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Understanding esports players' health

A first step towards adequate medical care

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UNIVERSIDADE DA MAIA

UNDERSTANDING ESPORTS PLAYERS' HEALTH

A first step towards adequate medical care

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Philosophy in Sports Sciences – Exercise and Health at Maia University

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Attestation authorship

I hereby declare that this submission is my own work. To the best of my knowledge and belief, it contains no material previously published or written by another person, nor material which has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.


Chapters II-VII of this present thesis comprise studies published (Chapters II-V, VII) or submitted to peer-reviewed journals for consideration (Chapter VI). All co-authors have approved the inclusion of joint studies in this doctoral thesis. All journals where the studies have been published authorised their inclusion in the present thesis.

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I hereby declare that the authors have no potential conflict of interest reported during the preparation of any studies conducted in this thesis:

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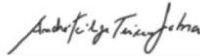
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Table of Contents

<i>Funding and support</i>	<i>I</i>
<i>Attestation authorship</i>	<i>II</i>
<i>Disclosure Statement</i>	<i>III</i>
<i>Table of Contents</i>	<i>V</i>
<i>List of Tables</i>	<i>VI</i>
<i>List of Figures</i>	<i>VII</i>
<i>List of Abbreviations</i>	<i>VIII</i>
<i>List of Articles</i>	<i>IX</i>
<i>Abstract</i>	<i>X</i>
<i>Resumo</i>	<i>XII</i>
CHAPTER I. Introduction and rationale	1
<i>General introduction</i>	<i>2</i>
<i>Primary thesis objectives</i>	<i>4</i>
<i>Methodology and thesis outline</i>	<i>5</i>
CHAPTER II. Esports deserve real sports medical attention	12
CHAPTER III. Associations between esports participation and health: a scoping review	24
CHAPTER IV. Perspectives of eFootball players and staff members regarding the effects of esports on health – a qualitative study	72
CHAPTER V. Physical activity levels of adult eFootball players	114
CHAPTER VI. Symptoms related to common mental problems and exposure to esports participation	135
CHAPTER VII. Mental health symptoms in eFootball players	161
CHAPTER VIII. General discussion and conclusions	188
<i>What are the main findings in the current thesis?</i>	<i>190</i>
<i>The health of esports players – what is the problem?</i>	<i>193</i>
<i>What is known about the health of esports players?</i>	<i>194</i>
<i>Do esports players and staff members have a say in esports and health research?</i>	<i>198</i>
<i>Where do physical activity and exercise fit in the esports world?</i>	<i>205</i>
<i>What about the mental health of esports players?</i>	<i>211</i>
<i>What are the next steps?</i>	<i>216</i>
Recommendations and implications for practice.....	<i>216</i>
Methodological considerations.....	<i>219</i>
Implications for future research.....	<i>223</i>
<i>Conclusions</i>	<i>225</i>
ACKNOWLEDGMENTS	239
SUPPLEMENTARY MATERIAL	242
<i>Chapter IV</i>	<i>243</i>
<i>Ethics approvals</i>	<i>256</i>
<i>Journals' permission to publish</i>	<i>261</i>

List of Tables

CHAPTER III

Table 1 Articles included in the current scoping review by research design	32
Table 2 Esports modalities studied in selected articles.	33
Table 3 Articles included in the current scoping review according to study aims, research design, and characteristics of the participants included in the study.	34
Table 4 Critical appraisal within sources of evidence	46
Table 5 Reported time spent with physical activity and/or exercise.	49
Table 6 Time spent with esports practice.	50
Table 7 Body mass index of esports players	51

CHAPTER IV

Table 1 Superordinate themes, subordinate themes, and themes	81
--	----

CHAPTER V

Table 1 Levels of physical activity stratified by age group	122
---	-----

CHAPTER VI

Table 1 Absolute (n) and relative (%) frequency of missing values	144
Table 2 Sample characterisation.....	145
Table 3 Reported exposure to esports participation.....	146
Table 4 Prevalence of symptoms of mental health problems in eFootball players	146
Table 5 Association between exposure to esports practice and symptoms of mental health problems in eFootball players.	147

CHAPTER VII

Table 1 Sample characteristics	169
Table 2 Characterization of esports practice	170
Table 3 Means, standard deviations, squared correlations, reliability, convergent and discriminant validity among all scales.	172

SUPPLEMENTARY MATERIAL

Table 1 Interview metrics.....	244
Table 2 Consolidated criteria for reporting qualitative studies (COREQ).	245
Table 3 Interview guide - players.....	251
Table 4 Interview guide - staff	253

List of Figures

CHAPTER V

Figure 1 Time spent per week (min-week-1) with physical activities, presented by type of physical activity, based on IPAQ-SF	121
Figure 2 Total energy expenditure (MET-min week-1) in each type of physical activity, based on IPAQ-SF.	121
Figure 3 Responses to the question “Who plans your physical training program?”	123
Figure 4 Responses to the question “What is your main reason for doing physical training?”	123

CHAPTER VI

Figure 1 Flowchart of sample selection process	139
--	-----

CHAPTER VII

Figure 1 The hypothesised path model for the relationships between distress in eFootball players with anxiety/ depressive symptoms, coping strategies, and the outcome variables sleep disturbance, alcohol consumption and poor eating habits.....	164
Figure 2 The hypothesised structural model for the relationships between distress in eFootball players, anxiety/depressive symptoms, coping strategies, and the outcome variables sleep disturbance, alcohol consumption and poor eating habits.....	174

SUPPLEMENTARY MATERIAL

Figure 1 The esports players’ health.....	255
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List of Abbreviations

4DSQ-4 – Four-dimensional Distress Screener
AUDIT-C - Alcohol Use Disorders Identification Test Consumption
AVE - Average Variance Extracted
BMI - Body mass index
CI – Confidence Interval
CFI - Comparative Fit Index
CR - Composite Reliability
DSM-V - 5th edition of the American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders
eFootball - Electronic football
FPF - Football Portuguese Federation
GHQ-12 - 12-item General Health Questionnaire
HR – Heart Rate
ICD-11 - International Classification of Diseases
IGDS9-SF - 9-item Internet Gaming Disorder Scale
IOC - International Olympic Committee
IPAQ - International Physical Activity Questionnaire
IPAQ-SF - International Physical Activity Questionnaire – short-form
IQR - Interquartile range
FPS - First-Person Shooter
MET - Metabolic equivalent of task
MOBA - Multiplayer Online Battle Arena
MMORPG - Massive Multiplayer Online Role Player Game
PFS - Portugal Football School
PRISMA-ScR - PRISMA Extension for Scoping Reviews
PROMIS-SD - Patient-Reported Outcomes Measurement Information System - Sleep Disturbance
Q1 - First quartile
Q3 - Third quartile
RMSEA - Root Mean Square Error of Approximation
SD - Standard deviation
SEM - Structural Equation Modelling
SMHAT-1 - Sports Mental Health Assessment Tool 1
SMHRT-1 - the Sports Mental Health Recognition Tool 1
SRMR - Standardised Root Mean Residual
TLI - Tucker–Lewis Index
WHO - World Health Organization
 \bar{x} - Mean

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Virtual sports deserve real sports medical attention.
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BMJ Open Sport & Exercise Medicine 2021;7(4):
e001149.<https://doi.org/10.1136/bmjsem-2021-001149>

Abstract

Esports are now part of our contemporary society. The demands of competitive esports and the emerging risks of esports participation, exposure, and professionalisation could influence players' health. Therefore, the present thesis builds upon the more recent findings about health-related parameters in esports players.

Six studies following a mixed-methods approach were conducted to characterise health-related parameters in esports players (Chapters II to VII of the current thesis). Chapter I comprised a viewpoint that analysed the role of sports and exercise professionals in esports players' health support. The scoping review in Chapter III mapped the themes studied about health and well-being and esports participation and debates on the gaps that need further investigation. Then, Chapter IV qualitatively evaluated the perceptions of elite esports players and staff members of a national eFootball team about the esports players' health. This was followed by three cross-sectional studies conducted with Portuguese eFootball players (a sports-related esports modality). Chapter V evaluated their physical activity levels and motivations to perform physical activity. Chapter VI studied the prevalence of symptoms of common mental health problems in eFootball players and their association with esports participation. Finally, Chapter VII developed a model to explore the association between symptoms of common mental problems and esports players' coping mechanisms using a two-step robust maximum likelihood method of the Structural Equation Modelling approach.

The most studied and perceived health-related parameters in esports players were related to mental health (e.g., symptoms of common mental health problems, cognitive function) and physical health (e.g., physical activity, eye or musculoskeletal problems). Some factors associated with esports participation might lead to health problems in esports players requiring healthcare support, especially for health prevention; physical activity has been discussed to have a crucial role, even with players reporting high levels

of physical activity. Symptoms of common mental health problems were prevalent but not associated with esports participation in eFootball players. Indeed, health outcomes related to mental health problems were associated with players' adaptative or maladaptive coping strategies.

Several health-related parameters still need to be addressed to ensure adequate healthcare provision for esports players. Given the role of physical activity and mental health for esports participation and the current development of esports within traditional sports organisations, those involved with sports and exercise medicine should be part of the discussion on the health effects of esports participation.

Resumo

Os esportes são já parte da sociedade contemporânea. A exigência das competições de esportes e os riscos que podem advir da participação, treino e profissionalização em atividades relacionadas com esportes podem influenciar a saúde dos praticantes de esportes. Assim, a presente tese aprofunda o conhecimento mais recente sobre parâmetros de saúde nos praticantes de esportes.

Foram realizados seis estudos aplicando uma metodologia mista, para caracterizar os parâmetros relacionados com a saúde dos praticantes de esportes (Capítulos II a VII da presente tese). O Capítulo I inclui um *viewpoint* que analisou o papel dos profissionais do esporte e exercício no apoio clínico prestado aos praticantes de esportes. A *scoping review* no Capítulo III mapeou os temas que têm sido estudados sobre a saúde e bem-estar dos praticantes de esportes e, ao mesmo tempo, identificou as lacunas do conhecimento científico ainda existentes e que requerem investigação no futuro. Depois, no Capítulo IV é apresentado um estudo qualitativo que analisou as percepções que praticantes e membros do staff de uma seleção nacional de eFootball têm sobre a saúde dos praticantes de esportes. Foram depois realizados três estudos transversais considerando uma amostra de praticantes de eFootball (uma das diferentes modalidades de esportes). Assim, no Capítulo V foram avaliados os níveis de atividade física e motivações para a prática de atividade física. No Capítulo VII foi estudada a prevalência de sintomas de doença mental e a sua associação com a participação em esportes. Por fim, no Capítulo VII foi desenvolvido um modelo teórico, usando a metodologia de análise de equações estruturais por máxima verossimilhança, para explorar a associação entre sintomas de doença mental e os mecanismos de *coping*.

Os parâmetros mais estudados, e percebidos pelos praticantes de esportes foram relacionados com a saúde mental (ex., sintomas associados a problemas de saúde mental, função cognitiva) e a saúde física (ex., atividade física, problemas de visão, problemas musculoesqueléticos) dos praticantes. Alguns fatores relativos à participação nos esportes podem predispor a problemas de

saúde que necessitam de cuidados de saúde, especialmente para prevenção em saúde. Para a prevenção em saúde, a realização de atividade física por parte dos praticantes de esports tem sido discutida como tendo um papel crucial, mesmo que os praticantes reportem elevados níveis de atividade física. Os sintomas associados a problemas de saúde mental são prevalentes, mas, em jogadores de eFootball, não foram associados à participação em esports. De facto, as consequências para a saúde relacionadas com problemas de saúde mental foram associadas às estratégias de *coping*, adaptativas ou mal adaptativas, dos praticantes de esports.

O estudo de vários parâmetros relacionados com a saúde dos jogadores de esports deve ainda ser aprofundado para garantir que sejam prestados cuidados de saúde adequados aos praticantes de esports. Considerando o papel essencial da atividade física e da saúde mental nos praticantes de esports e a crescente inclusão dos esports nas organizações desportivas tradicionais, os profissionais do exercício e saúde devem participar na discussão das consequências para a saúde da participação em esports.

CHAPTER I.

Introduction and rationale

GENERAL INTRODUCTION

Technology has been revolutionised our societies, changing our experiences, behaviours and life. With new occupational activities, new challenges arise, and so does the need for further investigation [1]. Esports are one such example.

Esports are a contemporaneous socio-cultural phenomenon, comprising sports, media, entertainment, and culture in a digitized environment that have been described as “the next big thing in media and entertainment” and “the most gigantic industry that nobody’s ever heard of” [2]. Generally, esports has been described as an organized and competitive form of gaming¹ with a specific goal (e.g., winning a prize) [4] where players need training and expertise to thrive, besides particular mental (e.g., sporting intelligence; problem-solving or spatial skills) and physical skills (e.g., dexterity) [3, 5, 6, 7, 8, 9, 10, 11]. Similar to traditional sports, there are different esports categories or genres (i.e., strategy, battle arena, sports) and modalities (e.g., League of Legends®, Fortnite® and FIFA EA Sports®) [12] that can be played individually or collectively, varying in terms of complexity, hardware needs (e.g., keyboard, mouse) and physical engagement that require differentiated motor skill proficiency [3, 7, 13]. Notably, the competitive nature with a competition calendar and league structures, as well as the involvement and training, resemble competitive sports rather than leisure activities [7, 12, 14].

Esports popularity has increased worldwide [15], with the esports audience currently exceeding 532 million people and the online population exceeding 5.115 billion [10]. Besides, the number of players and followers who see esports as a professional career is also growing [14, 16].

¹ Gaming – Gaming refers to playing mobile, PC or console games in a single or multiplayer game mode for leisure or entertainment purposes ASOIF. IF Gaming and esports strategy. Lausanne - Switzerland 2021

Different entities, including those related to sports, are starting to manifest interest in esports and acknowledging its potential global effect. Recently, some esports modalities (e.g., Tic Tac Bow®, Tennis Clash®, WBSC eBASEBALL™) were included in competitions held by the International Olympic Committee (IOC), being part of the new Olympic Esports Series 2023 (a global virtual and simulated sports competition) [17]. Additionally, several sports organizations have now incorporated esports as one of their modalities, with players sharing the same clinical staff and healthcare services [4, 18]. Given gaming mechanics, competition atmosphere and specific lifestyle, esports players might be susceptible to unique health problems and injuries, which could need differentiated healthcare support [19]. While there are differences between recreational and esports players being noted [20], previous studies have reported unhealthy lifestyle behaviours [e.g., decreased levels of physical activity and sedentary behaviour, increased body mass index (BMI), poor nutrition habits, sleep-related outcomes], next to esports' exposure impact on mental health (e.g., anxiety, depression, addiction) and physical health (e.g., eye strain, musculoskeletal pain) [21, 22]. Indeed, while esports participation becomes performance-oriented [23] and a remunerated activity, there might be a shift from extrinsic to intrinsic motivations to play, with social, psychological, cultural and economic factors interacting and impacting esports players' health [24].

Therefore, sports and exercise medicine professionals are called to lead scientific research on health-related parameters in esports players so that they can promote and deliver adequate healthcare to esports players, and be equipped to participate in the conversation about including esports in traditional sports events. Likewise, sports and exercise medicine professionals might be essential to clarify the connection between esports and health by applying their knowledge on athletes from traditional sports to prevent and manage potential detrimental health consequences of competitive and professional esports participation.

Still, scientific literature on esports players is limited, especially regarding the participants' health [25, 26]. In the first steps to understand esports player's health, including players and staff members of esports organizations in the development of scientific research on esports and health will potentially help direct the research and support given to esports considering their needs. On the other hand, improving the recognition and inclusion of esports in the scientific agenda could also enhance the perception that esports players, staff members (e.g., coaches, medical team) and even the general population have on the impact of esports on health and performance.

Indeed, improving health literacy and knowledge about the constraints of esports participants could help prevent esports-related physical injuries, reduce burnout and other mental health problems, and prolong the average career length of esports players.

For all the above, towards adequate medical care, there is a need to understand how esports participation interacts with participants' health. This would guide the next steps for health support to esports players and the reasoning about what could be the future implications of esports participation on health. With scientific bases, this thesis will aim to give a baseline description of the current health problems in esports players to help develop adequate health promotion and prevention strategies so that proper healthcare support could be given to those participating in esports.

PRIMARY THESIS OBJECTIVES

The present thesis aims to build an evidence-based description of esports players' health, being a starting point for the progress of adequate healthcare delivery in the esports context.

This initial approach to the esports players' health will start to answer three core questions about the health of esports players: "Why study the health of esports players?", "What is already known about esports and health?" and "What esports players and staff members perceived about the health of

esports players?”, for which a viewpoint, a scoping review and a qualitative study following the principles of thematic analysis will be used.

First, this thesis will give a broad panorama of esports player’s health by reflecting on the potential role of sports and exercise medicine professionals in esports (Chapter II), summarizing the current knowledge and gaps in the literature regarding esports players’ health (Chapter III) and by proving the perspectives that esports players and staff members have on esports players’ health (Chapter IV). Second, based on the main topics that emerged from the initial broad studies, this thesis will describe levels of physical activity (Chapter V) and symptoms of mental health problems and their association with esports exposure (Chapter VI) in a sample comprising players from the same esports genre (i.e., sports). Finally, a pathway model is proposed to study the association of symptoms of mental health problems and coping strategies (Chapter VII). Using an exploratory design, the last three chapters will complement the results found in the initial broad evaluation of the current knowledge about the health of esports players.

Therefore, the discussion about the inclusion (or not) of esports as a sports activity will not be part of the scope of the present thesis.

METHODOLOGY AND THESIS OUTLINE

In this thesis, quantitative and qualitative studies that intend to provide answers to the mentioned overarching objective are presented.

Chapters II to IV introduce contemporary views and current scientific evidence on the relationship between esports and health.

Specifically, Chapter II is a viewpoint where it is argued that the health of esports players is a topic that deserves scientific and clinical attention. It is proposed that sports and exercise medicine professionals lead this discussion and reflect on the potential positive and detrimental health effects of esports participation, providing scientifically-based arguments to answer better the current esports professionalism and its integration in traditional sports organizations. This viewpoint elaborates and exposes the initial arguments

behind the development of the present thesis before a more exhaustive evaluation of the current literature about esports and health.

This is followed by Chapter III, which contains a scoping review summarising the current scientific understanding of the relationship between esports participation and players' health and well-being. Because of the exploratory nature of scoping reviews, this chapter supports the initial rationale for improving the recognition of health problems in esports players that would require adequate health support, mapping the recent findings about health and esports players in the literature.

The qualitative study in Chapter IV gives the esports players and staff members a voice by which they are allowed to share their experiences and thoughts on the relationship between esports and health, and suggested strategies to manage their health. Hence, to complete a broad panorama of what would be the health-related parameters in esports players, a qualitative study adds the insight of players and staff members of the real-life impact of esports on health.

Thereafter, Chapters V to VII provide new insights into esports players' health through original studies carried out in a sample of electronic football (eFootball) players playing FIFA EA Sports®. FIFA EA Sports® is a specific esports modality from the sports genre, which gameplay core is based on traditional sports [3], being the most successful example of a sport-centric simulation game and the first to get an official license from the world governing [13]. Considering that the most recurrent topics in the initial broad evaluation of esports health were physical activity and mental health, three exploratory studies were developed to better characterize those themes in players from the same esports modality.

Chapter V presents a preliminary cross-sectional survey that characterizes and describes the physical activity levels and physical training habits, besides motivations to perform physical activity, of eFootball players. Considering that most reports on esports players contradicted the idea of “sedentary athletes”, arisen in the viewpoint, and that physical activity was discussed as

part of the main strategies to manage the factors of esports affecting the mental and physical health of esports players, a preliminary cross-sectional evaluation strengthens the understanding esports players physical activity habits.

This is followed in Chapter VI, a study that describes the prevalence of symptoms of mental health problems and their relationship with exposure to eFootball participation. For the study in this Chapter, data collection tools that have already been applied in a traditional sports context were applied.

Finally, Chapter VII explores the association between distress and anxiety/depression symptoms, sleep disturbance, adverse alcohol consumption and poor eating habits based on adaptive or maladaptive symptoms. Indeed, as the need for a better understanding of the physical activity of esports players, a better characterization of the prevalence of mental health problems was required, considering the previous broad evaluation that identified mental health as being crucial for the health of esports players. Chapter VI describes the prevalence of mental health symptoms in esports players and their (no) association with esports exposure. Since those problems were prevalent, a model was tested to understand where health professionals (e.g., doctors, psychologists, physiologists) supporting esports players could interfere to minimize the risk of adverse health behaviours.

Chapter VIII is a general discussion that brings all the thesis Chapters together. In this discussion, there is a reflection on the obtained results and their incorporation into the broader context of the current thesis. Practical and future applications based on the main findings of Chapters II to VII studies are addressed.

Considering that esports is an evolving topic, submitted to constant actualization and reformulation, the terminology used to identify “esports” changed between sources and even during the chapter’s progress (e.g., e-sports, virtual sports, eSports)[10]. Since the terms are typically used interchangeably, and the meaning remains the same, to maintain the

coherence between chapters, it was decided to uniform the presentation, using “esports” as the sole term in all chapters. In the same way, when referring to participation in football-related esports (e.g., electronic Football, eFootball), we follow the current term used by the FPF esports department and uniformed the term to “eFootball”. Hence, the terms used differ from the published version of the articles presented in Chapters II to VII.

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CHAPTER II.

Esports deserve real sports medical attention

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Virtual sports deserve real sports medical attention.

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ABSTRACT

In recent years, virtual sports or “esports” have grown exponentially both recreationally and at the professional level. Esports comprise several regulated videogames played competitively, using electronic platforms. Some esports competitions present a structure comparable to traditional sports, and esports players, even with major skills and mental focus, need preparation and training to thrive. However, little is known about the demands of esports competitions and continuous training. As the popularity and stakes raise, concerns about the health and emerging risks of esports participation might arise. Indeed, in the absence of proper descriptive data about the specific characteristics of esports population (including factors such as screen time, physical activity, overuse injuries or training environment), effective prevention and care cannot be developed nor provided. Therefore, quality healthcare and prevention strategies are needed. In the current viewpoint, we argue that those involved with sports science and medicine should lead the discussion and reflect on the health effects of esports participation, providing scientifically based arguments to better answer to the current esports professionalism.

In our contemporary society, there is an increasing concern about screentime and the potential adverse effects this has on short- and long-term health [1]. The World Health Organization (WHO) has already released guidelines on physical activity, acknowledging the risk associated with sedentary behaviour. However, guidelines that mention screen-based sedentary activities are available for children only. Have you ever considered that screentime might be synonymous to time spent on sports?

Sports can be defined as a game, competition, or activity needing physical effort and skill that is played or done according to rules, for enjoyment and/or as a job [2]. The Australian Bureau of Statistics adds that sports are activities “involving physical exertion, skill and/or hand-eye coordination as the primary focus of the activity, with elements of competition where rules and patterns of behaviour governing the activity exist formally through organisations” [3]. Therefore, sports practice might include almost any kind of physical activity or exercise, and it is influenced by different contexts and individual disposition. On the other hand, there is still no consensual definition for esports. Generally, esports comprise a number of different videogame modalities, played competitively on controlled environments, with structure and regulations similar to traditional sports (e.g., leagues, ladders and tournaments) [4-7]. There are different esports categories, like Sports (e.g., FIFA EA Sports®), First-Person-Shooter (e.g., Call of Duty®), Battle Royal (e.g., Fortnite®), Strategy (e.g., Starcraft®), Multiplayer Online Battle Arena (e.g., League of Legends®).

Over the past decade, esports have grown exponentially and now also reaches competitively into the realm of traditional sports. Several professional esports competitions have emerged to a similar structure (Figure 1), popularity (Figure 2) and revenue (Figure 3) as professional sports. For instance, FIFA recently introduced the FIFA eNations Cup, that took place in England, where 16 national teams representing all of FIFA’s confederations competed against each other. The nations themselves hosted national eFootball championships to find their national team and selected 2 players who

represented their country at the FIFA eNations Cup. The French team – with the players “Maestro” and “DaXe” – were the inaugural winner of this tournament.

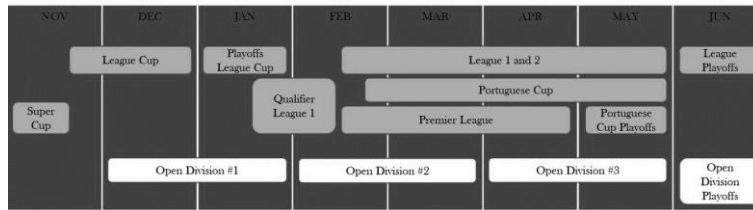


Figure 1 Set-up of the eFootball (EA SPORTS FIFA19) 2018-19 season for clubs, as organised by the Portuguese Football Federation

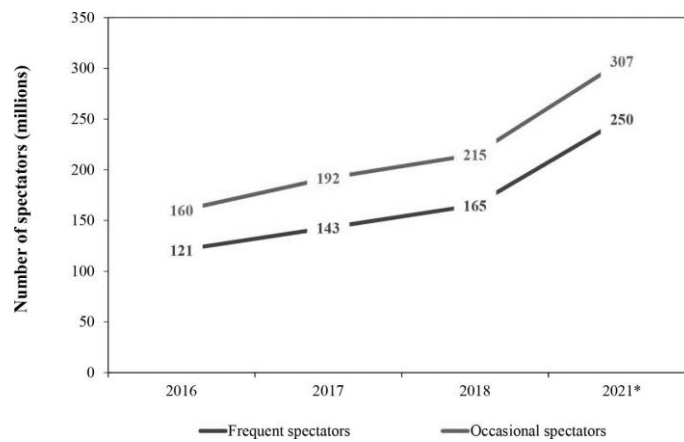


Figure 2 Global overview of esports spectators (in millions of people). Historical information and projection* based on data retrieved online from: <https://www.wepc.com/news/video-game-statistics/>; and NewZoo, Free 2018 Global esports market report, 2018.

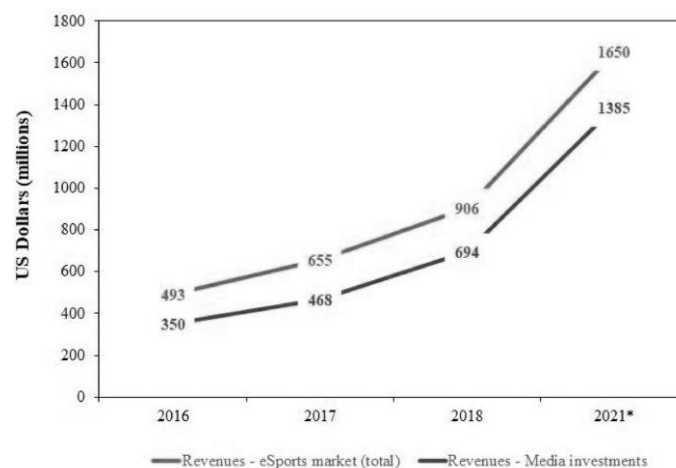


Figure 3 Global overview of esports revenues (in millions of USD). Historical information and projection* based on data retrieved online from: <https://www.wepc.com/news/video-game-statistics/>; <https://www.mmogames.com/wp-content/uploads/2018/05/2017-vid>

A legitimate sport?

This is a question under contemporary academic deliberation, and without a definite answer so far [5, 8]. The International Olympic Committee also held a debate to discuss precisely this question [9]. The outcome was that competitive esports, although not in line with the rules and regulations of the Olympic movement, could be considered a sporting activity while the players involved prepare and train with an intensity that could be comparable to athletes in traditional sports. This statement recognised the high skill, dexterity and mental focus required to compete in esports at a professional level. However, the literature is still scarce and conflicting results on the physiological impact (i.e., heart rate, blood pressure and perceived stress) of esports practice have been reported (Leis O. Stress in Esports: A Systematic Literature Review – Halle, Germany 2019).

Rudolf and colleagues, (personal communication: Stress im esports – Ein Einblick in Training und Wettkampf. esports Konferenz “Professionalisierung einer Subkultur?” - Bayreuth, Germany 2016) in a very small study involving 5 male Counter Strike® players found that the acute stress measured through cortisol levels and heart rate were comparable with those found in elite athletes from other sports. As such, without answering the question of whether we are dealing with a legitimate sport, future studies on elite esports participants should focus on training effort and competition stress experienced by the athletes [3]. Undeniably, esports is part of our contemporary culture. Likely, we have only witnessed the start of this movement to date. With the increasing popularity and high stakes (Figure 2 and 3), the professionalism of esports will continue to rise. This begs the rhetorical question, with competition already at a high level, whether sports and exercise medicine could provide quality care and health protection for esports professional players. The available evidence to do so is ‘thin’, and a big push is required to get up to speed [10]. Therefore, in this viewpoint, we propose some topics that should be addressed initially to provide a baseline for quality sports medical care in esports.

A sedentary athlete?

It has been scientifically underpinned that sedentary time, albeit attenuated by physical activity levels, is associated with negative long-term health [11]. It is an ecological fallacy to believe the esports athlete is similar to the general inactive youth population as described in public health research. For example, exergames, combine videogaming and exercise, since they use movement as an interface with the game itself, promote maintenance and improvement of physical status [12]. Also, a recent cross-sectional survey amongst 928 eFootball players (mean age of 24 ± 6 years-old, 99% men) registered with the Portuguese Football Federation showed that 79% of the 721 valid responders performed regular physical training [13]. Interestingly, 73% reported having high levels of physical activity and performed vigorous-intensity activity at least 3 days a week achieving a minimum of 1500 MET-min.week⁻¹ or performing any combination of exercise on 7 or more days a week, that takes at least 3000 MET-min.week⁻¹ (Figure 4), which is above the recommended levels by the WHO Guidelines for Physical Activity [14].

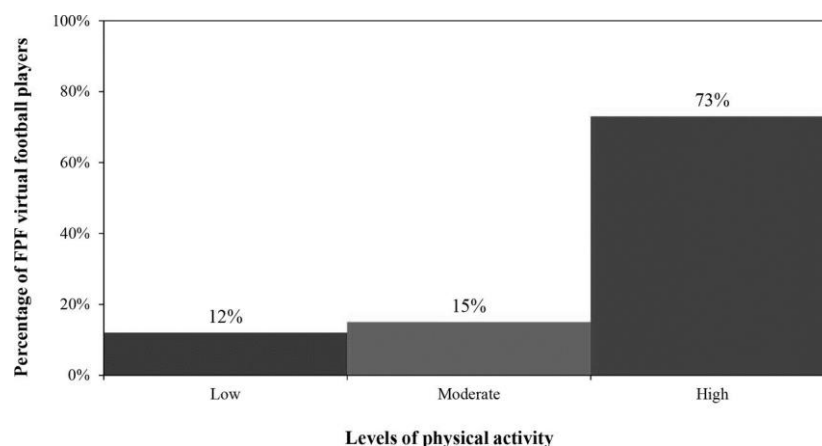


Figure 4 Levels of physical activity based on IPAQ survey data of eFootball players registered with the Portuguese Football Federation and participating in official esports competitions ($n = 721$; $\chi^2 = 499.52$; $p < 0.01$) [13].

Similar conclusions were drawn in a study conducted in Finland on elite esports players (mean age 29 ± 4 years-old, 97% men), with the participants reporting physical activity exceeding three times those recommendations. Overall, this implies we are dealing with a specific demographic, and we

require a better understanding of who these individuals are, and how short- and long-term health is affected by sedentary time in the esports population. In addition, general adverse health effects of a high amount of screen-time may be prevalent in esports players [15]. Increased screen-time is associated with detrimental effects on sleep, psychological state, petulance, and cognitive and socio-emotional development. Also, there is a risk of musculoskeletal complaints due to repetitive fine motor strain through computer use. In the absence of proper descriptive data on such general symptoms in the specific esports population, effective prevention and care cannot be developed nor provided.

The demands of esports competitions

Finally, we know little to nothing about the psychological and physiological demands of the various esports competitions, nor how the psychological and physical health of these athletes are affected on the short- and long-term. Although only cross-sectional in nature, a recent study on 65 collegiate esports players from 9 universities across the USA and Canada reported that esports players are susceptible to overuse injuries, with asthenopia (eye fatigue), neck pain, and back pain being the most prevalent injuries [15]. These injuries are arguably logical; esports practice could mimic some negative features of other occupations that require long periods using computers and consoles (e.g., administrative professionals, technology jobs, transportation careers, blue-collar workers, etc.), repetitive or forceful movements, awkward and static postures, poor lighting environments and prolonged sitting in the same position. All of which are physical causes and risk factors associated with described poor work-related health outcomes [16].

Competition pressure on the rise

With an increase in competitive stakes, the influence of competition on professional esports is likely to increase in the near future, and with our current lack of knowledge, we are ill prepared for this looming development.

First, with the increased social and media impact of esports and the rise of competition rewards or sponsorship, the pressure for a better performance probably will rise. Even with extended research related to supplements use on high-performance athletes, such as adverse effects, safety and composition [17], there is no scientific information base on substances used by esports players at high levels nor the health consequences of their use. Secondly, this pressure could predispose esports players to experience anxiety or other mental problems. Recently, the International Classification of Diseases (ICD-11) included for the first time the “gaming disorder” in the group of “disorders due to addictive behaviours” [18], esports practice might be associated to this disorder, but, as stated by the WHO, “studies suggest that gaming disorder affects only a small proportion of people who engage in digital- or video-gaming activities” [19]. This severely hampers our ability to know better and improve preparation strategies for esports players before competition, and to protect their health through a competitive season.

Still, it should be noted that despite some esports clubs are already paying salaries to esports players, the prize money of esports tournaments is the primary method for acquiring financial security for the participants themselves. Professional esports players might be just a small number of the thousands of participants regularly engaged with esports [20], but with the expected growth of professional esports players, also grows the necessity to better understand their ‘work’ environment and potential emerging risks, to better anticipate and prevent negative health outcomes.

The role of sports and exercise medicine in esports

Esports is booming and there is an increase in competitiveness and professionalization, yet little is known about how to train and prepare best for esports. Just as any other professional athlete, an esports athlete deserves our best care. For that, it is us – those involved with sports and exercise medicine – who should lead the discussion and reflect on the health of esports players. After all, without a doubt, esports have entered our realm, so we need

to be pro-active in gaining an understanding on this contemporary phenomenon and we must face this new reality with scientifically-based arguments to be prepared for the professionalism of esports.

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CHAPTER III.

Associations between esports participation and health: a scoping review

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Associations Between Esports Participation and Health: A Scoping Review.

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ABSTRACT

Esports are a contemporary phenomenon, with millions of people involved. Still, scientific literature on the topic is scarce. Anecdotal reports, mostly based on what is known from videogames practice, have associated esports with unhealthy lifestyles and health-related problems. The present scoping review aimed to provide an overview of findings from studies regarding the health and well-being in adult esports players, while identifying the most studied topics in the field and those still lacking scientific research.

The search was conducted in MEDLINE, Scopus, Web of Science, B-on, and ESCBO databases. Studies regarding health consequences of esports practice conducted with adult esports players were included. No exclusion criteria concerning age, sex, esports modality or esports level were applied, but articles related to other forms of video gaming or gambling were excluded. The search was limited to peer-reviewed articles. Opinion and review articles were excluded.

There were 1416 articles retrieved from which 33 met the inclusion criteria. Lifestyle habits, sleep, exercise and physical health (including musculoskeletal health), esports practice, physiological demands, and mental health were the main topics of investigation. Several gaps in the literature were identified, namely studies on cardiovascular, respiratory or metabolic health, or consuming-related risks. Also, the lack of homogeneous methodologies and definitions used in esports-related studies was identified. Esports practice has been associated with different health-related symptoms, but more studies using robust methodologies and appropriate research designs are needed. Topics such as cardiovascular health or the use of performance-enhancing drugs are lacking.

BACKGROUND

Esports are a contemporary phenomenon. Players use their physical and mental abilities to participate in organized and regulated competitions of different esports modalities [e.g., sports, first-person shooter (FPS), Multiplayer Online Battle Arena (MOBA), etc.]. Esports are run in an electronic environment [1, 2], but differ from just playing videogames, which is a recreational activity [3].

To attain the highest levels in esports competitions and tournaments, esports players need to excel in both mental and physical abilities [4, 5]. For this purpose, esports players spend long hours training [6], in a process similar to that of professional athletes in any traditional sport [7]. With increased professionalization, pressure to perform, and the media impact of esports, it is expected that players, just like traditional athletes, may also experience several health-related problems [2, 8, 9, 10]. As esports popularity and stakes rise, it is essential, in order to develop and provide effective prevention and adequate medical care, to understand specific characteristics of the esports population, such as sedentary behaviour, levels of physical activity, health-related problems (e.g., mental health problems, overuse injuries), or training [10].

