

Dietary Habits and the Use of Nutritional Supplements by esports Competitors: A Scoping Review

Hábitos dietéticos y uso de suplementos nutricionales por competidores de deportes electrónicos: una revisión de alcance

Hábitos alimentares e uso de suplementos nutricionais por competidores de e-sports: uma revisão de escopo

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Received: 2024, March 21 • **Aproved:** 2025, November 20

Doi: <https://doi.org/10.12804/revistas.urosario.edu.co/revsalud/a.14304>

To cite this article: Ribeiro FJ, Poínhos R. Dietary habits and the use of nutritional supplements by esports competitors: a scoping review. Rev Cienc Salud. 2026;24(1):1-25. <https://doi.org/10.12804/revistas.urosario.edu.co/revsalud/a.14304>

Abstract

Background: Video games are associated with lower diet quality, and the popularity of esports has increased dramatically in recent years, intensified by the COVID-19 pandemic lockdowns. Simultaneously, alcohol, energy drinks, and fast-food industries have increased their advertising investments for this audience. However, existing literature regarding esports players' dietary and supplementation habits is uncertain. **Objectives:** To conduct a scoping review on esports players' dietary habits. **Design:** Adopting the PRISMA extension for scoping reviews methodology, searches were conducted on Web of Science, Scopus, Pubmed, Google Scholar, and Esports Research Network. **Results:** Seventeen relevant publications were identified, which surveyed a total of 8,760 esports players. Four papers involved German, three USA, three Polish, two Portuguese, one Brazilian, one Norwegian, one Danish, one Hungarian, and one Chinese esports contenders. One international study included players from the USA, Australia, Canada, Germany, and the UK. Fourteen were cross-sectional, and three were observational studies. Ten studies applied

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web-based surveys, two applied questionnaires, three applied food diaries, and another three applied semi-structured interviews. Nine studies assessed caffeinated drinks intake, eight characterized alcohol consumption, six described fruit and vegetables, and four evaluated the consumption of dietary supplements. *Conclusion:* This scoping review unveiled seventeen studies that included information regarding the dietary habits of esports players. The diet quality of esports players may be inadequate, ingesting fewer portions of fruits and vegetables than recommended. Additionally, caffeine consumption seems common in esports.

Keywords: esports; video games; nutrition; dietary supplements; caffeine; alcohol drinking.

Resumen

Introducción: Los videojuegos se asocian con una menor calidad de la dieta, y la popularidad de los eSports ha aumentado dramáticamente recientemente, potenciada por el COVID-19. También ha ido aumentando la publicidad de alcohol, bebidas energéticas y comida rápida dirigida a este público. Sin embargo, la literatura existente sobre los hábitos dietéticos y de suplementación de los jugadores de eSports es incierta. *Objetivos:* Realizar una revisión de alcance de los hábitos alimentarios de los jugadores de eSports. *Materiales y métodos:* Se adoptó la extensión PRISMA como metodología de búsqueda en Web of Science, Scopus, y PubMed. *Resultados:* Se han descubierto diecisiete publicaciones relevantes, que encuestaron a un total de 8760 jugadores de eSports. Cuatro artículos involucraron a contendientes de eSports alemanes, tres estadounidenses, tres polacos, dos portugueses, un brasileño, un noruego, un danés, un húngaro y un chino. Un estudio internacional incluyó a jugadores de EE.UU., Australia, Canadá, Alemania y el Reino Unido. Catorce fueron estudios transversales y tres fueron estudios observacionales. Diez estudios aplicaron encuestas basadas en la web, dos cuestionarios, tres diarios de alimentos y otros tres aplicaron entrevistas semiestructuradas. Nueve estudios evaluaron la ingesta de bebidas con cafeína, ocho el consumo de alcohol; seis, frutas y verduras; y cuatro, suplementos dietéticos. *Conclusiones:* Esta revisión reveló diecisiete estudios sobre los hábitos dietéticos de los jugadores de eSports. La calidad de la dieta de los jugadores de eSports puede ser inadecuada, ya que ingieren menos porciones de frutas y verduras de las recomendadas. Además, el consumo de cafeína parece común.

Palabras clave: eSports; videojuegos; nutrición; suplementos dietéticos; cafeína; consumo de alcohol.

Resumo

Introdução: os videogames estão associados a uma dieta de menor qualidade, e a popularidade dos esportes aumentou nos últimos anos, potenciada pela covid-19. Simultaneamente, as indústrias de álcool, bebidas energéticas e *fast-food* aumentaram os seus investimentos publicitários para esse público. No entanto, desconhece-se a literatura existente sobre os hábitos alimentares e de suplementação dos jogadores de e-sports. *Objetivos:* realizar uma revisão de escopo sobre os hábitos alimentares dos jogadores de e-sports. *Materiais e métodos:* adotando a extensão PRISMA para metodologia de revisões de escopo, foram conduzidas pesquisas na Web of Science, Scopus, PubMed, Google Scholar e Esports Research Network. *Resultados:* foram encontradas 17 publicações relevantes, que incluíram um total de 8760 jogadores de esportes. Quatro artigos envolveram competidores alemães, três dos Estados Unidos, três poloneses, dois portugueses, um brasileiro, um norueguês, um dinamarquês, um húngaro e um chinês. Um estudo internacional incluiu jogadores dos Estados, da Austrália, do Canadá, da Alemanha e do Reino Unido. Quatorze estudos eram transversais e três observacionais. Dez estudos aplicaram questionários on-line; dois aplicaram inquéritos; três aplicaram diários alimentares; e outros três aplicaram entrevistas semiestructuradas. Nove estudos avaliaram o consumo de bebidas cafeinadas; oito caracterizaram o consumo de álcool; seis de frutas e vegetais; e quatro de suplementos alimentares. *Conclusões:* esta revisão de escopo revelou 17 estudos que incluíram informações sobre os hábitos alimentares de jogadores

de e-sports. A qualidade da dieta desses jogadores pode ser inadequada, ingerindo menos porções de frutas e vegetais do que o recomendado. Além disso, o consumo de cafeína parece ser comum.

Palavras-chave: e-sports; videogames; nutrição; suplementos alimentares; cafeína; consumo de álcool.

