competition and participation have been delayed. Sufficient attention has not been paid to the development and evaluation of preventive interventions which address the harms that video games interrelating with eSports can cause. Similarly, there are gaps in the evidence on ways to encourage safe and healthy digital gaming among the ever-growing eSports gamers population. In order to develop evidence-based guidelines and intervention strategies that contain body composition, body fat, and BMI, these gaps should be filled in with systematic scientific research.

***Keywords**: BMI, eSports, Body Composition, Body Fat.*

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1. Introduction

Electronic sports (eSports) are defined as a professional sports competition played online between two or more people by Scholz & Barlow (2019), and high-level playing and watching of digital gaming by Hamilton et al. (2012). eSports are sports that are facilitated by electronic systems, and in which players and teams interact through human-computer interfaces (Hamari & Sjöblom, 2017). In addition, eSports (eSports, electronic sports, competitive games, professional gaming, etc.) can be defined as a new field that is being launched as a new form of sports and is being played with various game modes individually and teamwise by competing on Computer-console-mobile platforms. In 2020, the global revenue of the eSports industry is estimated to be up to $1.1 billion, attracting the attention of 500 million people worldwide (Newzoo, 2017). These forecasts emphasize the rapid evolution and growth of the eSports industry, even if they are not accepted by everyone. This growth is attributed to the growing popularity of digital communication, which increases the consumption of eSports, gives opportunities for potential investment, and paves the way for sponsorships (Lee & Schoenstedt, 2011). With the transformation of many sports branches into eSports, the commercialization of the sector has made rapid progress. While individuals are initially engaged in video games for fun, they are then confronted with competitive games within the gaming communities (Jin, 2010). The playing of these competitive tournaments at the national and international levels has accelerated the sponsorship of teams and the professionalization of eSports (Scholz & Barlow. 2019).

In 2020, the negative effects of the economic, educational, and social repercussions of the global pandemic, Covid 19, on the world have been revealed. In the same way, it has also led to the disruption of traditional sports, negatively affecting the billion-dollar sports industry (Goldman & Hedlund, 2020). With the postponement of traditional sports, there has been a rapid increase in spectators who turn towards digitally presented sports. In particular, eSports has been seen as a potential way to fill the void of traditional sports (Ke & Wagner, 2020).

Health problems related to gaming are highlighted by the American Psychiatric Association (APA) and the World Health Organization (WHO), which recognize online gaming disorder as a part of the diagnosis within the scope of the 11th revision of the international classification of diseases (Jo et al. 2019). Compared to traditional sports environments, eSports lacks the educational nature of healthy lifestyle choices. Since eSports, by its very nature, require a long period of sedentary screen time, there is a need to maintain and improve the health of athletes (Rudolf et al. 2020). It is believed that eSports will pose great risks for a large number of chronic diseases due to prolonged inactivity (Bailey et al. 2019; Patterson et al. 2018). Prolonged screen time, accompanied by prolonged sedentary behavior are considered to be risk factors for numerous chronic diseases (Bailey et al. 2019) and deaths due to these chronic diseases (Biswas et al. 2015). Weight gain caused by inactivity is among the documented negative health problems of eSports to date (Vandewater et al. 2004; Bayrakdar et al. 2020). It has been noted that more than 40% of eSports players do not do any physical activity (DiFrancisco-Donoghue et al. 2019). But with regard to energy expenditure, there is some evidence that active video gamers (e.g., exercise games) tend to increase energy expenditure or physical activity levels (Anderson&Bushman, 2001; Prescott et al. 2018). And this suggests that active video gamers who focus on fitness or exercise can participate to health-promoting physical activities. But it is reported that children with a higher weight play video games more often (Marshall et al. 2004; Vandewater et al. 2004). In some studies, however, inconsistent results have been reported between playing video games and obesity in children (Rey-Lopez et al. 2008). For example, a recent systematic review of 40 studies published from 2010 to 2017 showed that 85% of the studies had a positive relationship between adiposity and screen time in children and adolescents. However, this review did not specifically study video games isolated from other screen activities and did not specify the effects of rising-generation games on obesity (Tripathi & Mishra, 2020). This study will demonstrate an updated review of the relationship between eSports and BMI, combined with advances in eSports in recent years with the prevalence of obesity.

Therefore, the purpose of the study is to decisively review the potential relationships between eSports and BMI by examining recently published observational studies and interventions. Accordingly, the answer to the following main question will be sought:

1. What is the current status of observational evidence (cross-sectional data published between 2016 and 2021) of the relationship between eSports and BMI?