Recent systematic reviews on both esports and videogame players have evaluated mental and physical consequences of gameplay. For example, mixed results have been found as regards the relationship between playing esports competitively and psychophysiological stress [11]. Moreover, a systematic review that used restrictive inclusion criteria, covering empirical studies published only in English between 2017 and 2020, concluded that in esports and videogame players aged between 14 and 25 years, excessive esports play caused social, emotional, addiction, and psychological problems such as depression and aggression [12]. As for lifestyle behaviors, in youth involved with both esports and online video gaming (i.e., players, spectators, and live streams audiences [13]), the authors affirmed an association between gaming and increased body mass index (BMI), a poor diet and problems

related with videogame addiction associated with a specific esports modality (i.e., Massive Multiplayer Online Role Player Game – MMORPG). Additionally, interest in the topic has also been illustrated in numerous narrative reviews and opinion articles on several health-related issues, such as sleep and musculoskeletal problems related to esports practice [14, 15, 16, 17].

Notably, the discussion about the differences between esports and playing videogames recreationally has arisen in recent years [18]. Also, the lifespan of esports players has increased [19]. Therefore, studies are needed on adult individuals regularly engaged in esports. Besides, mental health is a common major concern when referring to esports and videogame practice, but esports players might be prone to other health problems. To our knowledge, there is no current review aiming to evaluate health-related problems exclusively in adult esports players (thus excluding individuals who just play videogames). Nevertheless, given the relative novelty and heterogeneity of the topic, the development of a scoping review would, at this stage, be sound and comprehensive.

Scoping reviews are a relatively new approach that follows a structured, rigorous, and transparent process in order to examine emerging topics, particularly when a specific topic has not been comprehensively reviewed or exhibits a complex or heterogeneous nature, and identify potential gaps in the knowledge [20, 21]. Thus, scoping reviews are designed to provide an overview of the existing evidence, regardless of the quality of the included articles, and a formal assessment of methodological quality is not commonly performed [20]. Given the relative novelty of research in esports, scoping reviews might help to clarify the scientific knowledge concerning the relation between esports and health. In the present scoping review, therefore, we place in perspective the current body of literature on esports participation and health, identifying relevant studies that have been conducted exclusively with adult esports players, as well as potential gaps in the literature that might currently exist [22, 23]. We thus aimed to identify the current state of

research regarding health and well-being related to esports practice. Secondly, we aimed to identify possible gaps in the literature related to general health problems in people engaged in esports, so as to promote key topics for future research. Overall, we aimed to answer the following questions: (i) is the practice of esports related to health problems in people engaged in them?; (ii) which health-related consequences of esports practice have been studied in adults?; and (iii) what are the gaps in the scientific literature regarding esports and health?

METHODS

Protocol and registration

The present scoping review followed the Joanna Briggs Institute (JBI) Guidelines on Scoping Reviews [20, 24] and the PRISMA Extension for Scoping Reviews (PRISMA-ScR) [22]. As suggested by the JBI guidelines, before starting this scoping review, the protocol was developed and registered on <https://osf.io/rt9xm/> (on 2020-12-28).

Eligibility criteria

This scoping review included studies conducted exclusively with esports players. All esports modalities and levels of play were applied. Articles related to other forms of video gaming (e.g., videogames for health interventions, recreational practice of video games) or gambling were excluded. No exclusion criteria related to age and sex of the participants, or to cultural/sub-cultural factors, geographic location or race were applied. Based on the languages fluently spoken by the members of the research team, studies published in English, German, Dutch, Spanish, Italian, French, and Portuguese were included. No date frame was applied. Overall, analytical observational studies (including prospective and retrospective cohort studies), case-control studies, and analytical cross-sectional studies were considered. Moreover, descriptive observational study designs (i.e., case series, case reports, and descriptive cross-sectional studies) and qualitative studies were considered

for the analysis. There was no exclusion based on publication form (e.g., conference proceedings, journal publications). Nevertheless, review articles (e.g., narrative reviews, scoping reviews, systematic reviews), consensus papers, and opinion articles (e.g., letters to the editor, viewpoints, comments) were excluded, in order to avoid duplication of results.

Information sources and search strategy

First, an initial limited search of MEDLINE and Web of Science was undertaken to identify articles on the topic, and to better adjust keywords and index terms. In the preliminary search, no current or underway systematic reviews or scoping reviews with only esports players were identified. Second, a full search strategy on MEDLINE, Scopus, Web of Science, B-on, and EBSCO was adopted for text words in the titles and abstracts of relevant articles, and the index terms employed to describe the articles were used to develop the final query. The search strategy was adapted for each included database. This resulted in the following search query: *(esport* OR "virtual sport*" OR "competitive video games" OR "electronic sports" OR "e-sport*" OR "professional video game*") AND (health OR illness OR injury OR fitness OR mortality OR morbidity OR lifestyle OR "well-being" OR wellbeing OR "physical activity" OR sedentar* OR nutrition OR eating OR sleep) NOT (exergam* OR esporte* OR esporti* OR gamma* OR gambl*)*. The search query was first used on MEDLINE and then converted for each subsequent database.

Finally, the Esports Research Network (<https://esportsresearch.net/literature/items/search>) and the reference list of all included sources of evidence were screened for additional studies that might have been missed with the initial search strategy. All databases were screened on 5 February 2021, and updated on 14 April 2021. The updated search noted seven more eligible articles that met the inclusion criteria, and these were added to the present scoping review.

Data charting process

All retrieved articles were indexed in EndNote X8®, and duplicated articles were excluded. Two independent reviewers (AMP and JC) screened titles and abstracts for assessment against the inclusion criteria. Potentially relevant sources were retrieved in full. Then, the full text of the selected articles was independently screened for eligibility against the inclusion criteria by two independent reviewers. During the screening process for eligibility, a data chart was used to report all excluded articles. The main reasons for exclusion at each step of the process (based on the title, abstract, or full-text reading) were “not being related to esports” (e.g., internet addiction) and “articles related to other forms of videogames” (e.g., videogames for health interventions). When a consensus was not met at each stage of the selection process, discussion was resorted to, and there was no need for an additional reviewer.

Synthesis of results

AMP and JC were responsible for data extraction from included papers, using a data extraction chart developed by the authors which included specific details about the participants, concept, context, study methods, and key relevant findings, according to each of the main topics. Additionally, a thematic analysis of key findings was performed considering esports modalities (e.g., Sports, MOBA, FPS), healthy lifestyle habits (e.g., sleep, nutrition, well-being), and function (i.e., physical, physiological, musculoskeletal, mental), as developed during article reading. Additionally, the draft data extraction tool was modified and revised as necessary while extracting data from each included evidence source (e.g., two previous topics “acute injuries” and “overuse injuries” – were combined to form a broader topic called “musculoskeletal health”). Any disagreements between reviewers were resolved through discussion, resulting in the selection of 2 articles and the exclusion of 9 articles by agreement, after full re-reading and careful confrontation of the inclusion and exclusion criteria.

RESULTS

Numerical analysis

All included articles were submitted to a thorough selection according to the inclusion and exclusion criteria. The search results and the study inclusion process are fully reported in a PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analysis Extension For Scoping Reviews) flow diagram (Figure 1).

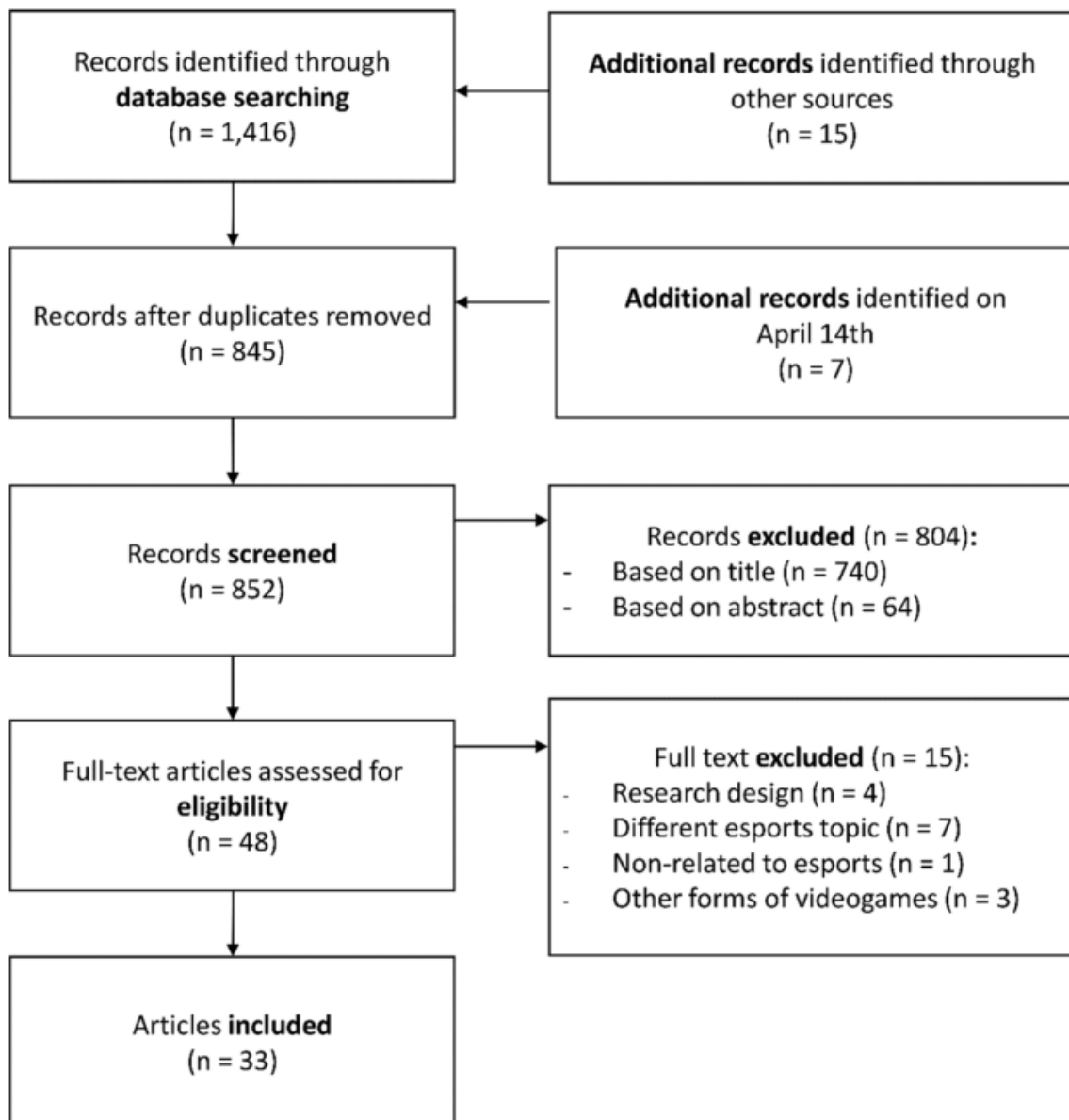


Figura .1 PRISMA-ScR flow diagram

There were 1,416 articles retrieved from 5 databases used in the present scoping review. Overall, 740 articles were excluded based on the title, 583 articles were not related to the topic, 123 referred to other forms of videogames (e.g., videogames for health monitoring, recreational gaming), 28 were not related to health topics in esports, and 1 was a review. Several articles were excluded for more than one reason. Reading the abstracts led to the exclusion of a further 64. Of these, 33 articles did not meet the inclusion criteria for research design, 12 were related to other forms of videogames, and 12 did not refer to health topics in esports. There were 19 review articles about esports or videogames, and these, together with 11 opinion articles, were excluded. Therefore, after full reading, a total of 33 articles were selected; these were published between 2012 and 2021 (6 in 2019, 15 in 2020, and 7 in 2021). Most of the articles were published in peer-reviewed journals (n=28), 4 were conference abstracts, and 1 was published in a book. All articles were published in English. In terms of research design, most of the included articles had a cross-sectional design (n=25; 76%) (Table 1).

Table 1 Articles included in the current scoping review by research design

Research design	n (%)
Transversal/cross-sectional	25 (76)
Qualitative study	3 (9)
Cohort study	2 (6)
Randomized control trial	1 (3)
Case-control	1 (3)
Case-report	1 (3)

Twenty-two journals have published articles related to health and well-being in esports. The top 3 journals with more articles published were: the *International Journal of Environmental Research and Public Health* (n=5, 15%), the *International Journal of Gaming and Computer-Mediated Simulations* (n=3, 9%), and *Frontiers in Psychology* (n=3, 9%).

The definition used for esports players differed between studies. Almost half of the articles included players from more than one esports modality, with 4 articles covering only League of Legends® players (Table 2).

Table 2 Esports modalities studied in selected articles.

Esports modality	n (%)
>1 esports modalities	16 (49)
League of Legends®	4 (12)
StarCraft®	2 (6)
Counter-Strike: Global Offensive®	2 (6)
Fortnite®	1 (3)
Overwatch®	1 (3)
FIFA®	1 (3)
Non-defined First-Person Shooter	1 (3)
Non-defined	5 (15)

Sample sizes varied between 1 and 4,284 participants (median 65 participants; Q1=20, Q3=188). Most participants were men (median 98%; Q1=90%, Q3=100%). Four articles did not specify the sample size, and 14 articles did not characterize the participants by genre. All articles included participants between aged 16 and 27 years. Table 3 describes the selected articles according to study aims, research design, and description of the participants.

Table 3 Articles included in the current scoping review according to study aims, research design, and characteristics of the participants included in the study.

Title	Date	Study aims	Design	Population	Samp le size	Espo rt	Genre (% men)	Age (years)
Himmelstein et al. [25]	2017	To gain insight into the mental skills that competitive gamers already possess and utilize, the mental obstacles or barriers competitive gamers encounter, and the role performance psychology may play in esports.	Thematic analysis	\geq the rank of Platinum 5 (lowest of the platinum sub-levels)	5	LoL	100	From 19 to 23
Kari et al. [26]	2019	To explore training routines of professional and high-level esports players with added focus on their physical exercise	Mixed methods (quantitative and a qualitative interview)	(survey) 31 professional esports players and 84 high-level athletes (interview) 7 professional esports players	115 / 7	DM	ND	20.8 ± 4.4
Kang et al. [27]	2020	To qualify esports players as professional sports players in terms of their psychological and cognitive characteristics by comparing them to the most popular professional sports players (i.e., professional baseball players).	Case-control	Korean Esports Association professional esports players (n = 55), pro-baseball (n=57) and age- and sex-matched healthy comparison subjects (n = 60)	172	DM	ND	ND
Rudolf et al. [28]	2020	To examine demographics and health behaviour of video game and eSports	Cross-sectional	German esports players: 14 current and 33 former professional	1066	DM	91.9	22.9 \pm 5.9

		players and the associations between video game playtime and health behaviour.		players, 355 amateurs, 577 regular players and 87 occasional players				
Han et al. [29]	2012	1) To study patterns of brain volumes between patients with online game addiction (POGA) and pro-gamers; 2) to evaluate vulnerability and resistance to gaming addiction in POGA and healthy controls	Case-control. Use of magnetic resonance imaging (MRI) and voxel-wise comparisons of grey matter volume	18 healthy controls + 17 pro-gamers (competition winner between every 30000 aspirants) + 20 Patients (P50 and impaired behaviors or distress due to a maladaptive pattern of internet video gameplay)	55	Star Craft	ND	20.8±1.5
Kari et al. [30]	2016	To examine at a descriptive level training, physical exercise, and players' perceptions	Cross-sectional, based on an online survey	31 Professional players (based on team contracts or achievements in international tournaments), 84 high-level players	115	DM	ND	20.8±4.4
Valladão et al. [31]	2020	1) To compare the HR response during a 3-hour seated session of the esport Fortnite with resting HR; 2) to analyze possible relationships among demographics, gaming performance, and physiological data.	Cross-sectional evaluation of mean and peak resting HR collected during two HR measurements in a controlled laboratory setting.	College student from the University of Mississippi and the Ole Miss Esports Club team	23	Fortnite	100	21.0±1.8
DiFrancisco-Donoghue et al. [32]	2020	To investigate activity levels, BMI, and body composition in collegiate esports	Cohort. Daily activity monitored for 24 h for 14	13 collegiate men esports players members of the American	24	Overwatch	ND	20.2±1.7

		players as compared to age-matched controls.	consecutive days by a Fitbit Charge and self-reported questionnaire for number of days performing intentional exercise and the duration of exercise	Collegiate East Coast Esports League	11 non-esports players				
Fiskaali et al. [33]	2020	To explore whether students enrolled in sports programs differ from regular students (gamers and non-gamers) on psychological measures of mental well-being, social and academic self-efficacy as well as loneliness and gaming addiction	Cross-sectional survey	College students		104	ND	ND	ND
Smith et al. [34]	2019	To examine the various stressors faced and the associated coping strategies employed by seven esports competitors	Semi-structured interview	high-level competitive esports players, who had recently participated in a competitive event CSGO competition	7		CS:GO	100	20.6±2.1
Zhao et al. [35]	2019	To evaluate the situation of Chinese esports players about Chinese cultural norms and related cognitive and evaluative beliefs, and how and to what	A qualitative study based on ethnographic interviews	24 top Chinese eSports players, /professional players, 4 coaches 7 CEOs/managers/directors	35		DM		ND

		extent do esports players transform themselves as athletes through mental changes within a professional eSports career.						
Hyun et al. [36]	2013	To study how cognitive flexibility and the volume of the brain cortex would be correlated with the career length of online pro-gamers.	Cross-sectional evaluation. Use of high-resolution magnetic resonance scans to measure cortical thickness	Members of the Korea eSports Association	23	Star-Craft	100	19.8±1.7
Zwibel et al. [37]	2019	To understand lifestyle behaviors, exercise lifestyle habits, and common injuries of eSports players in the collegiate setting.	Cross-sectional survey	Collegiate varsity eSport players from 9 colleges and universities	63	DM	94	From 18 to 22
DiFrancisco-Donoghue et al. [38]	2019	To study lifestyle habits of collegiate esports players and a proposed healthcare model for eSport athletes	Cross-sectional evaluation bases on an anonymous, self-reported electronic questionnaire	Esport players from 8 different universities in the USA	65	DM		From 18 to 22
Sanders et al. [39]	2020	To confirm the relationships and explore the mechanism underlying these relationships in esports. Hypotheses:	Cross-sectional, based on 3 inventories administered via Qualtrics: Mental Toughness Index, Self-	16 recreational gamers (>6hours per week)	16	ND		22.0±2.7

	<p>1) mental toughness will correlate positively with mental health;</p> <p>2) self-compassion will correlate positively with mental health;</p> <p>3) mental toughness will correlate positively with self-compassion;</p> <p>4) self-compassion will mediate the mental toughness-mental health relationship</p>	Compassion Scale, and Mental Health Continuum – Short Form.							
Lindberg et al. [40]	2020 To investigate the prevalence of MSK pain, the association between MSK pain and esports-related training volume, and the association between MSK pain and physical activity levels	Cross-sectional, based on questionnaires.	146 Danish esports players 154 athletes were used to assess the association between the primary outcome and physical activity 188 athletes were used to assess the association between the primary outcome and the amount of time spent on esports-related training	154/ 188	DM	97.9	17.1±2. 3		
Pluss et al. [41]	2020 To investigate the perceptual-motor abilities of esports players using an expert/non-expert paradigm	Cross-sectional. Use a testing battery to evaluate manual dexterity, speed-accuracy trade-off, and	25 professional esports players at the highest level of competition (15 MOBA - Lol + 10 FPS - Overwatch);	75	DM	85.3	24.2±4. 2		

		<p>response times. Fine motor skills and hand-eye coordination were assessed using a grooved pegboard. Minimizing movement errors were assessed using an adapted computer-based clicking task. Simple two-choice and four-choice response times along with a go/no-go assessment that used congruent and incongruent precues in a four-choice response time task were assessed using a customized, four-button controller.</p>	<p>25 recreational players that participated in esports on a casual basis;</p> <p>25 control healthy participants with no experience in esports. From the Oceania region (Australasia, Melanesia, Micronesia and Polynesia)</p>					
Sousa et al. [42]	2020	To examine physiological and cognitive changes after a session of esports gameplay for two types of games: first-person shooter and multiplayer online battle arena games.	Prospective cohort. Sessions of 151 min± 49 min). Evaluation of BP, HR, RR, visual acuity, and FTT) In addition,	Members of the NYIT esports team	17	DM	100	20.0±1.82

			participants were administered a series of online executive function tests. Subjects were then fitted into a Hexoskin R shirt, which monitored their HR throughout gameplay.					
Andre et al. [43]	2020	To describe the physiological and perceptual responses in a live collegiate esports tournament.	Cross-sectional. Three measurements periods of HR and HR variability (i.e., pre-competition, in-competition, and post-competition)	Members of the University of Mississippi Esports team	14	DM	100	19.8±1.0
Tham et al. [44]	2020	To address whether in-game social support can replace real-world social support in protecting problematic gamers from symptoms of depression and anxiety.	Cross-sectional	Student pool at Michigan State University; A second, simultaneous sample (n = 41) Esports association at the same university	361	ND	59	Median = 21
Lee et al. [45]	2021	To investigate the sleep and mood of professional esports athletes.	Cross-sectional. Use of a wrist-activity monitor for 7 (Australian and South	Professional esports athletes from South Korea (N = 8), Australia (N = 4), and the USA (N = 5)	17	FPS	100	20.0±3.5

			Korean teams) –14 (US team) days and completed subjective sleep and mood questionnaires					
Behnke et al. [46]	2020	To examine how social challenge and threat influence gaming outcomes, and whether psychophysiological factors may explain these effect	Case-control. Measures of HR, PEP, CO, TPR	72 (88%) recreational gamers; 7 (8%) non-professional esports gamers (competing in local or online tournaments); 3 (4%) gamers did not report their status	82	CS:GO	88	10.5±2.5
Poulus et al. [47]	2020	To explore stress and coping in esports athletes and the influence of mental toughness.	Cross-sectional. Use of the MTI, MTQ6, Stress Appraisal Measure, and Brief COPE Inventory	Esports athletes ranked in the top 40% of one of five major esports	316	DM	89.6	22.6±3.4
Gray et al. [48]	2018	To investigate the effects of playing a coalitionary-based esports on young men's steroid hormone levels.	Cross-sectional. Use of saliva samples before and after competitions lasting 15 and 27 min in duration.	Esports players from the University of Nevada, Las Vegas (average of ranked player games = 301.28±437.60; average composite experience and skill = 2.73±1.40)	26	LoL	100	20.5±1.4
Trotter et al. [49]	2020	1) To investigate the relationships between obesity and self-reported physical activity levels, drinking and	Cross-sectional online survey	Participants from 65 countries	1772	DM	87.2	ND

smoking frequency, and general health perceptions in esports players;

2) to investigate the cross-sectional association between obesity, physical activity, general health, smoking and drinking frequency and player in-game ranking;

3) to compare esports players' obesity and smoking and drinking frequency to international reference data.

Thomas et al. [50]	2019	To examine markers of cognitive function and mental and physiological fatigue in a convenience sample of elite eSport players ingesting an ergogenic supplement or placebo during a simulated competition	Randomized control trial. Use of cognitive and physical measures four times per testing day: before and after three consecutive LoL games. Each game was separated by 15 min for testing procedures and strategic debriefing of gameplay.	Elite LoL esports players	9	LoL		21.0±2.0
Banyai et al. [51]	2019	1) To compare recreational and esports gamers via demographics, gaming-related characteristics, the severity of	Case-control, using an online survey.	205 Hungarian speaking esports gamers (gamers who attended online or LAN esports	4284	ND	89.89	23.1±6.6

		gaming problems, gaming motives, and psychiatric symptoms; 2) to examine the mediation effect of gaming motives between psychiatric distress and gaming disorder.		competitions at least 6–11 times or more in the past year); 4079 recreational gamers.				
Gomes et al. [52]	2021	To evaluate the characteristics of the sleep-wake cycle of LoL athletes in pre-training, training, pre-competition, and competition routines.	Cross-sectional, based on questionnaires (PSQI, ESS, Morniness–Eveningness Questionnaire), and data from 7-day monitoring using actigraphy. The esports players lived in the Gaming House and adhered to the same routine in both the training and competition conditions.		20	LoL	100	20.5±0.8
Pereira et al. [53]	2021	To evaluate the levels of physical activity, sedentarism, and lifestyle habits of physical training of adults engaged with eFootball in Portugal.	Cross-sectional structured online survey using the International Physical Activity Questionnaire and a set	EFootball players registered on the Portuguese Football Federation Esports online	433 / 565	FIFA	98	Median = 22 (IQR =8)

			of questions regarding lifestyle habits of physical training						
Haupt et al. [54]	2021	1) To show the effects of esports on the cardiovascular system and energy expenditure; 2) to compare esports with dynamic exercise.	Case-report. Determination of HR and oxygen consumption during 30-minute video game	1 male amateur esports player (84 cm, 60 kg)	1	ND	100	32	
Toth et al. [55]	2021	1) To differentiate the sensorimotor performance of a key game-play skill among esports players of different skill levels; 2) to quantify training effect on performance; 3) to investigate the effect of tDCS on performance improvements.	Case-control. Baseline, post and retention 10-min tests using a bespoke CS:GO Flick Test Software Controls: played Tetris for 10 min 5-day consecutive training sessions (1 st training session immediately after the Baseline test and the last training immediately before the Post-test). Controlled	17 <i>Non-Gamer</i> Expertise ≤ 10 h/week to action video games, no rank); 32 <i>Low Skill Gamer</i> Expertise ≥ 5 h/week playing CS:GO <i>Silver 1 to Gold Nova 3 rank</i> ; 39 high skill gamer ≥ 5 h/week playing CS:GO <i>Gold Nova Master to Global Elite</i> .	145	DM	ND	19.8 \pm 1.8 to 26.0 \pm 4.8	

		environment (Esports Science Research Lab)						
Banyai et al. [56]	2021	To explore the moderating effect of different coping strategies and types of video game usage (professional [e-sport] or recreational) on the relationship between psychiatric symptoms and GD	Cross-sectional. Web-based questionnaire	161 (4.63%) esports gamers that participated in esports tournaments > 6-11 times in the previous year.	3476	DM	90.13	23.2±6.5
Mendoza et al. [57]	2021	To analyze the neuroendocrine stress response, psychological anxiety response, and perceived match importance between expert and non-expert control gamers in an official competitive context	Case-control. Use of questionnaires and saliva samples were taken 10 min before and 10 min after the games were concluded	45 volunteer men gamers; 20 control individuals; 25 expert gamers who competed in official esports tournaments (Platinum ranking)	45	DM	ND	From 18 to 27

Legend: BP - blood pressure, CO - cardiac output, DM – different esports modalities, ESS - Epworth Sleepiness Scale, FTT - finger-tapping test, HR - heart rate, Lol – League of Legends, MTI - Mental Toughness Inventory, MTQ6 - Mental Toughness Questionnaire 6, PEP - pre-ejection period, ND – non defined, PSQI - Pittsburgh Sleep Quality Index, RR - respiratory rate, TPR - total peripheral resistance.

Thematic analysis

The most relevant results from the selected articles were grouped according to lifestyle habits, exercise, and physical health, body composition, musculoskeletal health and function, physiological demands, and mental health (Table 4).

Table 4 Critical appraisal within sources of evidence

Health-related topic	n	References
Lifestyle habits	10	[28, 29, 32, 37, 40, 45, 49, 50, 52, 55]
Exercise and Physical Health	19	[26, 28-32, 35, 37, 38, 40, 43, 45, 46, 49-52, 56, 57]
Body composition	7	[31, 32, 40, 43, 45, 49, 50]
Musculoskeletal Health	8	[25, 26, 35, 37, 38, 40, 41, 55]
Physiological demands	11	[31, 36, 41-43, 46, 48, 50, 54, 55, 57]
Mental Health	15	[25, 27, 29, 34-36, 39, 42, 43, 45, 47, 51, 55-57]

Lifestyle habits

Smoking habits, alcohol and caffeine consumption, nutrition and sleep characteristics were assessed in 10 different articles. Overall, esports players appeared to have good lifestyle habits.

Smoking habits

According to a cross-sectional study conducted with 1772 Danish esports players from different esports modalities, 92% reported no smoking lifestyle habits, with only 4% smoking daily, and 8% smoking at least once a week, no association having been found between smoking lifestyle habits and in-game ranking [49]. Similar conclusions have been found regarding lower smoking frequency, especially when compared with the general population [29, 40].

Alcohol consumption

In a large-scale study [49] of smoking lifestyle habits, most esports players reported not drinking alcoholic beverages (65.1%, n=1150). Of those who reported drinking alcoholic beverages, 0.5% (n=9) reported drinking daily, while 34.9% (n = 616) reported drinking alcohol at least once a week. In these

studies, in-game player rank was not associated with drinking consumption. In another study that evaluated alcohol consumption and its effects on brain function, there were no differences between esports players and other healthy subjects [29].

Caffeine consumption

As for caffeine consumption, a daily caffeine dose of 114.7 ± 118.3 mg was reported [45]. Another study referred to an average daily consumption of 1 ± 0.8 cups of caffeine beverage a day [37]. Also, in a randomized, double-blind, placebo-controlled cross-over trial that evaluated the consumption of an energy drink in a convenience sample of 9 elite League of Legends® players, no significant improvement in performance parameters was found apart from average reaction time and handgrip strength on the left hand [50].

Nutrition habits

Even though esports players seem to be conscientious about diet [37], in an open-ended self-assessment of diet quality, 4 out of 9 of the participants felt they consumed a healthy diet [50], with reports of a mean fruit and vegetable consumption of 2.7 ± 1.8 portions/day [28].

Sleep characteristics

Different articles suggested that esports players sleep between 7.1 ± 1.3 to 8.1 ± 1.2 hours per night [28, 40, 50], with no differences in sleep time between esports and aged-matched controls [32]. However, in a cross-sectional observational study with 17 professional FPS players using wrist-activity monitors for 7–14 days, the median total sleep time was lower than 7 hours per night [45]. It has also been suggested that esports players have significantly delayed sleep time [45, 52], and most individuals were considered to have “moderately evening” and “definitely evening” chronotypes. Moreover, it has been found that esports players mentioned good sleep quality [28], while several sleep problems were described, including

excessive daytime sleepiness [45, 52], insomnia [45], trouble falling asleep [40, 45] and daytime dysfunction [55]. Additionally, those problems seemed to be exacerbated during competitions [45, 52, 55].

Exercise and physical health

Physical activity and exercise

According to various studies examining physical activity and exercise, 65% [37] to 88.7% [26] of esports players exercise regularly. However, 11.3% [26, 30] to 40.0% [38] mentioned that they did not undertake in any type of physical activity.

Maintaining or improving overall physical health was the main reason for doing physical exercise for 45.2% of professional esports players [26, 30], 47.6% of high-level athletes [26, 30], and 66.7% of eFootball players [52]. In a structured interview with professional esports players, all considered physical exercise helpful, resulting in better general health and a more active lifestyle [26]. Other motivations for doing physical activity which were highlighted were improving overall physical capacity, exercising for fun or enjoyment, and improving physical appearance [26, 30, 52]. Notably, the proportion of esports players who reported doing physical exercise to be more successful in esports ranged between 6.1% [52] and 8.7% [26]. Good physical health was said to “increase concentration, mood, and energy levels, thus helping to focus through daily training and tournaments”, and esports players considered physical activity and exercise as having potential benefits for esports performance, in opposition to coaches and teams that put relatively little emphasis on it [26]. However, following interviews and a survey, Kari and colleagues [26] concluded that physical exercise seemed to be largely unstructured and unsystematic, though esports players usually plan their physical exercise, with some even relying on an exercise professional (e.g., personal trainer, team’s physical coach/physiotherapist) or an outside service [26, 30, 52]. Overall, esports players reported doing physical exercise for more than 1 hour per day and more than 3 days per week (Table 5).

Table 5 Reported time spent with physical activity and/or exercise.

Hours per day (h/day)	Hours per week (h/week)	Days per week (days/week)
1.1 ± 0.8 [30]	18 (Q1, Q3 = 12, 28) [52]	4.2± 1.7 [50]
1.0 [26]	3.9 ± 2.4 [43]	3.5 ± 2.2 [43]
1.1±0.8 [26]	>2.5 (moderate to vigorous physical activity) [28]	3 ±1.7 [37]
2.6 [52]		
≥0.5 [37]		

In a study conducted exclusively with eFootball players, the participants reported expending 2,880 (1,920–4,800) MET-min·week⁻¹ with vigorous activities, 1,080 (600–2,160) MET-min·week⁻¹ with moderate activities, and 1,155 (462–2,376) MET-min·week⁻¹ walking, and 84.6% (n = 366) of the participants reported high levels of physical activity [52]. Based on the IPAQ scoring protocol, the total energy expenditure with physical activities was 5,625 (3,675–8,586) MET-min·week⁻¹ [52]. Different questionnaire-based studies found that a relevant proportion of esports players met the guidelines of the World Health Organization for physical activity [26, 30, 31, 52], ranging from 19.7% [49] to 87.1% [52]. Likewise, physical exercise was twice as high as the minimum recommended in the guidelines of the American College of Sports Medicine (i.e., 150 min/week) [31]. Yet, when non-questionnaire tools (e.g., accelerometers) were used, esports players exercised significantly less than age-matched controls, with significantly lower weekly steps [32].

Sitting time and esports practice

Esports players, independently of physical activity levels, spent considerable time in sedentary activities, ranging from 5.3 (3.5–8.0) hours/day [52] to 7.7±3.6 hours/day [28], and frequently spent more than 3 hours without a standing break [37, 38].

According to a 17-year-old professional player, esports practice is said to be “like any full-time sports profession and [...] they [players] train in a manner like other sports” [35]. Consistently, in a typical week, esports players reported spending 15.7±8.5 [28, 46] to 18.2±9.2 hours training their esports [56], ranging from 15 to 40 hours/week [57] (Table 6).

Table 6 Time spent with esports practice.

Hours per day (h/day)	Hours per week (h/week)	During competition (h/day)
5.28±2.57 [26]	24.2 (21.7–26.7) (unstructured) [40]	5.5–10 ¹ [38]
3–6 ([59%] vs 16% >7 [37]	6.9 (6.3–7.5) (structured) [40]	
9.21±4.36 [45]	17.3 (15.0–19.5) (total) [40]	
10.3±2.1 [50]	18.9±11.6 [43]	
2.5 (IQR: 2.0, 3.7) [52]		
2.6±1.31 [56]		

Note: ¹ before competitions. Legend: IQR – Interquartile Range

When comparing the time spent in structured and unstructured esports practice, less time spent in structured esports practice [Median= 6.9 (6.3 to 7.5) (95% CI) hours/week] was reported, compared to unstructured esports practice [Median = 17.3 (15.0 to 19.5) hours/week] [40]. Furthermore, the time spent in esports training on a normal day varied between studies, from nearly 3 hours/day [37, 52, 56] to approximately 10 hours/day [45, 50]. Besides esports practice, esports players also reported playing other videogames (e.g., 1.8±2.8 hours/day) [50] and spending a considerable time using the internet [29]. Player in-game rank was moderately and positively associated with esports practice frequency and the number of days spent playing esports [49]. Additionally, the time spent practicing before competition tended to increase [38, 52].

Body composition

Esports players showed higher body fat percentage, lower lean body mass, and lower bone mineral density, despite no BMI differences between esports and non-esports players [32]. Different articles used BMI to characterize body composition of esports players, mostly as a secondary outcome. Esports players appeared to be more likely to have a BMI categorized as normal, pre-obese, and obese classes 2 and 3 [49]. But most studies on esports players were based on self-reports, and on-site evaluations estimated BMI from 22.3± 4.8 to 25.7 ± 3.9 [31, 40, 43, 45, 50] (Table 7).

Table 7 Body mass index of esports players

Body mass index (Kg/m²)
22.3 ± 4.8 [40]
24.1 ± 5.5 [43]
24.7 ± 16.8 [45]
25.6 ± 3.4 [50]
25.7 ± 3.9 [31]

A weak positive association between BMI and video game-play time was found [28], while one study showed no positive correlations between BMI and electronic gaming time [31]. Moreover, BMI was negatively associated with esports practice hours per week [31], and esports practice at higher levels was inversely correlated with BMI, better players showing a lower BMI [29, 49].

Musculoskeletal health and function

According to an esports coach who was interviewed, esports players “have remarkable motor skills and are quick with their hand-eye coordination” and “should have the ‘perfect’ dynamic and static vision to capture and process the message in an instant from any moving images” [35]. Other additional skills and reflexes include the speed of hand movement and speed-accuracy trade-off [25, 55]. However, when investigating the perceptual-motor abilities of esports players using an expert/non-expert paradigm, professional and recreational esports players could not be distinguished in terms of skills [41]. In a cross-sectional evaluation with 188 esports players, 42.6% reported musculoskeletal pain within the previous week, with the back (31.3%), neck (11.3%), and shoulders (11.3%) as the most common body complaint sites [40]. The median number of pain sites was 2 (range 1–13), and the mean pain intensity was 4 (range 0 –19). Interestingly, 6.25% had pain which limited their participation in esports-related activities [40]. The other common complaints described in esports players were eye fatigue, wrist pain, and hand pain [37, 38].

