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Problem gaming and adolescents' health and well-being: Evidence from a large nationally representative sample in Italy

Natale Canale [a,*], Frank J. Elgar [b], Erika Pivetta [a], Tommaso Galeotti [a], Claudia Marino [a], Joël Billieux [c,d], Daniel L. King [e], Michela Lenzi [a], Paola Dalmasso [f], Giacomo Lazzeri [g], Paola Nardone [h], Arianna Camporese [i], Alessio Vieno [a]

[a] Department of Developmental and Social Psychology, University of Padova, Italy
[b] Department of Equity, Ethics and Policy, McGill University, Montreal, Quebec, Canada
[c] Institute of Psychology, University of Lausanne, Lausanne, Switzerland
[d] Center for Excessive Gambling, Addiction Medicine, Lausanne University Hospital (CHUV), Lausanne, Switzerland
[e] Flinders University, Adelaide, Australia
[f] Department of Public Health and Paediatrics, School of Medicine, University of Torino, Italy
[g] Department of Molecular and Developmental Medicine, University of Siena, Siena, Italy
[h] National Centre for Disease Prevention and Health Promotion, Italian National Institute of Health, Rome, Italy
[i] ULSS 6 Euganea Company, Padova, Italy

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ABSTRACT

Playing video games is a common leisure activity for adolescents, but a minority can develop maladaptive gaming patterns and experience impairments in various health domains. Most research has been conducted within the dichotomy of "non-problematic gaming" and "problematic gaming" with convenience and unrepresentative samples, necessitating further investigation to provide more robust and generalizable evidence. In this study, we examined the impact of gaming on different groups of gamers with distinct degrees of gaming involvement in relation to various psychological and physical health outcomes and behaviours. Data included a nationally representative sample of 89321 adolescents (11–17 years) from the 2022 Italian Health Behaviour in School-aged Children study. We compared groups of gamers (low risk, high risk, and problematic) with non-gamers concerning their (mental) health, nutrition, physical activity, sleep, and social well-being. Logistic regressions were used to estimate the odds ratios (adjusted for gender, age, material deprivation, and family structure). Compared with non-gamers (33.7 % of the sample), low-risk gamers (51.6 %) reported better health-related outcomes (i.e., lower risk of depression, lower stress, fewer psychological and somatic symptoms). High-risk (11.6 %) and problematic gamers (3.1 %) showed significantly higher impairments in all health-related outcomes than non-gamers did, the associations being especially pronounced in the problematic gaming group. Video games are not inherently harmful, and adolescents who reported a low risk of gaming problems showed slightly better health-related outcomes than non-gamers did. However, a minority of vulnerable users engaged in problematic use associated with negative consequences, functional impairment (e.g., sleep interference), and various unhealthy behaviours.

1. Introduction

Recent advancements in video gaming technology that allow for highly immersive social interactions have contributed to an increased use of video games worldwide (Király et al., 2023). Gaming is recognized as one of the most popular forms of digital entertainment. Research has found that gaming and mental health problems among adolescents increased during the COVID-19 pandemic (Kauhanen et al., 2023; Teng et al., 2021). Although researchers have explored the effects of gaming on various negative health outcomes in adolescents (e.g., psychological distress and sleep problems), limited efforts have been made to consider the impact of gaming and related consequences on different groups of gamers with various degrees of gaming involvement.

* Corresponding author. Associate Professor of Social Psychology, Department of Developmental and Social Psychology, University of Padova, Via Venezia, 8 35131 - Padova, Italy.
E-mail address: natale.canale@unipd.it (N. Canale).

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List of abbreviations:

Gaming disorder (GD)
American Psychiatric Association (APA)
World Health Organization (WHO)
Problematic Gaming (PG)
Health Behaviour in School-aged Children (HBSC)
Internet Gaming Disorder Scale – Short Form (IGDS9-SF)
Internet Gaming Disorder (IGD)
Confidence intervals (CI)
Odd ratios (ORs)

In terms of study design, most studies in this field have been conducted in non-representative samples, limiting their generalizability. The aim of the present study, therefore, was to identify groups of gamers according to two cut-point criteria on the Internet Gaming Disorder Scale-Short Form (IGDS9-SF) (Monacis et al., 2016; Pontes & Griffiths, 2015) – a validated screening tool for gaming disorder – and to compare the health/well-being of these groups (i.e., mental health, well-being, nutrition, physical health, sleep, and social well-being) in a nationally representative sample of Italian adolescents.