2. Methodology

Therefore, the purpose of the study is to decisively review the potential relationships between eSports and obesity by examining recently published observational studies and interventions. Surveys have been made starting from 2016, given that competitive games began to appear after video games were played online against other people. The data includes all the studies published between January 2016 and December 2021. The literature review was conducted in the Google Scholar, Science&Direct, PubMed, and Web of Knowledge databases. The following keywords were used in the relevant search engines. eSport+BMI, eSport+nutrition, eSport+health, eSport+physical activity, eSport+sleep. Observational studies evaluating the relationship between obesity and eSports are also included. Studies examining the relationship between a predictor variable (obesity-related behaviors such as sleep or nutrition) and BMI are also included (Turel et al. 2017; Cameron et al. 2016; Kracht et al. 2020). Each and all reviews have been conducted not only in the titles of articles but also in abstracts -in cases where this option is available- for the following reasons: (1) titles can sometimes be limited and may not include the words eSports and BMI; (2) authors may use a variety of different terms or synonyms corresponding to the concept of eSports and BMI. Studies conducted on individuals with a chronic disorder (autism) or used a non-observational study design (such as case intervention, qualitative or systematic studies) are not included in this review.

Two authors (AB and PA) independently reviewed the abstracts taken from the first review. The full-text articles of the selected abstracts were

evaluated independently by the same authors. Any disagreement on the issue of eligibility after the abstract or full-text process has been resolved by the third and fourth authors (GK and IB). The reference lists of the included articles have been scanned for eligibility. The data were extracted into a form in terms of study type, population characteristics (age, race, environment, and country), study methodology, eSports, and BMI.

3. Results

The selection of the studies is described in detail in Figure 1. 364 articles were identified, including 361 articles from the initial review and 3 articles through the reference lists of the included articles. After 125 articles were removed, 239 original articles were scanned. 123 articles were not included in the review since they include chronic disorders (n=23), are interventions or qualitative studies (n=53) and systematic reviews or meta-analyses (n=47). The 47 abstracts excluded from the scope include assessments that are out of scope (n=9), include a summary of opinion (n=8), and do not include the BMI concept (n=19), eSports and BMI assessment (n=11).

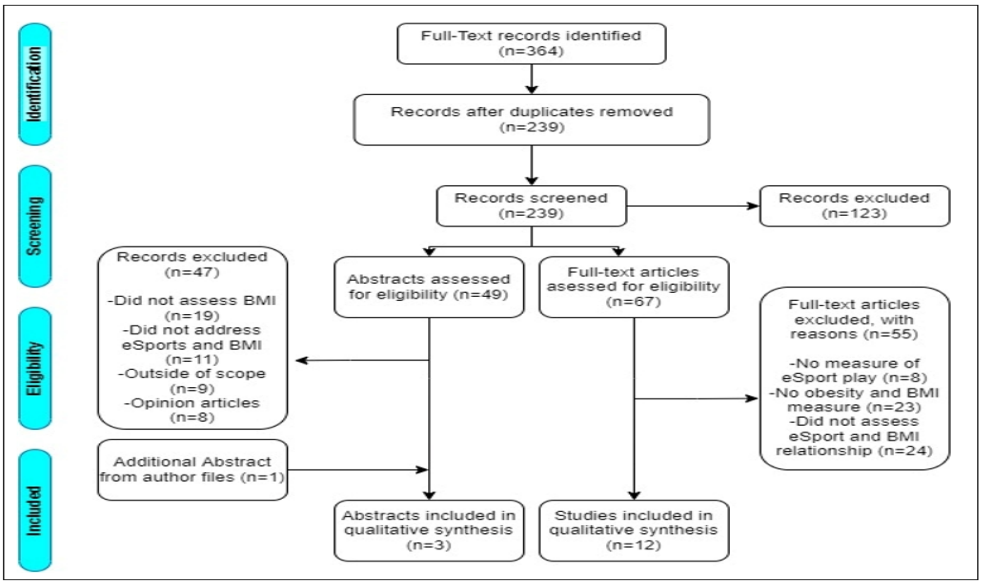

Figure 1. Selection of included research

The articles excluded from the scope (n=55) include assessments without eSports measurement (n=8), obesity and BMI measurement (n=23), and the relationship between eSports and BMI (n=24).