Introduction

*E*sports has been defined as organized video game competitions, played across a spectrum of professionalism (1). Some authors consider that esports originated in the early 1990s, coinciding with the advent of the internet, electronic equipment, and software with multiplayer game support (2). Fast-forward to 2022, the gaming and esports industry has been the subject of tremendous growth, which has been accelerated by the COVID-19 pandemic lockdown restrictions, and now rivals the popularity of classic sports (3).

Companies that commercialize drinks (alcohol and energy drinks) and low-quality ultra-processed foods (“junk food”) have been increasingly promoting their products at esports-related events (4). This topic concerns health authorities as video games are associated with increased sedentary behavior, low-quality food intake, and weight gain (5). Insufficient ingestion of fruits and vegetables is associated with an increased prevalence of chronic diseases and a decreased number of healthy life years (6). The consumption of sugary drinks, including energy and sports drinks, is positively associated with weight gain (7) and deteriorated oral health (8). Diet quality may also influence cognitive performance, as alcohol and diets based on ultra-processed or high-energy foods promote body fat gain and neuroinflammation, which may decrease cognitive performance (9).

Additionally, various companies advertise dietary supplements of questionable efficacy for esports competitors and eGames fans (10). There is limited evidence regarding the safety and cognitive enhancing effectiveness of herbal supplements, including Ginkgo biloba, ginseng, and guarana (11), and these are frequently adulterated and misbranded (12). Despite existing evidence that supports its cognitive-enhancing properties in healthy adults (11), caffeine consumption isn't risk-free for health and may cause anxiety, jitteriness, arrhythmia, and insomnia (13). The use of nutritional supplements by video gamers may be exaggerated and is an added health risk (14).

Although previous reviews were conducted on the topic of the health of video gamers, these did not focus on esports players (15). Its organized and highly competitive nature, recognition by the International Olympic Committee as a sport, and the existence of individuals who dedicate themselves part-time or full-time to esports, who may practice for up to 10 hours a day, distinguish esports from the recreational practice of video games and justify the need to direct greater attention to the health of esports players, including nutritional aspects (16).

As the extent of existing data on the dietary and supplementation habits of esports competitors is unknown, it is necessary to comprehensively outline the investigation published in this field, examine research practices, and pinpoint knowledge gaps. Thus, we conducted a scoping review to systematically present the results on the dietary and supplementation habits of esports contestants, to perform a critical appraisal of the web surveys applied to esports players, and to identify research gaps on the topic of nutritional habits among esports competitors.

Materials and methods

This scoping review adopted the PRISMA extension for Scoping Reviews ScR methodology (17). A preprint for this project has been registered on the Open Science Framework (OSF) and is freely accessible (<https://doi.org/10.17605/OSF.IO/FHACP>). Before developing the protocol for the review, a preliminary investigation of the existing literature was conducted on the Esports Research Network website to assess the existence of studies on this topic and to gather and define the esports-related terms to include in the systematic search. A search protocol was drafted and piloted on the Web of Science database by both authors. Following the pilot phase, the goals were clarified, the search strategy was optimized, the eligibility requirements were adjusted, and the basic data-charting form to extract the information was tested and adjusted.

The following keywords and boolean operators were developed and applied in the searches conducted on the databases: (“esport*” OR “e-sport*” OR “e-game*” OR “electronic sport*” OR “virtual sport*” OR “e-athlete*” OR “professional gaming” OR “competitive gaming” OR “competitive videogame*” OR “online gam*” OR “digital gam*” OR “computer gam*” OR “video gam*”) AND (“nutrition” OR “diet*” OR “food*” OR “beverage*” OR “drink*”).

In February 2024, the lead author employed the search strategy to perform a comprehensive literature search in the Web of Science, PubMed, Scopus, and Google Scholar databases in order to find potentially relevant publications. The full Esports Research Network library (<https://esportsresearch.net/>) was manually searched by reading the titles of the items for any pertinent publications.

Both authors reviewed the retrieved articles, selected the publications that would be assessed for possible inclusion in this review, and individually evaluated the full texts available before agreeing on the actual articles to be included. The search strategy was developed, tested, and optimized by the lead author in close collaboration with the university librarian.

The searches were limited to observational and cross-sectional studies published in academic journals between 1990 (the birth decade of esports) and 2023 (2). To be included in the review, articles had to contain information regarding the dietary habits of esports competitors

(e.g., fruit and vegetable intake, alcohol, coffee, or dietary supplements). Articles that did not meet the established criteria were excluded, including those focused on recreational or single-player video gaming. No linguistic limitations were applied, as suggested by existing guidelines (18). However, articles without an English-language abstract were not included. No age restrictions were applied regarding the age of the eSports players participating in the studies included in the review. Following each database search, the retrieved citations were exported to Endnote X9. Duplicates, conference proceedings, thesis, books, reviews, meta-analyses, letters, commentaries, and studies conducted on animals were then removed. The remaining articles' titles and abstracts were scanned by both authors, and those that did not fulfill the eligibility requirements were excluded. Following the application of the search strategy, the lead author sought the full texts of all remaining articles, which were read and considered for inclusion in this review. References from included articles were also screened to identify potentially relevant articles. Divergences regarding the articles to be included were settled through discussion and consensus.

The complete search strategy employed for all databases is provided as Supplementary Material. The PRISMA 2020 Search Flow Diagram (Figure 1) was used as a template to detail the systematic research procedures and register the search results (19).