Adolescents are a vulnerable group for the development of maladaptive patterns of gaming due to specific risk factors, including neurological immaturity and psycho-social issues (Gao et al., 2022). Gaming disorder has been recognized by the World Health Organization (WHO) as a condition characterized by impaired control over the activity, increased priority given to gaming to the detriment of other daily duties, and continuation of gaming despite the occurrence of negative consequences, causing significant functional impairment (Reed et al., 2022; World Health Organization, 2019). However, in this study, we use the term "problematic gaming" (PG), indicating a hazardous and risky pattern of use, and assume a continuum from low-harm gaming to dysfunctional and impaired gaming involvement, in line with recent research (Larrieu et al., 2022; Nogueira-López et al., 2023). The Interaction of Person-Affect-Cognition-Execution (I-PACE) model (Brand et al., 2016, 2019) offers a comprehensive theoretical framework for understanding internet-related problematic behaviours (such as PG), proposing that an individual's fundamental characteristics (e.g., mental health, personality, biology, psychological needs, and coping styles) play a role in the onset, persistence, and recurrence of various problematic internet uses such as PG. Such a model, which considers individual differences as important vulnerability factors, aligns with influential models from other disciplines. For example, in the field of media psychology, the Differential Susceptibility to Media Effects Model (Valkenburg & Peter, 2013) suggests that each adolescent has a unique level of susceptibility to the effects of social media: Although social media use may undermine the well-being of some adolescents, it may enhance the well-being of others, and have no effect on yet others. Based on such conceptual frameworks, it is expected that involvement in gaming affects adolescent well-being in different ways – either positive or negative – in terms of individual characteristics and/or environmental factors. Accordingly, systematic reviews and meta-analyses have reported associations between gaming/PG and mental and physical health issues, such as depression (Männikkö et al., 2020; Ostinelli et al., 2021), anxiety (González-Bueso et al., 2018), sleep problems (Kristensen et al., 2021), excess body mass and poor eating habits (Chan et al., 2022), and reduced vigorous physical activity (Pelletier et al., 2020). Nevertheless, some studies reported null findings (Hygen et al., 2020; Király et al., 2017; Männikkö et al., 2015; Pelletier et al., 2020) or potential benefits of gaming in cognitive, emotional, social, and physical domains, such as achieving a sense of mastery and improving self-esteem (Tichon & Tornqvist, 2016); experiencing positive affect in individuals who have a tendency to use video games to escape from daily stressors and avoid negative emotions (Larche et al., 2021); developing social connections with others, cooperative and prosocial behaviours, and social support (Granic et al., 2014); and promoting motor skills and increasing physical activity (Benzing & Schmidt, 2018).

One reason for such inconsistent findings may be attributed to the methodological and sampling limitations in the literature (King et al., 2020; Rumpf et al., 2019). Previous research largely relied on underpowered and non-representative samples (e.g., self-selected samples recruited through a snowball technique). A second explanation for the mixed and frequently conflicting research findings is that existing studies defined and operationalized well-being through a limited number of dimensions, for example, by focusing on physical or psychological symptoms, thus providing an incomplete profile of the impacts of gaming in adolescence. Well-being is a multidimensional and complex construct that has been defined in numerous ways (Meier & Reinecke, 2021; Valkenburg, 2022), most conceptualizations taking a holistic view of health and encompassing physical, mental, and social domains (World Health Organization, 2021). Research also shows that the associations between different components of adolescent well-being are often moderate at best (Diener et al., 2018; Ross et al., 2020). For this reason, in the current study, we operationalized well-being by using indicators from several domains: physical, psychological, behavioural (health-related behaviours), and social. Such operationalization allows us to optimally investigate the impact of gaming/PG on distinct components of adolescent well-being. In addition, previous epidemiological studies conducted in large and representative samples of adolescents relied on a dichotomic characterization of gaming experiences (e.g., "non-problematic gaming" and "problematic gaming") (Colasante et al., 2022; Nogueira-López et al., 2023; van der Neut et al., 2023), whereas a more nuanced approach would recognize various groups on a continuum of harm (Brunborg et al., 2013; Wegmann et al., 2022). This continuum encompasses functional/recreational (healthy) gaming on one end and dysfunctional (disordered) gaming on the other end (Wegmann et al., 2022). For example, based on the number of *DSM-5* criteria fulfilled, it was suggested that three groups of gamers can be identified: recreational/non-problematic, at-risk/problematic, and those characterized by pathological behaviour (Wegmann et al., 2022). As postulated by Wegmann et al. (2022), an approach that combines quantitative techniques (e.g., number of criteria fulfilled) with qualitative techniques (e.g., investigating daily functional impairment) and also considers mental health variables (Yen et al., 2022) has the potential to provide a more accurate and fine-grained assessment of PG.

Numerous tools have been developed for screening gaming disorder (GD), many based on the *DSM-5* conceptualization. Many GD tools are also comparable from a psychometric perspective and share similar content and factorial structure (King et al., 2020). The IGDS9-SF scale (Monacis et al., 2016; Pontes & Griffiths, 2015) is an established, brief, and well-studied instrument with psychometric properties comparable to other instruments based on the nine *DSM-5* criteria (e.g., King et al., 2020). This measure has been used in studies with children and adolescents, as well as to validate a diagnostic interview schedule for adolescents (Tonyali et al., 2023). The IGDS9-SF, like many GD measures, has been evaluated with different scoring approaches. Although Monacis et al. (2016) identified a cut-off value of 21 to distinguish between disordered and non-disordered gamers in the Italian validation of the IGDS9-SF, many studies have instead relied on the American Psychiatric Association (APA) criterion of experiencing five or more symptoms "often" or "very often" (APA, 2013). In the present study, we used a continuum-based conceptualization of PG, leading to the identification of four distinct gaming categories: "non-gamers" who reported having never (or almost never) played video games, "low-risk gamers" who reported some gaming activity but had a total score below the established cut-point of 21 on the IGDS9-SF and indicated fewer than five symptoms on the IGDS9-SF as occurring "often" or "very often", "high-risk gamers" who had a total score above the cut-point of 21 but still reported fewer than five symptoms as occurring "often" or "very often", and "problematic gamers" who exceeded both the cut-point of 21 and reported five or more symptoms as occurring "often" or "very often". The rationale behind combining both cut-off criteria was to limit the risk of false positives (i.e., over-pathologization) through a more conservative approach.