Sixty-seven articles are left for full-text scanning. Since most articles (n=24) were evaluated without specifically reporting on the relationship between eSports and obesity, fifty-five articles were not included in the full-text scanning. As a result, the data of 15 articles determined in accordance with the purpose of the study were evaluated (Trotter et al. 2020; DiFrancisco-Donoghue et al. 2020; Andre et al. 2020; Lee et al. 2021; Rudolf et al. 2020; Tartar et al. 2019; Schmidt et al. 2020; ValladÃo et al. 2020; Cox, 2019; Alexander et al. 2020; Bayrakdar et al. 2020; Giakoni-Ramírez et al. 2021; Bahrilli et al. 2020; Paramitha et al. 2021; Dykstra et al. 2021).

The descriptive characteristics of the included articles are given in Table 1. The sample sizes of the included studies range from 6 to 1772. The vast majority of the studies were conducted in the United States of America (n=6). The sample age range in the studies ranges from 17 to 30. The age range was not specified in three studies (Trotter et al. 2020; Schmidt et al. 2020; ValladÃo et al. 2020).

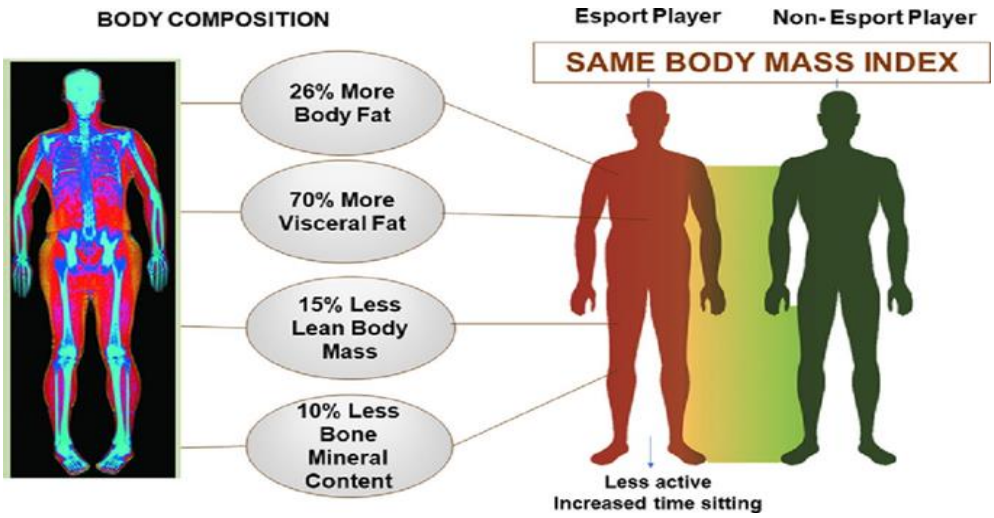

Figure 2. Body Composition (DiFrancisco-Donoghue et al. 2020)

Figure 2 shows that the body fat of the athletes is more than 26%, the visceral fat is more than 70%, the fat-free mass is less than 15%, and the bone mineral content is less than 10%. In addition, it has been reported that there is no difference in BMI between eSports athletes and athletes engaged in traditional sports, but eSports athletes have higher body fat ratios (DiFrancisco-Donoghue et al. 2020).

It is also reported that in eSports, an average athlete's BMI can be classified as normal (Rudolf et al. 2020). On the other hand, the evidence in studies examining the relationship between eSports and BMI is unclear. For example, it has been noted that the BMI level of the gamers who play video games or eSports is higher than that of non-gamers (Weaver et al. 2009). Nevertheless, it has been reported that eSports are less harmful to participants' BMI compared to computer games or other sedentary activities (Trotter et al. 2020).

The next studies: Descriptive characteristics of included studies (*n = 15*), highlight in following: Author and Year, Country, Sample and Participant, Measurements Findings:

1.Trotter et al. 2020
Australia
-N=1772
-eSports athletes from 65 different countries-SF-1 General Health, Physical activity level, BMI: kg/height2. There is a negative relationship between PA and BMI. There is no relationship between the frequency of eSports and BMI. BMI is inversely proportional to in-game ranking (better gamers have a lower BMI level)

2.DiFrancisco-Donoghue et al. 2020
United States of America
-experimental group n=13
-control group n=11, age range 18-30
-College Esports players

All measurements were taken during the peak season. Exercise (min/session/day/week), Body fat (%) Number of steps (2 weeks). There is no difference between the groups in terms of BMI p=0.35

-BMI of the experimental group=23.7, BMI of the control group=24.9.