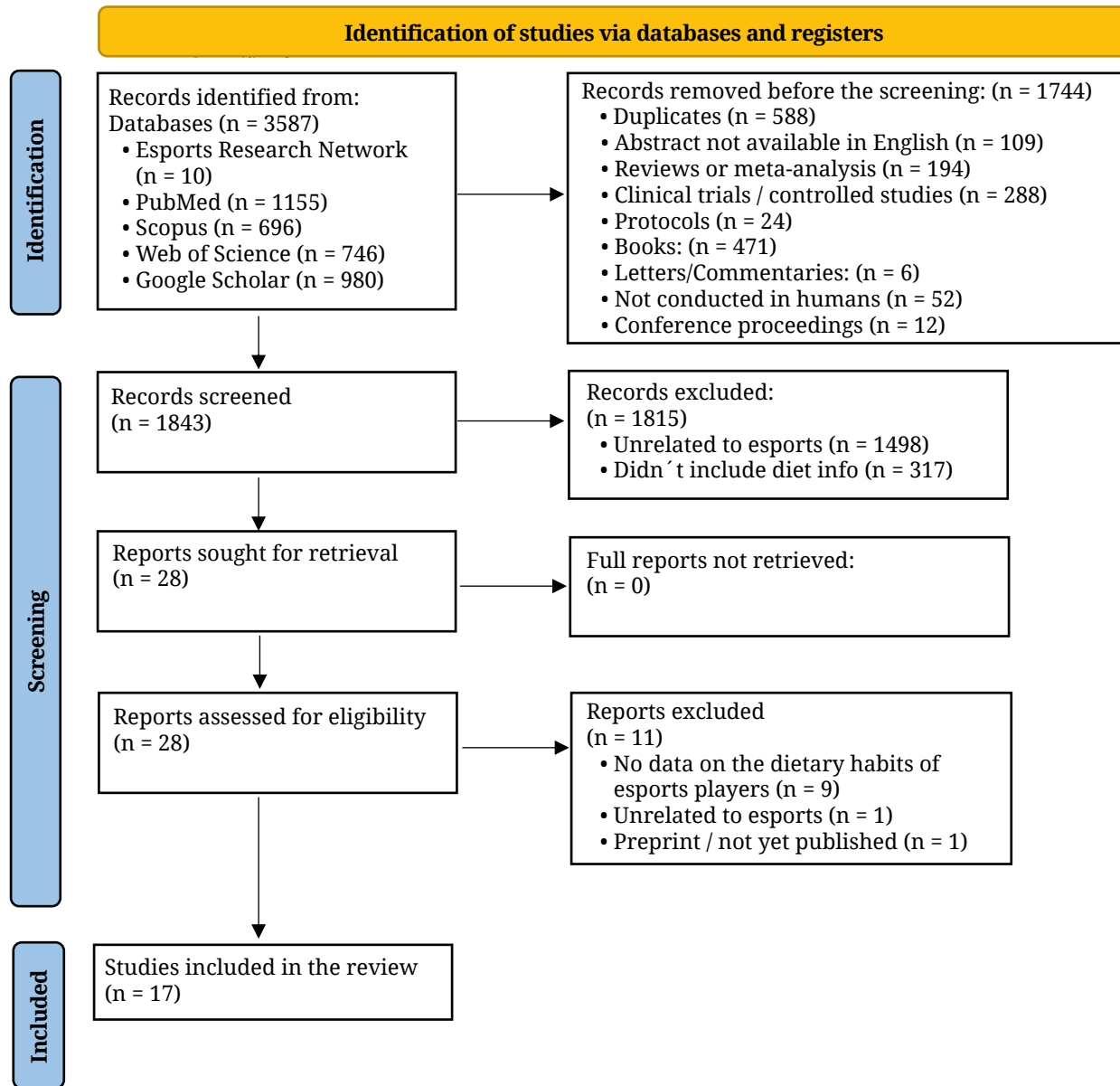


Figure 1. PRISMA 2020 search flow diagram

Because the methodology can influence the results, and in order to assess the bias, strengths, weaknesses, and applicability of study findings, it is recommended that studies that include surveys should comprehensively report the procedures applied, and provide access to the applied questionnaire, including information regarding its psychometric properties (20). The lead author applied The Checklist for Reporting Results of Internet E-Surveys (CHERRIES) to critically evaluate the methodologic quality and applicability of the outcomes of the articles that applied web surveys, while the second author verified its application in a subsample (21). The two authors collaborated to construct a data-charting form to extract the information considered most relevant to the topic of this review. This included the name of

the first author, publication year, nationality, study goals, population, age, sample size, study design, methodology, key findings, and conflicts of interest. In an iterative procedure, the two reviewers mapped the data autonomously, debated the findings, and updated the data-charting form as necessary. Disagreements over study selection, data extraction, and the final articles to include in this review were resolved by discussion.

Results

The application of the search scheme resulted in the retrieval of a total of 3587 references: 1155 from PubMed, 980 from Google Scholar, 696 from Scopus, 746 from Web of Science, and 10 items from the Esports Research Network.

The next stage led to the exclusion of 588 duplicates, 109 items without an English abstract, 471 books, 288 clinical trials or controlled studies, 24 study protocols, 12 conference proceedings, 6 letters to the editor, commentaries, and others, 194 review articles and meta-analyses, 52 studies not conducted or related to humans, 1499 references not related to esports, and 9 items that did not contain information regarding the dietary habits of esports players.

After this process, the available papers for each of the 28 remaining references were retrieved. The screening of their references did not reveal additional relevant papers to be included in the review. 9 items were excluded due to the absence of dietary consumption information on esports players, and 1 item was excluded due to being a preprint document, not yet peer-reviewed or published in an academic journal.

Finally, 17 studies were included in this scoping review and thoroughly screened by the authors (22-38). Full articles were accessible for all 17 studies.

Thirteen studies have been published in peer-reviewed scientific journals (23-28, 30, 32, 34, 36-38), while the studies conducted by Jasny and Sodomirski (33) and Huth (24) were published in lesser-known, university journals.

Critical appraisal of web-based cross-sectional studies

Of the ten studies that applied web-based surveys, only one provided access to the complete questionnaire they applied as a table, appendix, supplementary material, or other forms (23). Additionally, the studies conducted by Huth (24) and Rudolf et al. (23) did not comment on the validity or reliability of the questionnaires applied. This assessment revealed that nine articles failed to meet the majority of the 30-item CHERRIES guidelines. The reports ranged from 16.7% to 70% compliance with the CHERRIES checklist items (Table 1). Several studies did not report essential methodological information, including timeframe of data collection, institutional review board approval, adaptive questioning, participation and completion rates, and statistical corrections.