1.1. The current study

Using a large population-based sample, in this study, we aimed to (1) identify groups of gamers based on their level of gaming involvement, applying the two cut-point criteria from the IGDS9-SF, and (2) test the association between gaming groups (non-gamers, low-risk gamers, high-risk gamers, problematic gamers) and several indicators of health and well-being (i.e., low mood, at risk of depression, loneliness, high stress, two or more weekly psychological symptoms, two or more weekly somatic symptoms, low life satisfaction, excellent health), nutrition and physical health (i.e., excess body mass index (BMI), eats breakfast daily, daily fruit consumption, daily vegetable consumption, daily cola/soft drinks, daily desserts/sweets, daily salty snacks, vigorous physical activity, daily time spent gaming), sleep (i.e., low-quality sleep and sleeping less than 7 h/night), and social well-being (i.e., low family support and low peer support).

Sociodemographic factors known to influence gaming and PG were also considered as covariate variables in this study, including age, gender, material deprivation, and family structure (e.g., living in single-parent households) (Colasante et al., 2022; Stevens et al., 2021). From previous literature (Chan et al., 2022; González-Bueso et al., 2018; Kristensen et al., 2021; Männikkö et al., 2020; Nogueira-López et al., 2023; Ostinelli et al., 2021; Pelletier et al., 2020) and according to the I-PACE model (Brand et al., 2016, 2019), the Differential Susceptibility to Media Effects Model (Valkenburg & Peter, 2013), and the continuum-based conceptualization of PG (Wegmann et al., 2022), we expected the groups of adolescent gamers to differ according to health and well-being, with the high-risk and problematic groups being characterized by the lowest health and well-being in comparison to non-gamers.

2. Methods

2.1. Study design and data sources

Data were collected as part of the 2022 Health Behaviour in School-aged Children (HBSC) study. HBSC is a WHO collaborative cross-national survey of school students, which collects data every four years on well-being, social environments, and health behaviours in early adolescence (11, 13, and 15 years). The 2022 HBSC survey includes data from more than 50 countries across Europe and North America, all adhering to a detailed international study protocol (Inchley et al., 2021).

The sampling procedure adopted in 2022 in Italy followed the agreed-upon international rules. Cluster sampling was used, with the school class as the primary sampling unit (Bennett et al., 1991). More details about this type of sampling method and the main disadvantages are described elsewhere (Lazzeri et al., 2022). From the complete list of public and private schools and classes of each region provided by the Ministry of Education, the Italian National Institute of Health team extracted a national and regionally representative sample of classes for each age group (11, 13, 15, and 17 years old). Since 2017, an Italian legislative decree has recognized HBSC as the only national surveillance system for adolescent health and has suggested including the 17-year-old age group, in addition to the samples of 11-, 13-, and 15-year-olds. As in the last two surveys, the sample size for each region was about 1200 adolescents for each age group. This sample size was corrected for the general population of students to achieve a precision of ±3.5 % (95 % confidence interval [CI], 7 % between the minimum and maximum limits for a binomial proportion of 50 %). Over-sampling of 5 % for the third grade of lower secondary school and of 15 % for the second grade of upper secondary school was applied to compensate for students who repeated the class; additional over-sampling of 10 % was considered for those who were expected to refuse to participate. The Italian HBSC 2022 survey included 94178 students (97.3 % of the response rate at the individual level) aged 11, 13, 15, and 17, and 88.7 % (5669) of the total sampled classes (6388).

Students' parents received an information consent form with a description of the purpose of the survey before the day of data collection. Families could refuse participation by filling in the consent that was returned to the teachers in each involved class. The study was conducted according to the guidelines of the Declaration of Helsinki. In 2022, the Italian HBSC study protocol and questionnaire were formally approved by the Ethics Committee of the Italian National Institute of Health (protocol: AOO-ISS-22/11/2021–0040602 Class: PRE BIO CE01.00).

2.2. Measures

The HBSC survey comprises validated measures of key aspects of adolescents' lives that are relevant within a cross-national context (Inchley et al., 2021), including Italy (Lazzeri et al., 2022). Full details of the development and validity of the measures are presented in the HBSC 2021–2022 protocol (Inchley et al., 2021).

2.2.1. Gaming disorder symptoms

Participants were asked to report their gaming frequency by answering "How often do you play video games?" Possible options included the following: (1) "Never or almost never", (2) "Less than 1 day a week", (3) "1 day a week", (4) "2 or 3 days a week", (5) "4 or 5 days a week", and (6) "Almost every day". Participants who declared that they played video games were further invited to complete the IGDS9-SF (Monacis et al., 2016; Pontes & Griffiths, 2015). This screening tool consists of nine items assessing the extent to which participants endorse the IGD criteria described in Section III of the *DSM-5* (APA, 2013). Participants were asked to rate their level of agreement with each item, using a five-point scale: (1) "Never", (2) "Seldom", (3) "Sometimes", (4) "Often", and (5) "Very often". Total scores for the IGDS9-SF are computed by summing the individual answers to all nine items (ranging from 9 to 45 points), with a cut-off point of 21 determining possible IGD (Monacis et al., 2016). The recommended APA approach was implemented to discriminate between problematic and non-problematic gamers; those responding with "often" (4) or "very often" (5) on at least five of the nine items were considered problematic gamers (Nogueira-López et al., 2023).