Again, following the results from a qualitative study with esports players [26], some of them stated that actively stretching wrists and “moving around”

between games could help minimize some of those problems. Still, the players appeared to be more concerned about “passive preventive measures like having proper preparation”. Also, rehabilitation or preventive exercises were performed occasionally – or commonly, when esports players were already feeling some pain or stiffness.

Physiological demands

Heart Rate

In a study conducted only during a Fortnite® session [31], esports players experienced a stressful physiological response to esports practice by significantly increasing their mean heart rate (HR) compared to mean resting HR (76 ± 10 vs 70 ± 11 bpm) and peak esports HR compared to peak resting HR (120 ± 16 vs 81 ± 11 bpm). Another study conducted with FPS esports gamers [42] suggested that this game type resulted in a larger change in low to peak HR and in systolic blood pressure increase when compared with MOBA games, thus showing that FPS games may elicit a greater sympathetic nervous system response [42], since blood pressure and respiration rate increased significantly after and during game-play, respectively.

In a live collegiate esports tournament, mean HR during the competition was elevated compared to mean HR pre- and post-competition (131.4 ± 19.0 vs 97.1 ± 19.9 bpm; and 101.9 ± 17.4 bpm), peak HR during the competition was elevated compared to peak pre- and post-competition (188.1 ± 32.9 vs 119.6 ± 20.1 bpm; and 119.9 ± 16.3 bpm; $p < 0.001$), and in-competition R-R intervals were lower (465.7 ± 69.0) compared to pre- (643.6 ± 138.5) or post-competition (616.1 ± 110.0) [43]. No significant differences were found in HR variability. Regarding perceived exertion, players reported a mean score of 3.7 out of a maximum of 10 arbitrary units, and a mean mental fatigue rating of 3.7 on a scale of 1 – 7 [43].

Hormonal response

Salivary testosterone, cortisol, dehydroepiandrosterone, and androstenedione levels did not change from before esports practice and within 10 min after play; also, hormonal levels were not affected by playing against people vs. the computer, or by winning or losing [48]. Playing duration was, however, positively related to changes in testosterone ($r=0.410$, $p=0.037$), dehydroepiandrosterone ($r=0.461$, $p=0.018$) and androstenedione ($r=0.421$, $p=0.032$) during play against people [48]. Aldosterone levels decreased overall, and cortisol decreased more according to the number of ranked games played ($r=0.563$, $p=0.003$) [48]. Nevertheless, during an official esports competition, the expert esports players presented higher cortisol levels in pre-competition situations [57]. A study conducted with a single male amateur esports player (32 years, 184 cm, 60 kg) compared a 30-min videogame and a cycling test [54]. HR increased from 85 to 137 bpm and was almost identical in both trials, but oxygen consumption and energy expenditure were about three times higher during cycling. In contrast, blood glucose increased slightly during esports (+0.7 mmol/L) and decreased during cycling (-2.2 mmol/L) [54].

Performance

Expert esports players showed better average reaction time [50, 55], less susceptibility to speed-accuracy trade-off [41, 42, 55], faster response times [42, 55], and were better at using or ignoring information. Still, esports players might be susceptible to cognitive fatigue [42]. When evaluating cortical thickness, increased cortical thickness in the prefrontal and parietal cortices was correlated with winning rates and higher performance [36].

Confounders

Factors such as study setting (e.g., live vs. online, home vs. laboratory, real competition vs. study scenario), study duration, the time when the evaluation took place, nutritional status, and previous physiological arousal could be

possible confounders for the results obtained regarding the physiological demands of esports practice and competitions [31, 43, 46, 48, 57]. Also, different physiological responses could occur, depending on the time of the day when the game took place and on the game itself [42].

Mental health

Neurological function

In a prospective observational cohort study with 17 esports players, aiming to examine physiological and cognitive changes after a session of FPS and MOBA games, mental flexibility was significantly improved after game play. At the same time, the number of errors was not affected [42]. Also, problem-solving ability, impulsivity, and response inhibition increased, and reaction time decreased, after game play; the same time, esports players tended to make a significantly higher number of errors and be less accurate [27, 29]. Esports players did however display improved cognitive function (i.e., executive function, spatiotemporal abilities) and working memory, and faster reaction times, even when compared with athletes from traditional sports (i.e., pro-baseball players) [27].

Pro-gamers showed increased grey matter volume in the left cingulate gyrus [29]. Moreover, there was a decreased grey matter volume in the left middle occipital gyrus and right inferior temporal gyrus. Furthermore, another study found that career length was positively correlated with cortical thickness in three brain regions (i.e., right superior frontal gyrus, right superior parietal gyrus, and right precentral gyrus) [36]. Also, the right medial superior frontal cortex was thicker in the pro-gamers with longer career length and higher winning rate [36].

Mental health problems

As regards mental health problems, problematic gaming (i.e., when playing videogames interferes with daily functioning) was significantly associated with decreased real-world social support and increased in-game social

support, probably due to depression and anxiety [44]. Notably, the results in a qualitative study showed that, in terms of gaming motivations, esports and recreational gamers play videogames differently (i.e., esports gamers scored significantly and considerably higher on specific motives such as competition, social and skill-development) [51]. However, psychiatric symptoms were both directly and indirectly associated with gaming disorder via gaming motivations, with a significant effect, mediated through escapism (i.e., gaming excessively to avoid real-life problems) between the higher levels of psychiatric distress and gaming [51]. Additionally, pro-gamers appeared to have normal to mild levels of internet addiction, and mild levels of impulsivity [36].

Stress

In a qualitative study based on interviews aiming to examine different stressors faced by 7 esports players [34], various internal stressors were identified by the participants. Communication problems between teammates and coaches, lack of shared team goals or confidence in teammates, consequences of losing (e.g., getting emotional, making mistakes), intra-team criticism (e.g., negative comments, being dropped), life balance, and difficulty in lifestyle management were examples of internal stressors identified by esports players. On the other hand, the opponents, social media, interviews, and logistics (e.g., unfamiliar environment, immediate audience reaction) were identified as external stressors [25, 34]. The players reported that perceived stress on a “big stage”, or while performing in front of audiences, was greater than the pressure perceived when playing in a comfortable environment, such as the players’ own home, particularly if they had no proper coping skills [25]. Players who had difficulty separating life and gaming also demonstrated more perceived stress. Additionally, team-related issues, like team communication, criticism from teammates and in-game leaders, and not sharing team goals were identified as stressors. Mental toughness was associated with perceived control and stress intensity, with

results indicating a possible overlap between mental toughness and the stress-coping process among high-performing traditional sports and competitive esports players. However, a correlational analysis demonstrated no association between overall mental toughness and stressor intensity [47]. On the contrary, mental toughness was associated with selecting more problem-focused and emotion-focused coping strategies, and less avoidance coping strategies [47]. Self-compassion reduced or mediated the relationship between mental toughness and mental health [39]. There was no association between achievement level, perceived stressor intensity, threat, and challenge. Nevertheless, esports players who reported higher levels of emotional control were able to reduce the intensity of the perceived stressor [47].

Anxiety and depression symptoms

In esports players, country of residence [45], level of expertise [36], real-world social support [44] sleep problems, daily training time [45], and stress level [45] were associated with depression symptoms. Motivations [51] and mood [55] did not appear to be linked with depression symptoms. As for anxiety symptoms, esports players showed similar levels to pro-baseball players [27]. Anxiety was correlated with expertise level, self-confidence, and pre-game cortisol levels [57]. Moreover, expert esports players displayed a positive correlation between cognitive anxiety and perceived match importance, and a negative correlation between somatic anxiety and self-confidence [57]. Factors such as inadequate coping [25, 56], lack of guidance regarding mental and emotional growth, and stigma [35] have been pointed out as psychological problems in esports players.

DISCUSSION

The present scoping review aimed to map health-related problems in people engaged with esports, including the consequences of practicing esports, and to highlight in this relatively new area of research possible gaps in our knowledge. Several articles on lifestyle habits, exercise and physical health, body composition, musculoskeletal health, physiological demands of esports practice and mental health were found, but in general the studies used distinct methodologies and were conducted with esports players from different backgrounds and esports modalities.

Overall, the results showed that people engaged in esports present satisfactory lifestyle habits and no major health problems related to esports participation, as opposed to previous conclusions reached for young esports players or video gamers [12, 13]. This might be due to the diversity of studies included on esports and health (not subject to a time frame or a specific publication language), but it should be noted that studies dealing with recreational videogame practice, which can act as a confounder, were not included. It is now clear that the current stakes of esports do not call for recreational activity, and esports players now train and present lifestyle habits that could be similar to that of athletes from traditional sports [58].

In general, esports players did not present problematic alcohol consumption, higher smoking lifestyle habits, or caffeine abuse. Moreover, esports players reported being conscious about their diet and having a healthy diet. Despite presenting a higher body-fat percentage, lower lean body mass, and less bone mineral, esports players did not seem to be overweight, as previously argued [59]. Given the increased sponsorship of esports competitions (and sponsors might be related to alcoholic beverages, energetic drinks, or snacks), responsible health policies could be important to minimize the adverse health effects of unhealthy lifestyle habits [60].

Notably, sleeping duration in esports players could be generally considered normal for the adult population [61]. However, esports players showed delayed sleep onset. This might be related to the esports calendar and the

routines of practicing videogames, as the gaming culture and game type usually have an evening setting [14]. Additionally, esports players appeared to have poor sleep quality which might impact their daily life. Sleep is considered vital to health, with critical roles in brain (e.g., neurobehavior, cognitive performance, memory, mood regulation), neuroendocrine and cardiovascular functions [61]. According to an opinion piece about sleep and esports performance, sleep restriction may lead to cognitive deficits, thus affecting esports performance (e.g., “slowing down” esports players, “putting them at a competitive disadvantage in the fast-paced world of esports”) [15]. Also, the sleep of esports players may be affected by the modality played, whether the game is played on a team, the size of the team, and game characteristics [14]. Hence, it would be important for future studies on esports to clearly specify the esports modalities concerned (e.g., sports, FPS, MOBA) and to avoid generalization to all esports of the conclusions obtained.

Contrary to the general notion that esports associated with sedentary activities, different studies found satisfactory physical activity levels in esports participants, with 65 to 89% of esports players being physically active, values that are higher than those of the general population. Interestingly, as esports players improved their ranking or level, they also seemed to improve their physical activity levels. This might be important in counteracting the effects of long hours practicing esports, which is a sedentary activity [60]. Knowing that esports players are followed by millions of fans and viewers [3], and might be seen by many as an example to follow [18], the fact that esports players still manage to be physically active could indirectly promote and encourage the practice of physical activity in other players, viewers, and followers. This effect might be reinforced by the fact that esports players mostly reported being physically active in order to maintain or improve overall physical health rather than in order to be successful in esports. Nevertheless, physical activity and exercise practices might be unstructured and unsupervised, and esports players may generally be responsible for their own training. Therefore, the engagement of sports and exercise professionals

working with esports players should be promoted, with a view to structure programs that could also promote esports performance [60]. Still, the results presented in the present scoping review should be interpreted cautiously, since most studies were based on surveys and questionnaires which may overestimate behaviors perceived as positive, with no on-site evaluations. Large-scale evaluations and interventions comparing different esports modalities will contribute to throw light on physical activity and exercise habits, and their relation to esports performance [62].

The physiological demands of esports practice have been assessed in different studies, using HR, HR variability, blood pressure, cardiac efficiency, respiration rate, and rating of perceived exertion. In addition, hormonal response (e.g., testosterone, cortisol, dehydroepiandrosterone, and androstenedione) has also been assessed. Conflicting results were obtained as regards the physiological demands of esports practice, both during training and competitions. However, the methodologies, parameters and measures differed between studies, so proper conclusions could not be drawn at this stage. Furthermore, specific skills (e.g., cognitive and motor skills, hand-eye coordination, dynamic vision, etc.) have been described in esports players and are likely present in esports players at higher levels of play.

As with traditional sports or even common professional occupations and jobs, there were reports of musculoskeletal problems among esports players [63, 64], even though the sample included in studies conducted specifically on esports were relatively small. Moreover, the studies did not distinguish esports practice level or ranking, or even those individuals who play esports professionally. Therefore, it would be worth investigating the incidence and prevalence of musculoskeletal consequences of esports participation (e.g., prolonged and aberrant postures, cervical, thoracic and lumbar pain, shoulder overuse, elbow and wrist pathology, carpal tunnel syndrome, cubital tunnel syndrome [16, 17, 64]) as possible long-term consequences of playing esports at high or professional level [10, 59].

Finally, esports practice has also been linked to common mental health problems, such as stress, anxiety, and depression. These mental health problems might be associated with esports practice, but also with personal features (e.g., coping mechanisms, mental toughness), context (e.g., esports teams, coach, media) and competition setting (e.g., online and on-site competitions, level of expertise). Again, studies that address appropriate methodologies clearly describing the studied population and esports modality, are needed to evaluate mental health problems related to esports practice, given that identifying risk groups and mental health problems would contribute to promoting well-being within the esports community [65]. Potentially this might also help to prevent negative consequences for daily living and indirectly improve esports performance. Different strategies have been suggested as ways of preparing for enhanced performance and minimizing anxiety or stress symptoms, including playing different games, deep breathing, doing push-ups, listening to music and adjusting body temperature [25], or adopting adequate coping mechanisms (e.g., venting, behavioral disengagement, acceptance, planning) [56, 65].

As regards the different methodologies used to evaluate daily lifestyle habits (i.e., smoking, alcohol consumption, caffeine, and nutrition), most studies rather than using validated tools, only described those habits. In general terms, esports practice has been associated with different health problems and with lifestyle habits that could be risk factors for health problems. However, contrary to anecdotal reports, esports players also demonstrated healthy lifestyles when compared to the general population or even to athletes from traditional sports. In relation to esports, the existence of mixed results and the limited research considering the impact of video gameplay on lifestyle factors such as nutrition and sedentary behaviour have been acknowledged [60].

Given the non-consensual esports definition used by different authors, the selection criteria used to identify esports players varied between studies, and this could limit more robust conclusions about esports players. Many articles

only identified esports players without mentioning the specific esports modality, or, when they did, most of the conclusions obtained referred to esports in general. This limited the results obtained, because different esports modalities might have specific constraints related to the platform used (e.g., mobile, personal computers, consoles, etc.), the setting where they are practiced (e.g., teams vs individual practice), or even competitive ranking. In addition, contextual factors (e.g., leagues, esports development, staff support) and competition levels differ greatly between countries. In fact, competition level has been associated with stress, and this might have affected some of the results regarding mental health and performance [3]. Likewise, the use of various measuring tools, methodologies, sample sizes or esports subpopulations, and the time spent in physical activities, which that varied considerably between studies, could also affect more robust conclusions on the topic.

What are the gaps in the scientific literature regarding esports and health?

Scoping reviews are a type of knowledge synthesis that follow a rigorous, transparent and trustworthy approach to map evidence on a topic with a view to identifying main concepts, theories, sources, and knowledge gaps, particularly when the studied topic is heterogeneous, as is the case with the associations between esports practice and health. Rather than aiming to answer single or precise clinical questions, as in systematic reviews, we hope the current scoping review has provided an overview of what has been studied at this stage about health and well-being in esports practice.

Even with a total of 1,416 articles found, only 33 articles studied health features related to esports practice. Although a methodological assessment of the quality of the included articles is not applicable in scoping reviews [21, 22], we noted quantitatively that 76% of the articles had a cross-sectional design, with only 1 randomized control trial and 2 cohort studies. Longitudinal studies would be important to examine the health impact of

esports practice and its consequences, especially in view of the increased number of professional esports players who spend long hours training. As previously noted, studies with bigger sample sizes, validated measurement tools, non-questionnaire evaluations, and experimental evaluations are needed. Also, studies comparing esports players, the general population and athletes from traditional sports from different sports could help in developing strategies and guidelines to be followed and providing care for esports players, minimizing possible negative consequences of esports practice [10]. This information would also be relevant to provide science-based arguments promoting the debate as to whether esports should be considered (or not) a sport. Despite being a relatively new phenomenon, esports are already associated with important economic and social impacts. Therefore, a consensual definition of esports practice is needed for future analyses which may clearly distinguish esports modalities, rather than considering all esports as one and the same. For example, the International Olympic Committee promoted dialogue and cooperation with a view to incorporating esports into the sports movement, but recognized only electronic games simulating sports (e.g., FIFA, NBA 2K) in its statement [66]. Similarly, the Association of Summer Olympic International Federations also recognized that esports could be a means to engage younger fans in sports, highlighting that esports should “be taken seriously, if not for its physical demands, then at least for its widespread appeal, the requirement of technical skill and fierce competition” [67].

As concerns health-related topics that are currently missing in the literature, we did not find studies related to cardiovascular (e.g., cardiorespiratory fitness, heart disease, hypertension), respiratory (e.g., sleep apnea) or metabolic (e.g., diabetes) health and function, or regarding health and function of sensory organs (e.g., vision, audition). Additionally, studies on esports-related injuries have few participants, with no longitudinal study on this important topic having been made. Based on what is known from studies conducted on video gamers [68, 69], practice-related injuries might also be

present in esports players. Also, given its similarity with traditional sports as regards competition and pressure to achieve the highest levels, we believe that studies about the use of performance-enhancing drugs (i.e., doping behaviour) are also missing in esports. Recently, following what occurs in traditional sports where an international independent agency (World Anti-Doping Agency) is responsible for harmonizing anti-doping policies in all sports and all countries, the International Esports Federation launched the Anti-Doping Rules on esports participation [70]. One might speculate that many substances prohibited by anti-doping rules (e.g., dextroamphetamine/amphetamine, beta-blockers) might be used by esports players. Thus, in order to properly address this topic, we argue that studies evaluating the use of performance-enhancing substances and doping behaviour, especially with consistent study design and reporting [71], are of the utmost importance in esports.

CONCLUSION

Overall, the studies on esports players showed satisfactory lifestyle habits, with no major health problems related with esports practice. However, studies with more robust methodologies and appropriate research designs would provide better insights regarding the associations between esports participation and health. The studies included in the current scoping review showed that esports are still a relatively novel area of research, and several knowledge gaps have been identified regarding the consequences of esports practice for health and well-being, namely cardiovascular issues or the use of performance-enhancing drugs.

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CHAPTER IV.

Perspectives of eFootball players and staff members regarding the effects of esports on health – a qualitative study

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ABSTRACT

Recently, esports have been argued to impact esports players' health, particularly for those competing at higher levels. Esports are a relatively new phenomenon, and an inside perspective regarding esports players' needs and experiences is essential to promote adequate health support for this population. Thus, in this qualitative study, we explored the perspectives of elite esports players and staff members regarding the effects of esports participation on health. Ten semi-structured interviews were performed with members of the Portuguese FIFA (i.e., FIFA EA Sports®) eFootball National team (i.e., five elite electronic football players, one world-class electronic football player, two national team coaches, and two members of the esports department). Data analysis was undertaken following the principles of thematic analysis.

We identified four major superordinate themes: health definition (1), factors of esports that impact mental (2) and mental health (3), and strategies to improve esports players' health (4). Esports-related factors such as gaming, competition, and performance were said to impact mental health, while equipment, facilities, and esports-related sitting time affect physical health. To minimise those risks, four main strategies were suggested: optimising and scheduling esports training, improving lifestyle habits with an emphasis on physical health, enhancing facilities and equipment, and improving health support, particularly with a mental health professional.

Esports players and staff members are concerned and aware of esports' mental and physical demands. Understanding what esports players need and perceive about their health, complemented with the view of staff members, and their proposed strategies for health promotion might help define and prioritise healthcare needs, which could help players and the broad esports community.

BACKGROUND

The popularity of esports worldwide is noteworthy [1]. Currently, esports comprise regulated competitive video games [2]. The industry dynamics have shifted towards traditional sports models (e.g., official leagues, stable fan bases, and more extensive and consistent investments) [2], with several esports modalities now being part of competitions held by the International Olympic Committee (IOC) [3]. Likewise, as professional athletes, esports players need intense training and commitment to remain competitive while developing and mastering specialised skills [2, 4, 5, 6, 7]. In fact, gaming has been positively associated with improved cognitive benefits such as perceptual-cognitive abilities, domain-specific skills, and a wide range of visuospatial and attentional tasks (e.g., psychomotor and cognitive speed, creativity, strategic thinking, problem-solving, anticipation, response mapping, attention, working memory [8, 9, 10]. Nevertheless, aligned with the increased pressure to perform (e.g., pool prizes, media impact), professionalisation, and training and competition settings (e.g., dark rooms, play mechanics), theoretically, esports players might be prone to a unique set of health problems and injuries that would require proper healthcare attention [11, 12, 13].

Health at its fullest is the highest attainable standard for every human [14]. In 1948, the World Health Organisation (WHO) defined health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”. Many perceive health as not being a dichotomous variable (i.e., healthy vs unhealthy) but one that occurs along a continuum between more healthy and less healthy [15], with more realistic views considering that people have ‘the ability to adapt and to self-manage [16].

Recently, different problems affecting the health of esports players have been described, including mental health [6, 17, 18] and musculoskeletal problems [19, 20, 21], most of them being preventable with adequate and prompt care. Factors related to esports increased proficiency and competitive status [10, 17, 22], including perceived stress responses (e.g., nervousness and

excitement before a competition and post-competition responses) [23] and the dependence on performance achievements [18, 24, 25, 26], have been reported to contribute to mental health symptoms in esports players [27], that could predispose to unhealthy lifestyles (e.g., caffeine or alcohol use, smoking habits) and other mental health problems (e.g., sleep disturbance) [17, 23]. Conversely, musculoskeletal problems (e.g., wrist or hand pain, back pain) have been reported in different studies on esports players [28, 29], and the risks associated with musculoskeletal problems may increase with excessive gaming [29]. Additionally, esports participation is sedentary, with players gaming between 3-10 hours per day [30].

Hence, to provide adequate healthcare and protect esports players' health, it is crucial to listen to the players and staff members involved in esports to understand their beliefs, attitudes, and needs regarding their health and the healthcare support currently given to this population. For that, qualitative research is an adequate approach to generate in-depth insights into beliefs, assumptions, values, or practices and is a valuable tool [31, 32]. Recently, qualitative studies have emerged in esports-related research, namely studies with players from different countries and esports modalities on subjective experiences of stressors and coping [22, 23, 33], perceptions of success determinants [24], perceptions of training effectiveness [34] and indexing esports performance [35]. Still, those problems and perceptions studied might depend on the context (e.g., esports modalities, country, esports settling development) [30, 36]. Moreover, besides esports players, team staff, particularly esports coaches, might give an essential insight into esports players' health [37]. They frequently work as intermediaries between teams and players and can be the first contact of esports players when any health problem occurs. Yet, they are not usually involved in studies related to esports. Thus, unlike previous research, this study will include participants and staff members partaking in electronic football (eFootball) competitions, a specific esports modality. If players can give their insights on what they are already experiencing, staff members could help define what they can offer.

Recently, entities like the IOC [3] have included sports-related esports in their competitions [38], so clarification on the perceived needs and current state of healthcare provision from players and staff members (providers) in this specific context might be necessary. Besides, knowing the heterogeneous development in esports teams and supporting structures worldwide, new insights on the perceptions of the current needs of esports participants will contribute to better preparing the structure of healthcare support in esports settings. Including staff providers (i.e., coaches and members of the esports department), will increase diversity of perceptions in the current status of health perceived by esports primary stakeholders. Additionally, those perceptions might differ between players and staff members, including esports coaches [39, 40].

Ultimately, the present study aimed to gain new insights and to understand the perceived needs regarding health and strategies to support esports players, to ultimately help promote adequate care for these participants, advancing the understanding of how esports players from higher competitive levels and staff members working with them perceive about health, the impact of esports participation and the health care support currently given in esports circles. To do so, we qualitatively investigated the perceptions that esports players and staff have on health, how esports affect their health and potential strategies to improve esports players' health in the esports context. Doing so, we hope to advance on previous literature that quantitatively and qualitatively has evaluated health-related parameters in esports players, which calls for more research in this area.

METHODS

Ontological and epistemological assumptions

This qualitative study follows a critical realist perspective approach, which posits that we interact with an actual external world and that this world existed before our language, ideas, and concepts about it [41, 42]. Hence, knowledge of the world is deemed relative to historical context, our

perspectives and interests, and the influence of others on us. As a result, any accounts of our understanding of reality are fallible [43]. With this epistemological and ontological position, a qualitative interview-based methodology was chosen to explore participants' realities, experiences, and perceptions of what may cause such experiences [44].

Participants

We recruited elite and world-class (adapting [45]) FIFA esports players (i.e., esports players that have at least one call to be part of the Portuguese eFootball national team and with competition-relevant tricks and performance achievements or being in the top three at a major international event such as the World Championship, respectively), the Portuguese national team coaches, and the coordinators of the FPF eFootball department for this study. With this sample, we included primary stakeholders [38] comprising the eFootball national team. Only participants older than 18 years were included.

Procedures

The present study was conducted in collaboration with the Portuguese Football Federation (FPF) and the FPF electronic Football (eFootball) department, responsible for the coordination of the National eFootball team training camps and the National eFootball League (e.g., FPF Digital Challenge, FPF Portuguese Cup, etc.). Aiming to capture a wide range of perceptions of primary stakeholders in the esports ecosystem [38], purposive sampling was used to identify and select the sample group.

Following the lead author's institutional data protection policy and explaining the study's main goals, the FPF eFootball department provided a list of potential participants for the study. Those who expressed interest in participating gave their contact details to directly arrange the interview with the principal researcher (AMP). Additionally, participants were asked to provide the contact of other further potential participants [46].

Data collection

Based on the provided contacts of potential participants given by the FPF eFootball department, 14 players that participated recently in the Portuguese eFootball national team and all four members of the staff were contacted. Six players and all staff members accepted the invitation, while eight players did not respond after three contact attempts. Yet, the last two players interviewed and included in the present study did not add new information, indicating data saturation [47]. All participants provided oral informed consent before the interview. After the interview, the participants were asked to complete an anonymous online form using SurveyMonkey® for sample characterization. This survey included questions related to age, gender, education, occupation, and sports registration status (i.e., registered in a sports federation in any other sports) and esports participation. The study was approved by the Portugal Football School Ethics Committee (CE PFS 01.2021).

Interview guide

Individual semi-structured interviews were held and recorded online using Microsoft Teams® by the first author (AMP) between January 2022 and April 2022. The interviews were scheduled depending on the participants' availability. The interviews followed two flexible interview guides, one for esports players and one for staff members (see supplementary material) that slightly differed depending on participants' activity (e.g., players: *“Did you already feel any health problems due to your esports practice?”* versus staff: *“what health problems are more frequent in esports players?”*; players: *“What type of healthcare services are usually given by esports teams?”*; staff: *“What kind of medical support do you think you could/should have for your elite esports practice?”*). This interview format allowed the interview guide to be supplemented by follow-up and probing questions according to participants' responses, allowing us to explore new topics raised by participants [48]. AMP developed the interview guides comprising three main topics: 1) health

definition, 2) health effects (positive and negative) of esports participation, and c) healthcare for esports participants. The interview guide was discussed with CB, PB and JB to enhance rigour (e.g., discussion flow, starting with broad questions to more specific ones). CB and PB are familiar with qualitative research, having developed qualitative studies in sports and esports contexts. Indeed, a pilot interview was conducted with a Portuguese recreational gamer working as a community manager for elite esports players and by a researcher familiar with using qualitative methods; this led to minor changes in the initial questions (e.g., “*affects your health*” changed to “*players’ health*”) and was crucial to avoiding jargon that could be used by AMP as a healthcare professional. Indeed, the first two interviews were reviewed by CB during a meeting to evaluate how AMP conducted the interviews.

Other follow-up questions were used during the interviews to clarify any points (i.e., “*How do you think esports practice affects esports’ player health? And here it can be positively or negatively*”; “*when you talk about “it’s mental”, what do you mean by that?*”). A last question was added at the end of each interview, asking for feedback on the interview and describing aspects the participants thought were important but were not part of the questions (i.e., “*If I wanted to know more about the health of esports players and their perspectives on health, what should I have asked or what could we have talked about more during this interview?*”). All interviews were conducted in Portuguese, the native language of all participants and the first author.

Data analysis

Data collection, analysis and manuscript redaction considered Tracy’s “big tent” criteria to enhance rigour [49]. The interviews were video recorded, transcribed verbatim (AMP), and then repeatedly read and analysed by two researchers (AMP and CB; step 1).

Pseudonyms were randomly selected using typical Portuguese names (aligning to the participants' gender) and replaced participant names to assure anonymity in all data collection. Chosen names consider the initial

letter of each name according to participants' activity, (i.e., J=Player, C=Coach, D=esports Department). Collected data from the 10 interviews were analysed following the six steps of thematic analysis proposed by Braun and Clark [50]: 1) familiarisation with data, 2) generation of initial codes, 3) search for the more mentioned themes, 4) review themes based on frequency, 5) define and name themes primarily according to frequency, then based on patterns of meaning and shared core concept, and 6) produce the report with process description. Some steps were frequently overlapped for a more rigorous data analysis (e.g., steps 2 and 3, 5 and 6). Thus, the final superordinate, subordinate and ordinate themes were data-driven, following a stepwise process of coding and re-coding with an inductive approach to thematic analysis [51, 52]. Therefore, the final themes do not reflect the questions asked during the interview nor the research team's beliefs [50, 51]. All data analysis was done in Portuguese (the native language of AMP, CB, and JB). The selected quotes were translated to English by AMP and verified by JB and an official translator. CB guided all stages; the researcher has vast experience with qualitative research, including thematic analysis. Given the volume and complexity of the data collected, data were reanalysed several times, based on the input of CB, for a more concise data presentation, ultimately to respond to the study goals. JB, who was an interviewed-blind author, participated in the last 3 steps to sense-check the preliminary themes and report, contributing with their sports and exercise background and analytic thinking. Any disagreement with coding was settled through discussion between AMP, CB, and JB during five online meetings throughout the process. Initial disagreements regarding data presentation were resolved for a more concise data presentation with three main topics. Self-reflection, aligned with mentoring and supervision from CB, PB (who also has a vast experience with qualitative research), and JB, was crucial to guarantee "transparency", thus minimising any personal bias and preconceptions the first author could have due to their experience in clinical practice.

RESULTS

In the present study, the most debated themes were grouped into four superordinate themes: the participants' definition of health, factors of esports that impact health (mental health and physical health), and strategies used to improve esports players' health in general, as shown in the following sections (Table 1 and Figure 1 in supplementary material).

Table 1 Superordinate themes, subordinate themes, and themes

Superordinate theme	Subordinate Theme	Themes
Health definition	General health definition	General health definition
	Mental health definition	Mental health definition
	Physical health definition	Physical health definition
Factors affecting mental health	Gaming	Cognitive ability
	Competition	Symptoms of mental health problems
		Addiction to competition
		Mental fatigue
	Performance	Sense of achievement
Symptoms of mental health problems		
Performance anxiety		
Factors affecting physical health	Equipment and facilities	Eye problems
		Poor postures
		Musculoskeletal problems
Sitting time	Sedentarism	
Strategies to improve esports players' health	Optimizing esports training and scheduling	Time management
		Scheduling daily routines
		Having other activities
	Improving lifestyles	Physical activity
		Other lifestyle habits
	Enhancing facilities and equipment	Examples of improvements to facilities and equipment
Improving health support	Health prevention	
	Mental health support	
	Other examples of health support	
	Health-related research	

Participants answered without distinguishing eFootball or esports in general. Gaming, performance, and competition related to esports were the most significant subordinate themes illustrating factors affecting players' mental health. At the same time, equipment, facilities, and esports-related sitting time were the main factors affecting esports players' physical health. For all those factors, different strategies grouped into four main subordinate themes were suggested to minimise esports-related physical and mental health consequences. The mean duration of the interviews was 37 ± 10 minutes (range: 28-55 minutes; see supplementary material).

Sample characterization

Ten participants were included in the study: six male eFootball players partaking in FIFA eFootball competitions ($M = 22\pm 3$, ranging from 18-26 years of age) and four male members of the staff, which included the coaches of the eFootball national team and coordinators of the FPF esports department ($M = 32\pm 3$, ranging from 28-35 years of age). Three out of four members of the staff were former esports players.

All interviewed players profited financially from esports and were part of an esports team; yet, only three were exclusive esports players. The players usually practised esports between 1-8 hours per day ($M_{h.min} = 4.15\pm 2.29$ per day) for 3-7 days a week. Recreationally, four players also spent 1-3 hours per week playing other video games ($M_{h.min} = 1.30\pm 1.23$ per week). Additionally, all staff members were also recreational gamers, spending 2.00 to 10.00 hours per day gaming. Nine participants usually practised recreational sports besides esports. In the year data collection occurred, the Portuguese eFootball National team ranked first on the FIFA eNations ranking and won the 2022 FIFA eNations Cup.

Health definition

General health definition.

In line with the WHO definition of health, well-being was frequently subdivided into physical, mental, and social well-being, along with being healthy, feeling well, and "having no diseases", were the subordinate themes used to define health, as explained by Joaquim: *“ends up as being ... about physical, mental, social well-being and more than all of this, perhaps we aren't only well in these states, but we feel well in ourselves. I think that's the main thing.”*

In fact, they struggle to give their own words to the definition.

José: “Health might be... It's difficult to explain what it is, but I would say that maybe something that make us, I mean, something that we think to make us feel good on a daily basis and being healthy means being ok, not being sick and, obviously, do not have any worries about us... I think it's hard to explain without using the word.”

Besides, all participants noted that "health" encompassed both physical and mental health, with eight participants stating that good mental health is needed for good physical health and vice versa. This is exemplified by Duarte that defined health as *“if a person is well in their health, has no disease, has anything similar associated ...there are various types of health considered: physical, mental health.”*

Mental health definition.

As exemplified by Duarte that stated that mental health is *“not having any type of problems, whether depressions, whether stresses, ... it's about being aware of everything that is going on.”*, "Mental health" was perceived as being happy and not having any symptoms of mental health problems, such as depression, stress, or anxiety, and essential for players' well-being.

In line with Jonas that said *“Mental health is psychological well-being, being secure in yourself, confident”*, the other two players added that mental health encompasses the feeling of confidence, motivation, and well-being.

Physical health definition.

"Physical health" was described as being physically active, with no mobility problems, and independent in daily living activities, as exemplified by Duarte: *"the physical is the motor level and everything else [...] doesn't depend on anything, nor on anybody for doing the basic and daily things."* Conversely, physical health was also associated with having no health problems or diseases.

Joel: "that's the health people talk about when we ...hen we are sick or when we have some health problems ... [...] for example obesity or sometimes a more serious type of disease, cancer and those things."

Factors of esports that impact mental health

The (subordinate) themes identified by the authors following data analysis as impacting mental health were "gaming", "competition", and "performance". In this context, gaming refers to playing video games, which is needed for recreational and esports players; competition refers to all organised competitive events where esports players participate; and performance is gauged by the results obtained in esports competitions [53]. Esports was considered a mentally demanding activity, where focus, quick thinking and good mental health are key to motivation and success in esports performance.

Gaming

Gaming was argued to positively impact cognitive ability by helping players work and develop reflexes, thinking capacity, quickness of thought, multitasking ability, game perception, and knowledge:

Carlos: "the brain gets a lot quicker, for example, you become able to develop various ... various tasks at the same time, what they call multitasking, ... your brain becomes more flexible, [...] the cognitive capacities always ended getting better worked ... and explored ... and increased."

Besides improving other daily activities, those factors were also considered needed to reach the highest competitive scene.

“David: [players] can benefit very much from this competitive practice, above all by really stimulating the brain, [...] the question of reflexes and also the actual knowledge that you have to have.”

Competition

Different participants suggested that esports competition could predispose or exacerbate pre-existing symptoms of mental health problems (i.e., anxiety and sleep problems) and promote addiction (i.e., to competition and winning at all costs) and mental fatigue.

Joaquim: “because at this level, the competition is not going to be physical, it’s mostly going to be mental, it’ll cause us a lot of ... a lot of emotions, much anxiety, much stress, much frustration real exhaustion.”

David also added that: *“Players can feel a bit addicted to the competition, to the playing of the game and not knowing when to stop, how to stop, how to take a break.”*

Moreover, esports competitions were considered a "strenuous mental activity (Carlos)" where players feel exhausted after competition moments, even when competing for relatively short periods, as exemplified by José: *“ the playing of esports always leaves me very tired [...], many hours and when we have to be very concentrated and very focused, and this ends up leaving us with this feeling of tiredness despite not having done any actual sport”.*

Performance

All participants acknowledged the mental health impact of performance, which is weighted on competition results. Therefore, when players accomplished their performance goals, they improved their sense of achievement, felt happier, and felt more confident with better self-esteem, which was repeatedly stated to improve mental health, as noted by Júlio:

“when things are going well, when the season is going well, is a good one, when all the work is going well, it very positively affects your mental health”.