-The total body fat percentage of eSports players was significantly higher (p=0.05). The control group performed significantly more physical exercises p=0.001

-daily screen time is approximately 2.5 times higher in the experimental group p=0.001

3.Andre et al. 2020

United States of America

-N=18, age range 18-22

-College Esports players, Weekly eSports duration

-Weekly exercise duration

-BMI was identified as 24.1

-The weekly esports duration was identified as 18.9. The weekly exercise duration was identified as 3.9.

4.Lee et al. 2021

-N=17, age mean 20, data was collected from 3 different countries

-Professional Esports players, daily training duration, BMI was identified as 24.1

-The average daily training duration was identified as 9.21.

-The relationship between BMI and daily esports was not examined in the study.

5.Rudolf et al. 2020

Germany

-N=1066, age mean 23

-Former professional eSports athletes, and Amateur Esports players

-Sedentary behavior, Health status

-Physical activity

-BMI was identified as 24.6 However, the BMI level of the players who are older or have quit eSports has been identified as 26.0.
-Weekly physical activity is between 2.5 and 5 hours.
-It has been found that professional eSports athletes are more active than amateur and former eSports players.

6.Tartar et al. 2019
United States of America
-experimental group n=30, control group n=30, age mean 28.6
-Pulse rate per minute
-5 or more video games were played per week for 6 months.
-BMI of the experimental group=26.87, BMI of the control group=27.72.
-Experimental group Pulse=77.7, control group pulse=78.9

7. Schmidt et al. 2020
-N=23
-winner and loser Esports players. Cortisol, Anxiety. Winner players BMI=22.6, loser players BMI=26.5, p=0.03

8.ValladÃo et al. 2020
United States of America
-N=21
-Students of the University Esports Club
-Weekly exercise duration, BMI was identified as 25.7
-Weekly Esports duration = 13
-A significant relationship was stated between BMI and eSports duration

9.Cox, 2019
United States of America
-N=23, age mean 20.7
-Those who play eSports -BMI

-Heart Rate -BMI=25.8
-During the eSport, the heart rate average per minute is 119.8
-During resting, an average of 75.6
-It has been found that playing eSports for a long time creates physiological stress

10.Alexander et al. 2020-N=6, age mean 24
-Professional eSports Athletes
-Blood pressure, Heart Rate
-BMI=28.8 (range 22.9-34 kg/m2)
-Systolic blood pressure=130 mmHg, Diastolic blood pressure=75 mmHg

11.Bayrakdar et al. 2020
Turkey
-N=137, age mean 19.92
-Professional eSports Athletes, Level of Physical Activity
-Daily eSports duration
-BMI=26.03
-Daily Esports duration is 9.34
-There is a negative relationship between BMI and the level of physical activity
-There is a positive relationship between BMI and daily eSports duration

12.Giakoni-Ramírez et al. 2021
Spain
-N=53, age mean 21.01, Professional eSports Athletes
-Esports experience
-BMI=26.03
-The BMI of those who are new to eSports is higher, and as the experience increases the BMI rate decreases
-There is a negative relationship between BMI and eSports experience

13.Bahrilli et al. 2020
Turkey
-N=47, age mean 20.98
-Professional and semi-professional Esports players
-Daily screen time
-Pain, Fatigue
-BMI=24.47
- Daily screen time=8.1 hours.
-There is a positive relationship between pain and screen time.

14.Paramitha et al. 2021
Endenosia
-N=50, Age =21.5
-Professional eSports Athletes
-Level of Physical Activity
-Sleep duration, Gaming duration
-BMI=22.4
-Sleep duration=420.5 minutes
-Gaming duration=183.9 minutes
-It is reported that the level of physical activity is high

15.Dykstra et al. 2021
United States of America
-N=27, Age =21.5
-Athletes of the esports club
-VO2Max
-BMI=25.6
-It is reported that by increasing the aerobic capacity, eSports players will be more alive and kicking, and their performance will increase.