2.2.2. Outcome-related measures

A detailed list of the outcome variables (and related measures) is presented in Table 1. Outcome variables were selected with the aim of obtaining a comprehensive and holistic view of adolescent well-being, encompassing physical, psychological, behavioural (health-related behaviours), and social domains (World Health Organization, 2021). More specifically, the selected measures were related to mental health and well-being (Topp et al., 2015; Warttig et al., 2013), nutrition and physical activity (Inchley et al., 2021), sleep quality and duration (Essner et al., 2015), and social well-being (Zimet et al., 1988). Furthermore, four control variables were included: (1) gender (coded 1 for males and 2 for females), (2) age (in years), (3) living with at least two parents/step-parents (coded 0 for no and 1 for yes), and (4) material deprivation in the home (Currie et al., 2008). Material deprivation was assessed with a six-item index of assets in the home and family activities (cars, computers, holidays, own bedroom, bathrooms, and dishwasher) (Currie et al., 2008). A total summary score of these items was transformed into a weighted proportional rank (ridit) with a normal distribution and a 1-point scale (minimum of 0, maximum of 1, mean of 0.5). Finally, daily time spent gaming was assessed with a single item (see Table 1).

Table 1
Outcome variables: questions, rating system, and computation.

VARIABLE	QUESTIONS	RATING SYSTEM	COMPUTATION
Low mood	- WHO-5 Well-Being Index (Topp et al., 2015) (5 items): - I have felt cheerful and in good spirits - I have felt calm and relaxed - I have felt active and vigorous - I woke up feeling fresh and rested - My daily life has been filled with things that interest me	(0) At no time (1) Some of the time (2) Less than half of the time (3) More than half of the time (4) Most of the time (5) All the time	A raw score ranging from 0 to 25 was calculated by summing the responses to the five items. The standardized score ranging from 0 to 100 was calculated by multiplying the raw score by 4. Individuals who scored less than 50 in the standardized score were classified as "low mood" (World Health Organization, 2024b).
At risk of depression	- WHO-5 Well-Being Index (Topp et al., 2015) (5 items): - I have felt cheerful and in good spirits - I have felt calm and relaxed - I have felt active and vigorous - I woke up feeling fresh and rested - My daily life has been filled with things that interest me	(0) At no time (1) Some of the time (2) Less than half of the time (3) More than half of the time (4) Most of the time (5) All the time	A raw score ranging from 0 to 25 was calculated by summing the responses to the five items. The standardized score ranging from 0 to 100 was calculated by multiplying the raw score by 4. Individuals who scored less than 28 in the standardized score were classified as "at risk of depression" (World Health Organization, 2024b).
Loneliness	- During the past 12 months, how often have you felt lonely?	(1) Never (2) Rarely (3) Sometimes (4) Most of the time (5) Always	Most of the time/Always (1) vs Never/Rarely/Sometimes (0) (Inchley et al., 2021).
High stress	- Cohen Perceived Stress Scale (Warttig et al., 2013) (4 items): - How often have you felt that you were unable to control the important things in your life? - How often have you felt confident about your ability to handle your personal problems? - How often have you felt that things were going your way? - How often have you felt difficulties were piling up so high that you could not overcome them?	(1) Never (2) Almost never (3) Sometimes (4) Fairly often (5) Very often	For items 1 and 4, responses were recoded from 0 to 4 (i.e., Never = 0 and Very often = 4). Coding for items 2 and 3 was reversed (i.e., Very often = 0 and Never = 4). The scores were added to obtain a sum score. Tertiles were calculated and combined: 1st and 2nd (0) vs 3rd (1) (Warttig et al., 2013).
Two or more weekly psychological symptoms	In the last 6 months: how often have you had the following ….? - Feeling low - Irritability - Feeling nervous - Difficulties sleeping	(1) About every day (2) More than once a week (3) About every week (4) About every month (5) Rarely or never	Items were recoded from 1 to 0 (i.e., About every day/More than once a week = 1 and About every week/About every month/Rarely or never = 0). The scores were added to obtain a sum score. Individuals who scored equal to or higher than 2 were classified as having two or more weekly psychological symptoms (Inchley et al., 2021).
Two or more weekly somatic symptoms	In the last 6 months: how often have you had the following ….? - Headache - Stomach ache - Backache - Feeling dizzy	(1) About every day (2) More than once a week (3) About every week (4) About every month (5) Rarely or never	Items were recoded from 1 to 0 (i.e., About every day/More than once a week = 1 and About every week/About every month/Rarely or never = 0). The scores were added to obtain a sum score. Individuals who scored equal to or higher than 2 were classified as having two or more weekly somatic symptoms (Inchley et al., 2021).
Low life satisfaction	Here is a picture of a ladder. The top of the ladder "10" is the best possible life for you and the bottom "0" is the worst possible life for you. In general, where on the ladder do you feel you stand at the moment? Tick the box next to the number that best describes where you stand.	(10) Best possible life (9) . (8) . (7) . (6) . (5) . (4) . (3) . (2) . (1) . (0) Worst possible life	Responses were dichotomized as low life satisfaction (0–5) and high life satisfaction (6–10) (Inchley et al., 2016).
Excellent health	Would you say your health is … ?	(1) Excellent (2) Good (3) Fair (4) Poor	Excellent (1) vs Good/Fair/Poor (0) (Schnohr et al., 2016).
Excess body mass index (BMI)	- How much do you weigh without clothes? - How tall are you without shoes?	Participants were asked to report their weight in kilograms and to report their height in centimetres.	BMI is calculated according to the WHO categorizations (World Health Organization, 2024a). Individuals were categorized as Overweight/Obese (1) vs Normal weight/Thinness/Severe thinness (0).
Eats breakfast daily	How often do you usually have breakfast (more than a glass of milk or fruit juice)? Please tick one box for weekdays and one box for weekend.	Weekdays (1) I never have breakfast during the week (2) One day (3) Two days (4) Three days (5) Four days (6) Five days Weekend	Participants who ticked weekdays (item 6) and weekend (item 3) were recoded as having breakfast daily (Inchley et al., 2021).