Table 1. Critical appraisal of cross-sectional studies (CHERRIES)

		Friehs et al. (29)	Rudolf et al. (23)	Huth (24)	Trotter et al. (22)	Ip et al. (25)	Kósa et al. (26)	Goulart et al. (36)	Soffner et al. (35)	Matias et al. (37)	Ribeiro et al. (38)
Design	Describe survey design	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	RB (Institutional Review Board) approval and informed consent process										
Development and pre-testing	IRB approval	✓	✓	-	✓	-	✓	✓	✓	✓	✓
	Informed consent	-	✓	-	✓	-	✓	✓*	✓	✓*	✓
	Data protection	*	-	-	-	-	-	-	-	-	✓
Recruitment process and description of the sample having access to the questionnaire	Development and testing	✓*	✓	-	-	-	✓	✓*	✓*	-	✓
	Open survey versus closed survey	✓	-	-	-	-	-	✓	✓	✓	✓
	Contact mode	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Advertising the survey	✓*	✓*	✓*	✓*	✓*	✓*	✓*	✓*	✓*	✓*
	Web/E-mail	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Context	✓	✓	✓*	✓*	✓	-	✓*	✓*	✓*	✓
	Mandatory/voluntary	✓	-	-	✓	-	✓	✓	✓	-	✓
	Incentives	✓	✓	-	-	-	-	-	✓	-	✓
	Time/Date	✓	✓	-	-	✓	✓	-	✓	✓	✓
	Survey administration	Randomization of items or questionnaires	-	-	-	-	-	-	-	-	-
Adaptive questioning		-	✓	-	-	-	-	-	✓	-	-
Number of Items		-	✓*	-	-	✓*	✓*	-	✓*	-	✓
Number of screens (pages)		-	-	-	-	-	-	-	-	-	✓
Completeness check		-	-	-	-	-	-	-	-	-	-
Review step		-	-	-	-	-	-	-	-	-	-

Continue

		Friehs et al. (29)	Rudolf et al. (23)	Huth (24)	Trotter et al. (22)	Ip et al. (25)	Kósa et al. (26)	Goulart et al. (36)	Soffner et al. (35)	Matias et al. (37)	Ribeiro et al. (38)
Item category	Checklist item										
Response rates	Unique site visitor	-	-	-	-	-	-	-	-	-	✓
	View rate (Ratio of unique survey visitors/ unique site visitors)	-	-	-	-	-	-	-	-	-	✓
	Participa- tion rate (Ratio of unique visitors who agreed to partici- pate/ unique first sur- vey page visitors)	-	✓	-	-	-	-	-	-	-	✓
	Comple- tion rate (Ratio of users who finished the survey/ users who agreed to partici- pate)	-	✓	-	-	-	-	-	-	-	✓
Preventing multiple en- tries from the same in- dividual	Cookies used	-	-	-	-	-	-	-	-	-	-
	IP check	-	-	-	-	-	-	-	-	-	-
	Log file analysis	-	-	-	-	-	-	-	-	-	-
	Registra- tion	✓	-	-	-	-	-	-	-	-	-
Analysis	Handling of incom- plete ques- tionnaires	✓	✓	-	-	✓	-	-	✓	-	✓
	Question- naires submitted with an atypical timestamp	✓	-	-	-	-	-	-	-	-	-
	Statistical correction	-	-	-	✓	-	-	-	-	-	✓

✓ Described; ✓* Description incomplete; - Not described; * Not applicable.

Synthesis of results

Interview-based studies

The goal of the Schubert et al. (30) study was to investigate how professional esports competitors perceived the use of compounds that improve performance, including energy drinks. They applied online semi-structured interviews to 9 male FIFA professional esports contestants (18 to 27 years) from clubs taking part in top-tier German FIFA tournaments. The data collected by these investigators suggest that the use of oral tobacco (e.g., Snus), energy drinks, and gaming boosters (e.g., LevUp, Emporgy) is widespread among professional FIFA players. Gaming boosters are dietary supplements sold in powder form which typically contain high amounts of caffeine, some vitamins, and amino acids, and may also include herbal extracts.

Baumann et al. (27) interviewed twenty (17 male, 3 female) Norwegian students between 17 and 21 years of age ($M = 19$, $SD = 1.4$ years) who regularly competed in esports and practiced esports 5.5 hours per day on average. “Counter-Strike: Global Offensive” and “League of Legends” were the most popular game titles. The interview included questions regarding the volunteer’s esports performance, lifestyle, and health habits, including dietary patterns. According to these authors, energy drink consumption was large, with approximately 75% ingesting it at least weekly, and about half of the responders consumed it daily, ingesting at least one unit (500 ml) on each occasion. This corresponds to an intake of at least 150 mg of caffeine per serving. The participants ate between three and four meals per day, excluding snack meals. Approximately half of the responders reported regularly skipping breakfast.

Jasny and Sodomirski (33) interviewed 12 seasoned players ($M = 28$ years) of a card game (Magic: The Gathering) regarding their training regimes for esports tournaments, including dietary habits. Four respondents stated that they strive to tailor the type and amount of food they ingest in their usual diet according to their bodies’ requirements, predominantly to remain healthy. Seven participants stated that nutrition is very important during tournaments and change their dietary habits during these periods. The dominant practice is to avoid heavy foods and overeating, opting for easily digestible food, such as fruits and nuts, and drinking enough water to remain hydrated.

Self-administered surveys

Friehs et al. (29) investigated the opinions on the use of performance-enhancing compounds in esports, including food and food supplements, by collecting data from three Reddit sources: a Reddit scraper, ad comments, and a survey. They attempted to elicit responses to five questions, three of which were about perceptions of dietary supplement intake. The survey was applied to 566 egamers (477 male, 65 female, 23 others), which averaged 25.9 ($SD = 6.6$) years. Regarding esports genres, 421 participants competed in shooters, 190 in a multiplayer online battle arena (MOBA), 179 in strategy, 139 in racing, 75 in fighting, and 43

in sports games. In response to the question “Do users in online communities disclose using enhancers to improve performance?”, a large number of comments (30 out of 77) disclosed the use of some type of performance enhancer without being asked. For the question “What is the perceived prevalence of performance enhancement usage among top-level players?”, on average respondents guesstimated that 81.3% of all professional players are using nutritional supplements (e.g., caffeine, tyrosine) and that about half (49.1%) use accepted drugs such as alcohol, nicotine, and cannabis.

Rudolf et al. (23) applied an online survey to characterize the demographics and health behaviors of video gamers and esports Germany contestants. A total of 1066 individuals, which averaged 22.9 (SD = 5.9) years old, of which the majority were male (91.9%), participated in the study. The average amount of fruit and vegetables consumed per day was 2.7 (SD = 1.8) servings. There were no statistically significant differences regarding this variable between player status categories. Only 11% of the sample met WHO’s daily guideline of 400 grams of fruit or vegetables.