Compared to players who do not play eSports; College eSports players are stated to be less physically active, have low fat-free mass, and

have a high body fat percentage (DiFarancisco-Donoghue et al. 2020). Although the body fat percentage is high, it has been reported that eSports players are in the normal weight ad fat class compared to international references. It has also been reported that although eSports players look healthy in general, a small group is significantly fat (Trotter et al. 2020). Average BMI was in the overweight range for South Korean players, while Australian and US participants were reported to be at the limit of the overweight and generally to be at the limit of fattiness (Lee et al. 2021). It has been reported that the BMI mean of players who are older and have quit eSports is to be fat, and the BMI level of professional eSports players is in the normal range compared to amateur and former players (Rudolf et al. 2020). It has been reported that there are no significant differences in the BMI variable in the two articles with experimental and control groups. The BMI values of the experimental groups were reported to be lower than control groups. (DiFrancisco-Donoghue et al. 2020; Tattar et al. 2019). In addition, it has been stated in an article that the BMI of those who play eSports increases as they get older (Rudolf et al. 2020). In the BMI assessment conducted on the winner and loser eSports players, it was reported that the winner players had a normal BMI and the loser players were fat (Schmidt et al. 2020).

Concisely, it is reported that the BMI levels of those who are new to eSports are high, but the BMI decreases positively as the experience increases (Giakoni-Ramirez et al. 2021), and as the in-game ranking increases, eSports players have better BMI (Trotter et al. 2020), active eSports players have better BMI compared to former eSports (Rudolf et al. 2020), those who have been playing eSports for six months have a better BMI than those who have not (Tartar et al. 2019), winner players have better BMI levels than loser players (Schmidt et al. 2020), and the BMI level of beginner eSports players is higher and the BMI rate decreases as the experience increases (Giakoni-Ramirez et al. 2021).

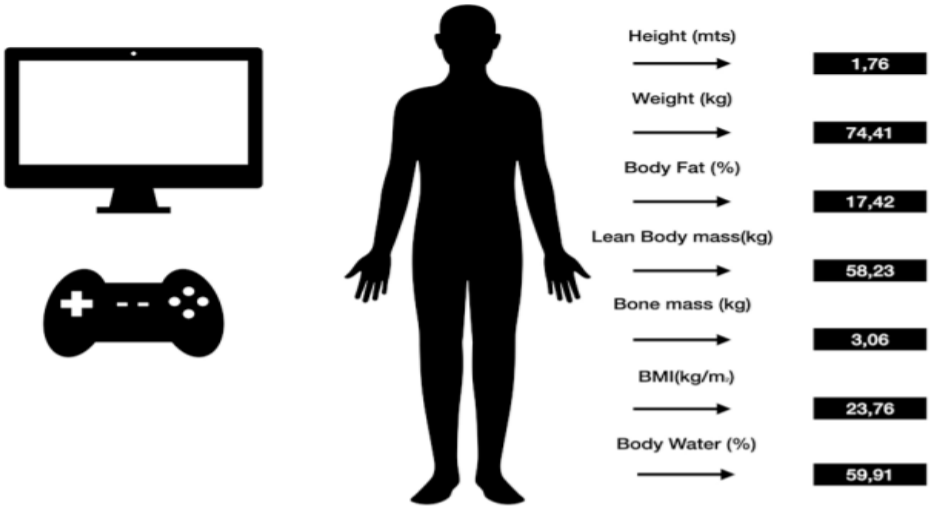

Figure 3. Representation of the body composition profile of the group of professional esports players (Giakoni-Ramirez et al. 2021).

Figure 3 shows the body composition profile of the analyzed athletes. Height (m), weight (kg), fat mass (%), fat-free mass (kg), bone mass (kg), BMI (weight/height^2) and values such as total body water (%) are displayed. According to the article, it is reported that the BMI levels of professional ESPORTS players are at the normal ranges. In addition, it has been reported that eSports practiced for a long period of time do not have any negative effect on the body composition of professional athletes (Giakoni-Ramirez et al. 2021).

In the studies reporting the eSports duration on a weekly basis, the BMI level of college eSports players who play eSports for over 15 hours per week is normal (Andre et al. 2020), and those who play less than 15 hours per week have a BMI level of fat (ValladAo et al. 2020). There are differences in the data of studies examining those who play Esports for over 8 hours daily. It has been reported that the BMI level of professional athletes who play eSports for an average of 9.21 hours per day is normal (Lee et al. 2021), and the BMI level of professional athletes with a daily average of 8.21 is normal (Bahrilli et al. 2020), the BMI level of professional athletes with 3.01 gaming duration is normal (Paramitha et al. 2021). But in an article, the BMI value of athletes with a daily eSports time of 9.34 was reported as fat (Bayrakdar et al. 2020).