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Table 1 (*continued*)

VARIABLE	QUESTIONS	RATING SYSTEM	COMPUTATION
		(1) I never have breakfast during the weekend (2) I usually have breakfast on only one day of the weekend (Saturday OR Sunday) (3) I usually have breakfast on both weekend days (Saturday AND Sunday)	
Daily fruit consumption	How many times a week do you usually eat fruit?	(1) Never (2) Less than once a week (3) Once a week (4) 2–4 days a week (5) 5–6 days a week (6) Once a day every day (7) Every day, more than once	Once a day every day/Every day, more than once (1) vs Never/less than once a week/once a week/2–4 days a week/5–6 days a week (0) (Inchley et al., 2021).
Daily vegetable consumption	How many times a week do you usually eat vegetables?	(1) Never (2) Less than once a week (3) Once a week (4) 2–4 days a week (5) 5–6 days a week (6) Once a day every day (7) Every day, more than once	Once a day every day/Every day, more than once (1) vs Never/less than once a week/once a week/2–4 days a week/5–6 days a week (0) (Inchley et al., 2021).
Daily cola/soft drink consumption	How many times a week do you usually drink colas or other soft drinks that contain sugar?	(1) Never (2) Less than once a week (3) Once a week (4) 2–4 days a week (5) 5–6 days a week (6) Once a day every day (7) Every day, more than once	Once a day every day/Every day, more than once (1) vs Never/less than once a week/once a week/2–4 days a week/5–6 days a week (0) (Inchley et al., 2021).
Daily dessert/sweets consumption	How many times a week do you usually eat sweets (candy or chocolate)?	(1) Never (2) Less than once a week (3) Once a week (4) 2–4 days a week (5) 5–6 days a week (6) Once a day every day (7) Every day, more than once	Once a day every day/Every day, more than once (1) vs Never/less than once a week/once a week/2–4 days a week/5–6 days a week (0) (Inchley et al., 2021).
Daily salty snack consumption	How many times a week do you usually eat salty snacks?	(1) Never (2) Less than once a week (3) Once a week (4) 2–4 days a week (5) 5–6 days a week (6) Once a day every day (7) Every day, more than once	Once a day every day/Every day, more than once (1) vs Never/less than once a week/once a week/2–4 days a week/5–6 days a week (0) (Inchley et al., 2021).
Vigorous physical activity 3+ days/week	Outside school hours: how often do you usually exercise in your free time so much that you get out of breath or sweat?	(1) Every day (2) 4 to 6 times a week (3) 3 times a week (4) 2 times a week (5) Once a week (6) Once a month (7) Less than once a month (8) Never	Every day/4 to 6 times a week/3 times a week (1) vs 2 times a week/once a week/once a month/less than once a month/never (0) (Inchley et al., 2021; World Health Organization, 2020).
Low quality sleep	- Short Adolescent Sleep Wake Scale (Essner et al., 2015) (10 items) - When it's time to go to bed, I want to stay up and do other things. - In general, I am ready for bed at bedtime. - In general, I try to "put off" or delay going to bed. - When it's time to go to sleep, I have trouble settling down. - In general, I need help getting to sleep (for example, I need to listen to music, watch TV, take medication, or have someone else in the bed with me). - After waking up during the night, I have trouble going back to sleep. - After waking up during the night, I have trouble getting comfortable. - After waking up during the night, I need help to go back to sleep (for example, I need to watch TV, read, or sleep with another person). - In the morning, I wake up and feel ready to get up for the day. - In the morning, I wake up feeling rested and alert.	(1) Never (2) Once in a while (3) Sometimes (4) Quite often (5) Frequently (6) Always	Items 1, 3, 4, 5, 6, 7, and 8 were reversed (i.e., 1 = 6, 2 = 5, 3 = 4, 4 = 3, 5 = 2, 6 = 1), and then a sum score was calculated, with higher scores indicating better sleep quality. Tertiles were calculated and combined: 1st (1) vs 2nd and 3rd (0) (Inchley et al., 2021).
Sleeping less than 7 h/night	- When do you usually go to bed if you have to go to school the next morning? - When do you usually wake up on school mornings?	Go to bed (1) No later than 21:00 (2) 21:30 (3) 22:00	The difference between bedtime and wake time was calculated. Scores lower than 7 h (1) vs scores equal to or higher than 7 h (0) (Hirshkowitz et al., 2015).