Huth surveyed 339 German individuals (91.9% males; $M = 26.5$, $SD = 6.8$ years) to compare the dietary habits of esports competitors ($n = 241$) with non-players (24). These authors asked how healthy they thought their nutritional habits were on a 5-point scale, and assessed the frequency of consumption of various food groups by asking how often they consumed fruits, vegetables, alcohol, caffeine, sugary products, dairy, meat, noodles, and fast food over the past 4 weeks on a 9-point scale. Participating in esports was associated with poorer eating habits, with significantly less consumption of fruits and vegetables, although esports players also drank less caffeinated and alcoholic drinks.

Trotter et al. employed an online health assessment questionnaire that included self-reported alcohol intake among 1772 esports competitors (87.2% males) (22). There were respondents from 65 different countries. About two-thirds (65.1%) stated they didn’t drink alcohol at all, while 34.9% stated they drank at least once a week. Those who consumed alcohol did so on an average of 1.8 days per week. Only 0.5% declared drinking every day.

Ip et al. (25) applied a web-based survey on video gamers engaged on internet forums and in-person on electronic games competitive events. The inquiry included questions regarding dietary supplements and alcohol consumption over the past 12 months. Five hundred and twenty-six respondents (84.2% males; $M = 23.9$, $SD = 4.9$ years) finished the inquiry with 77.0% being from the USA. The most reported substance was caffeine (58.1%) in the form of caffeinated drinks (33.8%), energy drinks (19.2%), and caffeine pills (5.1%). Other dietary supplements were also consumed: 3.8% used vitamin B12, 2.3% Yerba mate, 1.5% melatonin, 1.3% Guarana, 0.6% Ginkgo Biloba, 0.2% Kava, 0.2% Panax Ginseng and 0.2% had ingested Valerian. Regarding alcohol consumption, 38.6% exhibited binge drinking (defined as ≥ 5 drinks on one occasion) in the previous 12 months, and 12.9% were heavy drinkers (defined as ≥ 5 alcoholic beverages within the same event at least five days in a month).

Kósa et al. (26) applied an online questionnaire to 2313 Hungarian esports players (92.4% males; 93.3% between 18 and 25 years). These authors aimed to characterize internet addiction and health risk factors associated with that condition, including alcohol intake. Their research revealed that 14.1% of respondents regularly consumed alcohol and that internet addiction was substantially linked to regular alcohol consumption ($OR = 18.357$; $p < 0.001$).

Goulart et al. (36) conducted a study that assessed sleep patterns and physical activity and detailed the dietary habits of esports players. They recruited 103 male and 16 female elite esports athletes aged 16 to 35 (mean = 23.1, $SD = 5.0$) who completed a set of surveys, cognitive testing, and ten days of food records via the Automated Self-Administered 24-Hour Dietary Recall (ASA24) software. The participants were classified as professional, elite, or avid eSports athletes, and played for an average of 6.3 ($SD = 1.1$) days per week, and 4.8 ($SD = 2.0$) hours in each gaming session. The authors reported the average total daily consumption of dairy: 1.4 ($SD = 0.8$) cups, fruit: 0.4 ($SD = 0.6$) cups, vegetables: 1.1 ($SD = 0.6$) cups, whole grains: 0.7 ($SD = 0.9$) cups, fiber: 13.1 ($SD = 5.6$) g, caffeine: 74.6 ($SD = 90.7$) mg, and added sugar: 14.1 ($SD = 10.8$) g. Most participants did not ingest the recommended micronutrient values stipulated by the USDA Dietary Guidelines for Americans 2020-2025.

Lam et al. (28) conducted a cross-sectional descriptive study to investigate the health profiles and health conditions of professional mobile-gaming athletes. They also inquired the volunteers regarding alcohol and coffee consumption habits. A total of 50 male Chinese esports players ($M = 20.0$ $SD = 1.67$ years) competing in a top-level MOBA tournament participated in this study. These investigators reported that 19.4% of the individuals consistently consumed alcohol and 28.6% regularly ingested coffee, and did not find a significant association between career duration and either alcohol intake or coffee consumption.

Szot et al. (31) applied Food Frequency Questionnaires to assess the dietary patterns of 233 male Polish esports players aged 18 to 26 years ($M = 20.5$, $SD = 2.0$). The participants played for 4 to 6 hours per day on average. The majority (69.1%) played Counter-Strike: Global Offensive and 30.9% played League of Legends. Most of the sample (74.8%) reported having 3 or 4 meals per day. Only 10.4% followed a regular meal pattern. Approximately one quarter (27.0%) reported drinking 1.5 L or 6 glasses of fluids per day, 35.7% 2 L, and 37.4% more than 2 L per day. Nearly half of the sample (46.4%) reported drinking soft drinks, one-quarter (26.6%) reported drinking energy drinks, and 8.6% reported drinking alcohol three or more times per week. Regarding unhealthy dietary patterns, three-quarters (75.5%) of the sample had fried foods, roughly half (54.9%) ingested sweets, 28.3% had fast food at least 3.5 days per week. Regarding healthy dietary patterns, only 13.7% ate fruit and 11.2% ingested vegetables at least 2 or 3 times a day.

Kulecka et al. (32) characterized and compared the gut microbiomes of 109 male Polish esports players ($M = 20.9$, $SD = 2.4$ years) to the microbiomes of a male control group. The egamers had a mean BMI of 23.5 ($SD = 3.8$) kg/m^2 . The majority (52.4%) played Counter-Strike:

Global Offensive, 46% League of Legends, and 1.6% StarCraft. Of the initial sample, 59 esports players and 36 students also completed a quantitative dietary assessment performed through a three-day food diary and a weighting method. These researchers found that the total energy value, protein, carbohydrate, fiber, sucrose, and fructose intake were significantly lower in the esports players' diet compared with the physical education students' group ($p < 0.01$).