Conversely, bad results were explained to unveil or promote mental health problems, frequently described as “sadness”, “frustration”, “despair”, “isolation”, and even “depression” (e.g., *José: whatever the performance that you want to have, may even end up leaving us sad, anguished, frustrated*), performance anxiety (e.g., *David: These problems of anxiety, of stress... happen a lot. And they even happen in music and in other areas where there is a lot of social pressure, the spectacle ... the performance. [...] the other side of the coin is a bit, after this accumulated pressure, that then becomes a pressure cooker and can ... and can really fall apart*) and excessive gaming (e.g., *Jaime: Players who are full-time FIFA, have FIFA as their focus and very often can exaggerate the number of hours they put into the game. It may even be unnecessary at times*).

According to all interviews, common mental health symptoms and other personal stressors (e.g., being a professional player) could hinder performance by interfering with cognitive ability and attention to gameplay, ultimately creating a vicious circle of thinking and behaviour (i.e., decreased performance leading to mental health symptoms and vice versa). Carlos explained that as *“If we have expectations, that are just too high and then we are not able to meet them or similar...the biggest and most various reasons can ... can bring this, this kind of anxiety [...] that turns into a snowball, doesn't it?. If the results are going to bring ... more or less pressure in accordance with what we can do.”*

Factors of esports that impact physical health

The other major theme derived from the interviews was physical health. All participants associated esports with physical health problems, primarily due to equipment and facilities used while playing and related sitting time.

Equipment and facilities

Gaming equipment (i.e., monitor, gaming chair and controller) and the facilities where competition and training generally occur (i.e., indoors and dark environments, artificial lights) were discussed to affect physical health in the short- (e.g., *Joaquim: I already feel some pain or other, when it's an exhausting day of competition ... I get to the end and already feel something*) and long-term (e.g., *Carlos: In the long term ... I speak for myself ... I feel that some bad habits of playing in front of television [...], can help with deteriorating and bring some diseases, such as myopia.*)

Accordingly, the main problems associated with equipment were eye problems, poor postures, and musculoskeletal problems, while the facilities were mainly responsible for eye problems. Indeed, five players and one coach mentioned that they had already suffered from vision problems, dry eyes and headaches while playing esports, which tended to compromise performance.

Jaime: "When I spend a lot of time in front of the monitor, I feel some tiredness, headaches, a slight discomfort and also a bit in my eyes."

Both players and staff members discussed that esports players are likely to play in what they described as incorrect postures (e.g., close to the monitor or reclined on the chair) that were highlighted to contribute to back pain and poor body posture. Two players reported they had already felt discomfort and stiffness while playing.

César: "Having a bad posture, we're always going to try and conform with it and if we get used to playing the game like that, it's not going to have major implications if we always play in that position, if we always compete like that. The problems are later, in the long term."

Repeated movements and inappropriate gaming equipment, mostly in stiff positions, contributed to musculoskeletal problems, comprising local pain or minor injuries on fingers, hands, back (especially lumbar region) and knees, which generally did not require medical intervention.

Júlio: "In terms of future health problems, it's the ... for me, it's the ... knees and knee and posture problems. [...] If your posture is not correct,

..., backpains [...] problems with your bones, in your fingers due to being always making movements and I don't know ... the tension."

Sitting time

César: "The fact of ... there being a lot of correlation with videogames being ... being kind of sedentary ... related to sedentarism. I think that they can bring some of the complications associated with this."

Increased sitting time related to esports practice was discussed to impact overall health, impairing eating habits and contributing to musculoskeletal problems while also exacerbating existing problems due to prolonged use of the equipment and incorrect postures for long periods.

José: "We do not unwind, we spend a lot of time sat down. Obviously, we do not burn the calories that we need to take on and this is going to affect our physical condition negatively."

Strategies to improve esports players' health

Four main strategies were suggested to improve esports players' health.

Optimising esports training and scheduling

Joel: "There's a lot of that idea of "the more hours you put in, the better you're going to be", but not always. Perhaps four hours well worked are worth more than eight hours not well worked."

Having appropriate time management (e.g., more efficient training sessions combined with physical activity, rather than spending long hours practising esports), scheduling pauses between games and training sessions and including periods for other activities were reported as strategies for minimising mental and physical health risks and increasing performance.

This has been mostly explained by the member of the esports department:

David: "A well-defined timetable, with a well-defined rhythm, almost a well-defined routine so that they are always the best prepared, not only

at the level of the state of spirit but also at the physical level, being prepared for the activities.”;

Duarte: “They should have, to safeguard against the micro-cycles, more breaks. [...] That is, the player is sat down for twenty minutes, there should afterwards be a break of five to ten minutes in compensation. [...] A player should pay as much attention to the moments of rest as to the moments of competition.”

For that, as exemplified by Jonas: *“I switch off completely from video games. I go to the cinema and see a film, I try not to I try to really rest my working instrument that is my hands ... the players that turn in the best performances are normally the people that are able to distract themselves from this world and have a social life and an active physical life [...] I always try and keep myself occupied with various things so that my thoughts are not only focused on this because I think it’s important to have this outlet, this means of escape”* having other activities (e.g., studying, being with friends, having other activities and life goals, playing sports) were examples of activities to refrain from esports, thus optimising esports training. Moreover, to prevent musculoskeletal problems, participants explained that they usually decide to have other activities with no screen or sitting time involved.

Those strategies were also said to prevent mental health problems related to low performance.

José: “Doing some of the activities that can help me build my self-esteem, good thoughts, relaxation, distracting myself, thinking about various things. [...] That’s it, playing sport or going out for a walk [...] even when I lose, I go out to train [physically] because whenever I arrive home after this training, I feel very good about myself.”

Improving lifestyle

Jaime: “Also looking after ourselves, that is, to play some sport. I think that’s also health. Having a balance diet, having time to sleep, at least eight hours or about that, at least in my case.”

Avoid drinking or smoking, having (or aiming to have) a careful diet, improving sleeping time and being physically active were lifestyle habits mentioned to improve esports players' health.

Carlos: “Those behaviours that we say are healthy or that science believes are correct, to remain capable. [...] Avoiding those, avoiding those less good habits both in terms of diet and in terms of sleeping, even smoking and drinking.”

Besides, all participants indicated physical activity as one of the most common habits to promote health, noting the positive impact of physical activity on mental and physical health.

Carlos: “I think that physical activity helps us to, to unwind. I don't know what exact word to use but unwind, to improve our energies and release those energies that are ... the least good in order to be able to then think more rapidly, eloquently and rationally.”

Thus, increasing physical activity was suggested to minimise the mental health consequences of gaming, performance, and competition by being a tool to "clear up their mind", reduce mental health symptoms, and improve mental capacity (e.g., focus) and overall energy. Since esports was reported as a "mentally demanding activity", performance is believed to be optimised when players regularly do physical activity.

José: “I note that when I train [as do exercise], my performance in the game is always better and when I don't train, some days, I feel that ... well, sometimes I have a bit lower level of performance [...] but I really feel this connection and I think that's why I also believe it's really important to do sport.”

Regarding physical health, physical activity was argued to avoid and minimise musculoskeletal problems by counteracting the consequences of being in inadequate postures, rigid positions and doing repetitive movements.

Carlos: “Health prevention, I mean...a believe that it's an important point, besides physical activity.”

Also, players highlighted that physical activity is important as an alternative to rest from playing and to balance the health risk they face due to high sitting time related to playing esports. This is illustrated by Júlio when referring “*It’s more difficult to be fit. [...] we spend a lot of time sat down playing, I think this clearly affects your physical health.*”.

Enhancing facilities and equipment

David: “Investment even in equipment that we know is not going to greatly wear out our ... our vision or a good chair. [...] The monitors should be high technology monitors [...] that in their technology have the means of not being so aggressive on the sight.”

More appropriate chairs, controllers, and monitors with more advanced technology, developed to minimise risks on both vision and posture, are preferred to prevent physical health problems.

Specifically, to prevent visual problems, different participants added that players should respect the distance between the chair and the monitor.

Improving health support

David: “In the preventive sense, even before there are any problems, knowing that they [esports players] are at a higher level and that there is some risk, already preparing themselves and being aware and having support for those earlier signs [...] safeguarding against future problems if there is intervention now, immediately, to be able to offset the dangers that may come from these areas.”

Having access to clinical support, comprising of mental health professionals (e.g., psychologist), medical doctors (e.g., ophthalmologist, team doctor), nutritionists, exercise professionals (e.g., personal trainer), and physical technicians (e.g., physiotherapist), were explained to help prevent or mitigate health consequences of esports practice.

David: “Making recourse to a specialist [...], somebody who is able to accompany us and so if we are not able to understand something that is

our problem, or the capacity to perceive what is taking place there, then, it's always about recourse to a specialist on the subject able to help us."

All participants expressed the need for esports teams to have access to a mental health professional regularly to prevent and recognise mental health problems or to help players manage them.

Joaquim: "I think that psychological support is very important [...] I think it's so important having a person only focused on this, on everything ... everything that the game requires so that, perhaps, we have ... for what the life demands ... and then everything mixed"

Moreover, since esports have been reported to demand high mental activity, it was added that psychologists could provide players with strategies to properly cope with the strains of esports competitions to improve performance. In fact, during the interviews, it was consensual regarding the crucial role of a mental health professional (e.g., psychologists, doctors) for prevention, treatment, and performance improvement, being proposed that they could act during daily practice and competitions while working with other support staff to help players.

César: "At the psychological level, I think it makes sense to have somebody accompanying the players more frequently, that might be able to have more impact [...] in competitive environments, having somebody there able to check the mental health of players and be able to better understanding ... some of the indications of mental health may bring added advantages."

Still, given the lack of structural mental support within esports teams (i.e., only one player stated to have access to certified mental health support within the esports team) or access to qualified personnel, esports players explained that they usually rely on their families, friends, coaches, and team players for mental support during and after competitions and during periods of increased stress related to esports.

Joaquim: “We end up having our coach who give us, perhaps, this mental support, who also kind of has this function as well and more than at the tactical and technical level.”

This has been reiterated by coaches, noting their role in supporting esports players during training and, especially, during competition. Moreover, coaches and staff members exemplified their role to foment team cohesion.

Indeed, it was noted that esports is important for socialisation and social life, this being another positive health impact of esports participation to support players' mental health.

Joel: “The advantage of esports means you end up having, if you have a team, you always have somebody. So, you're in this but you're not in this alone. [...] And we do end up creating a family of some type.”

Besides, mental health support access to a nutritionist in an esports team could be a tool to educate players on better nutritional habits on what to eat or avoid improving performance and well-being while training and competing (i.e., food choices that could enhance mental capacity).

José: “Now, thinking about the nutritionist... what we should and should not eat, but also the calories that we are consuming, what is it that has more and what has less, what are the options that might be able to help us, for example, in levels of concentration...”

Most players and staff acknowledged that elite esports players could benefit from having access within their clubs to a medical doctor that evaluated physical problems and a physiotherapist or osteopath to prevent or treat musculoskeletal pain and injuries.

Júlio: “Perhaps, perhaps it's that... so if I begin getting pains in my fingers and hands. having a doctor who understands this. who makes x-rays or anything else that may help for the pains to go away.”

To prevent any major health problems, it was proposed by different participants that esports players should be given access to a health screening with a general clinical history and cardiovascular, musculoskeletal, and ophthalmologic health, like the sport's pre-participation exam.

Duarte: “having this support and already foreseeing the existence of such situations. people know that there are potential dangers, potential injuries that can come from the exhaustive utilisation involved in these competitions, of practising and playing this sport, perhaps then it would be possible in many cases to delay or prevent something that may end up happening as a direct consequence of this sport.”

Finally, supporting scientific research related to the health consequences of esports is needed so more efficient strategies can be employed, this being one of the topics highlighted by staff members (i.e., David, César) and one player (i.e., José).

David: “Sharing, almost constantly sharing these facts so that we are able to gather and increase knowledge about the sport, about what it needs. Connecting this to the particular performance of the clubs, of the players and increasingly involving more specialists, in diverse areas so that they can help in applying more healthcare to eFootball.”

One suggestion was to learn from what has been studied and found in workers facing similar occupational constraints (e.g., persons in technical or administrative support occupations) and replicate it to improve health prevention and care for esports players, thus improving how health support is given.

César: “It’s trying to seek a parallelism for something that is very similar or another very similar activity and I think that’s the starting point.”

Likewise, the findings should be widely shared, so those involved with esports can be aware of the health risks of esports, how health can impact esports performance, and what they might need to improve both health and performance.

DISCUSSION

Health at its fullest is the highest attainable standard for every human [14]. Some participants also noted that being healthy also means being able to adapt and to self-manage, as stated in recent definition propositions [15, 16]. In the present study, esports participation was discussed to affect esports players' mental and physical health. Overall, participants in the current study recognised that, generally, esports players benefit from esports participation as this activity might improve esports players' cognitive ability and facilitate mental health when players achieve good performances. Yet, esports participation might also negatively affect mental health by predisposing players to symptoms of common health problems related to esports competition and decreased performance, and affect physical health, as a consequence of using esports equipment for long periods or in an incorrect way and the detrimental effects of spending too much time sitting. To counteract those negative impacts, the participants explained different strategies of health prevention that could be used. Furthermore, some strategies were suggested to play an important role in various forms of prevention (e.g., physical activity).

The esports players' health

The importance placed on factors affecting esports players' health has been recently acknowledged, mostly by qualitative research. Workers and athletes from traditional sports have also discussed physical and mental health problems and share similarities with esports players. For instance, the European Agency for Safety and Health at Work [54] recognised that physical and mental health problems are among the most important occupational safety and health problems in Europe, being frequently connected [54]. Yet, no inclusion and clarification of the impact of esports as a new profession has been made for such entities. Mental health cannot be separated from physical health, as evidenced by mental health symptoms and disorders increasing the risk of physical injury and delaying subsequent recovery in sports [55]. Hence,

even with scarce literature in the esports context, the different factors on esports players' physical and, mainly, mental health have been discussed to impact the overall health [30, 56, 57, 58].

Mental health

Recent studies on esports found similar conclusions about the mental health impact of gaming, competition, and performance [30, 58]. As explained in the background section, gaming has been previously described to be a factor positively affecting esports players' health, with effects on cognition, improved abilities and skills in a different range of domains (e.g., attention, visuo-spatial, memory, strategy, etc.) that would help players in esports participation and for common daily activities [8, 30]. These positive impacts were widely discussed during the interviews.

Still, as seen in traditional sports [59, 60, 61], factors related to esports competitions and performance have also been reported to contribute to mental health symptoms in esports players [27] and acknowledged during the interviews. Additionally, symptoms were found to impair performance, which may also exacerbate symptoms of mental health problems, with impact on overall health [17, 23]. In the present study, the competition itself and the dependence on performance were the factors most affecting players' mental health rather than team-related issues or communication problems previously described and perceived in other esports contexts [18, 24].

Furthermore, as studied for traditional sports, the risk of mental health symptoms in elite athletes is related to physical health problems, decreased performance or maladaptive perfectionism [55], so an empirical connection between esports players and athletes from traditional sports could be made.

Physical health

The most identified themes regarding physical problems were visual and musculoskeletal problems, in line with previous studies [28, 62, 63]. Besides, players acknowledged the known impact of sedentarism on health. Indeed,

visual problems related to dark environments with artificial lights, intense light from monitors, or inappropriate distance between players and monitors, have been described [64] and might be responsible for symptoms related to digital eye strain [63, 65, 66]. Furthermore, those environments might lead to other adverse health outcomes by affecting circadian biology, neurobehavioral processes, and health, including disrupted sleep, obesity/diabetes, depression, heart disease, cancer or impaired immune system [67].

As for musculoskeletal problems reported, as also noted with increased esports practice and longer careers, it is expected that problems such as overuse or overtraining injuries might arise [19, 20, 21, 62], impacting their performance. Additionally, knowing that esports practice is a sedentary activity, as broadly studied, could predispose players to increase all-cause and cardiovascular mortality risk [68]. Moreover, sedentary time might increase physical problems connected with long hours of competition, poor posture, and screen time. Indeed, posture and working in awkward positions, repetitive work or environmental conditions, as in esports environments, are known physical risk factors related to musculoskeletal problems and injuries in the back, upper limbs and lower limbs [54]. Fortunately, the participants noted that they preferred having an active lifestyle when not in esports-related activities. This aligned with recent reports in esports and gaming players that showed no adverse associations between video game play time and physical activity [69].

Strategies to improve health in esports players

Different strategies to deal with factors affecting esports players' health were suggested during the interviews. Contrary to anecdotal beliefs and previous reports, elite esports players do not need to spend most of their day playing to excel in their practice [56, 70]. Variations on how to train, more efficient and specific scenario practices or training with more skilled or challenging opponents could improve esports training while reducing excessive esports

practice [34]. Also, to improve performance, players may need to increase gaming breaks with other activities and reduce esports training duration [22, 57]; strategies that were referred to during the interviews. Self-regulated breaks during long play sessions and tournaments, such as simple walks, small breaks with other activities, or long-term removal from esports, have also been suggested in other contexts and esports modalities [24, 71], especially as adaptative coping strategies to help avoid stressors present in esports competitions (e.g., technical issues and antisocial behaviour of other players) [72]. Additionally, those strategies could help prevent mental (e.g., mental fatigue) and physical health (e.g., back pain) problems mentioned to be present in esports players.

Additionally, as explained, esports players should improve their lifestyle habits to promote and prevent health problems. Players recognised that physical activity, nutrition, sleep, and fitness could benefit esports performance [23, 34, 69]. For example, based on studies on dietary patterns for cognition and mental health, healthy diets could give players the extra edge to enhance esports performance and mental health [73, 74, 75]. Conversely, knowing that unhealthy eating habits have been associated with cognitive decline and mental health problems, such as depression [73], nutritional literacy may help prevent such problems in a population relying on mental capacity and health. The role of physical activity, including exercise or regular sports practice (i.e., football), was the most stated strategy to improve esports players' health. The positive impact of physical activity was recognised in all factors affecting esports players' health by improving lifestyle habits, enhancing and maintaining physical fitness and performance, optimising esports training, or being an alternative activity to esports practice or refraining from esports. As reflected during the interviews, physical activity might enhance cognitive abilities, like learning, memory, attentional and executive processes [75, 76]. Likewise, it could minimise common mental health symptoms (e.g., depression, anxiety) and improve psychological well-being and quality of life by improving the feeling of control,

self-efficacy, or self-esteem [76], which were frequently associated with mental health during the interviews. Indeed, physical activity is known to be beneficial in people with symptoms of mental health problems, such as distress, anxiety, and depression, especially in healthy individuals, like our participants, showing medium effects when compared with the care normally given [77]. Other general health benefits associated with increased physical activity (e.g., improved all-cause mortality and chronic diseases like hypertension, specific cancers, or type-2 diabetes) should be considered [78]. Likewise, replacing sedentary time with physical activity would provide players additional health benefits by reducing the detrimental effects of high levels of sedentary behaviour and screen time on health (e.g., musculoskeletal complaints [78, 79]. Therefore, comprehensive physical training interventions may help optimise esports skills and maximise performance and health [1, 80].

To avoid other physical health problems, esports players should rely on up-to-date technology, like high technological screen devices and more ergonomic consoles and chairs. Learning from strategies proposed for work-related health problems, possible interventions that should be taken within esports teams could include equipment adaption to esports framework (e.g., ergonomic redesign), and physical activity promotion, besides adjustment of training schedules [81]. Likewise, attention to logistics and events issues, like giving time for players to adapt to the competition setting and to use different computers, peripherals, or monitors, and avoid recurrent changes in the calendar, could have a positive impact on reducing mental stress faced during competitions, besides its impact on physical health [22].

Even acknowledging the need for health prevention and on-time care, a structured esports medical team is not a common reality for most elite esports players [56], including those participating in the current study. Still, all participants mentioned that esports players would benefit from such support. Having mental health support was essential to the esports players' health. Likewise, validated (for esports players) screening tools, like the Sports

Mental Health Assessment Tool 1 (SMHAT-1) or the Sports Mental Health Recognition Tool 1 (SMHRT-1), recently proposed by the International Olympic Committee for elite athletes, would have a valuable role for early diagnosis and prevention of mental health problems in esports players [82]. Moreover, since physical problems affect performance and general health, monitoring overuse and overtraining injuries while understanding the risks of physical conditions on health problems development is also needed [12]. Thus, the most suggested support staff in the present study was a medical team comprising psychologists, medical doctors, personal trainers, and physiotherapists or osteopaths. This is similar to the support teams in traditional sports. It aligns with a previously integrated health management model proposed by DiFrancisco-Donoghue et al. [83]. Moreover, education on symptoms and consequences might be a strategy to avoid health problems in esports players and one of the main roles of healthcare professionals working in esports teams. Esports coaches are in a critical position to improve players' literacy about mental health problems, recognition, and treatment, giving them support to seek help when needed [59]. Indeed, close friends and family members would be other potential sources of mental support, particularly when players feel affected by decreased performance and competition tolls. Particularly, esports coaches could minimise the negative impact of competition on elite players by giving players mental support, setting team standards, and developing team interpersonal communication [23, 24]. The coaches interviewed in the present study (and the members of the esports department that had a strong connection with coaches and players of the national team) are aware of their role for mental health support and awareness. As also observed, esports could improve socialisation and social life [9] for factors such as support from esports partners, commitment to team players and team-building activities that have been recognised as beneficial for mental health [56, 84]. Since those activities were mentioned to be part of the common activities on the training camps of the national esports team, team issues within the national team were not mentioned to impact mental

health. Instead, the positive effect of esports teams to promote socialization and social support within esports players and staff members was discussed.

Practical applications

Following the arising themes linked to esports health, interventions targeting esports players' mental and physical health (e.g., including primary and secondary stakeholders on health policies and support, improving resources, increasing awareness to esports players' health, learning from what has been done in similar contexts) are needed to improve and protect esports players' health.

First, since many of the current strategies are self-organised, stakeholders engaged with esports (e.g., coaches, support staff, managers, and sponsors) have a key role in promoting the health literacy of esports players, ultimately facilitating esports players' self-efficacy [69]. Improving resources, such as adequate equipment and access to proper healthcare resources, should be a focus for future interventions [54]. As such, the present study highlights that both players and staff members are already aware of the impact of esports participation on health, and mostly share the same beliefs on how to employ the positive effects of esports participation and what could be strategies to prevent health-related problems related to esports participation.

Finally, research integrating esports players is needed to promote a more widespread promotion of physical and mental health, and to substantiate the perceived constraints of esports practice for the esports players' health (e.g., differences in performance due to physical problems, overuse injuries, burnout, sleep problems, coping mechanisms for competition and performance anxiety [27, 71]). Our findings highlight that exercise and health professionals (e.g., sports physicians, psychologists, nutritionists) have an important role in health literacy promotion and support because of the similarities between the health consequences of elite esports practice and sports. Additionally, health literacy and information regarding the

potentially negative effect of esports participation could prompt on-time care at first sight of physical problems [28, 81].

Methodological considerations

As previously mentioned, the last two interviewed participants did not add any new information about the esports players' health (e.g., they also discussed the two main topics: mental and physical health), thus reaching theme saturation. Although we developed questions, including the follow-up questions, to encourage participants to feel comfortable in the interview, some participants frequently found it challenging to share their experiences which appeared to contribute to the interview duration. We acknowledge that because this is the first qualitative study conducted by AMP, the questioning adopted could be improved. Moreover, the response-driven questions during the interviews could be biased by AMP's clinical background and her mindset focused on a health prevention approach.

Additionally, during thematic analysis, a distinction between player and staff member responses was not performed. Contrary to our initial beliefs when designing this study, the participants discussed themes regardless of whether players or staff members were comparable, suggesting a consensual perception of the health factors of esports participation and preventive strategies. This could be related with staff members' experience with gaming and esports, besides their actual role and specific tasks [85]. Still, even with compatible perceptions, the way they discussed and understood the esports players' health and strategies proposed to support health might have enriched our study by adding different explanations within the same theme [85, 86].

Lastly, since we only included Portuguese participants associated with eFootball participation, the results discussed here might differ in other esports modalities or national contexts [87, 88], as different esports vary regarding the demands and the characteristics needed to excel [9]. The factors affecting esports players' health could be related to how health is perceived

nationally and the current development of eFootball in Portugal. Still, as a reflexive exercise on the findings and the cited health impact of esports participation, we hope that the results found can be transferable for other esports groups (e.g., national federations and clubs), promoting constructive and action-orientated conversations within esports and traditional sports organisation leaders, coaches and sports and exercise professionals working with esports players [89].

CONCLUSION

Elite and world-class eFootball players and staff members considered that specific esports factors (e.g., competitions, logistics) impact players' mental and physical health. Esports players should optimise their lifestyle habits and training, including logistics while relying on social and clinical support to counteract those factors. Also, it is up to esports teams and those belonging to the whole esports ecosystem (e.g., industry and game developers, esports teams, players and followers, and competition organizers) [38] to be aware of the health impact of esports participation, and the strategies proposed here, so they are properly able to offer adequate logistics for their players and to optimize the clinical support given within esports teams, with emphasis on health literacy, health prevention, and support. Given the exponential growth of esports and the relative impact on players, followers and stakeholders, working on factors affecting (positively and negatively) mental and physical health, and defining strategic plans to improve and manage esports players' health will be important for esports teams and all the community involved in this contemporary phenomenon.

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CHAPTER V.
Physical activity levels of adult eFootball
players

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ABSTRACT

Esports, including eFootball, are a worldwide phenomenon. Yet, little is known about the physical activity levels of individuals engaged in eFootball participation. Therefore, we aimed to perform a preliminary evaluation of the levels of physical activity, sedentarism and habits of physical training of adults engaged with eFootball in Portugal. This was a cross-sectional investigation based on a structured online survey using the International Physical Activity Questionnaire (IPAQ) and a set of questions regarding habits of physical training. The participants (n = 433) reported spending a median of 5,625 MET-min week⁻¹ being physically active. Still, the participants spent 320 min/day sitting, and 150 min/day practicing eFootball. According to the IPAQ scores, high physical activity levels were reported by 84.5% of the participants, and 87.1% were considered physically active considering the WHO guidelines on physical activity and sedentary behaviour. Overall, 60.0% of the participants reported planning their own physical training. Maintaining or improving overall physical health was one of the main reasons for doing physical training (66.7%), with only 6.1% responding being active to improve eFootball performance. Overall, the results showed that eFootball players accomplished the standard recommendations for physical activity, with high levels of physical activity, and encompassing regular physical training focused mostly on health promotion, rather than improved eFootball performance.

BACKGROUND

Esports, or electronic sports, comprises a group of different videogame genres (e.g., *sports, first-person shooter, etc.*) played on a specific environment (i.e., in-site, on-line or both), mostly in national and international competitive tournaments [1-4]. Generally, esports are organized video game competitions set by rules that require skill and have a broad following; however, esports currently lack great physicality and institutionalization [5]. Over the last few years, the interest in esports has increased. Not only by players, but also esports enthusiasts, spectators and investors [6]. Moreover, different scientific fields (e.g., marketing, law, exercise and health) also started to elaborate on the topic, turning esports into one fruitful topic for scientific research. In 2017, there were more than 215 million frequent esports viewers and enthusiasts [7]. Even though only a few esports players can reach the professional level [8], in many countries, for some esports players their practice goes beyond just playing videogames as a hobby [9]. Portuguese esports players are entering the realm of esports and their level grows; thus, it is important to know more about screen time, inactivity and sedentary behaviour due to esports, with no distinction between recreative or professional esports players. Excessive screen time, inactivity and sedentarism behaviour a global public health problem and have been associated with negative short- and long-term health-related problems, such as cardiovascular diseases, mental problems and cancer [10-12]. Contrarily, high levels of physical activity have been associated with a reduction in mortality and major comorbidities [13-16].

Interestingly, recent studies on physical activity levels of videogame and esports players stated that esports participation and involvement-related physical activity is high and could be a driving force to enhanced physical activity for both players and viewers [4, 17]. This would be especially relevant in those esports related to traditional sports [18], such as eFootball. Actually, esports players at elite levels of different esports genres have been reported to be physically active, which is against the empirical notion that esports

players are inactive [19, 20]. Besides, exercise and physical activity might be important to increased esports performance [17, 21]. With Portuguese esports scene rising [22] – with special emphasis in eFootball –, it is vital to know more about the physical activity levels of people engaged with esports and understand the relationship between esports practice, sedentary time and motivations for being physically active. Therefore, the aim of the current preliminary study was to characterize and describe the physical activity levels and physical training habits of people engaged in eFootball, a popular esports genre related to a traditional sport (i.e., soccer).

METHODS

Participants and procedures

The present preliminary study was conducted to fulfil a preliminary approach to understanding how to start scientific research in eFootball players in Portugal, and how to improve the methodologies and research designs for the forthcoming investigations. It involved a convenience sample of eFootball players registered on the Portuguese Football Federation (FPF) Esports online platform in May 2018. The study employed a cross-sectional design based on a structured online survey comprising of two parts. Part 1 included the Portuguese version of the International Physical Activity Questionnaire – short-form (IPAQ-SF) [23]; and Part II consisted of a set of questions regarding habits and motivations for physical training. To be included in the study, the participants had to fulfil the following inclusion criteria: being registered on the FPF Esports platform and aged ≥ 18 and < 65 years [according to the International Physical Activity Questionnaire – short-form (IPAQ-SF) [23] and to the recommendations for physical activity proposed by the WHO for adults [16]]. Also, the complete response to every relevant IPAQ question and responses to all applicable questions related to habits of physical training were the criteria for entering the analysis for each part of the questionnaire. To be registered in the FPF Esports platform, the participants were only required to give the name, birth date and e-mail account,

disregarding being a regular or one-time player. The registration did not categorize the participants by occupation or level of play, with no added value separating professional and recreational players. Instead, daily practice time was assumed as esports commitment. All participants were previously informed about the objectives of the study and a written informed, voluntary, consent was provided in the invitation to participate. Participation in the study was entirely voluntary and privacy rights were protected. The study was approved by the Data Protection Officer of the FPF and the Ethics Committee of the Faculty of Sports, University of Porto (CEFADE/31/2019). A link to the online survey was sent via e-mail to all the 5,748 eFootball players registered with FPF Esports platform (99% men, $n = 5,687$; and 1% female, $n = 61$). The questionnaire was available via SurveyMonkey® for a period of one week. The estimated time to complete the questionnaire was previously estimated to be 2–4 minutes. Overall, 926 participants (16% of the invited sample) accepted to participate and met all the inclusion criteria.

Part I – Levels of Physical Activity

The IPAQ is a questionnaire that assesses self-reported physical activity levels; it has been validated worldwide [23] and in different populations [24-26]. The IPAQ-SF, a short form of IPAQ, has been recommended for large population-based studies and has been validated for the Portuguese population ranging from 15 to 69 years-old [27]. Based on 7 items, the IPAQ-SF considers the time and energy expended (metabolic equivalent of task, MET-min week⁻¹) in vigorous-intensity activities, moderate-intensity activities and walking, which were done for more than 10 minutes in the prior 7 days. MET levels of 3.3, 4.0 and 8.0 were attributed for walking, moderate and vigorous intensity activities, respectively. Each participant was assigned to one of three categories: a) highly active if Vigorous physical activity in 3 or more days a week, accumulating at least 1,500 MET-minutes per week or 7 days or more in which the combination of moderate/ vigorous activity or walking cumulate at least 3,000 MET-min week⁻¹), b) moderately active if 3

or more days of vigorous physical activity per week (more than 20 minutes per week) or more than 4 days with moderate physical activity and/or walking (at least 30 minutes per day) or 5 or more days with a combination of vigorous/moderate physical activity or walking that cumulate ≥ 600 MET-min week⁻¹) or, c) low active (when the participant did not any physical activity or it is insufficiency to meet the criteria for highly or moderately active categories) [23]. Total MET-min week⁻¹ variable was calculated adding individual MET-min week⁻¹ for each activity intensity: vigorous, moderate and walking. As proposed by the IPAQ-SF scoring protocol guidelines [23], values of less than 10 minutes were recoded as “0” and values greater than 960 minutes of physical activity were truncated to 960 minutes. Thus, when physical activity variables (i.e., vigorous and moderate physical activity and walking) exceeded 180 minutes per day, they were truncated to 180 minutes only. The IPAQ-SF also includes a question about sitting time. This question was: “During the last 7 days, how much time [hours per day and minutes per day] did you spend sitting on a weekday?”, which analyzed separately from the questions included in the score of physical activity. Finally, the levels of physical activity were analyzed according to the recommendations on physical activity and sedentary behaviour proposed by the WHO in 2020 [16]. Still, bouts of less than 10 minutes of physical activity were recoded following the IPAQ-SF scoring protocol.

Part II – Habits and motivations for physical training

To evaluate the habits and motivations of eFootball players, a set of questions (i.e., “What are the main reasons for physical training?”, “Who plans your physical training program?”, “Which influence as physical training on your sports performance?”) were structured based on a previous study [19]. Questions were added to estimate the time dedicated to exposure to eFootball, the time spent with screen time, and five multiple-choice questions regarding the habits of physical activity. The participants were asked about physical training achievement, the person or professional responsible for physical

training, reasons for doing physical training, perception of the effect of doing physical training on esports performance and about the perception of physical training compared to other esports players. In all the questions where none of the possible answers applied, an option “cannot say” was included. The questions were previously translated by an official translator from English to Portuguese, and then externally validated by an English and Portuguese native speaker and by two English-native speakers.

Data analysis

Data analysis was done separately for Part 1 (n = 433) and Part 2 (n = 565). R (R Core Team, 2019) [28] was used to analyze the data collected. Considering the IPAQ-SF guidelines for data processing and normality distribution tests, that proved non-normality, quantitative variables (i.e., age, time and exergy spent with physical activity and time spent in sedentary activities) were described with median and IQR, first and third quartiles (Q1, Q3). Categorical variables were described using absolute (n) and relative (%) frequencies. For comparative analysis, Chi-square was used and a statistical value of α ($\alpha = 0.05$) was considered.

RESULTS

The median age of the responders was 22 (Interquartile Range, IQR = 8) years-old, with 98% (n = 916) being men. Participants who did not report all the IPAQ-SF questions, nor did answer all applicable questions related to habits of physical training were excluded. This resulted in 433 valid answers for Part I, with 429 (99%) responses from men and 4 from women (1%), and 565 valid answers for Part II, with men responding in 99% (n = 557) of the cases.

Part I – Levels of Physical Activity

The respondents reported spending a median of 1,080 (Q1, Q3 = 720, 1,680) minutes per week on physical activities, equivalent to an average of 154

minutes per day (Figure 1). A median of 320 (210, 480) minutes was spent in sedentary activities during work or leisure time (e.g., working on the computer, reading, watching television, etc.) each day (Figure 1).

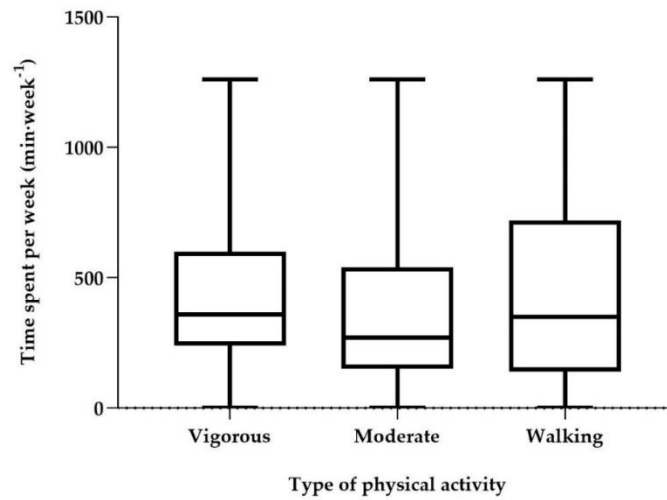


Figure 1 Time spent per week (min·week⁻¹) with physical activities, presented by type of physical activity, based on IPAQ-SF

The total energy expenditure with physical activities was 5,625 (3,675, 8,586) MET-min week⁻¹. The participants reported expending 2,880 (1,920, 4,800) MET-min week⁻¹ with vigorous activities, 1,080 (600, 2,160) MET-min week⁻¹, moderate activities and 1,155 (462, 2,376) MET-min week⁻¹ walking (Figure 2).

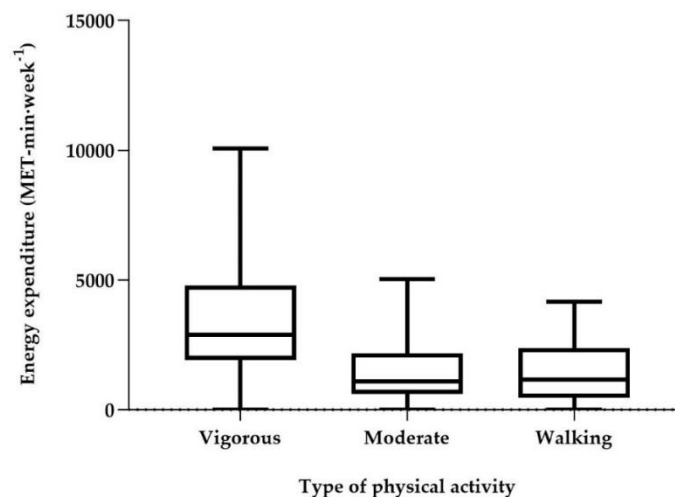


Figure 2 Total energy expenditure (MET·min·week⁻¹) in each type of physical activity, based on IPAQ-SF.