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Table 1 (*continued*)

VARIABLE	QUESTIONS	RATING SYSTEM	COMPUTATION
		(4) 22:30 (5) 23:00 (6) 23:30 (7) 0:00 (8) 0:30 (9) 1:00 (10) 1:30 (11) 2:00 or later Wake up (1) No later than 5:00 (2) 5:30 (3) 6:00 (4) 6:30 (5) 7:00 (6) 7:30 (7) 8:00 (8) 8:30 (9) 9:00 (10) 9:30 or later	
Daily time spent gaming	On a day that you play games, about how much time do you spend gaming?"	(1) "1–2 h" (2) "2–4 h" (3) "4–6 h" (4) "6–8 h" (5) "8 h or more"	In line with current literature (Jeong et al., 2021), responses were recoded as follows: 0 indicates gaming less than 4 h and 1 more than 4 h
Low family support	- Family support subscale of the Multidimensional Scale of Perceived Social Support (Zimet et al., 1988). - My family really tries to help me - I get the emotional help and support I need from my family - I can talk about my problems with my family - My family is willing to help me make decisions	(1) Very strongly disagree (2) . (3) . (4) . (5) . (6) . (7) Very strongly agree	A mean score was computed by adding the items together and dividing by 4. Mean scores lower than 5.5 were categorized as low family support (1) vs high family support (0) (Inchley et al., 2021).
Low peer support	- Peer support subscale of the Multidimensional Scale of Perceived Social Support (Zimet et al., 1988). - My friends really try to help me - I can count on my friends when things go wrong - I have friends with whom I can share my joys and sorrows - I can talk about my problems with my friend	(1) Very strongly disagree (2) . (3) . (4) . (5) . (6) . (7) Very strongly agree	A mean score was computed by adding the items together and dividing by 4. Mean scores lower than 5.5 were categorized as low peer support (1) vs high peer support (0) (Inchley et al., 2021).

2.3. Data analysis

The stratified sample by geographic region was weighted to achieve a nationally representative sample: each region contributed proportionally to the overall sample based on the distribution of the student population in Italy by age category. Each student was assigned a weight equal to the reciprocal of their probability of inclusion in the regional sample. Regional weights were also adjusted based on the eligible student population, estimated after data cleaning across age groups. Missing data in the outcome variables ranged from 0.2 % (daily fruit consumption) to 10.2 % (excess BMI). Most cases had complete data (79.0 %) or had missing data on one of the outcome variables that we examined (16.1 %). Less than 5 % of the sample had missing data for more than one outcome. After data cleaning and applying the inclusion criteria, we found that 89321 students' data were eligible for analysis (distributed in 5669 classes). We used responses to a general item about gaming frequency ("How often do you play video games?") and two cut-point criteria on the IGDS9-SF (see the introduction for details) to identify four levels of involvement with gaming (non-gamers, low-risk gamers, high-risk gamers, and problematic gamers). In the following section, we report the weighted prevalence and 95 % CIs of the health outcomes shown in Tables 2 and 3. Logistic regressions were used to estimate the odds ratios (ORs) of gamers (low-risk, high-risk, and problematic) in comparison to non-gamers for each outcome variable. ORs were adjusted for gender, age, material deprivation, and family structure.

3. Results

3.1. Descriptive characteristics of gaming

Socio-demographic characteristics stratified by gaming severity are tabulated in Table 2. One-third of the participants reported being non-gamers (33.7 %), with a major prevalence of females (76.2 %). About half of the respondents were classified as low-risk gamers (51.6 %), almost two-thirds being male (62.2 %). High-risk gamers constituted one-tenth of the population (11.6 %), the majority being male (72.4 %). Problematic gamers constituted 3.1 % of the sample, with a higher prevalence of males (73.7 %). The relative proportion of problematic gaming was significantly higher in younger age categories (from 40 % in 11-year-olds to 9 % in 17-year-olds). Conversely, non-gamers were more prevalent in older age groups. There was a higher rate of non-gamers/low-risk gamers among students who lived with at least two parents/step-parents (82–83 %) than among their peers classified as problematic gamers (74 %). No differences were observed regarding material deprivation (Table 2).

3.2. The associations between gaming and outcome variables

The complete ORs results are reported in Table 3 and summarized in Fig. 1. Compared with non-gamers, low-risk gamers reported significantly better health-related outcomes in terms of a lower risk of depression (OR = 0.86, 95 % CI = 0.80–0.93), lower stress (OR = 0.92, 95 % CI = 0.87–0.98], and fewer psychological (0.85, 95 % CI = 0.80–0.90) and somatic symptoms (0.92, 95 % CI = 0.87–0.99). Nevertheless, low-risk gamers also showed significantly worse health-related outcomes in terms of global health (OR = 0.91, 95 % CI =

Table 2
Characteristics of the sample and outcomes by gaming group.