Krurup et al. (34) aimed to examine cardiovascular, blood parameters, and dietary intake changes in gamers for two 18-hour inactive video gaming periods, separated by a 6-hour interval, in a LAN party-like setup. This study involved nine Danish male esports competitors ($M = 25.8$, $SD = 2.6$ years), who registered their dietary intake in food diaries. On average, during the 42-hour experiment, the participants ingested a total of 8004.9 ($SD = 438.4$) kcal, of which 6160.6 ($SD = 332.9$) kcal were derived from foods and 1844.3 ($SD = 365.3$) kcal from beverages.

Soffner et al. (35) assessed the dietary habits and other health-related variables of German video gamers and esports competitors through a web-based survey. Their sample totaled 817 individuals (87.1% males), with a mean age of 24.2 years ($SD = 6.9$). Two hundred and ten respondents were categorized as "esports players" (20 professionals, 190 amateurs), and 607 as "video game players". Esports players consumed a significantly greater daily amount of energy drinks ($M = 0.2$; $SD = 0.6$ servings) than video gamers ($M = 0.1$; $SD = 0.4$ servings; $p = 0.02$). Compared to the video game players, esports players reported a statistically significant greater average consumption of fast food, red meat, and poultry.

Matias et al. (37) applied an online questionnaire on 235 players (85.1% males) aged 18 to 56 years old. The majority (81.3%) self-classified as amateurs, while 18.7% reported being semiprofessional or professional players. Nearly a third (29.8%) reported consuming dietary supplements; the most consumed were animal-based protein (30%), multivitamins (15.7%), and creatine (14.3%). The mean coffee intake was 2.1 ($SD = 1.0$) cups per day, and more than half (60.4%) of the players reported drinking coffee daily.

Ribeiro et al. (38) applied an online survey to a sample of 274 (256 males) Portuguese and 305 (273 males) Brazilian esports players. With a median age of 24 years ($P_{25} = 20$; $P_{75} = 30$), 12.4% of the participants self-classified as professional esports players, 25.4% as semi-professional, and 62.2% as amateurs. Almost a third (32.3%) consumed dietary supplements, mostly whey protein (59.4%), creatine (47.1%), and caffeine (33.2%). The majority (84.5%) had fewer than five servings of fruits and vegetables per day. Nearly three-quarters (70.1%) consumed sweets or commercial pastries, while over half (65.8%) had coffee, 63.4% ate fast food, and almost a quarter (23.0%) ingested energy drinks on one or more occasions per week.

Discussion

Summary of the evidence

The 17 relevant publications uncovered by this scoping review surveyed a total of 8,760 esports players. Four papers involved German (23,24,30,35); 3 USA (25,29,35); 3 Polish (31–33); 2 Portuguese (38,37); 1 Brazilian (37); 1 Norwegian (27); 1 Danish (34); 1 Hungarian (26); and 1 Chinese esports contestants (28). One international study included players from the USA, Australia, Canada, Germany, and the UK, among others (22).

Fourteen were cross-sectional studies, and three were observational studies. Ten studies applied web-based surveys, two applied questionnaires, three applied food diaries, and another three applied semi-structured interviews (27,30,33).

The methodological quality of most of the cross-sectional studies that applied web-based surveys may be suboptimal, as most failed to adhere to a significant proportion of the recommendations described in the CHERRIES checklist.

The available data suggest that esports players commonly consume caffeine and alcohol. Moreover, one study reported a significantly higher consumption of energy drinks among esports players compared to video game players (35), and another described a higher consumption of caffeine supplements in comparison to a reference population (38). Internet addiction has been significantly associated with a lower adherence to a healthy dietary pattern and regular alcohol consumption.

The existing data suggests that esports players consume less alcohol than reference populations. Several studies (23,24,26,31,35) uncovered a lower consumption of alcohol in esports players, while one study (25) registered a higher consumption in esports players compared to a reference population.

Most esports competitors do not follow healthy dietary patterns and do not consume the amount of fruits and vegetables advised by the WHO (39). The low intake of fruits and vegetables, and the consumption of fast food and alcohol may negatively impact these players' cognitive performance and general health.

Caffeine consumption involves potential side effects, including sleep disturbances, anxiety, jitteriness, cardiac arrhythmias, and increased blood pressure (13). The European Food Safety Authority has set 400 mg per day and single dosages of up to 200 mg for non-pregnant healthy adults as caffeine amounts that do not raise health concerns (13).

Limitations

The distinction between esports and general recreational multiplayer video gaming seems fuzzy as different authors attribute different definitions for esports. This hardened the choice on which publications to include in this review.

Despite the many scales and checklists available to assess the quality of observational studies, there is a lack of a gold standard, and the application of the available tools requires various levels of subjectivity.

Additionally, this scoping review primarily gathered data on the most popular and typically sedentary esports genres. The dietary patterns of Exergames, or active esports games, may be significantly distinct.

Future directions

Future studies should clearly describe the title of the esports game in which their participants train and compete, as there may be significant differences in the lifestyle and dietary habits between players of distinct esports genres. Also, it is necessary to address the potential link between video game disorder and diet quality, to define the potential impact of the esports genre and gaming rank on dietary practices, and to describe the dietary habits of exergame competitors. Additionally, it is crucial to characterize the micronutrient status of esports players. In particular, due to their prolonged indoor time, these individuals may be more susceptible to vitamin D deficiencies. This vitamin plays an important role in the healthy function of eyesight, the central nervous system, and sleep regulation, and these aspects are of paramount importance as performance in esports depends mostly on a high level of cognitive performance, including eye-hand coordination.

Conclusions

This scoping review unveiled 17 studies that had information on the dietary habits of esports players. The majority of the studies that applied web surveys lack methodological adherence to existing guidelines and could be improved. From the available literature, one may infer that the dietary habits of esports competitors are not ideal and of similar or poorer quality than those of the general population, namely ingesting fewer daily amounts of fruits and vegetables. Conversely, esports players may consume less alcohol than the general population. Caffeine, in the form of coffee, energy drinks, guarana, yerba mate, and caffeine pills, has been referenced as the supplement of choice and is typically ingested by esports competitors.

Funding/Financial Disclosures

Several authors reported receiving public or private funding. Kósa et al. (26), Kulecka et al. (32), and Jasny and Sodomirski (33) reported receiving public funding. AOK Rhineland/Hamburg funded the Rudolf et al. (23), and Soffner et al. (35) studies. DairyMAX Inc. financially supported the Goulart et al. (36) investigation. Huth (24), Baumann et al. (27), Schubert et al. (30), and Krarup et al. (34) did not report any funding information. Other studies stated that they did not receive any external funding.