Following the guidelines for data processing and analysis of the IPAQ-SF, 84.53% (n = 366) of the participants reported high levels of physical activity, while 12.93% (n = 56) reported moderate levels, and 2.54% low levels of physical activity (n = 11). Levels of physical activity differed between age groups, with 90.08% (n = 118) of eFootball players younger than 20 years-old responding that high levels of physical activity comparing with 55.00% on the group between 35 and 39 years old (Table 1). Considering the WHO recommendations for physical activity (16), 87.07% (n = 377) of the participants met those recommendations, with no significant differences between age groups ($p > 0.05$).

Table 1 Levels of physical activity stratified by age group

Age group (years-old)	Level of Physical Activity [n (%)]		
	Low	Moderate	High
<20	2 (1.53)	11 (8.40)	118 (90.08)
20-24	4 (3.05)	15 (11.45)	112 (85.50)
25-29	2 (2.20)	15 (16.48)	74 (81.32)
30-34	1 (2.08)	5 (10.42)	42 (87.50)
35-39	2 (10.00)	7 (35.00)	11 (55.00)
≥40	0 (0.00)	3 (25.00)	9 (75.00)

Note: Levels of physical activity based on IPAQ – short form scoring protocol: Low level – no physical activity or insufficient to meet the other levels; Moderate Level – 3 or more days of vigorous physical activity per week (more than 20 minutes per week) or more than 4 days with moderate physical activity and/or walking (at least 30 minutes per day) or 5 or more days with a combination of vigorous/moderate physical activity or walking that cumulate 600 or more MET-minutes per week; High Level – Vigorous physical activity in 3 or more days a week, cumulating at least 1500 MET-minutes per week or 7 days or more in which the combination of moderate/ vigorous activity or walking cumulate at least 3000 MET-minutes per week. ($\chi^2= 20.588$, $p = 0.024$).

Part II – Esports practice and physical training

The participants reported spending a median of 150 (120, 220) min/day in eFootball practice and 97.70% of the participants responded practicing esports at least for 10 min a day. Interestingly, 76.11% (n= 430) of the

participants stated to perform regular physical training. Of those, 258 (60.00%) reported planning their physical training themselves, followed by those who had their training planned by the esports team's coach (n = 81; 18.84%), a personal trainer (n = 58; 13.49%), the team's physical coach/physiotherapist (n = 20; 4.65%) or an outside service (n = 8; 1.86%) (Figure 3).

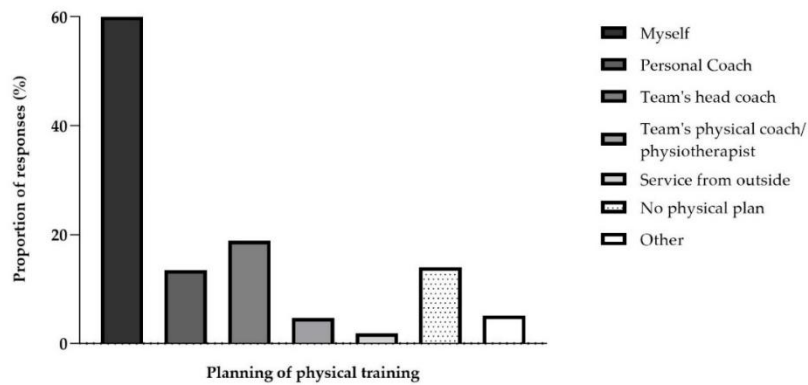


Figure 3 Responses to the question “Who plans your physical training program?”.

Note: More than one response was accepted.

Only 26 (6.05%) participants referred doing physical training to be more successful in esports. The most prevalent reason for doing physical training was maintaining or improving overall physical health (n = 287; 66.74%). Also, 213 (49.53%) participants reported doing physical activity to improve overall physical capacity. Exercising for fun or enjoyment or improving physical appearance were motivations for 178 (41.40%) and 174 (40.47%) participants, respectively (Figure 4).

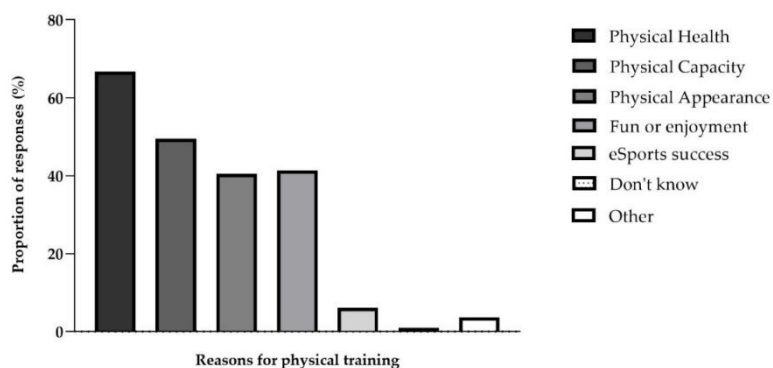


Figure 4 Responses to the question “What is your main reason for doing physical training?”.

Note: More than one response was accepted.

Despite a low percentage of respondents stated to partake in physical exercise to improve esports performance, 162 (38.66%) participants reported that doing physical training positively affected their performance. A total of 189 (45.11%) participants considered that physical activity had no effect on their esports performance, while 20 (4.77%) even considered that physical activity had a negative effect.

DISCUSSION

Esports participation is a contemporary phenomenon wrapped in feverous discussion, with the absence of physicality of esports and its assumed association with increased sedentary behaviour being a conflicting topic [4, 5]. To our knowledge, this is the first investigation on physical activity levels exclusively conducted in eFootball players. The results obtained in this preliminary cross-sectional investigation demonstrated that, on a normal day, the time spent in physical activities was higher than the time spent being sedentary or even practicing esports. Even knowing that the data presented here are only related to eFootball, the results might be a small indicator that the nature of eFootball might not be related to an inactive lifestyle and this preliminary study could open the door to new and more elaborated studies.

Physical activity

In the recent guidelines on physical activity and sedentary behaviour proposed by the WHO, physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure [16]. Participating in physical activities has been associated with lower rates of negative health outcomes and mortality, for both energy expenditure [13, 29, 30] and time spent with physical activity [31, 32]. In the current study, 87% of the eFootball players reported meeting the recommendations for time spent with physical activity for adults released by the WHO [16].

When analyzing physical activity patterns, walking and activities with vigorous intensity were the main activities done by the eFootball players. The

median of total energy expenditure with physical activities reported was 5625 MET-min.week⁻¹, a value that has been associated with enhanced health-related benefits [33]. The results positively differ from those reported in previous studies that evaluated physical activity levels in adults. In Portugal, Teixeira et al. [34] found that 58% of the Portuguese population was classified as moderately or highly active, while other authors, studying the Portuguese population reported that 70% of participants, aged 18 to 29 years, reached the recommendation of 30 min/day of physical activity [35]. Different studies also noted that men tend to exercise more, during more time and/or with higher intensities than women or older people [24, 29, 35-37]. This could partly explain our results regarding the time spent with physical activity, energy expenditure and levels of physical activity and inactivity, since the current study comprised mostly young men. Further, eFootball players practice a sports-related videogame, an esports genre that has been associated with exercising more, comparing with other videogame genres, such as Role-Playing Games [18, 38]. The surprisingly high levels of physical activity reported here might be important for understanding health status. Conflicting results regarding levels of physical activity in esports players from different esports genres as an all have been proposed [19, 20]. Remarkably, a recent study with 1,722 esports players from different esports genres and skill levels showed that esports players with a higher in-game rank were more physically active when compared to the remaining esports players [20]. Likewise, since esports players, including some of the top-level eFootball players, are followed by millions of people worldwide [6, 7], their high physical levels and physically active profile might influence others to follow the same steps.

The reported time spent in sedentary activities was comparable to other studies conducted with the Portuguese adults (i.e., average of 327 min/day) [34] or athletes (i.e., 500 min/day in runners and footballers) [39]. Nevertheless, it would be important to discriminate the type of sedentary activities in this population (e.g., reading, screen time, work practice) during

esports participation. Interestingly, the WHO now differentiates time spent watching screen-based entertainment (e.g., TV, computer, mobile devices) from active screen-based games where physical activity or movement is required [16].

For instance, sedentary habits such as TV viewing and cell phone use might increase total time spent sitting [40-42], which has been associated with increased all-cause mortality [11, 12].

The time spent with eFootball practice was reported to be 150 min/day. To our knowledge, there is no official data or epidemiological studies on the time spent practicing esports to improve performance. Based mostly on anecdotal and media reports, we believe differences might exist between elite and recreational esports players, and those differences may change with different esports genres. Still, at the time of data collection, as anecdotally reported by the FPF Esports department, the number of Portuguese professional eFootball players was still low and separating professional from recreational players seemed to add no additional value.

Esports practice and physical training

Sixty percent of the eFootball players reported planning their physical training by themselves. Yet, an exercise professional was chosen in 39% of cases. With the increased professionalization of esports, exercise and sports professionals may need to be prepared for the particularities and special needs of esports players, to help esports players minimizing problems related to their activity, like game-related injuries [4].

In line with other studies on motivation for doing physical activity [36, 43] maintaining or improving overall physical health was the main reason for physical training. Interestingly, only 6% of the eFootball players reported that improving esports performance was the main motive for doing physical activity, but 39% of the participants agreed that doing physical training positively affects their performance in esports. Kari and Karhulahti [19] also showed that 9% of elite esports players (from several esports genres) reported

the main reason for being active was improving esports performance and 6% believed that integrating physical exercise in their training programmes has a positive effect on esports performance. Actually, recent studies highlighted the association between physical activity and increased esports performance (i.e., accuracy and objective fulfilment, and cognitive aspects of gaming) [17, 21]. The fact that the current study included both elite and recreational eFootball players might be a reason to different perceptions to that question.

Strengths and limitations

The current preliminary study has some strengths and limitations that we would like to highlight. As previously stated, this is the first study on physical activity habits of eFootball players conducted in Portugal. At the time of the investigation, 5,748 eFootball players were registered in FPF Esports platform, and only 916 players accepted to voluntarily participate in the investigation. Hence, even with a significant number of registered players, the registration process of the FPF Esports platform did not require regular esports participation, meaning that only a small number might be really participating in esports competitions. That initial pool might not have comprised active members or even people who were really engaged with esports. Thus, this was a convenience sample rather than the total population of esports players. Though, we believe those who responded to the questionnaire are the ones that usually use their e-mail to esports-related information (e.g., tournament registration, competition calendar, etc.), hence, not one-time players. Moreover, this was the first scientific study conducted with FPF Esports players. The participants might differ from other participants in traditional sports in the FPF (e.g., soccer players) that are used to participate in surveys and scientific research. At the beginning of the study, limited information was available on how this population would be accepting or leading with questionnaires, or even if electronic questionnaires would be a good fit to their characteristics. Also, the way the survey was conducted (i.e., anonymous) did not allow on having direct follow-up on non-

responders and incite the participants to respond. Again, we were not able to have a randomly selected sample which might have increased the introduction of biases (i.e., selection and allocation bias). Though, the players more interested in physical activity might have been the ones more prone to respond to the questionnaire (i.e., volunteer bias) [16, 44, 45]. Therefore, generalization and external validity might be compromised [45].

Another arguable problem with this study was the surprisingly high levels of physical activity reported and the proportion of players meeting the WHO's recommendations for physical activity for adults. To evaluate physical activity levels, we used the Portuguese short version of the IPAQ. Different studies reported an acceptable validity and reproducibility [46, 47]. Even using anonymous on-line questionnaires, the eFootball players could have overreported positive behaviour (i.e., physical activity) and underreported negative behaviour (i.e., sedentary activity).

Finally, this is a cross-sectional study; it is not possible to establish causal relations or formally test hypotheses. Different reasons, such as a complex competition schedule, existence of different tournaments at the same time, short competition periods of 1 to 2 days or on-line tournaments determined the use of electronic questionnaires, instead of more robust methods to measure physical activity, such as, accelerometers. Still, for the purpose of a baseline description and the fact that research on esports players is relatively new, the use of questionnaires might be an important approach to start.

CONCLUSION

EFootball players revealed high levels of physical activity, with 87% meeting the WHO's recommendations for physical activity. Even though, most of the eFootball players were responsible for their own physical training. Notably, many resorted to an exercise professional for their physical training. Improving overall health, rather than esports performance, was the main motivation for physical activity.

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CHAPTER VI.

Symptoms related to common mental problems
and exposure to esports participation.

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ABSTRACT

The lifestyle of esports players and the health consequences related to esports participation is starting to be scientifically disclosed, with the link between mental health and esports participation being often acknowledged. Therefore, the current study aimed to evaluate symptoms of mental health problems in electronic football (eFootball) players, a sports-related electronic game, and to analyse the association of those symptoms with exposure to esports participation.

A cross-sectional investigation was performed using the Internet Gaming Disorder Scale, Distress Screener, General Health Questionnaire, Sleep Disturbance Domain of the Patient-Reported Outcomes Measurement Information System, Alcohol Use Disorders Identification Test Consumption, and a questionnaire regarding eating habits, besides self-report exposure to esports participation. Chi-Square Test was used to examine associations between symptoms of mental health problems and exposure to esports participation.

The final sample comprised 210 participants. Only 2% of eFootball players reported symptoms associated with gaming disorder. Still, 18% reported distress, 48% reported symptoms related to anxiety/depression, and 58% reported sleep disturbance. Most eFootball players reported no alcohol misuse (71%), but 69% showed poor eating habits. There were no associations between exposure to esports participation and symptoms of mental health problems.

Symptoms of mental health problems were reported, but there was no association with exposure to esports practice. Given the integration of esports players in traditional sports clubs and federations, the increased dependence on performance and results to thrive, and the professionalisation of esports participation, structured healthcare support, especially with a mental health orientation, would be beneficial for responding to esports players' needs and to improve esports performance, besides the potential preventive impact to promote overall health and well-being.

BACKGROUND

Esports encompasses the practice of ruled competitive videogames. With a crescent body of players, viewers, and capital investment, the esports phenomenon may reach the traditional notion of sport, covering different disciplines or modalities [1-3]. Developing special skills is crucial to excelling in esports practice (i.e., strategical, or tactical knowledge, hand-eye coordination, reaction time). There are currently established official leagues, stable fan bases, and more consistent investments and sponsorship [3, 4]. Recently, several sports organizations and clubs began to include esports, in line with other sports modalities.

This relatively new phenomenon has recently aroused the interest of the scientific community. The lifestyle of esports players and the possible health consequences of esports practice has recently started to be investigated and described [5], with conflicting results regarding the association between esports practice and health behaviours [6]. For example, studies conducted in Germany [7] or China [8], comprising esports players from different modalities, reported that esports players have at least a good health status, against studies including both esports players and video gamers [9]. Indeed, esports players seemed to be conscientious about diet [10], reported consuming a healthy diet [11], and reported not consuming alcohol [5]. On the other hand, Rudolf and colleagues [7] found weak but relevant detrimental associations between gaming and health outcomes, such as sleep or nutrition, while Weaver's study [12] found a linear association between self-reported sleeping problems, anxiety, alcohol or drug abuse with average playing time [13]. Thus, from a public health perspective, knowing that millions of people, especially children and adolescents, take part in esports regularly [14], both as players and viewers, it is relevant to study further the prevalence of symptoms of mental health problems in esports players so that proper health care strategies could be taken. Therefore, in the current study, we aimed to study the prevalence of symptoms of mental health problems in esports players from one sports-related electronic game (i.e., FIFA EA® Sports). As a

secondary aim, we studied if exposure to esports participation was associated with symptoms of mental health problems. We hypothesized that exposure to esports practice (hours per day and hours per week and the number of competitions per month) and being part of an esports team are associated with symptoms of mental health problems (i.e., gaming disorder, distress, anxiety and depression, sleep disturbance, alcohol misuse and poor eating habits).

METHODS

Participants

The present study involved a convenience sample of eFootball players (FIFA EA® Sports) registered on the Football Portuguese Federation (FPF) eFootball online platform. This is a secondary analysis from data collected in an ongoing study about the association between symptoms of mental health problems and potential associations between coping strategies, sleeping disturbance, alcohol consumption and eating habits in eFootball players, conducted by the same research team [15]. While in the first study we aimed to test a model to test the association between distress and anxiety/depression symptoms and potential associations between coping strategies, sleeping disturbance, alcohol consumption and eating habits, with the present study we aimed to analyse the presence of symptoms of mental health problems in adult eFootball players and the association between those symptoms and esports participation and exposure. No exclusion based on gender or professional status was applied. At the time of data collection (2019), there were 9,099 individuals registered on the FPF eFootball platform. Based on competition registration, in 2019, there were 584 players actively competing in FPF eFootball competitions [16]. Since there was no way to distinguish between active and non-active registered eFootball participants, an online questionnaire (SurveyMonkey®) was sent via e-mail to all the 9,099 eFootball participants registered in the FPF eFootball during December 2019. Still, only registered individuals who reported more than two monthly competitions

were considered for inclusion in our study. Additionally, only adult players (i.e., older than 18 years old and/or having a working occupation or reporting to be unemployed) were included. The online questionnaire comprised an initial section for sample characterisation, including esports participation, and 9 questionnaires that were not all included in the present study. The estimated time to complete the full online questionnaire was previously calculated to be 12-15 minutes. Overall, 916 participants accepted to participate and provided informed consent, but only 446 responded to the online questionnaire, and 316 met the inclusion criteria (Figure 1). The project was reviewed by the Data Protection Officer of the FPF and approved by the Portugal Football School Ethics Committee (Code 6/2020).

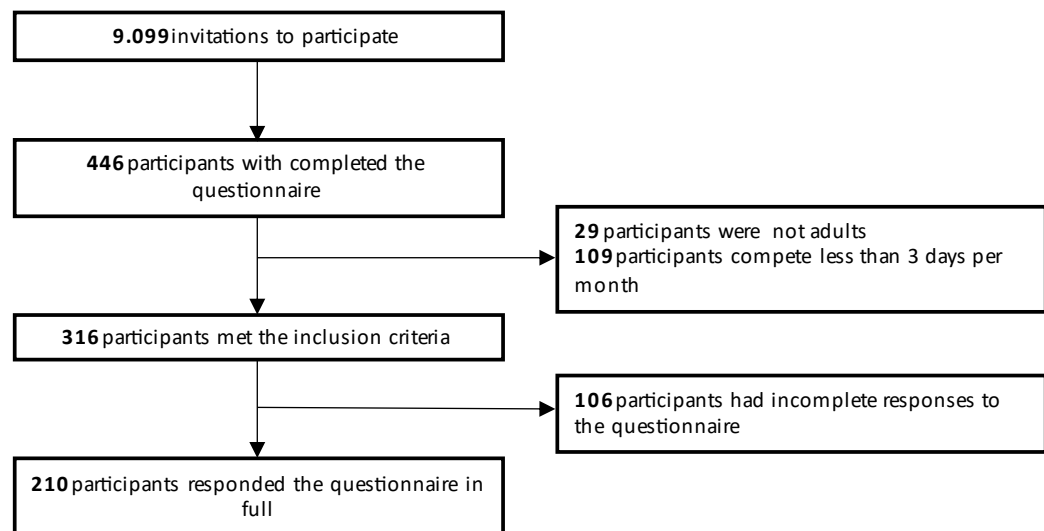


Figure 1 Flowchart of sample selection process

Measures

Demographics

An initial section of the questionnaire comprised questions related to age, gender nationality, education, and sports registration status (i.e., registered in a sports federation in any other sport) of the participants was collected, aiming to provide a sociodemographic characterisation of the sample. Self-reported weight and height were also collected. Body mass index (BMI) was calculated, and BMI categories were created following the Centers for Disease

Control and Prevention guidelines (i.e., underweight: BMI < 18.5; healthy weight: BMI between 18.5 to 24; overweight BMI between 25 to 29, obesity Class 1: BMI 30 to 34; obesity Class 2: BMI 35 to 39; obesity Class 3: BMI \geq 40) [17].

Exposure to esports participation

Reported time spent with esports training (hours per day and hours per week) and competitions were collected to characterise esports exposure in the initial section of the questionnaire. Besides the questionnaire used also included questions related to FIFA EA® Sports game mode (i.e., 1 vs 1, 2 vs 2, Pro-clubs), preferred game platform (i.e., PS4, Xbox, Personal Computer), type of esports practice (i.e., professional, or recreational), level of esports competition (i.e., national and/or international,) and is registered with an esports team. The questions were previously validated by the FPF eFootball department and an esports community manager to ensure the use of adequate designations in the esports context.

Symptoms of mental health problems

A second section of the questionnaire aimed to evaluate symptoms of mental health problems. For that, the measuring tools followed previous studies on symptoms of mental health problems in eFootball and professional football players [18], to which we added the 9-item Internet Gaming Disorder Scale (IGDS9-SF) to characterise gaming disorder. To evaluate alcohol misuse, the AUDIT-C was used. Adequate eating habits were assessed with Tjeerd, Frings-Dresen, and Sluiter's [19] questionnaire. Other symptoms of mental health problems, such as distress, anxiety/depression symptoms and sleep disturbance, were calculated following each tool cut-off.

Gaming disorder

Gaming disorder is defined in the 11th Revision of the International Classification of Diseases as a pattern of gaming behaviour ("digital-gaming"

or “video-gaming”) characterised by impaired control over gaming, increasing priority given to gaming over other activities to the extent that gaming takes precedence over other interests and daily activities, and continuation or escalation of gaming despite the occurrence of negative consequences [20].

The Portuguese short-form of the IGDS9-SF [21] was developed to evaluate the severity and detrimental effects of Internet Gaming Disorder. Its 9 items are based on Gaming Disorder diagnostic criteria stated in the 5th edition of the American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders – DSM-V [22] (e.g., “Do you feel the need to spend increasing amount of time engaged gaming to achieve satisfaction or pleasure?”), answered using a 5-point scale: 1 = “Never”, 2 = “Rarely”, 3 = “Sometimes”, 4 = “Often”, and 5 = “Very Often”. A cut-off of 32 was employed to distinguish between disordered and non-disordered gamers [23].

Distress

The Distress Screener [24], obtained from the distress subscale of the four-dimensional symptom questionnaire (4DSQ) [25], was used to evaluate distress in esports participants. This screener consists of three items (i.e., “During the past week, did you suffer from worry?”, “During the past week, did you suffer from listlessness?” and “During the past week, did you feel tense?”), scored between 0, if “never”, to 2, if “regularly or very frequently”. The presence of distress is assumed when the obtained score from summing up the answers for the 3 items is 4 or higher [25].

Anxiety and depression symptoms

Symptoms related to anxiety and depression in the previous 4 weeks (e.g., “Been able to concentrate on what you’re doing?”, “Felt you were playing a useful part in things?”) were assessed using the Portuguese self-administered version of the 12-item General Health Questionnaire (GHQ-12) [26]. Likert scoring “0-1-2-3” method was chosen to calculate the total score, where the higher value represented a more severe condition (e.g., a maximum score of

36) [27]. Total scores higher than 12 were considered as having minor psychological symptoms related to anxiety and depression [28].

Sleep disturbance

PROMIS® - Patient-Reported Outcomes Measurement Information System comprise different validated person-centred measures to evaluate and monitor physical, mental, and social health in adults and children. The sleep disturbance domain (PROMIS-SD) [29] was used to evaluate sleep disturbance. Four items reporting the last 7 days (e.g., “My sleep was restless”) were responded to on a 5-point Likert Scale with 1 for “Not at all” and 5 for “Very Much”. Total scores result from summing all four questions (ranging from 1 to 20). A t-score higher than 50 was considered indicative of sleep disturbance [29].

Alcohol misuse

To screen for risky drinking, alcohol abuse or dependence (alcohol misuse), we applied the Portuguese 3-item version of the Alcohol Use Disorders Identification Test Consumption (AUDIT-C) [30], a widely used tool to assess the frequency and quantity of alcohol consumption and frequency of binge drinking. AUDIT-C total score is obtained by summing up the 3 items, ranging from 0-12. A high probability of alcohol misuse is considered for scores of 5 or more in men and 4 or more in women. Given the small proportion of women, we only considered the male cut-off for data analysis.

Eating habits

Eating habits were accessed by applying the questionnaire developed by Tjeerd, Frings-Dresen and Sluiter [19], which questions about how many days per week the participant “eat healthy”, “eat regularly throughout the day”, “eat the first meal before 10:00 AM” and “eat the last meal before 8:30 PM”. The authors considered healthy habits if the participant reported consuming healthy meals at least 5 days per week. If there were at least 3 days per week,

the participant reported regularly eating throughout the day, having breakfast before 10:30 and having their last meal before 20:30.

Statistical analysis

Data collected were analysed with IBM SPSS Statistics 29.0.0.0 software. All continuous variables were tested for normality, with all variables demonstrating deviation from normality (i.e., Kolmogorov–Smirnov test and Levene test: $p < 0.05$). Descriptive statistics were obtained for all variables using absolute (n) and relative (%) frequencies for categorical variables (e.g., having an esports team) and median (M), interquartile range (IQR), and first and third quartiles (Q1, Q3) for quantitative variables (e.g., esports exposure). Additionally, mean (\bar{x}) and standard deviation (SD) are presented only for comprehension.

Total scores for quantitative variables related to symptoms of mental health problems were transformed into categorical variables following the cut-off suggested for each tool. Moreover, to analyse variables related to age, sitting time at work and exposure to esports participation (i.e., hours per day and hours per week and the number of competitions per month), 4 categories for each variable were created according to quartile distribution.

Before the analysis, all variables were tested for missing values due to non-response. Even though no specific items were missing for the different questionnaires applied, the proportion of missing values was higher through the last questionnaire questions, with missing values varying between 0 and 33.5% (i.e., responses relative to eating habits) (Table 1).

Table 1 Absolute (n) and relative (%) frequency of missing values

	Missing values n (%)	Complete responses
Esports training (minutes per day)	0 (0.0)	316
Esports training (minutes per day)	0 (0.0)	316
Number of competition days during a month	0 (0.0)	316
Having an esports team	0 (0.0)	316
IGDS9	0 (0.0)	316
Distress Screener	85 (26.9)	231
GSQ	97 (30.7)	219
PROMIS-SD	100 (31.6)	216
AUDIT-C	102 (32.3)	214
Eating habits	106 (33.5)	210

Since the questionnaires in the present study were health-related, any imputation missing values were performed. Still, to avoid sample bias, a sensitivity analysis of missing values was conducted to proceed with missing values elimination. Dichotomic variables (missing vs non-missing) values were created and tested against variables related to esports practice (i.e., esports training minutes per day and minutes per week, and the number of esports competitions per month), with independent t-test for continuous variables and contingency tables using chi-square for categorical variables. There were no differences between missing and non-missing values ($p>0.05$), except for esports training minutes per day and PROMIS-SD ($p=0.04$) and AUDIT-C ($p=0.03$), and esports training minutes per week and eating habits ($p=0.01$)

Chi-Square Test was used to examine associations between dependent (i.e., alcohol misuse and poor eating habits, gaming disorder, distress, anxiety and depression, and sleep disturbance) and independent variables (i.e., hours per day and hours per week of esports practice, number of competitions per month and being part of an esports team). A significance level of 0.05 was considered.

RESULTS

Demographics

There were 210 valid responses after the elimination of non-complete responses. The final sample included 206 (98.1%) male participants with a mean age of 28 ± 8 years. Most participants were portuguese (n=201, 95.7%) (Table 2).

Table 2 Sample characterisation

		n (%)
Gender	Male	206 (98.1)
	Female	4 (1.9)
Education	Did not study/finish any level	1 (0.5)
	Elementary school	3 (1.4)
	Non-academic degree	51 (24.3)
	High school	99 (47.1)
	University	56 (26.7)
Sports-registration status	Never been registered	55 (26.2)
	Registered in the past	137 (65.2)
	Still registered	18 (8.6)
Body Mass Index	Underweight	4 (1.9)
	Healthy weight	116 (55.2)
	Overweight	65 (31.0)
	Obesity Class 1	20 (9.5)
	Obesity Class 2	5 (2.4)
Esports practice remuneration	Non-remunerated	199 (94.8)
	Remunerated	11 (5.2)
Level of esports competitions	National	125 (59.5)
	International	8 (3.8)
	Both	77 (36.7)
Be part of the esports team	Yes	134 (63.8)
	No	76 (36.2)
The practice of other videogames	Yes	171 (81.4)
	No	39 (18.6)

Most participants do not receive remuneration for their participation. Still, 63.8% were part of an esports team, mainly competing in national circuits. The characterisation of participants' esports participation, including time spent on esports training and competitions (i.e., esports exposure), is shown in Table 3. Besides, participants report a median of 300 (IQR = 360) minutes per day sitting at work. Only 26.2% (n=55) spent less than 75 minutes per day sitting, with most (n=69, 32.9%) spending between 75 to 300 minutes sitting while working daily.

Table 3 Reported exposure to esports participation

	Median	IQR	Q1	Q3
Esports training (minutes per day)	180	90	120	210
Esports training (minutes per week)	750	480	600	1080
Number of competitions per month	8	8	4	12

Legend: IQR – interquartile range, Q1 – first quartile, Q3 – third quartile

Symptoms of mental health problems

The prevalence of symptoms of mental health problems (i.e., gaming disorder, distress, anxiety/depression, sleep disturbance, alcohol misuse, and poor eating habits) in eFootball players are shown in Table 3

Table 4 Prevalence of symptoms of mental health problems in eFootball players

Symptoms of mental health problems	Prevalence [n (%)]
Gaming disorder	Yes 4 (1.9)
	No 206 (98.1)
Distress	Yes 38 (18.1)
	No 172 (81.9)
Anxiety and depressive symptoms	Yes 100 (47.6)
	No 110 (52.6)
Sleep disturbance	Yes 122 (58.1)
	No 88 (41.9)
Alcohol misuse	Yes 61 (29.0)
	No 149 (71.0)
Poor eating habits	Yes 145 (69.0)
	No 65 (31.0)

Only 4 players (1.9%) might have a gaming disorder, with 18.1% (n=38) reporting distress, 47.6% (n=100) having symptoms related to anxiety/depression and 58.1% (n= 122) reporting sleep disturbance. Most eFootball players reported no alcohol misuse (n= 149, 71.0%), but most showed poor eating habits (n=145, 69.0%).

Contrary to our preliminary hypothesis, no associations existed between exposure to esports participation and symptoms of mental health problems, as shown in Table 5.

Table 5 Association between exposure to esports practice and symptoms of mental health problems in eFootball players.

	Esports practice						Having an esports team	
	Minutes per day*		Minutes per week*		Competitions per month*		χ^2	p
	χ^2	p	χ^2	p	χ^2	p		
Distress	3.63	0.30	2.57	0.46	3.81	0.28	1.47	0.22
Anxiety and depressive symptoms	2.09	0.56	0.55	0.91	0.24	0.97	1.91	0.17
Sleep disturbance	3.83	0.28	3.03	0.39	7.44	0.06	0.84	0.36
Alcohol misuse	3.40	0.33	3.14	0.37	3.97	0.26	0.95	0.33
Poor eating habits	0.65	0.88	3.62	0.31	4.65	0.20	2.89	0.09

*Stratified following quartile distribution.

DISCUSSION

In the present study, even with a reported low prevalence (i.e., 1.9%, n = 4) of gaming disorder symptoms, the prevalence of distress, anxiety/depression and sleep disturbance was relevant. Overall, 18.1% of players showed signs of distress, 47.6% reported symptoms of anxiety/depression, and 58.1% reported sleep disturbance. Despite 71.0% of the players having no alcohol misuse, a large proportion had poor eating habits (69.0%) on and spent considerable time in sedentary activities (i.e., sitting time at work and esports

exposure). Regardless, there was no association between symptoms of mental health problems and exposure to esports participation.

Prevalence of symptoms of mental health problems

The World Health Organization mentioned that “only a small proportion of people who engage in digital- or video-gaming activities might have a gaming disorder” [20], which is in line with the results presented here. Despite eFootball players reported spending around 3 ± 2 hours per day practising esports, less than 2% were identified as potentially having a gaming disorder. Like other performance dependence activities (e.g., musicians, athletes), esports exposure might depend on the time needed to improve gaming skills or spent in esports competitions rather than time spent due to gaming obsession or addiction [14, 31]. Yet, since there is no consensus on when exposure to esports might become problematic [32], careful consideration and characterisation of the time spent with esports participation that is needed to improve esports performance against what is considered excessive is essential.

As regards the other symptoms, when compared with the general population [33, 34] and former athletes [18, 35], the prevalence of distress was similar. Still, anxiety and depression symptoms, and sleep disturbance, were considerably higher in eFootball players, as already found in previous studies that compared esports and non-esports players [36]. The prevalence of distress found might be justified because most participants have a non-remunerated practice, despite being part of an esports team. Recent studies on professional esports players have associated esports with several internal (e.g., communication issues, lack of shared team goals) and external (e.g., event audience, media interviews) stressors [37]. Noteworthy, almost half eFootball players (47.6%) showed symptoms of anxiety/depression. It is worth mentioning the high prevalence of symptoms of anxiety/depression in the adult population in Portugal, with anxiety and depression disorders being in the top 10 of the leading causes of disability-adjusted life years [38], and this

is a possible justification for the high prevalence found in our study. Recognizing that eFootball players, even with no professional stressors, already experience distress, anxiety and depression symptoms will be critical to promote and endorse players with strategies to better cope with mental health symptoms and mental health problems [15, 37, 39].

Moreover, since the competitive nature of esports resembles the traditional sports competitive environment, even with no association between distress, anxiety and depression, and esports exposure, esports players might also be vulnerable to distress related to performance pressure, other physical and mental problems or stressful life events or intrinsic factors (e.g., maladaptive perfectionism), and manifest anxiety and depression symptoms [18, 40, 41]. Additionally, knowing that anxiety symptoms have been associated with impaired cognitive performance and overall functioning in general populations and elite athletes, poor performance could also predispose to increased symptoms of mental health problems, even with no diagnosis of mental health problem [41]. For all the above, having mental health professionals being part of the clinical structure of esports teams might be important to give players strategies to deal with interpersonal problems, athlete-family-team relationships, arousal and anxiety, conditions that are common in a competitive environment, ultimately aiming to enhance esports performance [42].

A large proportion of players reported having sleep disturbance (i.e., 58.1%). This is in line with previous research describing esports players' daytime dysfunction, increased daytime sleepiness, problems falling asleep and insomnia, exacerbated during competitions [36, 43-46]. In esports players, sleep quality was found to be significant positive predictors of mental ill health [39]. Likewise, sleep disturbance might be more prevalent in people already presenting mental health problems while also acting as a risk factor for mental health problems [47]. Indeed, sleep disturbance is associated with an increased risk of cardiovascular disease (e.g., hypertension, stroke), endocrine problems (e.g., diabetes, obesity), and cancer [48, 49]. Thus, to

improve the overall well-being of esports players while preventing short and long-term consequences of sleep disturbance, a better clarification of the causes and risk factors of sleep problems in this population is crucial to improve esports players' health. As well, esports stakeholders (e.g., coaches, team directors, event promoters) should be aware of sleep disturbance in esports so they too could have adequate esports training and competition calendar, equipment and facilities (e.g., screen devices, light sources), aiming to minimize the adverse consequences on sleep and, consequently, on esports performance [7, 32].

In the current study, 29.0% of players were at risk of alcohol misuse. Alcohol consumption in Portugal is among the highest worldwide, with 73.6% of the Portuguese population aged 15 to 64 years reporting alcohol consumption [50]. For the WHO, “no level of alcohol consumption is safe for our health”, which denotes the risks and harms associated with drinking alcohol [51]. Indeed, eFootball players reported poor nutrition habits, with a small group of participants in the current study being obese (n=25, 11.9%) and having problems with potential health consequences in the future [5]. Adding to sitting time due to esports exposure, 59.1% spent more than 300 minutes per day sitting while working. Increased time spent in sedentary activities is another public health problem that also has been associated with health risks for the general population [52]. Thus, helping prevent and manage alcohol misuse, poor eating habits and obesity, and other forms of sedentarism will positively impact esports players' overall health and might prevent the presence of chronic health problems in the future. Given the rising influence that esports players have on adolescents and young adults, health literacy and the spread of adequate health prevention strategies, including adequate lifestyle habits, could have a public health impact and could be a new way to access and promote adequate health care and literacy for esports players and followers [7].

Symptoms related to common mental problems and exposure to esports participation

Contrary to our preliminary hypothesis and previous studies including esports players from different backgrounds (i.e., esports modalities, different countries) [53], symptoms of mental health problems were not associated with exposure to esports participation.