	Level	Non-gamers 30440 (33.7 %)	Low-risk gamers 43803 (51.6 %)<	High-risk gamers 9200 (11.6 %)<	Problematic gamers 2506 (3.1 %)
Socio-demographic characteristic					
Gender	Male	7240 (23.8 %)	27259 (62.2 %)	6662 (72.4 %)	1847 (73.7 %)
	Female	23200 (76.2 %)	16544 (37.8 %)	2538 (27.6 %)	659 (26.3 %)
Age (in years)	11	4141 (13.6 %)	12477 (28.5 %)	3065 (33.3 %)	1010 (40.3 %)
	13	7009 (23.0 %)	11736 (26.8 %)	2892 (31.4 %)	804 (32.1 %)
	15	9226 (30.3 %)	10621 (24.2 %)	2093 (22.8 %)	466 (18.6 %)
	17	10064 (33.1 %)	8969 (20.5 %)	1150 (12.5 %)	226 (9.0 %)
Family affluence	Low	7679 (26.2 %)	10313 (24.3 %)	2408 (27.4 %)	722 (30.6 %)
	Medium	15680 (53.4 %)	23175 (54.5 %)	4504 (51.2 %)	1096 (46.4 %)
	High	5982 (20.4 %)	9011 (21.2 %)	1882 (21.4 %)	542 (23.0 %)
Living with at least 2 parents/step-parents	0	5489 (18.0 %)	7242 (16.5 %)	2091 (22.7 %)	653 (26.1 %)
	1	24951 (82.0 %)	36561 (83.5 %)	7109 (77.3 %)	1853 (73.9 %)
Health and well-being					
Low mood	0	14165 (47.3 %)	27313 (63.4 %)	4963 (55.4 %)	1187 (49.1 %)
	1	15797 (52.7 %)	15775 (36.6 %)	4001 (44.6 %)	1231 (50.9 %)
At risk of depression	0	23707 (79.1 %)	38009 (88.2 %)	7518 (83.9 %)	1798 (74.4 %)
	1	6255 (20.9 %)	5079 (11.8 %)	1446 (16.1 %)	620 (25.6 %)
Loneliness	0	24589 (81.1 %)	38113 (87.3 %)	7270 (79.5 %)	1765 (71.2 %)
	1	5713 (18.9 %)	5540 (12.7 %)	1873 (20.5 %)	714 (28.8 %)
High stress	0	18508 (61.6 %)	32453 (75.0 %)	5700 (63.1 %)	1368 (56.0 %)
	1	11536 (38.4 %)	10820 (25.0 %)	3330 (36.9 %)	1074 (44.0 %)
Two or more weekly psychological symptoms	0	11734 (38.7 %)	24221 (55.5 %)	3784 (41.4 %)	848 (34.2 %)
	1	18600 (61.3 %)	19447 (44.5 %)	5367 (58.6 %)	1632 (65.8 %)
Two or more weekly somatic symptoms	0	20205 (66.5 %)	34674 (79.3 %)	6631 (72.4 %)	1602 (64.5 %)
	1	10159 (33.5 %)	9027 (20.7 %)	2525 (27.6 %)	883 (35.5 %)
Low life satisfaction	0	22963 (75.8 %)	36264 (83.0 %)	6862 (75.0 %)	1610 (64.7 %)
	1	7327 (24.2 %)	7423 (17.0 %)	2287 (25.0 %)	880 (35.3 %)
Excellent health	0	22895 (75.5 %)	29349 (67.2 %)	6852 (74.9 %)	1825 (73.4 %)
	1	7424 (24.5 %)	14313 (32.8 %)	2301 (25.1 %)	663 (26.6 %)
Nutrition and physical health					
Excess BMI	0	23068 (86.7 %)	32893 (82.3 %)	6549 (77.6 %)	1681 (73.9 %)
	1	3537 (13.3 %)	7076 (17.7 %)	1887 (22.4 %)	594 (26.1 %)
Eats breakfast daily	0	16283 (53.6 %)	21120 (48.4 %)	5252 (57.4 %)	1534 (61.6 %)
	1	14083 (46.4 %)	22492 (51.6 %)	3901 (42.6 %)	958 (38.4 %)
Daily fruit consumption	0	18924 (62.3 %)	29065 (66.4 %)	6495 (70.8 %)	1739 (69.7 %)
	1	11464 (37.7 %)	14691 (33.6 %)	2682 (29.2 %)	755 (30.3 %)
Daily vegetable consumption	0	18950 (62.4 %)	30884 (70.6 %)	7029 (76.6 %)	1878 (75.5 %)
	1	11412 (37.6 %)	12842 (29.4 %)	2142 (23.4 %)	611 (24.5 %)
Daily cola/soft drinks	0	27825 (91.6 %)	39521 (90.4 %)	7675 (83.7 %)	1841 (74.0 %)
	1	2541 (8.4 %)	4207 (9.6 %)	1493 (16.3 %)	648 (26.0 %)
Daily desserts/sweets	0	22989 (75.7 %)	32804 (75.0 %)	6314 (68.9 %)	1476 (59.3 %)
	1	7377 (24.3 %)	10923 (25.0 %)	2851 (31.1 %)	1011 (40.7 %)
Daily salty snacks	0	25505 (84.5 %)	36839 (84.7 %)	7169 (78.7 %)	1766 (71.5 %)
	1	4681 (15.5 %)	6629 (15.3 %)	1943 (21.3 %)	705 (28.5 %)
Vigorous physical activity 3+ days/week	0	16072 (53.2 %)	19522 (44.8 %)	4449 (48.8 %)	1263 (51.1 %)
	1	14165 (46.8 %)	24026 (55.2 %)	4674 (51.2 %)	1209 (48.9 %)
Daily time spent gaming	0	–	39924 (91.9 %)	6680 (73.0 %)	1163 (46.8 %)
	1	–	3502 (8.1 %)	2466 (27.0 %)	1321 (53.2 %)
Sleep					
Low quality sleep	0	18399 (63.2 %)	28694 (68.5 %)	4128 (47.6 %)	822 (34.8 %)
	1	10708 (36.8 %)	13172 (31.5 %)	4550 (52.4 %)	1541 (65.2 %)
Sleeping less than 7 h/night	0	23291 (76.8 %)	35555 (81.5 %)	7034 (77.0 %)	1702 (68.4 %)
	1	7018 (23.2 %)	8064 (18.5 %)	2103 (23.0 %)	786 (31.6 %)
Social well-being					
Low family support	0	18467 (61.3 %)	29364 (67.4 %)	4749 (52.2 %)	1239 (50.1 %)
	1	11669 (38.7 %)	14187 (32.6 %)	4340 (47.8 %)	1236 (49.9 %)
Low peer support	0	19133 (63.6 %)	27659 (63.7 %)	4642 (51.1 %)	1274 (51.8 %)
	1	10936 (36.4 %)	15763 (36.3 %)	4443 (48.9 %)	1186 (48.2 %)

Excess body mass index (BMI): Overweight/obese (1) vs normal weight/thinness/severe thinness (0). From living with at least 2 parents/step-parents to low peer support, (0) = no and (1) = yes.