Funding

This research received no external funding or sponsorship.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author contributions

Fernando J. Ribeiro was responsible for the conceptualization, execution, database searches, data analysis, data extraction, critical appraisal of the included studies, and article drafting for this project, which he conducted as part of his Ph.D. candidacy. Rui Poínhos duplicated the data analysis, data extraction, and critical appraisal of the included studies and reviewed and commented on subsequent drafts of the manuscript.

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Anex. Data items

Author (year)	Country	Study aims	Study population	esports genres	Sample size and sex	Age	Study design	Methodology	Key findings	Conflicts of interest
Schubert et al. (30)	Germany	To explore the perceptions of esports professional players regarding the use of performance-enhancing substances.	Esports professional players	Sports (FIFA)	n = 9 males	18 to 27 y	Observational study	Semi-structured interview	The use of oral tobacco, energy drinks, and gaming boosters is vulgarized among professional FIFA players.	Not stated
Baumann et al. (27)	Norway	To assess the Norwegian esports students' sleep, nutritional, and physical activity habits and the link to health and performance.	Esports competitors	Shooter, MOBA	n = 20 (17 males, 3 females)	M = 19 y SD = 1.4	Observational study	Semi-structured interview	~75% ingest energy drinks weekly, and ~50% daily drinking ≥ 500 ml on each occasion. ~50% regularly skips breakfast.	None
Jasny and Sodomirski (33)	Poland	To investigate the attitudes of seasoned competitive players of MGT and their training regimes for esports competitions.	Experienced competitive esports players	MGT	n = 12 (sex not reported)	M = 28 y (25 to 38 y)	Observational study	Semi-structured interview	The dominant practice is to avoid heavy foods and overeating, opt for easily digestible foods, such as fruits and nuts, and drink enough water to remain hydrated.	Not stated
Friebs et al. (29)	USA and possibly other countries	To investigate the perceptions of performance enhancers usage in esports, including dietary supplements.	Casual gamers and esports competitors	Shooter, MOBA, Strategy, MMO, Racing, Fighting, Sports	n = 566 (477 males, 65 females, 24 others)	M = 25.9 SD = 6.6	Cross-sectional study	Web-based survey	81.3% of professional players uses nutritional supplements (e.g. caffeine, tyrosine), and 49.1% uses "socially accepted drugs" such as alcohol, nicotine, and cannabis.	Not stated
Ip et al. (25)	USA	To evaluate the frequency of illicit drug use and Internet Gaming Disorder (IGD) among adult gamers, as well as if any characteristics put someone at a higher risk for IGD.	Adult gamers including esports players	Not reported	n = 526 (84.2% males)	M = 23.9 SD = 4.9	Cross-sectional study	Web-based survey	58.1% ingest caffeine through caffeinated drinks (33.8%), energy drinks (19.2%), and caffeine pills (5.1%). 3.8% uses vitamin B11, 2.3% Yerba mate, 1.5% melatonin, and 1.3% Guarana. 38.6% are binge and 12.9% heavy drinkers. Higher prevalence of binge drinking compared to a reference population.	None

Continue

Author (year)	Country	Study aims	Study population	esports genres	Sample size and sex	Age	Study design	Methodology	Key findings	Conflicts of interest
Rudolf et al. (23)	Germany	To characterize the demographics and health habits of video game and esports participants.	Video games and esports players	Shooters, MOBA, Strategy, Sports, MMO	n = 1066 (91.9% males)	M = 22.9 SD = 5.9	Cross-sectional study	Web-based survey	The mean fruit and vegetable consumption is 2.7 (SD = 1.8) portions/day. Merely 11% ingest ≥ 5 pieces of fruit or vegetables per day.	None
Huth (24)	Germany	To determine the possible variations in dietary behavior between individuals who participate in esports and those who do not.	Esports players	Not reported	n = 339 (90% males)	M = 26.5 SD = 6.8	Cross-sectional study	Web-based survey	esports players ingest less fruits and vegetables, but also less caffeinated drinks and alcohol compared to a reference population.	Not stated
Trotter et al. (22)	65 countries; the most represented were the USA, Australia, Canada, Germany, and UK	To examine the link between obesity, physical activity, smoking habits, alcohol intake, and perceived health among esports competitors.	Esports professional players	Not reported	n = 1772 (87.2% male among 851 who reported this information)	Not reported	Cross-sectional study	Web-based survey	esports players are more likely to be categorized as non-drinkers (65.1%), compared to international reference data.	None
Kósa et al. (26)	Hungary	To assess the prevalence and health risk factors of internet addiction among adult esports players.	Esports players including professionals	Not reported	n = 2313 (92.4% males)	18 to 25 y (90.3%) 26 to 35 y (7.9%) > 35 y (1.8%)	Cross-sectional study	Web-based survey	Lower prevalence of alcohol consumption in esports players (14.1%) compared to a reference population (53.2%). Internet addiction is significantly linked to regular alcohol consumption (OR = 18.357, $p < 0.001$).	None

Continue

Author (year)	Country	Study aims	Study population	esports genres	Sample size and sex	Age	Study design	Methodology	Key findings	Conflicts of interest
Goulart et al. (36)	USA	To characterize the nutrition, sleep, and physical activity of professional or highly competitive esports players as well as their relationship to cognitive performance.	Elite esports players including professionals	Action (platformers, shooters, racing, and fighting); Action-adventure (e.g. Halo); Adventure; Role-playing; Strategy; Casual; Simulation (sports, driving); Simulations (towns, cities).	n = 119 (103 males, 16 females)	M = 23.1 SD = 5.0 (16 to 35 y)	Cross-sectional study	Web-based survey. Food diary (10 days) via ASA24 software	On average, the sample failed to meet existing guidelines, and doesn't ingest the recommended amounts of fruits, vegetables, whole grains, fiber, and micronutrients. Excessive ingestion of sodium, saturated fat, and cholesterol also reported. The consumption of vegetables and the recommended amount of riboflavin, phosphorus, vitamin B12, selenium, and protein ($\geq 0.8\text{g/kg}$) is associated with superior cognitive performance ($p < 0.05$).	None
Lam et al. (28)	China	To investigate the health profiles and health conditions of professional mobile gaming players.	Esports professional players	MOBA (mobile)	n = 50 males	M = 20.0 y SD = 1.7 (18 to 24 y)	Cross-sectional study	Questionnaire	19.4% consistently consume alcohol. 28.6% regularly ingest coffee.	None
Szot et al. (31)	Poland	To characterize the dietary patterns of esports players.	Esports players including professionals	Shooter, MOBA	n = 233 males	18 to 26 y	Cross-sectional study	Questionnaire	The sample exhibit irregular meal patterns and a Western diet style, with low fruit and vegetable intake, and relatively high fast food, fried food, red meat, salty snacks, sweets, soft drinks, and energy drink ingestion. Lower prevalence of alcohol users compared to a reference population.	<i>Continue</i> None