Our findings defy previous beliefs based mostly on anecdotal evidence or inferred from studies on gamers and recreational video game practice. For instance, esports practice has been associated with internet gaming disorder and other forms of addiction because players engage in prolonged online gaming; yet, as also found in the present study, esports players showed no functional impairment [32, 54]. Still, in line with our results, mental health symptoms, such as stress, anxiety, and depression, have been described in esports participants, and discussed to affect performance and health outcomes [15, 37, 44]. As happens in traditional sports, mental health symptoms might be common and significant because of the variety of stressors related to team-related problems, performance and media impact of competitions [55], mental health symptoms might be common and significant. Still, the pattern of mental health symptoms might be insufficient to meet specific diagnostic criteria for mental health problems [15]. Yet, even with no specific diagnosis, mental health symptoms related to esports exposure could cause significant distress, functional impairment or even impact esports performance [37, 55]. Besides, distress and anxiety symptoms in eFootball players have been linked and proposed to prompt maladaptive coping mechanisms, ultimately leading to symptoms of mental health problems [15], symptoms that we found to already be prevalent in the studied population (e.g., sleep disturbance, poor eating habits). In addition, special attention should be given to those players that, even competing at higher levels, are non-professionals and have other lifestyle commitments (i.e., work) that could induce stress, anxiety and depression symptoms and could exacerbate health problems related to esports practice, and vice-versa [32]. Opening the

conversation about mental health symptoms and mental health problems in the esports context might be important to destigmatise this public health problem while helping overcome difficulties that esports players might have to seek adequate help and identify potential problems faced, especially when becoming professional players [56]. Moreover, knowing that initial research about mental health problems in esports might be biased by that occurring in recreational gaming, further research distinguishing mental health problems and symptoms occurring in esports players rather than recreational players are important, to focus on the real impact of exposure to esports participation on mental health problems. As noted, contrary to empirical notions about gaming disorders and esports, gaming disorders might not be common in esports players.

Strengths and limitations

The present study aimed to analyse the prevalence of symptoms of mental health problems and their association with exposure to esports participation in a sample comprising eFootball players, thus been a complementary evaluation on a previous study about mental health symptoms in eFootball players. Having information on health problems that players are already experiencing and their association with esports participation are needed, especially to promote the discussion about what should be adequate health support in the esports context. Thus, knowing that there are differences between playing in distinct gaming platforms, modalities [32] and competition levels [31], a sample comprising only esports players from the same modality, rather than players from different modalities, could be a starting point. Besides, eFootball is an esports modality related to sports and players are starting to integrate traditional sports teams, sharing the same sports medicine teams for health prevention and management. Hence, the present study gives new insights into the needs of esports players, such as promoting mental health. Mental health prevention has also been a current

topic in sports-related research. Strategies used in sports contexts might also have a role in esports players due to the competitive nature of esports.

In the current study, previously validated tools were applied to investigate the prevalence of mental health problems' symptoms in esports players. The same tools were previously used to study both traditional sports athletes and are frequently used in the general population. Yet, those tools were never tested in esports, which could be subject to several potential issues. One such is that some of the employed tools were designed for screening purposes, not for diagnosis. Additionally, using self-report instruments might be affected by social desirability and recall biases. Moreover, generalizability and representativeness could not be made since we used a convenience sample.

Finally, mostly because of the questionnaire length, a considerable proportion of missing data can be attributed to drop-out. Missing data is common in questionnaire-based surveys and can reduce the representativeness of the selected sample, increasing bias and loss of precision, efficiency, and validity [57]. Thus, careful handling of missing data with a sensitivity analysis was performed.

CONCLUSION

Esports players experience symptoms of mental health problems, even with no association found with exposure to esports practice. The results presented here provide new insights into the mental health of esports players, providing new frameworks that could be applied in further studies comprising esports players. Like other traditional athletes, esports players would benefit from mental health support with a preventive and management perspective, integrating esports players' needs. Additionally, this support will help managers and professional teams develop sustainable strategies, aiming for esports players' growth and development while keeping their health in mind.

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CHAPTER VII.

Mental health symptoms in eFootball players

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ABSTRACT

The escalated competitive pressure and professionalisation of esports players could predispose them to mental health symptoms. We aimed to develop a model to explore the association between distress and anxiety/depressive symptoms and potential associations between adaptive or maladaptive coping strategies, sleeping disturbance, alcohol consumption, and eating habits in eFootball players.

The present exploratory cross-sectional study includes the Distress Screener, GHQ-12, Brief-COPE, PROMIS-SD, AUDIT-C, and a set of questions regarding eating habits. A two-step robust maximum likelihood method of the Structural Equation Modelling approach was used.

Both measurement model [$\chi^2/df = 1065.04 (637)$, $p < 0.001$; TLI = 0.91, CFI = 0.92, SRMR = 0.07, and RMSEA = 0.05; 95% Confidence Interval (CI) (0.043, 0.053)] and hypothesized structural model [$\chi^2/df = 1131.98 (648)$; $p < 0.001$; TLI = 0.90, CFI = 0.91, SRMR = 0.07, and RMSEA = 0.05; 95% CI (0.054, 0.06)] showed an adequate fit to the data. Stress was positively related with depression and anxiety symptoms. Only anxiety symptoms were linked with coping strategies. Maladaptive coping strategies were related to sleep disturbance, alcohol consumption and poor eating habits, whereas adaptive coping strategies were associated with less sleep disturbance, reduced alcohol consumption and better eating habits.

An integrative approach to help eFootball players when early signs of distress are present might help avoid other mental health symptoms that interfere with players well-being and overall health. Additionally, adequate coping strategies to manage anxiety symptoms due to distress may help counteract potential negative consequences for lifestyles habits in eFootball players.

BACKGROUND

Esports are a worldwide phenomenon, with more than 2.7 billion video gamers [1] and an estimated global audience of 474 million people worldwide [2]. In esports, gamers compete in organised and regulated competitions of different games in a virtual, “electronic” environment with a specific goal/prize [2, 3]. However, rather than a recreational activity, esports players now aim for sponsorship, professionalisation and bigger competition rewards. That increases the pressure for better performances, which is exacerbated by the increased social and media impact of esports [3].

Like athletes from traditional sports [4], esports players need training and expertise of mental and physical abilities to succeed [5-7]. With the stakes rising in the esports scene, it has already been proposed that several factors could predispose esports players to experience several health-related problems, including mental health symptoms [3, 8, 9], that can hinder performance and well-being [10]. To note, mental health problems are major causes of morbidity and disability worldwide, with 322 million people being estimated to suffer from depression and 264 million from anxiety [11]. Stress, alcohol consumption, sleep problems and dietary risks are also risk factors that also account for the Global Burden of Diseases [12] and might predispose to other noncommunicable diseases (e.g., digestive diseases, cardiovascular diseases, diabetes, obesity or even cancer) [13,14]. According to the International Olympic Committee (IOC) consensus statement on mental health in elite athletes [15], “mental health symptoms are more common, may be significant but do not occur in a pattern meeting specific diagnostic criteria and do not necessarily cause significant distress or functional impairment”. However, even with millions of people involved directly or indirectly with esports practice, the scientific literature is still scarce on this topic.

Therefore, it will be important to understand the prevalence of mental health symptoms and coping strategies in esports players and their association. Preliminary evidence suggests that esports players may be at a risk to mental

health problems relatively to their traditional athletes' counterparts. For such the present study aimed to develop a model to explore the association between distress and anxiety/depressive symptoms, as well as sleep disturbance, adverse alcohol consumption and poor eating habits based on adaptive or maladaptive symptoms in electronic football (eFootball) players, an esports modality related to sports. We hypothesised (Figure 1) that in eFootball players, distress symptoms are positively related with depressive (Hypothesis 1) and anxiety symptoms (Hypothesis 2), and that both depression (Hypothesis 3) and anxiety symptoms (Hypothesis 4) are positively connected to maladaptive coping strategies and negatively related to adaptative coping strategies. Also, we hypothesised that maladaptive mechanisms positively associate with the outcome variables sleep disturbance, alcohol consumption and poor eating habits (Hypothesis 5). In contrast, adaptative mechanisms have a negative association with the outcome variables (Hypothesis 6).

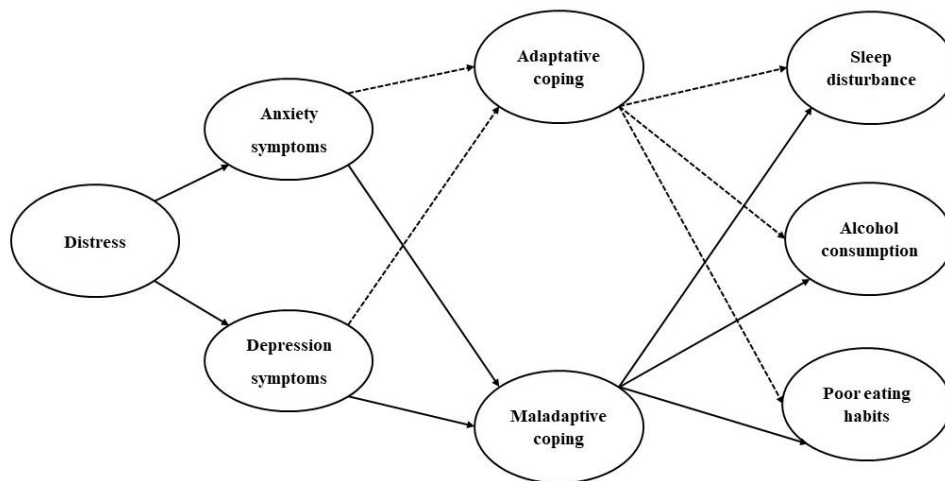


Figure 1 The hypothesised path model for the relationships between distress in eFootball players with anxiety/ depressive symptoms, coping strategies, and the outcome variables sleep disturbance, alcohol consumption and poor eating habits.

Note: positive paths in continuous lines and negative paths in dashed lines.

METHODS

Design

The current Structural Equation Modelling (SEM) study employed a cross-sectional design based on a structured online survey comprising the Distress Screener [16], the 12-item General Health Questionnaire (GHQ-12) [17], Brief COPE [18], the sleep disturbance domain of the Patient-Reported Outcomes Measurement Information System (PROMIS-SD) [19], Alcohol Use Disorders Identification Test Consumption (AUDIT-C) [20], and a set of questions regarding eating habits [21]. The measuring tools chosen were based on a previous investigation regarding the prevalence of common mental health symptoms in professional football players [22]. The Portuguese versions of GHQ-12, Brief COPE and AUDIT-C were employed, while previously translated versions (Teques P, Araújo D. Indicadores de Saúde Mental de Futebolistas Profissionais. 2019. XX Jornadas da Sociedade Portuguesa de Psicologia do Desporto) from the Distress Screener, PROMIS-SD, and a set of questions regarding eating habits were employed. A questionnaire to perform a sociodemographic characterisation, including questions related to esports practice and competitive status, was included; the procedures have been validated by the Portuguese Football Federation (FPF) Data Protection Office and the FPF Esports department. The study was approved by the Portugal Football Scholl Ethics Committee (CE PFS nº1/2021)

Study setting and participants

The study involved a convenience sample of eFootball players registered on the FPF Esports online platform. Registration on FPF Esports was a requirement to participate in the different esports tournaments and competitive events organised by the FPF Esports department. For that, only information regarding name, date of birth and contact e-mail were required, without the need to participate in esports competitions or keep up a determined FIFA EA Sports® rank.

All 9,099 eFootball players registered on FPF Esports in December 2019 received via e-mail an online survey, written in Portuguese, using SurveyMonkey®. The time to complete the full questionnaire was estimated to be 12-15 minutes. Participants younger than 18 years were excluded from the analysis.

Symptoms related to mental health problems and coping

Distress

The Distress Screener consists of 3 items (e.g., “During the past week, did you suffer from worry?”) scored between 1, if “never”, to 3, if “regularly or very frequently”. The score is obtained by summing up the answers for the 3 items. The presence of distress is assumed when a score of 4 or above is obtained [23].

Depressive and anxiety symptoms

Evaluation of symptoms related to anxiety (e.g., “Have you recently lost much sleep over worry?”) and depression (e.g., “Have you recently been feeling unhappy and depressed?”) in the previous 4 weeks was performed using the anxiety/insomnia and severe depression factors of the Portuguese version of GHQ-12 [24]. A Likert 4-point scoring method was used to calculate the total score, where the higher value represented more severe condition [25]. Following Goldberg and colleagues [17], scores higher than 2 were considered to establish the presence of anxiety /depression.

Adaptative and maladaptative coping

To assess situational coping strategies in eFootball players, the Portuguese version of Brief Cope [26] was employed. The Brief Cope is a self-report questionnaire with 28 items (e.g., “I’ve been refusing to believe that it has happened”) answered on a 4-point Likert-type scale (ranging from 1 = “I have not used this at all” to 4 = “I have used it a lot”). According to Carver [18], we used the 2 broad dimensions that cover the 14 scales of Brief Cope: 1) adaptive

coping strategies described as “active coping, acceptance, humour, religion, planning, positive reframing, and using instrumental and emotional support”, and 2) maladaptive coping strategies, such as “behavioural disengagement, denial, self-blame, self-distraction, substance use, and venting negative emotion”.

Sleep Disturbance

Patient-Reported Outcomes Measurement Information System comprises different validated person-centred measures to evaluate and monitor physical, mental, and social health in adults and children. Those measures, including validated translated versions, could be found online (www.healthmeasures.net). In the present study, PROMIS-SD [19] was applied to assess difficulties and concerns with getting to sleep or staying asleep, and perceptions of the adequacy and satisfaction with sleep [19,27] in the past 7 days. All 4 items (e.g., “My sleep was restless”) were responded to on a 5-point Likert Scale with 1 for “Not at all” and 5 for “Very Much”. Total score, ranging from 1 to 20, results from summing all 4 items. We considered a t-score higher than 50 as indicative of sleep disturbance.

Alcohol consumption

The 3-item version of the AUDIT (known as AUDIT-C) was used to screen for alcohol misuse [20]. AUDIT-C evaluates frequency and quantity of alcohol consumption and frequency of binge drinking, considering the total score the 1 obtained by summing up the 3 items, ranging from 0-12. Scores of 5 or more in men and 4 or more in women indicate a high probability of excessive alcohol misuse. Given the small proportion of women, the probability of excessive alcohol misuse was considered when a score of 5 or more was obtained.

Eating habits

Eating habits were evaluated using the questionnaire developed by Van der Veer *et al.* [21]. In their study, eating habits were assessed by asking how

many days per week the participant “eat healthy”, “eat regularly throughout the day”, “eat the meal before 10:00 AM”, and “eat the last meal before 8:30 PM”. We considered poor habits if the respondent regularly ate throughout the day, having breakfast before 10:30 and having their last meal before 20:30, less than 3 days/week.

Statistical Analysis

Descriptive data analyses for quantitative variables (e.g., age) were described by the mean (M) and standard deviation (SD). In contrast, categorical variables (e.g., preferred game, type of esports practice) were described using absolute (n) and relative (%) frequencies. The prevalence of variables under study was calculated using Wilson Score interval a 95% confidence interval (CI) and a t-score > 50 was use for maladaptive/adaptative coping, and a t-score > 50 for sleep disturbance. GPower 3.1 [28] was used to perform *a priori* power analysis. The required sample size was estimated to be 215 participants, based on the following input parameters: effect size $f^2 = 0.1$; $\alpha = 0.05$; statistical power = 0.95; and 5 predictors (i.e., distress, anxiety symptoms, depressive symptoms, adaptive and maladaptive coping). Non-descriptive data analysis was performed applying a two-step robust maximum likelihood method of SEM approach with IBM AMOS version 23 (IBM Corp., Armonk, NY) [29]. For such, the variables' quality adjustment to its indicators was analysed with Confirmatory Factor Analysis (CFA). To test the significance of the variables, direct and indirect effects, bootstrap resampling procedure (1,000 bootstrap samples) with 95% bias-corrected CI was used. An indirect effect was considered significant ($\alpha = 0.05$) if the 95% CI did not include zero [29]. CFA was used to evaluate the quality of the variable's adjustment in the Measurement Model. Four indexes were considered to estimate the local adjustment of the model to the data [29]. Comparative Fit Index (CFI) and Tucker–Lewis Index (TLI) > 0.90; Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Residual (SRMR) < 0.08. Additionally, to assess the model's global

adjustment, Composite Reliability (CR) ≥ 0.70 was used to evaluate the reliability and internal consistency, and Average Variance Extracted (AVE) ≥ 0.50 to evaluate each construct convergent validity. The discriminant validity will be assumed when AVE values are greater than the squared correlations between other constructs [29]. Additionally, to verify collinearity within all study variables, variance inflation factors < 10 were accepted to conduct regression analysis [29].

RESULTS

Participants

The online survey was fully completed by 292 eFootball players (response rate of 3.2%). The mean age was 27 ± 8 years (ranging from 18 to 72 years old), and 97.6% were men. Interestingly, 62.7% of the participants had been previously registered in a national sports federation, and 11% were still registered in a sports modality besides practising esports (Table 1).

Table 1 Sample characteristics

Variables		n (%)
Sex	Male	285 (97.6)
	Female	7 (2.4)
Nationality	Portuguese	280 (95.9)
	Other nationality	12 (4.1)
Education	Did not study/finish any level	3 (1.0)
	Elementary school	9 (3.1)
	Non-academic course	64 (21.9)
	High school	144 (49.3)
	University	72 (24.7)
Sports federation status	Non-registered	77 (26.4)
	Previously registered	183 (62.7)
	Still registered	32 (11.0)

Sample characterization regarding esports practice is shown in Table 2. The eFootball players mostly played *1 vs 1* and in *Pro-Clubs* mode, with 247 players using PS4 console. Even with only 6.2% (n = 18) being professional

eFootball players (i.e., they have eFootball as a full-time paid activity), 39.1% (n = 114) competed in international events and 54.1% (n = 158) were included in an esports team.

Table 2 Characterization of esports practice

Variables		n (%)
EA FIFA game mode*	1 vs 1	181 (62)
	2 vs 2	35 (12)
	Pro-clubs	182 (62.3)
Preferred game platform	PS4	247 (84.6)
	XBOX	15 (5.1)
	Personal computer	29 (9.9)
	Other	1 (0.3)
Type of esports practice**	Professional	18 (6.2)
	Recreational	274 (93.8)
Level of esports competitions	National	178 (61.0)
	International	11 (3.8)
	Both	103 (35.3)
Included in an esports team	Yes	158 (54.1)
	No	134 (45.9)
Practice of other videogames	Yes	233 (79.8)
	No	59 (20.2)

*More than 1 response was accepted; **professional practice = “My eFootball practice is remunerated”; recreational practice = “My eFootball practice is not remunerated”.

Preliminary analysis

Before applying a two-step robust maximum likelihood method of the SEM approach, a preliminary analysis was performed. Mardia’s coefficient (171.55) exceeded the expected values for the multivariate normality, leading to a Bollen–Stine bootstrap for subsequent analysis [31]. Additionally, variance inflation factors ranged from 1.05 (depression) to 2.24 (anxiety), showing acceptable conditions to conduct regression analysis [29].

Measurement Model

Mental health symptoms and coping strategies were prevalent in eFootball players. Almost a quarter of the participants demonstrated symptoms of distress and depression, and almost half of them presented sleep disturbance (Table 3).

The model showed convergent validity for distress, anxiety symptoms, and depressive symptoms and alcohol consumption ($AVE > 0.50$). In addition, all variables showed discriminant validity since the AVE of each latent variable was higher than the square of the correlations between all variables. Reliability was demonstrated for all variables ($CR > 70$), except for sleep disturbance and eating habits ($CR < 0.70$). Still, since those variables were theoretically important to the model, they were maintained. Means, SD, prevalence, squared correlations, reliability, convergent and discriminant validity among all scales used are shown in Table 3.

Regarding the correlation between variables, most of the variables were related to each other. Distress was related to all variables, showing a positive association with depressive symptoms, anxiety symptoms, maladaptive coping strategies, and the outcome variables sleep disturbance, alcohol consumption and eating habits, and a negative association with adaptive coping strategies. Depressive symptoms were only associated with anxiety symptoms, with no significant association for the other variables related to mental health symptoms. Conversely, anxiety symptoms were related to adaptive and maladaptive coping strategies, with significant positive associations with outcome variables. The two dimensions of coping strategies were positively associated. Adaptive coping was negatively related to sleep disturbance, alcohol consumption and poor eating habits. Conversely, maladaptive strategies positively associated with sleep disturbance but not for the other outcome variables. Similarly, no association between sleep disturbance and alcohol consumption was detected.

Table 3 Means, standard deviations, squared correlations, reliability, convergent and discriminant validity among all scales.

	1	2	3	4	5	6	7	8
1. Distress	1.00							
2. Depression	0.03**	1.00						
3. Anxiety	0.57**	0.06**	1.00					
4. Maladaptive	0.23**	0.01	0.14**	1.00				
5. Adaptive	-0.01*	-0.01	-0.06**	0.17**	1.00			
6. Sleep disturbance	0.10**	0.01	0.14**	0.03*	-0.05**	1.00		
7. Alcohol consumption	0.02*	0.01	0.05**	0.01	-0.03**	0.01	1.00	
8. Eating habits	0.05*	0.01	0.04**	0.01	-0.02*	0.04**	0.14**	1.00
% (CI_{95%}) / t-score	22.2 (17.8-27.3)	37.1 (31.9-43.0)	38.0 (32.6-43.7)	41.5 (35.9-47.1)	51.0 (45.3-56.7)	45.2 (39.6-50.9)	25.3 (20.6-30.6)	26.3 (21.6-31.5)
AVE	0.66	0.75	0.59	0.32	0.31	0.46	0.54	0.32
M	0.68	1.30	0.73	1.17	1.92	3.55	1.09	4.52
SD	0.64	0.78	0.74	0.57	0.55	0.86	0.76	1.39
CR	0.85	0.94	0.89	0.72	0.76	0.52	0.76	0.63

* p < 0.05, ** p < 0.01; Abbreviations: %, prevalence of mental health symptoms; AVE, average variance extracted; CR, Composite reliability; M, mean; SD, standard deviation.

The assessment of the measurement model included distress, anxiety symptoms, depression symptoms, coping strategies, sleep disturbance, alcohol consumption and poor eating habits as latent variables. The assessment of the measurement model showed an adequate fit to the data [$\chi^2/df = 1065.04 (637)$, $p < 0.001$; TLI = 0.91, CFI = 0.92, SRMR = 0.07, and RMSEA = 0.05; 95% CI (0.043, 0.053)]. Considering these results, we proceeded to test the hypotheses.

Structural model

The hypothesized structural model (Figure 2) demonstrated an acceptable fit to the data [$\chi^2/df = 1131.98 (648)$, $p < 0.001$; TLI = 0.90, CFI = 0.91, SRMR = 0.07, and RMSEA = 0.05; 95% CI [0.054, 0.06)]. According to our hypothesis, variables related to mental health symptoms were associated with each other, and between all dimensions of coping strategies, excluding symptoms of depression and maladaptive and adaptative coping strategies. Distress was positively related to symptoms of depression and anxiety. As expected, anxiety symptoms were positively associated with maladaptive coping strategies and negatively associated with adaptative coping strategies, that is, coping is a form of confrontation with anxiety symptoms. While adaptive coping strategies were negatively related to sleep disturbance, alcohol consumption and poor eating habits, a positive association with maladaptive coping strategies and the outcomes variables were detected. The model proposed accounted for approximately 11%, 52% and 73% of sleep disturbance, alcohol consumption and poor eating habits, respectively.

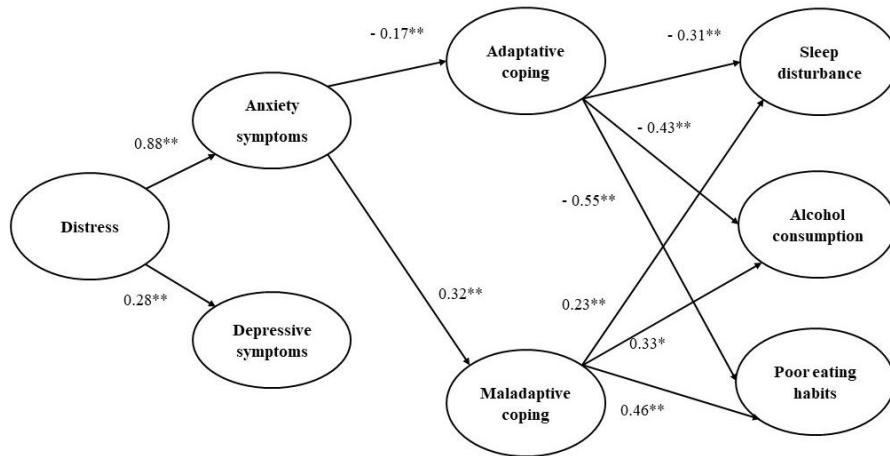


Figure 2 The hypothesised structural model for the relationships between distress in eFootball players, anxiety/depressive symptoms, coping strategies, and the outcome variables sleep disturbance, alcohol consumption and poor eating habits.

* Standardised path coefficients significant at the 0.01 level; ** standardised path coefficients significant at the 0.05 level. Non-significant paths were excluded for visual simplicity.

DISCUSSION

The present study aimed to describe the prevalence of mental health symptoms and coping strategies and how they are associated in a satisfactory sample comprising eFootball players exclusively. According to our *a priori* hypothesis, distress was positively related to depression and anxiety symptoms, but only anxiety symptoms were linked with active coping strategies. Adaptive coping strategies were negatively related to sleep disturbance, alcohol consumption and poor eating habits. Conversely, maladaptive coping strategies were positively related to sleep disturbance, alcohol consumption and poor eating habits.

Mental health symptoms

Distress, depressive symptoms, anxiety symptoms, sleep disturbance and poor eating habits were prevalent in eFootball players. Generally, athletes are vulnerable to mental health symptoms and disorders for factors such as stress related to their profession [32] and the type of sports practice (i.e., individual vs team sports), sports modality and various individual experiences (e.g., emotional, mental, physical and social experiences, etc.)

[15]. EFootball players may also face these factors in esports practice. Though mental health symptoms and disorders are prevalent in professional athletes, being similar [15] or even higher than the general population or former athletes [33]. In the present study, the prevalence of anxiety and depression symptoms in eFootball players were similar to the prevalence reported in football players (anxiety in 38% and depression in 37% vs 25-43%, respectively) [22]. Still, when compared with the Portuguese population [34] eFootball players showed a higher prevalence of mental health disorders. Notably, Portugal is the second European country with the highest prevalence of mental health disorders (23%), with anxiety being present in 17% and mood problems (i.e., depression symptoms) in 8% of the population [34].

Association between distress and anxiety/depressive symptoms

In line with previous studies [35-37], and according to our hypothesis, distress showed a positive association with both depression (Hypothesis 1) and anxiety symptoms (Hypothesis 2). A preliminary study on esports players concluded that different stressors pose significant challenges to the esports players; also, only those esports players who reported having higher levels of emotional control were able to reduce the intensity of the perceived stressor [35,36]. Hence, comparable to that happening in the traditional sports scene, the new opportunities to play at different professional levels can create more pressure, independently of esports participant's competitive experience [9]. That means that understanding risk factors for distress in this unique population could be key to minimise its consequences. Similarly, when distress is already present, the way esports players cope with anxiety and depressive symptoms might also have implications for their daily living.

Depressive symptoms and coping strategies

Contrary to our previous hypothesis (Hypothesis 3), no association was observed between depression symptoms and coping strategies. The results

differ from previous studies that proposed a relationship between the general distress response, depression symptoms and coping strategies [37,38]. Different factors, such as a sample comprising mostly man and younger adults, could have hindered the results obtained, since depression symptoms tend to be less prevalence in those populations. Further, comorbidity of depressive symptoms and state anxiety may be part of a general “psychological distress” response [37].

Anxiety symptoms and coping strategies

Anxiety symptoms were associated with coping strategies (Hypothesis 4), demonstrating a stronger association with maladaptive coping strategies than with adaptive ones. Individual predisposition to experience anxiety in a stressful situation and consequent coping styles could stimulate different responses to stressful conditions [15,37] in traditional sports and competitive esports players [10,35,39,40]. In line with Ntoumanis and Biddle’s study [40] coping strategies could be influenced by how athletes perceived anxiety to be facilitative or debilitating of performance. As traditional sports, being part of electronic sports competitive scene (i.e., esports team, competitive calendar, etc.) can also be perceived as challenging, threatening, or harmful (e.g., playing crucial competitions, coach-athlete conflicts, poor environment or internet conditions, and performance slumps), so appropriate coping skills are needed to deal effectively with situations that could increase anxiety symptoms, thus affecting, positively or negatively, esports performance.

Coping strategies, sleep disturbance, alcohol consumption and poor eating habits

Maladaptive coping strategies were positively associated with sleep disturbance, alcohol consumption and poor eating habits (Hypothesis 5), while adaptive coping strategies showed a negative association (Hypothesis 6). Two previous studies on esports players highlighted the link between coping mechanisms and mental illness. On a content analysis based on an

interview with 5 high-level competitive League of Legends players, emotional obstacles encountered by competitive gamers (e.g., ineffective attentional control, limited ability to regulate emotions, trouble performing under pressure, etc.) were related to the elements of optimal performance, such as inadequate coping strategies with anxiety symptoms [41]. In another qualitative study with 7 male esports players, the authors noted that despite the use of a range of different coping strategies, when in the presence of different stressors (e.g., external scrutiny and criticism, audience, media interviews, and problems with logistics), there was an overuse of maladaptive coping (i.e., avoidance strategies) [35]. In the present study, we showed that sleep disturbance, alcohol consumption and eating habits were linked with the capacity to cope with anxiety symptoms and were present in response to the individual coping mechanisms.

Coping strategies and sleep disturbance

Based on our results, the presence of sleep disturbance resulting from maladaptive coping strategies due to anxiety symptoms might be a comorbid situation associated with sleep problems [15,42]. The presence of sleep problems and disturbance due to inefficient anxiety control may impact esports performance and overall health. As such, sleep problems have been associated with athletic performance impairment across many sports [15]. Different studies acknowledge the presence of sleep problems in esports players [43-45]. Competition, which might induce distress and anxiety and previous stated, has been associated with sleep disturbance before competition and prolonged sleep onset and offset times [45].

Coping strategies and alcohol consumption

Poor mental health also seemed to be associated with alcohol consumption in athletes [42] and the general Portuguese population [34]. Factors such as the esports modality, competitive season, level of competition and extrinsic motivations for alcohol consumption (e.g., experimentation, self-esteem

improvement, alertness and energy improvement, team cohesion, etc.) [15] were associated with drinking problems in traditional sports. Still, they can also be a manifest of inadequate maladaptive coping strategies [15].

Coping strategies and eating habits

Adaptive coping (Hypothesis 6) and maladaptive coping (Hypothesis 5) were associated with different eating habits. Various studies suggested that psychological and emotional distress, including depression and anxiety, were associated with eating problems as an expression of maladaptive coping strategies [46,47]. Consequently, as stated for the sleep disturbance and alcohol consumption, attention to predisposing factors to unhealthy eating habits is needed. Thus, ineffective coping strategies might occur due to specific stressors and anxiety. The strategies used by esports players in different situations might contribute to various factors that might hinder esports practice and contribute to other lifestyle problems that may disturb esports performance (e.g., eating to suppress negative emotions, chronic stress) [46].

Practical implications

With the increasing number of esports players worldwide, we believe that health interventions focused on this unique population are needed to diagnose, manage properly, and monitor mental health symptoms for esports players' general health and performance. Likewise, awareness and open communications could avoid unpleasant consequences of improper coping strategies. Ultimately, it is vital to understand how those problems impact esports performance.

From what is known about athletes from traditional sports, ineffective coping mechanisms for common mental problems may have a negative impact on performance. However, given the association between distress, mental health symptoms, and coping strategies, interventions aiming to empower esports players to cope with different stressors could impact psychological well-being

and competitive esports performance. Various interventions have been proposed to improve adaptation to increased mental distress in athletes from traditional sports and be considered for esports players. First, interventions to promote emotional stability could help lower perceived distress intensity, potentially improving performance and quality of life [10]. Moreover, those strategies could have a long-term impact since psychological stress may impact behaviour and cognitive functioning [36]. Secondly, sleep disturbance has been associated with poor competitive performance, and the adaptation of strategies aiming at an adequate balance between rest and recovery (e.g., periodisation between practice and rest) might maximise adaptation to training and competition distress while reducing the likelihood of burnout or plateaus in performance in this population [48]. Likewise, interventions at early signs of anxiety symptoms in esports players could be important to minimise harmful alcohol consumption, mostly by intervening on the evicition of alcohol use to reduce distress and negative emotion. Likewise, the availability of more healthy snacks instead of comfort/fast food during competitive periods of expected distress and anxiety could be a first step to promote healthy eating habits in people engaged with esports and reduce compulsive eating during stressed and anxious moments [46,49].

Strengths and limitations

Limitations should be considered for this study, especially to enhance future studies on esports players. First, given the study design, causal relations and the findings' application to other contexts should be taken with caution. Here, we showed a theoretical model, based on Lazarus and Folkman's (1987) [50] cognitive-relational theory of emotion and coping, about the association between mental health symptoms and coping strategies, so different models and paths could be studied. Notably, it is important to state that the proposed model refers to variance average. Future studies, especially those with a longitudinal design, could be important to more robust interpretation of the results showed. Also, the study had a cross-sectional design, and

generalisation and external validity might be compromised. Additionally, a convenience sample could predispose to selection bias [51], thus compromising generalizability. Moreover, with the present design, where we sent the survey to all registered eFootball participants, despite being currently playing, there is no possibility to compare those who participate in the study, from those who did not. Probably, those who had more interest in mental health were the ones that chose to fulfil the formulary. This fact might also contribute to a low response rate. For such, prevalence estimates of mental health problems in this sample could be relevant to understand this specific sample given the novelty of the present study in esports research.

Therefore, future research on how distress within esports players impacts both health problems (e.g., anxiety) and outcome behaviours (e.g., alcohol consumption) through time could add important insights on short- and long-term consequences of esports practice. Additionally, studies performed with a broader sample comprising esports players from different esports modalities (e.g., MOBA, FPS, etc.), and comparisons between esports competition rank or professional status may add interesting insights on how to conduct further analysis and interventions for specific consequences of esports practice at higher levels. Given that different game types vary in their basic structural characteristics and gameplay, it is reasonable to assume that psychological symptoms related to different game types might also differ.

Second, we used self-reported questionnaires, and the external validity depends on the accuracy of the responses. It is known that questionnaires responses tend to underestimate problems (e.g., depression) and behaviours (e.g., alcohol consumption) with a negative connotation while overestimating positive ones. Additionally, the response rate was low; so close collaboration with the support staff of esports teams and team managers to promote participation in scientific investigations could be the first step to reach this population.

Third, there is no precise measurement tool to evaluate distress, specifically in esports settings. In the present study, the real cause of distress could not

be defined. Though, future studies should address the specific environmental constraints of the game to examine their impact. Additionally, we only classified coping strategies as adaptative or maladaptive. Still, we are aware that capturing other dimensions of coping would be appropriate because a dichotomic characterisation of coping may not adequately reflect the coping process's conceptual structure. Future research should include other forms of coping related to the esports scene.

CONCLUSION

This first-time study conducted in eFootball players demonstrated that mental health symptoms were present in eFootball players, especially for sleep disturbance and depression symptoms. Additionally, those symptoms were related. Distress was associated with both anxiety and depressive symptoms. Moreover, adaptive coping strategies related to anxiety symptoms might be relevant to counteract the negative consequences on lifestyles habits, such as sleep disturbance, alcohol consumption, poor eating habits, in people engaged with esports. In our exploratory model, distress demonstrated a stronger association with anxiety symptoms. Conversely, anxiety symptoms were linked to coping strategies and showed a stronger association with maladaptive coping. Poor eating habits were the outcome variable more associated with active coping, followed by alcohol consumption. Thus, preventive measures on the distress pathway will be important to enhance health-related parameters in esports players.

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CHAPTER VIII.

General discussion and conclusions

In this general discussion:

The main findings of Chapter II to VII are discussed, following the current knowledge about health-related parameters in esports players. Indeed, the main results from the studies included in this thesis are compared with what is known from the general population and athletes from traditional sports. Within this chapter, a brief discussion of the strengths and weaknesses of the separate studies is also developed. This chapter also includes a discussion on the practical implications of the main findings for future research and the healthcare support of esports players. Considerations and recommendations for those working with esports players and those aiming to understand more about this unique population are presented. Finally, the main conclusions from the outcomes of the studies included in the thesis are drawn.

What are the main findings in the current thesis?

This thesis includes six studies developed to describe and characterise health-related parameters in esports players, ultimately improving the understanding of esports players' needs regarding their health. Indeed, it aims to foster adequate healthcare strategies for those working closely with esports players (e.g., coaches, medical staff, esports managers) and esports players themselves.

Hence, this thesis presents a baseline description of the current state of knowledge regarding health-related parameters in esports players through Chapters II to IV. Then, considering the two main topics related to esports players' health, Chapters V to VII study the prevalence of health behaviours and symptoms of health problems in players from a specific sports-related esports modality (i.e., eFootball). Afterwards, considering the findings of Chapters II to VII, Chapter VIII addresses the practical applications of the findings for the support given to esports players and the future challenges that health providers and researchers working with esports players might find.