In studies indicating physical activity on a daily or weekly basis, a relationship has been reported between physical activity and BMI (Trotter et al. 2020; Bayrakdar et al. 2020). In the studies with 3.9 hours of weekly training time (Andre et al. 2020) and 2.5-5 hours of weekly training time (Rudolf et al. 2020), it was reported that the BMI was within normal ranges. In addition, it is stated that athletes increasing their aerobic capacity will maintain their BMI and improve their performance (Dykstra et al. 2021).

4. Discussion

This review aimed to review all observational studies examining the effects of eSports on BMI. In addition, it has systematically collected all published peer-reviewed observational studies on the BMI of eSports players in order to draw the attention of scholars and researchers on the subject of eSports and to encourage future empirical studies in the field of sports sciences. However, as demonstrated via a systematic literature search, few studies exist focusing on the BMI aspects of esports. Findings of the review demonstrated that one main topic has been investigated in the health literature: (i) The effects of eSports on BMI Some of the studies in the review show that becoming an eSports player is similar to the process of becoming a professional athlete in any sport (Giakoni-Ramirez et al. 2021; Bahrilli et al. 2020; Paramitha et al. 2021; DiFrancisco-Donoghue et al. 2020; Lee et al. 2021; Rudolf et al. 2020; Schmidt et al. 2020). There are many similarities between players who play eSports professionally and players who are defined as traditional athletes (Suits, 2007). But academicians have different views on regard eSports as a sport. In general, it is argued that eSports have a negative impact on people and society (Caillois, 2001). Despite the growing popularity of eSports, research on health problems among gamers has recently begun to appear. Despite the long hours and intense screen time required to reach the professional level in eSports (Garcia-Lanzo & Chamarro, 2018; Huang et al. 2017), research is limited in understanding the impact of such activities on the health of gamers. Current research suggests

that eSports are comparable to traditional sports (Freeman & Wohn, 2017a; Freeman & Wohn, 2017b).

Due to the popularity, eSports players have begun to spend quite a long time before electronic devices (dota2.com, 2016). This situation causes a negative effect on physical inactivity and BMI in eSports players. The most fundamental difference between eSports and traditional sports is physical activity. The most worrying thing about eSports is that players have sedentary activities for hours (Rudolf et al. 2019). Increased screen time is called sedentary lifestyle by academicians and experts. There are negative health effects as part of a sedentary lifestyle. One of these negative health effects is obesity (Choi et al. 2018; Cunningham et al. 2018; Polman et al. 2018).

Despite the different opinions about eSports in the literature, Polman et al. (2018) tried to take a different perspective on eSports, noting that it was discussed whether golf should be a sport and that academicians began to work through Tiger Woods' physical body conditions especially in the 1990s. Just as in traditional sports, in order to be the best in eSports, professional eSports players need to be physically healthy so that they can make quick decisions under time pressure and focus on the game process (Happonen & Minshkina, 2019). It is stated that today most golf players do sportive training with personal fitness trainers and eSports players also take care of physical activities in order to protect their health and to be more successful (Polman et al. 2018).

To date, among the common documented negative health problems of eSports, weight gain due to inactivity has been reported (Vandewater et al. 2004). While the BMI level of eSports players who have been sitting motionless by the screen for a long time is indicated as fat (Bayrakdar et al. 2020), another study stated that the BMI levels of professional eSports players sitting by the screen for more than 8 hours daily are normal (Lee et al. 2021; Bahrilli et al. 2020). Sedentary lifestyle and physical inactivity affect BMI (Ekelund et al. 2014). The current results have shown that the BMI level of adult eSports players is at the upper limit of the normal level (Andre et al. 2020; Lee et al. 2021; Rudolf et al. 2020; Bahrilli et al. 2020). The BMI values of athletes ranging between 16.79 and 40.4 kg/m^2 indicate that body

compositions are extremely variable. Last but not least, it is reported that this change in the BMI of eSports players may be caused by factors such as age, nutrition, physical activity, stress, sleep patterns, socio-economic status, amateurism, professionalism, and experience (Ball & Crawford, 2005; Dunton et al. 2009; Grandner et al. 2014; Bahrilli et al. 2020).

5. Conclusion

In the articles examined, different results are noticeable in relation to BMI. But it is seen that the BMI of eSports athletes who do eSports professionally is in the normal BMI range, as is the case with healthy people or athletes in traditional sports. However, it is stated that BMI is within the obesity limit/obesity range in non-professional, new to eSports, and players who have quit eSports. As a result, it can be said that athletes who play eSports professionally or do physical activity have a normal BMI, just like athletes who play traditional sports. It is also believed that athletes who engage in physical activity can keep their BMI under control and further improve their performance.

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