Continue

Author (year)	Country	Study aims	Study population	esports genres	Sample size and sex	Age	Study design	Methodology	Key findings	Conflicts of interest
Kulecka et al. (32)	Poland	To characterize and compare the gut microbiomes of esports players to the microbiomes of a control group.	Physical education students, esports players	Shooter, MOBA, RTS	n = 95 males (59 esports players)	M = 20.9 SD = 2.4	Cross-sectional study	Three-day food diary	Total energy, protein, carbohydrate, fiber, sucrose, PUFAs, and cholesterol intake are significantly lower in the esports players' diet compared to the controls (physical education students). No significant differences regarding alcohol intake.	None
Krurup et al. (34)	Denmark	To examine changes during two 18-hour inactive video gaming periods.	Esports competitors	Not reported	n = 9 males	M = 25.8 SD = 2.6	Cross-sectional study	Food diary (2 days)	Over 42 hours, the volunteers ingested a total of 8004.9 (SD = 438.4) kcal, 6624.9 ml (SD = 801.2) of fluids, and 1354.4 mg (SD = 106.6) of caffeine.	None

Continue

Author (year)	Country	Study aims	Study population	esports genres	Sample size and sex	Age	Study design	Methodology	Key findings	Conflicts of interest
Soffner at al. (35)	Germany	To research the dietary habits and other health-related variables of gamers and esports competitors.	Video games and esports players	Not reported	n = 817 (87.1% males)	M = 24.2 SD = 6.9	Cross-sectional study	Web-based survey	<p>Daily water consumption average 7.8 (SD = 5.0) daily servings and represented the main source of fluid intake. They also have 0.9 (SD = 1.8) servings of soft drinks, 0.9 (SD = 1.4) of coffee, 0.2 (SD = 0.5) of energy drinks, and 0.4 (SD = 0.7) servings of beer per day. The sample averages a daily consumption of 0.9 (SD = 1.0) servings of fruits, 1.7 (SD = 1.6) of vegetables, 0.3 (SD = 0.4) of fast food, 0.2 (SD = 0.4) of chips and savory snacks, 0.2 (SD = 0.3) of sweet bakery products, and 0.6 (SD = 0.8) servings of sweets.</p> <p>Fast food ($\rho = 0.13$; $p < 0.01$), energy drinks ($\rho = 0.14$; $p < 0.01$), and soft drinks ($\rho = 0.14$; $p < 0.01$) are positively (poorly) correlated with video game playing time.</p> <p>Higher consumption of energy drinks among esports players compared to video game players. Lower alcohol consumption in the total sample compared to a reference population.</p>	None

Continue

Author (year)	Country	Study aims	Study population	esports genres	Sample size and sex	Age	Study design	Methodology	Key findings	Conflicts of interest
Matias et al. (2023)	Portugal	To characterize gaming and health-related traits of esports players	Esports players	Shooter, MOBA, Sports simulators	n = 235 (85.1% males)	18 to 58 y 42.5% had 19 to 22 y	Cross-sectional study	Web-based survey	29.8% uses dietary supplements, mostly animal protein (30%), multivitamins (15.7%), and creatine (14.3%). The average coffee intake is 2.1 (SD = 1.0) cups/day. 60.4% drinks coffee daily. Regarding consumption of snacks and beverages ≥ 1-3 days per month, while gaming, 36.6% of the total sample eats chocolate, 35.7% eats fast food, 33.2% have soda, 16.2% drinks alcoholic beverages, and 14.5% drinks energy drinks.	None

Continue

Author (year)	Country	Study aims	Study population	esports genres	Sample size and sex	Age	Study design	Methodology	Key findings	Conflicts of interest
Ribeiro et al. (37)	Portugal & Brazil	To characterize the sociodemographics, gaming, and dietary habits of esports players.	Esports players	Shooter, MOBA, Racing simulators, Sports simulators	n = 274 (256 males) Portuguese & n = 305 (273 males) Brazilian	Median = 24 y (P25 = 20; P75 = 30)	Cross-sectional study	Web-based survey	32.3% uses dietary supplements, mostly whey protein (59.4%), creatine (47.1%), and caffeine (33.2%). 84.5% eats < 5 servings of fruits and vegetables per day. 70.1% eats sweets or commercial pastries, 65.8% have coffee, 63.4% eats fast food, and 23.0% have energy drinks on ≥ 1 occasions per week. 78.1% have ≥ 1 servings of red or processed meat, and 40.9% have ≥ 1 sodas per day. The average caffeine consumption from drinks is 179 (SD = 208) mg per day. 23.0% never eats breakfast, and 47.5% skips it ≥ 3 days per week. Portuguese and Brazilian esports players display lower adherence to the Mediterranean diet, lower consumption of fruits and vegetables, higher prevalence of breakfast omission, higher consumption of caffeine supplements, red or processed meat, fast food, soda, energy drinks, confectionery and sweets when compared to a reference population. Higher levels of Internet Gaming Disorder and professionalization correlated with a lower adherence to the Mediterranean diet.	None

M: mean; SD: standard deviation; MOBA: multiplayer online battle arena (e.g. League of Legends); MMO: massive multiplayer online game; Shooter: third and first person shooter (e.g. Counter-Strike: Global Offensive); RTS: real time strategy (e.g. StarCraft); HS: hearthstone; TT: Teamfight Tactics; MGT: magic the gathering; PUFAs: polyunsaturated fatty acids.