The main results found in Chapters II to VII are as follows:

Chapter II

Esports are growing within the sports context, and exercise and sports experts are called to support and study the health-related consequences of esports participation and exposure so that proper healthcare support can be given to esports players. This chapter presents novel arguments about the role of sports and exercise medicine experts to lead the discussion about the healthcare support of esports players. The viewpoint confronts several arguments in light of the potential consequences of competitive and professional participation in esports, such as increased pressure, musculoskeletal or mental health problems, besides the inherent health-related consequences of gaming (e.g., increased sitting time, screen time), defying the early perception of "sedentary players".

Chapter III

Despite being a relatively new phenomenon, different health-related parameters have already been disclosed in esports players. The main topics studied regarding esports players' health and well-being are lifestyle habits, exercise and physical health, body composition, esports exposure, physiological demands, and musculoskeletal and mental health. Remarkably, generally, esports players have satisfactory lifestyle habits, including an active daily routine, and no major health problems or injuries related to esports participation. Besides the positive impact of esports participation on neurological function, mental health symptoms (e.g., stress, anxiety, depression, sleep problems) have already been reported in esports players from different esports modalities. Hence, supporting clinical staff should be prepared for health problems in esports players so proper prevention strategies, treatment and management can be taken.

Chapter IV

When interviewing members of the Portuguese FIFA EA Sports® eFootball national team (i.e., five elite electronic football players, one world-class electronic football player, two national team coaches, and two members of the esports department), two main factors affecting esports players' health were highlighted – physical and mental health. In line with the previous two chapters, esports participation was discussed to have an impact (i.e., positive, and negative) on mental health and physical health, for which four preventive strategies were proposed. From the four most discussed strategies, the role of physical activity was emphasised for both mental and physical health prevention and management. Indeed, players and staff members largely discussed the mental health consequences of esports participation.

Chapter V

The role of physical activity in esports players' health has been demonstrated in recent literature and noted by players and staff members. When studying

the physical activity levels of eFootball players, surprisingly high physical activity levels were reported, sufficient to accomplish the recommendations proposed by the WHO. The main reasons reported by eFootball players for performing physical activity was improving overall health and fitness rather than improving esports performance. Possibly due to the current stakes of the development of esports, most eFootball players reported being responsible for their physical training, with only a few resorting to sports and exercise professionals.

Chapter VI

Given the impact of mental health in the esports context, when analysing the prevalence of symptoms of mental health problems in eFootball players, a considerable proportion of eFootball players already suffer symptoms of distress, anxiety/depression, and sleep disturbance, despite having no symptoms associated with gaming disorder, against previous anecdotal beliefs on esports players. Despite having no relevant alcohol misuse, eFootball players manifested poor eating habits. Still, symptoms of mental health problems were not associated with esports participation.

Chapter VII

Considering the prevalence of symptoms of mental health problems in esports players, to develop adequate strategies when symptoms of mental health problems are already present, an integrative model (following a Structural Equation Modelling) was tested in a sample comprising eFootball players. According to the proposed model, stress positively affected depression and anxiety symptoms. Anxiety symptoms were associated with coping strategies that, depending on being maladaptive, were associated with sleep disturbance, alcohol consumption and poor eating habits. In contrast, adaptive coping strategies were associated with less sleep disturbance, reduced alcohol consumption and healthy eating habits.

The health of esports players – what is the problem?

Esports are diverse in numbers and contexts; they are not a single activity but a group of video games in which participation is regulated and competitive. Each esports genre (e.g., first-person shooter, sports) and modality (e.g., Counterstrike®, FIFA EA Sports®) presents different and unique challenges [1]. Given the immense number of participants and followers, the presence of controlled and structured environments, social and public health impact, and social dependence [2, 3], esports became a fruitful area for developing scientific research. Indeed, from the economy, marketing, or social sciences to health and sports sciences, several areas are starting to elaborate on this phenomenon to promote a better understanding of this new era of players properly [4].

Chapter II explains the authors' perspectives on why there is a need to learn more about the health of esports players, presenting the main motives for developing the current thesis. Thus, it includes a point of view on the current inclusion and debate about esports within the major sports entities and the status of esports within a sports context, debating the grounds for including esports in the agenda of sports and exercise medicine experts.

Indeed, the viewpoint (Chapter II) also elaborates on the likely emerging health risks (e.g., mental health problems, physical injuries) related to esports participation due to its competitive nature and resemblance with traditional sports, its crescent professionalisation, and the significant dependence on performance achievements and high competition rewards, that are now a common reality for many esports players worldwide. The discussion continues by adding that there is a need for a better understanding of esports-specific demographics that could promote short- and long-term health risks, besides its impact on esports performance. As previously explained, putting aside the consideration (or not) of esports as "sports", different sports organizations and institutions are now including esports within their activities and agenda [5]. Those caring for esports players (e.g., medical doctors, psychologists, and exercise professionals) must have up-to-

date information to deal with health problems that might be more prevalent in esports players [3, 6]. Indeed, to promote and manage esports players' health, health professionals working with esports players might learn and replicate some of the support given to athletes from traditional sports while adapting similar diagnostic and measurement tools used in sports and competitive settings [7]. Most sports and exercise medicine professionals are capacitated to deal with the consequences of competitive participation, professionalisation and training in athletes from traditional sports [8]. As a result, sports and exercise medicine professionals should be part of the discussion on the emerging topics that should be promptly addressed in the esports context, such as forms of team communication and leadership, promotion of players' health and health literacy, the use of performance-enhancing substances and doping regulation, the legal framework of professional esports players and support for work-related injuries [9].

The panorama remains similar four years after initialising the project leading to the present thesis. Even with the crescent incorporation of esports into traditional sports agenda, the literature still misses several topics regarding esports and health-related problems in its population. Additionally, the health support currently given to esports players is not well-regulated and differs regarding esports modality, country, and teams [6]. Nonetheless, the paradigm about esports players has been changing, while emergent evidence is reckoning esports players' health profiles. For all the above, esports still deserves real sports medical attention.

What is known about the health of esports players?

To identify what is known about the health of esports players, in Chapter III, a scoping review is presented.

Scoping reviews were recently defined as:

"a type of evidence synthesis that aims to systematically identify and map the breadth of evidence available on a particular topic, field, concept, or issue, often irrespective of source (i.e., primary research,

reviews, non-empirical evidence) within or across particular contexts" [10].

Contrarily to systematic reviews, scoping reviews are not suited to evaluate questions of effectiveness, meaningfulness or feasibility [11] but primarily to exploratory purposes [12], such as to understand what is currently known about esports and health in scientific literature.

Since scoping reviews allow for more flexibility, including different sources of evidence [10], Chapter III identified many potentially relevant sources of evidence about health-related parameters in esports players [11]. Hence, choosing this methodology contributed to identifying the most studied topics related to esports and health, and served for familiarisation with the existing literature in this field. Besides, it gave the panorama on research designs frequently chosen in studies about esports, working as a guide for the generation of the following chapters comprising the present thesis.

Chapter III notes that until 2021, several articles have described health-related parameters (e.g., anthropometric evaluation, behaviours, and lifestyle habits) in esports players from different backgrounds and competitive levels. Esports exposure has been advocated to positively impact neurological function [4, 13], socialisation [14, 15], and undirecting, improving lifestyle habits [2] and as a form of health literacy [16]. On the other hand, health problems (i.e., mental health problems and physical health problems) have been discussed in esports players, some concerning esports exposure. Moreover, a description of the physiological demands of esports participation was also included.

When looking for the studies' aims of the included articles in the scoping review presented in Chapter III, evaluating mental health problems was the topic that incited more research (16 out of 33 articles included). There was no surprise, considering that esports players are commonly described as "cognitive players" [4]. Unpublished data following a brief search on PubMed (conducted May 10, 2023), using the same query and inclusion criteria of the scoping review on Chapter III, found 28 new articles published related to

esports and health. Mental health remained the main topic studied. Hence, studying health-related parameters in esports players, as noted in Chapters III and IV, would inevitably need to include the study of mental health problems in esports players (Chapters VI and VII).

Awareness of esports players' particular health needs, especially mental health, is key to promoting adequate care for people tangled with esports, including strategies from primordial prevention to treatment and rehabilitation [17].

Additionally, considering the brief research conducted in May 2023 (unpublished data), there were more studies regarding eating and nutritional habits and cardiovascular health in the esports population, which were lacking in the scoping review (from Chapter III). With the increased need to optimise performance and the known benefits of healthy eating habits for cognitive performance, including the evaluation of nutritional habits of esports players might be essential for improving esports players' health and, consequently, might be used to enhance esports performance [18]. Contrary to previous beliefs, esports players seem to have eating habits similar to the general population [19]. Still, the use of energy drinks might be higher than the rest of the population [19]. Energy drinks might increase performance, but their benefits have not yet been supported. Indeed, using energy drinks or other substances to improve performance is another topic needing further study to develop appropriate regulations on performance-enhancing substances used by esports players, complementing the already published anti-doping rules of the International Esports Federation [20]. Primarily, there is a need to characterise better the consumption habits of esports players, the motivations to do so, and what performance-enhancing substances have been usually offered to esports players and by whom. Then, clarification on the impact of those substances on performance is needed, so proper regulation of what could be considered doping could be made.

So far, the association between esports exposure and health problems has shown conflicting results. Thus, it is not a clear association. Nevertheless,

irrespective of being due to esports exposure, as shown in Chapter III, health problems already happen in esports players. Those might impair esports performance and well-being. Conversely, as mentioned by the participants in Chapter IV, impaired performance and well-being will also negatively impact mental health, so adequate care of mental health problems might help improve esports performance.

Moreover, the inclusion of esports on sports and health agenda has been noted with increasing arguments in the role of sports and exercise medicine professionals (e.g., medical doctors, exercise physiologists, and psychologists) [5, 21], reinforcing the view expressed in Chapter II. As noted in the scoping review (Chapter III), most studies regarding health and esports have been published in exercise, health, and psychology journals. In June 2023 [2023-06-21], according to the Web of Science® database, when using the same search strategy conducted in Chapter III, the "analyse results" tool showed that, currently, most published articles are included in the "sports sciences" category, being the top 3 publishers the *International Journal of Environmental Research and Public Health*, *Frontiers in Psychology* and *Frontiers in Sports and Active Living*. Indeed, considering "citation topic micro" categories, the top 3 are "Internet addiction", "Sports Psychology", and "Physical activity", reinforcing the increase interest of sports and exercise sciences to elaborate on esports.

As expected, being esports a relatively new topic in scientific research, the evaluation and characterisation of several health-related topics are still missing in the literature. For example, the incidence of physical and mental health problems is unknown. Likewise, clarification on concepts related to esports participation and identification of the differential characteristics of esports players are required. Besides, with increasing exposure to esports because of longer careers and professionalisation, new insights on the impact of esports participation might arise [22, 23]. Monitored health problems in professional esports players is needed, as the differentiation between health

problems present in esports players and health problems due to esports exposure.

Do esports players and staff members have a say in esports and health research?

With scientific research about the health of esports players in the beginning, it is essential to give players, and those working closely with them, a voice to know their thoughts on the esports players' health, their understanding of health, the factors of esports that might affect health and their suggested strategies to deal with the impact of esports participation. Esports players, esports coaches and team managers who are part of the inner circles of the esports ecosystem [24] would be the best experts to elaborate on the impact of esports participation on esports players' health. Giving players and staff members a say in esports and health will promote and best guide the following steps on health research and support, improving the effectiveness and quality of the healthcare given to esports players.

Hence, having Chapter IV in a thesis about esports and health seemed required. Discussing esports players' values, capabilities, preferences, and unique understanding of life, health and esports with health providers (e.g., doctors and sports scientists) could better clarify the best approach to improve the esports players' health [25].

Following Chapter III, the main themes found during the scoping review, namely lifestyle habits, exercise and physical health, body composition, esports practice, physiological demands, and musculoskeletal and mental health, were reinforced with the interviews analysed in Chapter IV.

To exemplify, "lifestyle habits" were discussed in Chapter IV in the superordinate theme "health definitions", and in "strategies to improve esports players' health", "exercise and physical health" were discussed in the subordinate theme "sitting time" and in the superordinate theme "strategies to improve esports players' health". "Esports practice" (as esports exposure) was included in the discussion about factors affecting physical and mental

health. Mental health was a central theme. Body composition and physiological demands were briefly discussed within other major themes. Esports players, classified as elite (i.e., players with competition-relevant tricks and performance achievements, competing at the international level and part of a national team) and world-class (i.e., players in the top 3–10 at a World Championships, within the top teams and achieving individual accolades, as the player of the year) expertise level [26], and staff members of a national esports team acknowledge that, when discussing the esports players' health, it is indispensable to talk about the positive and negative impact of esports participation on health, and about mental health and physical health. Indeed, considering the current support given to esports players, there are a few strategies to respond to the esports impact on health, with physical activity considered to have a crucial role in the management of the esports players' physical and mental health. Furthermore, esports players, all staff members working with esports players and other health professionals should work together to promote health and prevent the negative consequences of esports participation [27, 28].

Participants mentioned the importance of having good lifestyle habits to be healthy, and esports players generally express good health status and well-being and report good lifestyle habits [29, 30]. Esports players reported consuming few alcoholic beverages, have no smoking habits, and seem to be physically active [19, 30]. Although they reported mostly good eating habits, evaluating esports eating habits concludes that they might have unbalanced patterns and some nutritional deficiencies. Still, those were like the ones found for the general population [18, 19, 31].

In line with existing research, one of the four strategies mentioned to improve esports players' health is improving lifestyle habits. Besides having an active lifestyle, improved sleep (quality and quantity) and good eating habits were discussed to promote health and well-being, and to improve esports performance, which has also been discussed by the participants in the qualitative study presented in Chapter IV.

As noted in the interviews, exercise and being physically active are strategies players use to promote healthy habits, improve overall health, and counteract the impact of esports participation on mental and physical health, comparable to the results found in Chapter III. As also represented in Chapter V, esports players report to exercise regularly, sufficient to meet the WHO recommendations for physical activity [32].

The positive impact of physical activity and exercise have also been recognised to improve different areas of cognitive function (e.g., executive function, memory and processing speed), as demonstrated by epidemiological, neuroimaging and behavioural studies [33, 34, 35]. Specifically, acute and chronic interventions with physical activity positively affected cognitive function when studying adolescents and young adults [33], like most esports players. Single bouts of physical activity interventions positively affected attention and processing speed [36]. In contrast, chronic interventions (i.e., continuous physical activity over several weeks) increased processing speed, attention, cognitive flexibility, language and, especially, working memory [36]. Given that those skills were mentioned to be required to excel in esports and are also suggested to be increased with gaming, physical activity should be part of the esports training as a strategy to improve esports performance. Besides cognitive function, as acknowledged by the participants in the qualitative study (Chapter IV), physical activity and exercise also promote well-being by decreasing different symptoms of mental health problems (e.g., anxiety, depression, dysfunctional thought) and by increasing assertiveness, confidence, emotional stability, cognitive functioning, control or positive body image [35], that were discussed during the interviews as needed to be healthy and by minimising the effects of factors affecting the esports players health. As examined in Chapters IV, V and VI, esports players spend considerable time in sedentary activities. Still, given that a significant proportion of the sitting time might be due to esports exposure, it is necessary to understand the differences between esports-related sitting time and other forms of sitting time. In this specific population, sitting time might be work-related. Yet, even

performing a sedentary activity, esports players might not be more sedentary than the general population. According to the last Eurobarometer, 44% of the Portuguese and 41% of the European population spent more than 5.5 hours sitting daily [37]. More recently, globally, the median of mean daily sitting times was 4.7 (IQR: 3.5–5.1) hours across all countries with reports on sitting time. Based on the reporting sitting time in the studies comprising the scoping review (Chapter III), esports players spent 5.3 (3.5–8.0) to 7.7 ± 3.6 hours per day sitting. For domain-specific sitting time, the highest values were observed for sitting at work (approximately 4.3 hours/day) when compared with other domains (e.g., television or computer time) [38, 39]. Indeed, work-related sitting time might exceed 60% of total daily sitting, especially among workers between 18–29 years [39].

Sitting time was also discussed to exacerbate other problems associated with esports exposure, such as eye and musculoskeletal problems.

At the time of the data collection for the scoping review (Chapter III), there were no studies about eye problems in esports players. However, considering the impact of screen time on the occurrence of eye problems, esports players might be at risk of eye problems due to esports exposure and this risk was frequently mentioned in the interviews. After the publication of the scoping review (Chapter III), a small study with 50 top-tier players from mobile esports reported that 58% occasionally and 34% of the players frequently experienced eyestrain. In contrast, over 30% reported headaches while playing [40]. However, considering evaluations of 36 college students during a video game, gaming duration was not associated with eye problems. In the same group, the prevalence of eye problems such as refractive error and heterophoria was similar to the general population [41]. Yet, there might also be positive effects on visual capacity, being argued that professional esports players might have an increased visual perception field [42]. Because of the small sample sizes, conclusions cannot be made yet. Studies evaluating the incidence and controlling for confounding factors, such as screen time in other

activities due to mobile use, television vision or work-related screen time, are still lacking.

As Chapter III exposes, eight studies have discussed musculoskeletal health and function in esports players. According to the qualitative study (Chapter IV), physical health comprises physical function, having no musculoskeletal problems, and having no other diseases. Besides, musculoskeletal health is essential for function, mobility, working, and all aspects of life [43].

Previous studies on videogames reported that gaming for more than 3 hours a day might predispose to musculoskeletal problems, arguing that sitting time and repetitive movements while gaming would be important risk factors for musculoskeletal problems [44]. Even though not all studies proved an association between gaming and musculoskeletal problems, the most affected regions were the neck, shoulder and back [44], the same sites reported in esports players and mentioned in the interviews. When evaluating 50 elite mobile esports players, the neck remains the most referred pain site, followed by the fingers, back and head [40]. Still, the incidence of those problems is unknown. Other screen-based activities besides gaming, like computer work and smartphone use, that are also associated with repetitive movements, poor postures and prolonged sitting have been associated with musculoskeletal problems, which in combination might exacerbate the risk of musculoskeletal problems [44, 45]. Indeed, work-related exposure to screens, computer use and higher exposure to keyboard/mouse use increased the risk of musculoskeletal complaints, such as self-reported neck/shoulder or distal upper extremity symptoms (e.g., epicondylitis, tendinopathy/tendonitis in the shoulder, and hand, and De Quervain's syndrome) [46, 47].

Musculoskeletal problems are usually associated with pain and reduced function, besides negatively affecting mental health [45]. Indeed, the Global Burden of Diseases stated that occupational exposures leading to musculoskeletal disorders (e.g., low back pain, injury risk factors, noise) were responsible for the most significant disability-adjusted life years in the global population [48]. Additionally, they affect mental health besides sharing

similar risk factors for other chronic diseases like sedentary behaviour or poor eating habits [43].

Regarding mental health, esports participation was discussed by players, as in the literature, to have a positive and negative impact. Gaming might improve cognitive ability, which was corroborated in Chapter III for its impact on neurological function by improving mental flexibility, problem-solving ability, reaction time, and cognitive function.

On the other hand, esports participation has been noted to substantially affect mental health, with symptoms of mental health problems being reported in esports players. Additionally, mental health was one of the themes most discussed in the interviews and a crucial factor to be monitored and managed to improve the esports players' health. All players acknowledge that mental health professionals working with esports players are essential. Scientific literature, mainly by qualitative research, has reported that different factors related to esports participation, such as team-related issues and communication problems, would predispose to mental health problems [49, 50]. However, those described problems were not mentioned by the participants in the presented qualitative study (Chapter IV). Instead, the participants noted the importance of team support and the social impact of esports participation on mental health, which adds another positive effect of esports participation on health.

Differently, the pressure to perform and dependence on esports results, which might lead to stress, anxiety, depression, and burnout, were discussed in the interviews leading to Chapter IV.

For all the above, considering the crescent professionalisation of esports players, physical and mental problems associated with esports exposure theoretical will rise. As discussed in Chapter II and Chapter IV, the care used for working professionals and athletes from traditional sports could be adapted to esports players, especially those with a professional career. More studies monitoring injuries and health problems related to esports exposure are needed. Following the interviews, even with physical complaints, that are

mostly minor, esports players might not report them, but surveillance is needed. Hence, esports players should receive medical support comprising regular follow-ups and full medical check-ups to prevent or diagnose early problems such as overtraining injuries, burnout or other health problems [51].

Even sharing the same risk factors and complaints, and besides the crescent professionalisation of esports players, regulation on professional esports participation is lacking. Because of the previously mentioned similarities with athletes from traditional sports, occupational safety and health should also be a concern [52]. In esports players, the risk might be higher for mental health problems when compared with athletes from traditional sports because of the constant pressure to reach and maintain the highest performance standards (e.g., direct on-line contact with followers) and other risks such as violence (including online violence, corruption, cheating, and unregulated use of performance-enhancement substances) [52], besides not having structured health support, in most cases [23].

Additionally, most esports players are not exclusively professional esports players [53]. Considering the responses given by eFootball players to the question regarding their working situation in (unpublished) data collected for Chapters VI and VIII, from the 447 eFootball players that responded, only 3 (0.7%) were professional esports players, with 132 (29.5%) being students and all others having a professional career in other activity. Most players might combine esports participation with other school/working activities. Dual careers in sports have been discussed to have additional physical and mental health impact due to the need to adapt competitive participation and training along with work or with the educational system [51, 52]. Hence, as proposed to athletes from traditional sports with dual careers, cooperation between stakeholders, education, training, social and financial support, and employment are essential [51].

Considering the described health problems and risks of esports participation, as proposed to athletes from traditional sports, integrate esports players in

supporting structures comprising sport, educational, vocational and lifestyle systems and fomenting the dialogue between all staff members (i.e., researchers, physiotherapists, medical doctors, coaches, team managers) should be the base of the supported given [51].

Additionally, regulation of esports as a profession is needed so that players can access the same type of healthcare provision. On the other hand, with some clubs and international sports organisations integrating esports into their esports modalities [6], health professionals might need to be aware of the specific health problems that could be present in esports players so they can prevent and monitor those problems, mainly to prevent long-term problems associated with overuse. Improving access to health care was one of the main strategies proposed to improve esports players' health.

Given esports dependence on screens, more studies on the impact of esports exposure on the vision might be needed to adapt equipment (e.g., monitors) and to optimise competition calendars, as suggested in Chapter IV. Besides, in line with the examples of improvements to facilities and equipment given during the interviews (Chapter IV), improving work facilities (e.g., ergonomic workstation adjustments, forearm support), equipment, tools and controls, and fomenting workers' education and training are possible interventions that could be adapted to esports players [45, 46].

Where do physical activity and exercise fit in the esports world?

In sports and exercise medicine circles, discussions about esports inevitably go through the association between esports participation, sedentarism, and screen time [3]. Indeed, most arguments against esports inclusion within traditional sports refer to esports players' empirical lack of physical activity [3, 54]. Therefore, given the known health benefits of physical activity and, conversely, the consequences of a sedentary life, it was indispensable to evaluate the levels of physical activity of esports players when aiming to analyse health-related parameters in esports players (the primary goal of the present thesis). Physical activity is considered the oldest, cheapest, and

probably the most underused "medicine" [55]. Citing Sallis, "there is no better way to improve health and longevity" [56] – highlighting the importance of physical activity for preventing and managing common health problems and health in all population subgroups, regardless of age, sex, or environmental condition.

Throughout the current thesis, the importance of physical activity and exercise for esports players is recurrently recognised in several contexts. Specifically, physical activity is addressed when commenting on the rationale to embrace the discussion about esports participation in sports and exercise medicine field (Chapter II), when identifying existing literature that has evaluated the physical activity levels and sitting time of esports players (Chapter III), and when analysing the perception that players and staff members have about physical activity to improve the physical and mental health of esports players, besides the identification of sitting time as a factor affecting esports players physical health (Chapter IV). In Chapter VI, physical activity levels and motivations to be physically active were evaluated in a sample comprising eFootball players, thus complementing our knowledge about physical activity and esports players.

The results in Chapter V defy potential anecdotal perceptions of esports players as inactive people playing video games [2, 57]. Moreover, the findings of the present thesis corroborate the rationale to study esports and health, specifically from an sports and exercise medicine perspective (Chapter II). Together with mental health, physical activity is a central topic when discussing the health of esports participants. Interestingly, in this thesis, physical activity was discussed as a strategy to improve the health of esports players rather than a problem (as for physical inactivity) that needs to be addressed.

Generally, esports players meet the recommendations for physical activity proposed by the WHO for adults [32] and report having high physical activity levels [19, 29, 30], frequently higher compared to their country's general population, as also shown in Chapters III and V. eFootball players were no

exception. eFootball players reported even higher levels of physical activity than those in samples of esports players from different genres, as described in studies conducted after Chapter V [16, 18, 19, 30, 58, 59].

Nevertheless, as argued in Chapter V, the results should be taken carefully. Several factors might have contributed to the high physical activity levels found. For example, having a sample mainly comprising younger men playing esports from a sports genre would be a possible explanation for the high physical activity levels found [3]. Moreover, the relationship between esports from the sports genre, such as FIFA EA Sports® with sports has been argued to be a gateway to get the esports community (mainly comprising young people) more active or to raise their interest in physical activity [2, 16, 60]. Also, even using a validated and widely used questionnaire (IPAQ) [61], the results were based on self-reports that usually overreport positive and underreport negative behaviours. For instance, even though the included articles on the scoping review (Chapter III) related to physical activity levels also showed that esports players reported high levels of physical activity, when the evaluation of physical activity in esports players was performed using accelerometers, the esports players were significantly less active compared with the age-matched controls [18, 62]. Knowing that accelerometers may provide more reliable results than self-reported physical activity, studies using both questionnaires and accelerometers would complement this population's evaluation of physical activity [63]. Hence, future research that characterises physical activity levels might benefit from using other designs to improve the precision of evaluating physical activity levels.

As reasoned in Chapter IV, physical activity has been widely proposed to manage factors affecting esports players' physical and mental health. Additionally, participants mentioned physical activity as a part of most strategies used to work on the consequences of esports participation.

Different from the results found in Chapter V, where only 6% of the eFootball players reported doing physical activity to improve esports performance, and

39% agreed that physical activity has a positive effect on their esports performance, elite and world-class (as previously defined [26]) eFootball players and staff members of a national team, strengthen the importance of physical activity not only to improve overall health but also to improve esports performance.

Recently, the impact of physical activity on esports performance has started to be studied, with no clear association. For example, in a study evaluating players' performance within their esports (i.e., League of Legends®), short bouts of intense cardiovascular exercise (i.e., 15 min of high-intensity interval training) before esports participation positively impact cognitive performance based on target elimination and accuracy [64]. On the other hand, a study with 103 male and 16 elite female esports players between 16 and 35 years old found no significant associations between physical activity (evaluated using an activity tracker – LETSCOM Smart Band) and cognitive performance or cognitive resilience (using 3-dimensional multiple objects tracking test via Neurotracker X that evaluated division of attention, visual field performance at maximal speed, and 3D visual cues) [18]. In this case, since a simulation was used, not the game usually played by the participants, it could not represent the performance requirements [65]. In 2022, a systematic review aiming to evaluate evidence to support the role of physical activity or exercise on esports player performance, based on six articles retrieved until March 2022, concluded that most esports players believe in the positive impact of physical activity and exercise for esports performance, even though only a small proportion of players are doing it to improve esports performance [65].

Nevertheless, performing physical activity might capacitate players to manage the demands of the environment where training and competition take place (as discussed in the theme "Equipment and facilities" in Chapter IV), which might improve physical health and, indirectly, esports performance. Likewise, players from other esports also recognise the importance of physical activity and exercise (e.g., aerobic exercise) to help

them endure training and competition sessions [27, 65]. Media channels have promoted the potential role of physical activity in esports performance (improved concentration, perception and coordination) [57, 66].

Hence, although only a few studies are starting to evaluate the effect of physical activity on esports performance, and those showing different results, if not for the potential effect of physical activity on esports performance, physical activity might be essential for its known benefits for general health (as widely studied for the general population) and well-being. Also, physical activity might be performed to minimise the detrimental effect of esports-related sitting time [19, 67], as explained in Chapter IV.

As argued during the interviews analysed in Chapter IV, players might benefit from reducing the length of esports training and other forms of esports exposure to optimise performance. Indeed, as players suggested, physical activity might be a strategy to "unwind" from esports, improve performance, and promote overall well-being, mental health and physical health. Following the results in Chapter V, at least for eFootball players in Portugal, most players (i.e., 60%) reported being responsible for their physical activity training, and only 5% had their training planned by the team's physical coach/physiotherapist.

To help define a better structure for the health support given to players (e.g., offer physical activity training as part of esports training), monitoring of the exercise performed integrated in the esports training, rather than exercise performed with other goals (e.g., improve overall health), and a better characterisation of needs and motivations for physical activity and exercise is required [68]. This will promote the development of tailored interventions that might improve physical activity for health prevention and treatment options. Additionally, injuries related to exercise done for esports participation (as part of esports training and preparation) might require specific considerations for future monitorisation on the impact of esports on physical health (e.g., Is it an esports-related injury if it occurs while exercising for esports participation?).

As mentioned, esports players inevitably spend considerable time sitting [19]. Following the reported esports exposure of eFootball players (Chapter VI), eFootball players spend a median of 180 minutes (IQR = 90) per day and a median of 750 minutes (IQR = 750) per week training and report a median of 8 competitions (IQR = 8) competitions per month.

Although there are no time-based recommendations for sedentary time (e.g., time-based quantification or number or duration of bouts or breaks of sitting time), there is (moderate) evidence that increased sitting time increases the risk and incidence for all-cause cardiovascular disease and cancer mortality and type 2 diabetes. That association might vary by level of moderate-to-vigorous physical activity [67].

Hence, restricting the sitting time to the minimum necessary will be another strategy to counteract the negative impact of sedentarism on esports players' health, as previously discussed [61, 67]. Notably, as reported in the studies from Chapters V and IV, eFootball players spent 320 minutes per day sitting (Chapter V), 150 minutes per day practising eFootball (Chapter V), and a median of 300 (IQR = 360) minutes per day sitting at work (Chapter IV). Other studies reported slightly higher esports exposure (i.e., time spent with esports training for a day or a week) [18, 19, 30]. As discussed in Chapter V, increased sitting time in this population might be part of the esports inherit requirements [19, 29], being esports players no more sedentary than the general population.

Highly active athletes can simultaneously be highly sedentary [61]. Interestingly, contrarily to athletes from traditional sports that, despite being highly active, have an off-training sedentary behaviour significantly higher than the general population (i.e., mean of 576 ± 136 minutes per day sitting corresponding to more +79 minutes per day compared with the general population) [61], esports players might spend most of their off-training time having an active behaviour [29]. Hence, to properly prevent physical problems associated with esports participation (as found in Chapter IV), the

characterisation of domain-specific sitting time might contribute to a better description of factors affecting esports players' health (Chapter IV).

For all the above, it is not surprising that esports participation, mainly associated with the sports genre, has been proposed to have an enormous potential for physical activity and health promotion, being argued that could be a strategy to reach a usually neglected population, improve the engagement on existing sports offerings, to be a new form of intervention for health literacy [6, 16].

Finally, there should be considered the proposed association between physical activity, sitting time and mental health, especially considering that mental health was the other major topic discussed in the present thesis [69, 70]. In line with the perception of participants participating in the qualitative study (Chapter IV), improving leisure-time physical activity might positively affect mental health [68]. Indeed, considering the promising role of aerobic and resistance exercise for mental health, tailored interventions of physical activity and exercise to manage and treat mental health problems, such as anxiety and depression [70], that were found in esports players might be a future option for managing esports players' health.

What about the mental health of esports players?

Parallel to physical activity, mental health was widely discussed in the current thesis chapters. Elaborating on mental health was deemed required considering the course of the present thesis and the previously discussed considerations about the mental health of esports players.

Dependence on the cognitive ability to thrive in esports and the competitive pressure to perform, which potentially will rise with the crescent professionalisation of esports (Chapter II), are only two examples of factors of esports participation discussed to affect the mental health of esports players. Besides, mental health is one of the main topics studied about the health of esports players, as for the positive effect on cognitive function and the risk of promoting symptoms of mental health problems (Chapter III). The main

studied topics about the mental health of esports players were corroborated by players' perceptions about the relation between factors of esports participation (i.e., gaming, performance, and competition) and cognitive ability and sense of achievement, on the one hand, and symptoms of mental health problems, besides addiction to competition, mental fatigue, performance anxiety and excessive gaming, in the other hand (Chapter IV).

Like the health support given to athletes from traditional sports, healthcare and prevention strategies promoted by sports and exercise medicine professionals (e.g., team doctors, sports scientists) working with esports players should be particularly focused on the mental health of esports players. As well, the esports career has been described as an "emotional rollercoaster" [23], with positive and negative mental health consequences throughout the different stages of the esports player's career being described. As also noted by the participants in the qualitative study (Chapter IV), competition and performance might critically influence the mental health of esports participants [49, 71, 72, 73], as happens to athletes from traditional sports [74, 75, 76]. Good results and performances might inspire players to improve training to meet their goals and overcome the challenges of becoming successful esports players [23]. Besides, good performances might improve players' confidence and self-awareness, which are part of their understanding of mental health (Chapter IV). Studies have drafted similar conclusions involving players from different esports modalities and genres.

Conversely, the constant need to keep up on the top has been proposed to affect mental health negatively, predisposing players to mental stress, anxiety, self-doubts and burnout [23], which were symptoms recurrently discussed in the interviews for Chapter IV. Indeed, mental health is one of the themes more frequently evaluated in the current literature about esports and health [49, 73, 77, 78].

Thus, findings in the current thesis show that the potential positive impact of esports on cognitive performance has been acknowledged in the literature and perceived when interviewing players and staff members. Still, the

association between esports and cognitive performance has not been proven yet. Contrarily, symptoms of mental health problems, such as distress, anxiety, depression, and sleep problems, have been reported to be prevalent in esports players in the literature on esports and health but also mentioned by esports primary stakeholders. Therefore, for studying health-related parameters in esports players, clarifying the symptoms of mental health problems, how they are related to each other, and their association with esports exposure is indispensable. Hence, Chapters V and VI were developed. Those exploratory studies on Chapters VI and VII also found that symptoms of distress, anxiety, depression, and sleep problems are prevalent in eFootball players. Hence, as occurs for the general population and athletes from traditional sports, symptoms of mental health problems would hinder players' health and well-being and, consequently, might compromise esports performance and commitment to play.

Therefore, health professionals such as team doctors and psychologists should intervene and participate in the development of structured programmes to prevent mental health problems from occurring. Nonetheless, considering that esports players already report symptoms of mental health problems, improving screening and diagnostic tools to be applied to esports players should be part of the healthcare support offered to esports players. For instance, Chapter VII shows a possible intervention path to minimise adverse health outcomes when symptoms of mental health problems are already present. Different healthcare professionals can capacitate players to manage symptoms of mental health problems with proper coping mechanisms, ultimately aiming to avoid the occurrence of mental health problems.

Following the strategies discussed in Chapter IV, psychologists and other mental health professionals would have a crucial role in managing the health of esports players. Unlike athletes from traditional sports, where, historically, attention to physical injuries dominates health support, esports players would rely primarily on problems affecting their mental health [79].

It has been proposed that the cognitive effort (or "mental fitness") required to maintain esports players' proficiency and competitive status might be comparable to the ones present by athletes from traditional sports [80].

An integrated health management model [7, 81], comprising not only team doctors, psychologists and other health professionals but also family members, friends and esports colleagues to improve social support, would enhance the support given to esports players, mostly with impact on the mental health [77]. Besides, as previously discussed, other health professionals (e.g., physiologists) would also have a role by promoting other concomitant strategies to promote mental health (e.g., physical activity), especially in sharing knowledge and coordinating their strengths [82]. Hence, the mental health support for esports players, as the one proposed to athletes from traditional sports, should include the prevention, treatment, and manage mental health problems (i.e., illness) and also the enhancement of psychological skills (e.g., adaptative coping mechanisms) to improve esports performance [82].

The findings of studies developed through the present thesis can also promote the conversation about the real impact of esports participation on mental health. Against initial ideas about the mental health of esports players, the primary mental health problems are not gaming addiction but rather the presence of symptoms of mental health problems. The symptoms of mental health were consistently described in the literature (Chapters II and III), expressed by players (Chapter IV) and found in a sample of eFootball players (Chapters VI and VII) were similar to athletes from traditional sports and higher than the ones found in the general population (i.e., comparing with young male adults), as discussed in several Chapter of this thesis.

Hence, studying the health of esports players should shift from the stigmatised idea of gaming addiction (and, as mentioned previously, about physical inactivity) [3], derived from studies on recreational gaming, and focus on the understanding of the problems that are really affecting the health of esports players [3, 83]. Besides, stigma about the mental health

problems of esports players would exacerbate the incidence of mental health problems in esports players [23]. Thus, the findings of the present thesis give arguments to start the conversation about the actual mental health problems affecting this population, so players become more conscious about their health and illness, hence recognising the presence of mental health problems and becoming more comfortable seeking health support (for prevention, screening and treatment) and even see the promotion of mental health as a possible strategy to improve their esports participation [84]. Likewise, supporting staff of esports players and esports organisations could also be aware of the health problems affecting their players, so they can have a positive attitude toward preventing mental health problems and become capable of early recognition of mental health problems [83]. Hence, promoting health literacy in the esports context can also improve the control of symptoms of mental health problems and mental health disorders in esports players (e.g., anxiety, depression) [84, 85]. Therefore, considering that esports players and athletes from traditional sports share risk factors for mental health problems, such as dependence on performance or competitive pressure [86], future research and health support could aim to adapt the strategies currently used to improve the recognition, treatment and management of mental health problems of athletes from traditional sports (e.g., International Olympic Committee Sports Mental Health Assessment Tool 1 and Sports Mental Health Recognition Tool [87]).

On the other hand, esports participation has also been proposed to positively impact mental health (e.g., cognitive function, sense of achievement), which could be applied as a strategy to improve mental health in other gaming contexts [3]. Understanding that esports participation would also positively impact esports participants' health and well-being would be essential to guide the future steps on health support given to esports players and future research.

What are the next steps?

Recommendations and implications for practice

As demonstrated throughout the current thesis, esports participation may have positive and negative implications on esports players' health. These implications may depend on the context of esports participation (e.g., country of practice, competitive level), esports exposure, and players' strategies and coping mechanisms to manage their health [88]. In addition, esports players might also have health problems not associated with esports participation, which could interfere with their practice, performance, and well-being. That said, to promote and support esports players' health, health professionals should understand how to take advantage of the potential positive effects of esports participation (e.g., improving cognitive function and well-being, as shown in Chapters III and IV) and should have a preventive attitude to control the possible adverse effects of esports participation (e.g., distress, anxiety or depressive symptoms, as shown in Chapter VI and VII).

Potentially chronic health problems (e.g., overuse injuries) in esports players might require more health support than acute health problems (e.g., major traumatic fractures), as expected in several athletes from traditional sports. Thus, on-site medical support for all competitions and training sessions might not be fully justified in esports. Still, having straightforward access to healthcare support (e.g., insurance, medical team) for routine clinical evaluations to screen and monitor health problems should be promoted and part of the essential support given to esports players. Indeed, as frequently discussed in this thesis, medical teams accompanying esports players should be aware of the specific constraints of esports participation and risks, such as mental health problems, eye problems, overuse injuries or chronic pain.

An ideal health management model for esports players has been proposed elsewhere [81]. Still, some considerations about the health support given to esports players should be given considering the results presented in the current thesis. In the previously proposed model, the "primary care physician" role is vital to the pre-participation evaluation, screening,

assessment, and referral to other clinical specialities, such as psychology, psychiatry, ophthalmology, nutrition, exercise professional or physical therapy. Nonetheless, one should add that the primary care physician (or team physician) would be essential to promote health literacy in all the esports ecosystem. Also, the roles of the different professionals proposed in the DiFrancisco-Donoghue *et al.* model [81] are focused on the “amount of gameplay and any addictive behaviours” or “perform assessments if suggested on addictive behaviour”. Following the results presented here, screening and assessment of other symptoms of mental health problems rather than addiction behaviour should be prioritised. Different from addiction behaviour, other symptoms of mental health problems (e.g., distress, anxiety, depression, sleep disturbance) are prevalent in esports players and are perceived to impact esports participation. Thus, as also suggested by players, a mental health professional (e.g., psychologist) working closely with esports players would be essential in the esports context. Therefore, mental health professionals might need to work closely to optimise esports training, to capacitate players for the mental endurance of esports participation, and to give players tools to cope with esports exposure’s impact (e.g., performance anxiety, impact of media negative feedback). Indeed, when symptoms of mental health problems are present, irrespective of their cause (esports-related or not), mental health professionals might work with players to treat those mental health problems and prevent them from occurring posteriorly.

Team and social support are also indispensable to esports players’ health. Indeed, as discussed, evaluation of physical activity and nutrition might be essential to develop adequate programmes to improve esports participation and manage health problems, such as mental health problems.

In addition, having the support of sports and exercise professionals would also benefit esports players’ health as these professionals are capacitated to prescribe exercise plans to counteract the physical consequences of esports exposure. Recently, recommendations to prevent injuries and health

problems have been proposed for esports players, following what is known for similar activities (e.g., musicians). Those recommendations comprised warm-up (e.g., brief bouts of low-intensity aerobic exercise, dynamic mobility exercises and specific involved parts needed for their esports actions and mimic the movement patterns and the skills used in the esports training or competition), cooldown (e.g., soft stretches, relaxing postures, breathing and reflection), injury prevention exercises (e.g., compensatory exercises for an anterior dominant posture, strengthening and mobility, core training) and active routine breaks (e.g., a 6-min active break per hour of gaming) [89].

Regarding a pre-participation evaluation for esports players, it has been proposed to include the assessment of cardiovascular, visual, neurological and psychological state, a nutritional evaluation, a musculoskeletal and ergonomic examination, and personal history collection [7]. This proposed pre-participation evaluation for esports players was similar to a preliminary evaluation conducted in March 2019, during a national team training camp (data not reported), to understand how to perform on-site assessments of esports players, which comprised four main stations for medical evaluation based on the FIFA Pre-Competition Medical Assessment [90], optometric evaluation, musculoskeletal assessment and anthropometric evaluation. Indeed, improving health support with a health screening like the sports' pre-participation exam was one of the strategies to enhance esports players' health.

Chapter IV presents some recommendations and implications for clinical practice proposed by esports players and staff members of an eFootball national team that helped understand the support esports players are receiving and the strategies they already have to manage and improve their health, considering their own experiences. Converging the assumptive health problems in esports players with their real needs, following their current concerns and perceived health problems, would contribute to enhancing the promotion, management and health support given while helping define the aspects of the health of esports players that should be prioritised.

Besides, having the members of support staff (e.g., team managers, coaches) and health professionals knowledgeable of esports players' most common health problems would help teams organise and define structured health support for esports players, reflecting the support needed for mental health and physical health, that ultimately might contribute to esports players' performance and career.

Finally, promoting health education and effective information dissemination to esports players is needed so players become perceptive to their health and may promptly report symptoms of health problems to healthcare professionals and team members (e.g., esports coaches) when the first signs and symptoms appear [16]. As noted in Chapter VII, acting and capacitating players to have adaptative coping mechanisms when anxiety symptoms are present would reduce the risk of poor nutrition habits, alcohol misuse or sleep disturbance.

Methodological considerations

Because of its novelty, research about esports and health is emerging, but several areas are not well-known yet. Given the goals of the present thesis and, as previously explained, being the study of health-related problems in esports players a relatively new research topic, different methodologies were used in the current thesis to answer our research questions, namely opinion articles (i.e., viewpoint), synthesis (i.e., scoping review), quantitative and qualitative studies (e.g., qualitative study following semi-structured interviews and cross-sectional evaluations). Using different approaches to understand esports players' health was needed to answer our research questions but it was also essential to comprehend how research with esports players can be performed and its possible limitations. Following the known strengths of scoping reviews for understanding and mapping research themes in new emergent areas like esports, conducting a scoping review demonstrated the challenges of researching esports and health.

Currently, studies about esports have relatively small sample sizes, especially considering the significant number of people engaged with esports [91]. As felt during the development of the current thesis, getting esports players to participate in scientific research is a challenging process, as shown by the low response rate and access to esports players. Indeed, considering the registration process and the most common short careers of esports players, the number of active registered players might be far lower than the total number of registered players, which would affect the response rate. Again, synergies between research teams, health professionals supporting esports players and esports organisations could be a strategy to make players feel more motivated and predisposed to participate in scientific research. Additionally, considering that there are already esports training camps where esports players live or train and compete regularly, those esports training camps will probably be the ideal setting to perform on-site evaluations of health-related parameters in esports players. These might occur in esports modalities or countries where esports teams offer a major structure in esports players' routines comprising coaches and health professionals and where esports players have access to more resources to promote their health [62].

As also noted in Chapter III, most studies about esports have heterogeneous samples comprising esports players from different backgrounds and competitive levels, gaming platforms or gaming modalities, and between professional and non-professional players. Factors like the gaming platform used, the dependence on team members (for team esports against single players esports), esports exposure, career length and level of competitive involvement could be responsible for differences in the obtained results. As discussed in Chapter III, this might compromise the conclusions obtained [80, 92] because the demands of esports exposure and esports players' needs may vary substantially [4]. For example, Kempt et al. [80] argued that there might be individual differences in how each gaming platform impacts sleep, circadian rhythms, and other related physiological outcomes for factors such as proximity to screen devices, viewing geometry, and dose and intensity of

light exposure from screens. Likewise, Chapter III also acknowledges that the methodological design of most studies did not control for confounding factors like age groups, gender, and country-related esports development, or even other causes that might contribute to the same problems (e.g., sitting time throughout the day, work-related or esports-related sitting time) [38, 65]. Indeed, in Chapters VI and VII, a formulary for sample characterisation was developed to describe the extent of participants' involvement in eFootball, considering eFootball exposure (time spent training and competing), competitive level, game platform, working time, other daily activities), to improve the analysis of study population structure/characteristics and sample representativeness.

Moreover, the most accessible studies refer to esports participation in Europe and North America and are primarily published in English. However, considering the significant esports market in Asia [91], access to data and publications in other languages is still limited. This might impair the conclusions we have so far about esports and health [65]. Hence, future research on esports players and health would gain from combining and articulating data on esports players' health worldwide, with collaboration between research teams in different countries and contexts. Besides, allowing research related to esports and health to be shared in various scientific settings (e.g., sports and exercise medicine congresses) will be essential to disseminate the current knowledge and limitations on the topic.

The preference for conducting observational studies, mainly with a cross-sectional design, found in the scoping review (Chapter III) was no surprise. To understand “what is the real problem”, studying the prevalence of health-related problems in esports is required. Only after that more precise research questions could be made, which response might need other research designs [93]. Actually, only after describing the problems displayed by esports players, the study of its association with esports participation might be justified (being Chapter VI an example). Moreover, as found in the scoping review (Chapter III), measures used (e.g., questionnaires) commonly vary

between studies (e.g., use of non-validated tools or single-item tools), with most health-related parameters described being mainly based on participants' self-reports and purely for sample characterisation (e.g., body composition considering reported height and weight), rather than being the study's primary goal. Hence, Chapters V to VII included tools applied worldwide, including in athletes from traditional sports. Considering the known limitations of self-reported data, non-causal conclusions and common bias [94], future studies would benefit from confronting the obtained results with more objective measurement tools, which might complement the results and lead to a more robust description of the health-related parameters in esports players [18]. Indeed, using validated questionnaires might be necessary so that results can be compared.

Another topic to consider when researching esports is the terminology used in the scientific literature, which is ill-defined. As noted throughout the current thesis, because esports are constantly evolving, there is still a lack of standard definitions and accordance with the terminology to be used when referring to esports and its genres, which limits surveillance of health problems in esports players, predisposes to the heterogeneity in the data found and might compromise the identification of the "real" extent of the health problems associated with esports participation which challenges the research about esports. Thus, consensus on the definitions that should be used in esports research is needed to improve quality and reporting in scientific circles. For example, there are no indexed Medical Subject Headings for esports, even with different terminology used within esports (e.g., e-sports, eSports, virtual sports). Those constraints limit the selection of terms for a comprehensive search strategy and might hinder all published literature [95]. Even though several articles discuss the impact of health-related parameters in esports performance, there is no clear definition of "esports performance". According to McNulty and colleagues [65], performance might be evaluated based on gaming outcomes (e.g., score) or action performance (e.g., reaction time and mouse control for task performance; sportsmanship and personal

initiative for contextual performance), which might have different indicators and lead to misinterpretations of the impact of esports performance.

Finally, because of a common association between esports and recreational video gaming, gaming addiction, and its sedentary nature [96], when compared with other competitive activities, esports players and research related to esports are still subjected to preconceptions and misconceptions [3, 23, 79]. There is a need to differentiate research with esports from video games and, in addition, leave the constant negative presumptions and connotations to conduct and evaluate research related to esports. Separate esports participation from those is essential to ask for different research questions and furthering the knowledge about esports players.

The considerations mentioned above denoted the constraints that might limit the generalisation of the obtained results and the understanding of the most recent findings regarding the health of esports players. Therefore, careful reflection of the main conclusions should be taken, considering that there will be differences between professional and non-professional esports status, training and performance calibre [26], and esports genres and modalities (including individual and team esports). Hence, learning and adapting how research could be done with esports players is important further to complement the understanding of esports players' health.

Implications for future research

For all the above, future research on esports players' health might need to focus on an improved characterisation of mental and physical health problems, considering the incidence of health problems over time and their association with esports exposure and esports participation. Developing interventions to enhance the theoretical positive impact of esports participation on mental health and promoting a healthy lifestyle in the esports community is required. Furthermore, studying possible interventions to improve, manage and treat mental health problems and the consequences of esports exposure on esports players' physical health should be tested. With

the improvement of cognitive function due to esports participation being frequently proposed in the literature of esports, understanding how physical activity and mental health impact cognitive function is required to better respond to teams and players. Indeed, with better sample characterisation and broader samples, studying differences between male and female esports players should be a future topic for research. Of note, the number of women participating in esports is growing, accounting for most of a third (i.e., 34%) of esports followers and players in 2021 [97].

As discussed previously, approaching esports to traditional sports settings, with increased prize money and sponsorship, a thoughtful deliberation about what would be considered “doping” and its regulation is required. Hence, future studies might need to focus on the understanding and clarification of the use of performance-enhancement substances (e.g., Are esports players really using performance-enhancement substances in esports participation?; What performance-enhancement substances are being used by esports players?; What is the impact of using performance-enhancement substances on esports players’ health?) that would hinder fair play within esports participation.

Indeed, it is necessary to study the causality (causal nexus) of esports participation and exposure to health problems so that adequate occupational support would be given, which would protect esports players’ health and career.

The above-mentioned topics are only a few examples of the following steps for studying health-related problems in esports players. Esports and health can be a prolific research topic, where different areas of expertise, from medicine, exercise and sports sciences, sociology, psychology and other sciences, are still discovering their role [98, 99]. As observed, considering the similarities between esports and sports, researchers, especially from sports and exercise medicine, should embrace this topic and contribute to understanding the negative and positive effects of esports on players’ health.

CONCLUSIONS

The obtained results of the current thesis help integrate the current initial knowledge about the health of esports players. In line with the theoretical risks associated with esports participation (e.g., competition, professionalisation, esports-related sitting and screen time), literature has begun to acknowledge that esports players manifest specific lifestyle habits and health-related parameters. Hence, having good lifestyle habits, including high levels of physical activity, besides a positive notion regarding the role of physical activity for health, defy previous misconceptions about esports players. Surprisingly, in esports players, physical activity, rather than being a problem, should be seen as a strategy used in the continuum of esports players' health and esports participation. Several symptoms of mental health problems are prevalent in esports players, but there is a need to understand its association with esports participation. For example, in eFootball players, symptoms of mental health problems are not associated with esports exposure, and gaming addiction is not prevalent.

Health professionals (e.g., sports and exercise medicine professional) working with esports players play a pivotal role in protecting and optimising players' health and well-being. They could take advantage of the potential role of esports participation in improving cognitive function and well-being when managing the mental health of esports players. Besides, health professionals should also monitor the presence of mental and physical health problems and provide adequate care considering that esports participation might also negatively affect the health of esports participants. For this purpose, we must develop evidence-based strategies and guidelines supporting the health professional. As mentioned, players' mental health and lifestyle habits should be prioritised based on the findings of the present thesis. While esports players' care and research is still in its infancy, there is a known lack of context-specific evidence and – as such – an immediate need to accrue this evidence.

So far, the main themes studied in the literature about the health of esports players are those perceived by esports players (following the experiences and perceptions of a group of elite eFootball players and the staff members of an eFootball national team). Therefore, to best establish health support for esports players, health professionals and researchers should consider how esports players understand health and be aware of the factors of esports participation that esports players and staff members identify as affecting mental and physical health. To promote adequate and prompt care to esports players, we can learn and adapt from the support given to athletes from traditional sports, considering the competitive nature of esports participation and pressure to perform, but also from common desk-based professions, to adapt equipment and facilities and be aware of long-term physical problems. Meanwhile, as esports resemble traditional sports and while becoming part of sports organisations and sports competitions, sports and exercise medicine professionals should be part of developing adequate health support for esports players. Following our results, sports and exercise medicine professionals might also have a role by promoting and prescribing physical activity to esports players, as are already eFootball players resorting to an exercise professional for their physical training.

As discussed, the scientific community might just be at the beginning of research about esports and health. The results of the present thesis do not corroborate the beliefs that physical inactivity and gaming addiction are a generalised realm of esports. Instead, physical activity is vital in managing esports players' health, and even though symptoms of mental health problems are prevalent in esports players, gaming addiction is not. Indeed, there is still significant heterogeneity in esports science, which could be extended to research designs and methodologies and to the terminology used and the current development of esports, considering countries, esports modalities and genres. Moreover, even for the already studied topics about esports and health, there is a need to improve study designs and methodologies to develop research with larger sample sizes and evaluate the

impact of esports participation in the long term. This decisively affects how research has been conducted in esports. As also demonstrated and discussed, following the results of the chapters of the current thesis, there are still important topics that should be promptly addressed so adequate and on-time care can be delivered to esports players.

Lastly, improving health literacy and knowledge about this unique population would benefit by anticipating preventive measures for esports players, essential for health prevention and proper care. Future research should aim to continue the baseline evaluation of health-related parameters in esports players by improving the characterisation of esports-specific demographic, ultimately to capacitate to deconstruct previous misconceptions about the physical inactivity of esports players to understand the (physical and mental) health problems faced by esports players. Therefore, improving research designs and evaluating the long-term impact of esports participants will contribute to the whole body of evidence required to improve esports players' health.

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SUPPLEMENTARY MATERIAL



Chapter IV

Pereira AM, Bolling C, Birch P, Figueiredo P, Verhagen E, Brito J. Perspectives of eFootball Players and Staff Members Regarding the Effects of Esports on Health: A Qualitative Study. *Sports Med Open*. 2023; 9(1):62. <https://doi.org/10.1186/s40798-023-00617-0>

Authors' information

AMP is a PhD candidate and a family physician with a master's in sports medicine; AMP has been studying health-related parameters in esports players and has previously performed a pre-participation health evaluation of the National eFootball team in 2019. CB is a PhD and physiotherapist, experienced with qualitative analysis and research on perceptions of athletes and staff regarding injury and its prevention. PB is a PhD researcher and has previously investigated stress, and mental ill health in esports players, primarily using a qualitative approach. EV is a sport scientist and epidemiologist, experienced in conducting qualitative research, and has limited experience with esports. PF and JB are PhD exercise physiologists and researchers with expertise in sports sciences, exercise physiology, and training. AMP, PF, and JB are Portuguese researchers; CB is a Brazilian researcher working in The Netherlands; PB is from the United Kingdom; and EV is from the Netherlands.

Table 0-1 Interview metrics

Code	Date	Interview duration	Transcript words	Transcript paragraphs	Transcript lines
Carlos	07/01/2022	00:48:00	6451	131	444
Jaime	10/01/2022	00:28:32	4153	40	343
César	14/01/2022	00:32:20	4170	124	335
Joaquim	17/01/2022	00:28:02	3747	78	259
José	31/01/2022	00:32:18	5087	86	351
Júlio	01/02/2022	00:30:10	4907	96	319
Duarte	15/02/2022	00:55:20	7710	89	496
David	23/02/2022	00:49:00	7641	81	502
Jonas	07/03/2022	00:38:17	5147	123	369
Joel	12/04/2022	00:32:50	5129	185	419

Note: Pseudonyms were randomly selected using typical Portuguese names (aligning to the participants' gender) and replaced participant names to assure anonymity. Chosen names consider the initial letter of each name according to participants' activity, (i.e., J=Player, C=Coach, D=esports Department).

Table 0-2 Consolidated criteria for reporting qualitative studies (COREQ)

No. Item	Guide questions/ description	Explanation	Reported on #
Domain 1: Research team			
Personal characteristics			
1. Interviewer	Which author/s conducted the interview or focus group?	AMP conducted all individual semi-structured interviews	Under section "Interview guide"
2. Credentials	What were the researcher's credentials? E.g., PhD, MD	AMP, MD, MSc; CB, PhD; PB, PhD; PF, PhD; JB, PhD; EV, PhD	Under section "Authors' information"
3. Occupation	What was their occupation at the time of the study?	AMP, PhD candidate, medical doctor; CB Sports physiotherapist and researcher; PB, professor and researcher; PF, researcher; EV, professor; JB, exercise physiologist and researcher.	Under section "Authors' information"
4. Gender	Was the researcher male or female?	The interviewer is female, CB is female, and the other authors are male.	Under section "Authors' information"
5. Experience and training	What experience or training did the researcher have?	AMP is a PhD candidate and a family physician with a master's in sports medicine; AMP has been studying health-related parameters in esports players and has previously performed a pre-participation health evaluation of the National eFootball team in 2019. CB is a PhD and physiotherapist, experienced with qualitative analysis and research on perceptions of athletes and staff	Under section "Authors' information"

regarding injury and its prevention. PB is a PhD researcher and has previously investigated stress, and mental ill health in esports players, primarily using a qualitative approach. EV is a PhD sport scientist and epidemiologist, experienced in conducting qualitative research, and has limited experience with esports. PF and JB are PhD exercise physiologists and researchers with sports sciences, exercise physiology, and training expertise.

Relationship with participants

6. Relationship established	Was a relationship established prior to study commencement?	No.	
7. Participant knowledge of the interviewer	What did the participants know about the researcher? E.g., personal goals, reasons for doing the research	Participants were informed of the background and aims of the study before the interview in the invitation to participate. Participants were briefed on the purpose of the study and understood it. Ethical had granted, and participants reviewed the participant information documentation before giving their written informed consent to be involved. They were explained the medical background of AMP and provenance for the study.	Under sections "Procedures" and "Data collection"
8. Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? E.g.,	At the beginning of the interviews, AMP explained that she has been studying health-related parameters in esports players as a part of her PhD. AMP had	

	Bias, assumptions, reasons and interests in the research topic	previously performed a pre-participation exam on the FPF eFootball national team. She is a family doctor working in Portugal and a team doctor in the Portuguese Football Federation.	
Domain 2: Study design			
Theoretical framework			
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? E.g., grounded theory, discourse analysis, ethnography, phenomenology, content analysis	A critical realist perspective approach was used.	Under section "Ontological and epistemological assumptions"
Participant selection			
10. Sampling	How were participants selected? E.g., purposive, convenience, consecutive, snowball	A purposive sampling was used.	Under section "Procedures"
11. Method of approach	How were participants approached? E.g., face-to-face, telephone, mail, email	The FPF eFootball department provided a list of potential participants for the study. Those who expressed interest in participating gave their contact details to directly arrange the interview with AMP by e-mail. Additionally, participants were asked to provide the contact of other further potential participants.	Under section "Procedures"

12. Sample size	How many participants were in the study?	In total 10 participants.	Under section "Data collection"
13. Non-participation	How many people refused to participate or dropped out? Reasons?	Eight potential participants (players) did not respond after three contact attempts.	Under section "Data collection"
Setting			
14. Setting of data collection	Where was the data collected? E.g., home, clinic, workplace	All data was collected using Microsoft Teams.	Under section "Interview guide"
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	All interviews were conducted without anyone else present.	Under section "Interview guide"
16. Description of sample	What are the important characteristics of the sample? E.g., demographic data, date	They were described under the section "Sample characterization".	Under section "Sample Characterization"
Data collection			
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	This is outlined in the Methods section.	Under section "Interview guide"
18. Repeat interviews	Were repeat interviews carried out? If yes, how many?	No.	
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	All interviews were video recorded.	Under section "Data analysis"
20. Field notes	Were field notes made during and/or after the interview or focus group?	Personal notes were made during data collection.	

21. Duration	What was the duration of the interviews or focus group?	The mean duration of the interviews was 37±10 minutes (range: 28-55 minutes; see supplementary material).	Under section "Results" and Table 1 in supplementary material
22. Data saturation	Was data saturation discussed?	Data saturation was reached after 10 interviews.	Under section "Data collection"
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No.	

Domain 3: Analysis and findings

Data analysis

24. Number of data coders	How many data coders coded the data?	AMP independently coded all interviews and then discussed the data with CB to develop themes. JB sense-check the preliminary themes and report.	Under section "Data analysis"
25. Description of the coding tree	Did authors provide a description of the coding tree?	No.	
26. Derivation of themes	Were themes identified in advance or derived from the data?	The themes were data driven.	Under section "Data analysis"
27. Software	What software, if applicable, was used to manage the data?	Data was organized in an Excel file.	
28. Participant checking	Did participants provide feedback on the findings?	Participants did not provide feedback, but the published paper will be sent to all participants.	

Reporting			
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? E.g., participant number	Yes, within the main text of the "Results" section.	
30. Data and findings consistent	Was there consistency between the data presented and the findings?	Yes.	It was explained throughout the manuscript.
31. Clarity of major themes	Were major themes clearly presented in the findings?	Yes. The major themes are presented in the sections and subsections under "Results" and Table 1.	Table 1.
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Yes.	Under section "Data analysis"

Interview Guides

Table 0-3 Interview guide - players

Meaning of health
To start, what do you understand for “health”? / <i>Para começar, o que entende por saúde?</i> ... and healthcare services? / <i>e cuidados de saúde?</i>
Health problems For you, what are the main health risks due to esports practice? / <i>Para si, quais são os maiores riscos para a sua saúde decorrentes da prática de esports</i>
Esports impact on health How do you think esports practice affects esports’ player health? / <i>Como pensa que a prática de esports afeta a saúde do jogador de esports?</i> Did you already feel any health problems due to your esports practice? / <i>Que problemas de saúde já sentiu devido à sua prática de esports</i> Which problems do you fear having in the future due to esports practice? / <i>Que tipo de problemas receia sentir no futuro dada a sua prática?</i>
Health care How do you deal with those problems? / <i>Como lida com essas situações?</i> Which strategies do you use to prevent those health problems? / <i>Que Estratégias usa para prevenir esse tipo de problemas?</i>
Health support and needs Which healthcare services do you have access to? / <i>A que tipo de cuidados de saúde costuma ter acesso?</i> What type of healthcare services are usually given by esports teams? / <i>Que tipo de cuidados de saúde são normalmente disponibilizados pelas equipas de esports?</i> What kind of medical support you think you could/should have for your elite esports practice? / <i>Que tipo de apoio médico poderia ser dado para a sua prática de esports de elite?</i>
Future

Esports are growing. With that, whose problems do you think will need more attention from esports agents, like team coaches, sports agents, etc? / *Com o crescimento dos esports, quais pensa serem os problemas de saúde que venham a necessitar de atenção dos agentes envolvidos nos esports (ex. Treinadores, Diretores Desportivos)?*

Table 0-4 Interview guide - staff

Meaning of health

To start, what do you understand for “health”? / *Para começar, o que entende por saúde?*

... and healthcare services? / *...e cuidados de saúde?*

Esports impact on health

In your perspective, what is the impact that esports have for esports players health? / *Qual a sua perspectiva relativamente ao impacto da prática de esports para a saúde dos jogadores?*

That impact could be positive or negative (or both)? / *Pensa que esse impacto seja positivo ou negativo para os jogadores?*

Can you give some examples? / *Poderia dar alguns exemplos?*

Health problems in esports players

For you, what health problems are more frequent in esports players? / *Quais pensa serem os problemas de saúde mais comuns nos jogadores de esports?*

Which factors could be responsible for those problems? / *Que fatores podem ser responsáveis por esses problemas?*

What might be the consequences of those health problems for esports performance? / *Quais pensa serem as consequências desses problemas para a performance dos jogadores*

Esports as a risk factor for health

Which might be the major health risks due to esports practice? Why? / *Para si, quais são os maiores riscos para a saúde decorrentes da prática de esports? Porquê?*

Health support and needs

How can you help prevent and follow those health problems? / *Qual pode ser o seu papel na prevenção e seguimento desses problemas?*

What kind of medical support you think you could/should have for your elite esports practice? / *Que tipo de apoio médico pensa ser necessário para a prática de esports de elite?*

Which type of healthcare services could be given to the esports players who you work with? / *Que tipo de cuidados de saúde tem disponibilizados aos jogadores com quem trabalha?*

Future

Esports are growing. With that, whose problems do you think will need more attention from esports agents, like team coaches, sports agents, etc? / *Com o crescimento dos esports, quais pensa serem os problemas de saúde que venham a necessitar de atenção dos agentes envolvidos nos esports?*

What are your suggestions to improve healthcare services in esports population? / *Que sugestões daria para serem melhorados os cuidados de saúde nesta população?*

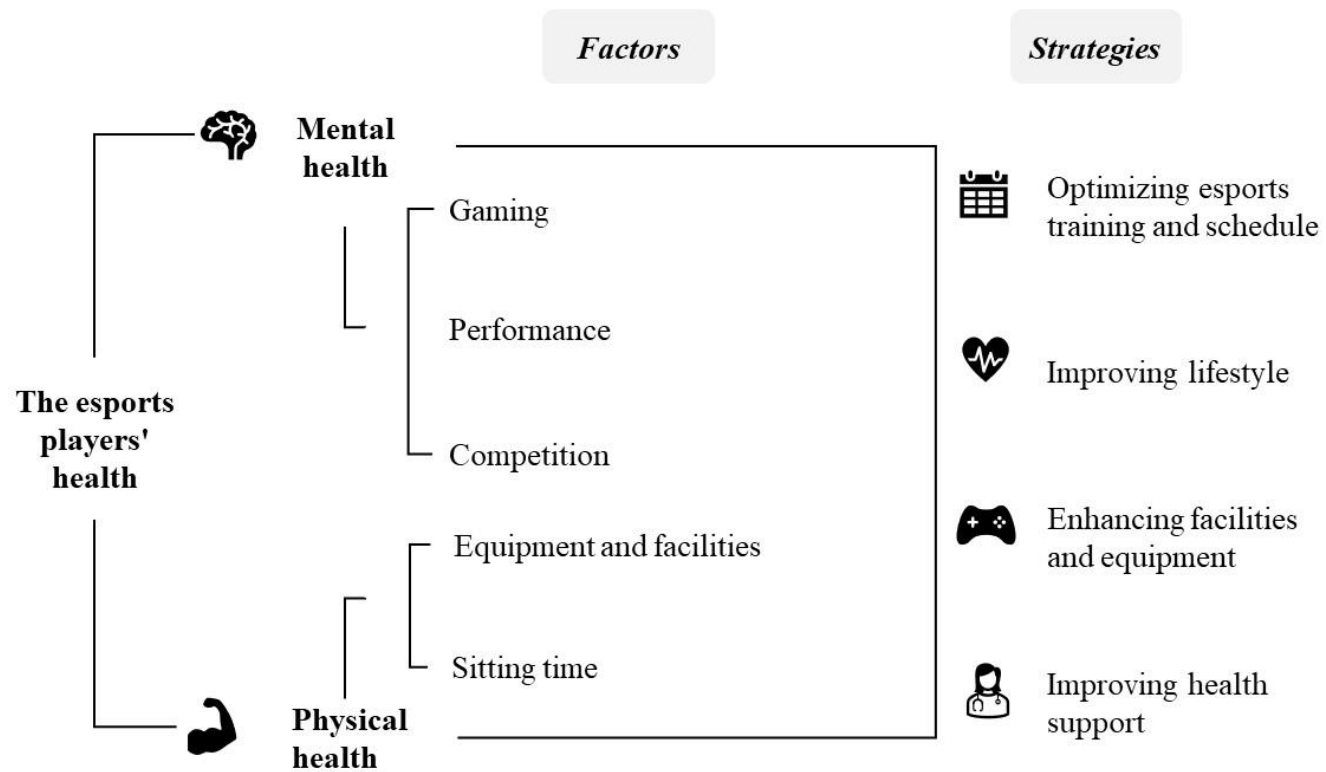


Figure 0-1 The esports players' health

Ethics approvals

The project leading to the current thesis was approved by the ISMAI Ethics Committee (CE PFS n°6/2020).

The procedures for Chapter IV to VII have been validated by the Portuguese Football Association (FPF) Data Protection Office and the FPF Esports department. The studies in Chapters IV, VI and VII were approved by the Portugal Football School Ethics Committee (CE PFS n°1/2021). The study in Chapter V was approved by Ethics Committee of the Faculty of Sports, University of Porto (CEFADE/31/2019).

The FPF Data Protection Office protected privacy rights.

Declaração

Para os devidos efeitos declara-se que o projeto CEFADÉ 31 2019 intitulado “Avaliação dos níveis de atividade física de praticantes de e-Sports”, submetido à Comissão de Ética da Faculdade de Desporto da Universidade do Porto por André Seabra, foi aprovado, por ter em conta os requisitos éticos recomendados.

Porto, 29 de Abril de 2020

A Presidente da Comissão de Ética



Zélia Maria Matos de Almeida Roque Pinto

COMISSÃO DE ÉTICA
INSTITUTO UNIVERSITÁRIO DA MAIA

DECISÃO FINAL

Parecer N.º 6/2020

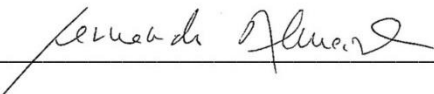
Investigador(a) responsável/orientador(a): Ana Monteiro Pereira Data de envio do projeto: 14.4.2020 Data da decisão final: 16.3.2021
Título do Projeto: Análise de parâmetros de saúde dos participantes de eSports

Resolução:

As alterações efetuadas pelos investigadores permitem a esta CE dar o seu parecer favorável ao projeto de investigação "Análise de parâmetros de saúde dos participantes de eSports".

ISMAI, 17 de março de 2021

O Presidente da Comissão de Ética



Doutor Fernando Almeida

COMISSÃO DE ÉTICA DA PORTUGAL FOOTBALL SCHOOL (CE PFS)

FEDERAÇÃO PORTUGUESA DE FUTEBOL

Formulário para Avaliação Ética de Estudos de Investigação

Título do projeto	ANALYSIS OF HEALTH-RELATED PARAMETERS IN PEOPLE ENGAGED WITH ESPORTS
Proponentes do projeto	Portugal Football School
Investigador responsável	Ana Cláudia Monteiro Pereira
Data de submissão	27.06.2021
Relatores	Joana Araújo
Data da aprovação do parecer	16.08.2021
O presidente da CE da PFS	André Seabra

PARECER N.º 1/2021

<input checked="" type="checkbox"/> PARECER ÉTICO FAVORÁVEL (a proposta é eticamente aceitável)	Motivos
<input type="checkbox"/> PARECER ÉTICO FAVORÁVEL COM RECOMENDAÇÕES (sujeito ao cumprimento de requisitos éticos e recomendações)	Motivos
<input type="checkbox"/> PARECER ÉTICO NÃO FAVORÁVEL	Motivos

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REQUISITOS

Do projeto de investigação destaca-se o seguinte:

This project aims to analyse, characterise, and describe novel information on health-related parameters (including mental health and lifestyle behaviours), as well esports agents' perceptions on health.

To archive their goals, the researcher intent to focus the current project in 3 main studies I – Esports participants perceptions on health and esports, II – Distress and mental health problems in esports participants, III – Health behaviours and Outcomes of Esports participants.

All of the documents asked were send it.

All the ethical requirements are in compliance.

RECOMENDAÇÕES

No que diz respeito aos documentos solicitados que são enviados, nomeadamente o Parecer da Comissão de Ética, chamamos a atenção que o facto de não estar assinado, não tem validade pelo que, para futuras situações, esta questão seja acautelada;

A data de início de recolha de dados tem uma data anterior à aprovação do estudo por parte da comissão de ética e por isso recomendamos a sua alteração.

Considerando o crescimento exponencial desta nova modalidade e o número cada vez maior de atletas, recomendamos que os dados recolhidos e sejam divulgados por toda a comunidade desportiva ligada ao futebol em prol da divulgação científica.

Sendo assim e perante o exposto, a Comissão de Ética decidiu pela emissão de um parecer **favorável** em relação ao presente projeto.

Encontramo-nos disponível para qualquer esclarecimento.



André Seabra

Presidente da Comissão de Ética da Portugal Futebol School

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BMJ Open Sport and Exercise Medicine Journal

Re: Author Self-Archiving & Permissions

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em nome de

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qua, 28/09/2022 09:56

Para: Ana Pereira <ana.pereira@fpf.pt>

Cc: bmj.permissions@bmj.com <bmj.permissions@bmj.com>

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- Virtual sports deserve real sports medical attention - <http://dx.doi.org/10.1136/bmjsem-2019-000606>
- Mental health symptoms in electronic football players - <http://dx.doi.org/10.1136/bmjsem-2021-001149>

Hoping for your kind consideration,

Best regards,
Ana Pereira

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Sports Medicine

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Ana Monteiro Pereira

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