0.86–0.97), eating fruit daily (OR = 0.81, 95 % CI = 0.76–0.85), eating vegetables daily (OR = 0.81, 95 % CI = 0.77–0.86), eating desserts or sweets daily (OR = 1.11, 95 % CI = 1.04–1.18), vigorous physical activity (OR = 0.91, 95 % CI = 0.86–0.96), and lower sleep quality (OR = 1.08, 95 % CI = 1.02–1.15). Regarding social well-being, in comparison to non-gamers, low-risk gamers reported lower support from their family (OR = 1.08, 95 % CI = 1.02–1.15), but they did not indicate significantly lower social support from their peers (OR = 1.02, 95 % CI = 0.97–1.07).

Compared with non-gamers, high-risk gamers exhibited less favourable outcomes in all health-related outcomes considered, including lower mood (OR = 1.66, 95 % CI = 1.52–1.82), higher risk of depression (OR = 1.52, 95 % CI = 1.35–1.71), higher loneliness (OR = 2.14, 95 % CI = 1.92–2.38) and stress (OR = 2.05, 95 % CI = 1.87–2.24), more psychological (OR = 1.86, 95 % CI = 1.69–2.04) and somatic symptoms (OR = 1.65, 95 % CI = 1.49–1.82), lower life satisfaction (OR = 1.80, 95 % CI = 1.63–1.98), worse health (OR = 0.52, 95 % CI = 0.47–0.58), being overweight (OR = 1.29, 95 % CI = 1.15–1.44), eating breakfast daily (OR = 0.63, 95 % CI = 0.58–0.68), eating fruit daily (OR = 0.69, 95 % CI = 0.63–0.76), eating vegetables daily (OR = 0.65, 95 % CI = 0.58–0.71), drinking cola and soft drinks daily (OR = 1.81, 95 % CI

Table 3
Logistic regression of health and well-being, nutrition and physical health, sleep, and social well-being (reference = *non-gamers*).

Variable	OR#	95 % CI
Low mood		
Low-risk gamers	0.95	0.90–1.01
High-risk gamers	1.66***	1.52–1.82
Problematic gamers	2.60***	2.22–3.04
At risk of depression		
Low-risk gamers	0.86***	0.80–0.93
High-risk gamers	1.52***	1.35–1.71
Problematic gamers	3.04***	2.52–3.68
Loneliness		
Low-risk gamers	1.02	0.95–1.10
High-risk gamers	2.14***	1.92–2.38
Problematic gamers	3.80***	3.23–4.48
High stress		
Low-risk gamers	0.92**	0.87–0.98
High-risk gamers	2.05***	1.87–2.24
Problematic gamers	3.08***	2.64–3.58
Two or more psychological symptoms		
Low-risk gamers	0.85***	0.80–0.90
High-risk gamers	1.86***	1.69–2.04
Problematic gamers	2.88***	2.44–3.39
Two or more somatic symptoms		
Low-risk gamers	0.92*	0.87–0.99
High-risk gamers	1.65***	1.49–1.82
Problematic gamers	2.56***	2.17–3.02
Low life satisfaction		
Low-risk gamers	0.98	0.92–1.05
High-risk gamers	1.80***	1.63–1.98
Problematic gamers	3.06***	2.63–3.56
Excellent health		
Low-risk gamers	0.91**	0.86–0.97
High-risk gamers	0.52***	0.47–0.58
Problematic gamers	0.55***	0.47–0.64
Excess BMI		
Low-risk gamers	1.05	0.98–1.14
High-risk gamers	1.29***	1.15–1.44
Problematic gamers	1.62***	1.37–1.91
Eats breakfast daily		
Low-risk gamers	0.95	0.90–1.00
High-risk gamers	0.63***	0.58–0.68
Problematic gamers	0.56***	0.48–0.65
Daily fruit consumption		
Low-risk gamers	0.81***	0.76–0.85
High-risk gamers	0.69***	0.63–0.76
Problematic gamers	0.70***	0.60–0.81
Daily vegetable consumption		
Low-risk gamers	0.81***	0.77–0.86
High-risk gamers	0.65***	0.58–0.71
Problematic gamers	0.65***	0.55–0.77
Daily cola/soft drinks		
Low-risk gamers	1.08	0.99–1.19
High-risk gamers	1.81***	1.60–2.06
Problematic gamers	2.86***	2.40–3.39
Daily desserts/sweets		
Low-risk gamers	1.11**	1.04–1.18
High-risk gamers	1.57***	1.44–1.73
Problematic gamers	2.27***	1.96–2.63
Daily salty snacks		
Low-risk gamers	1.04	0.97–1.12
High-risk gamers	1.53***	1.37–1.70
Problematic gamers	2.22***	1.90–2.61
Vigorous physical activity 3+ days/week		
Low-risk gamers	0.91**	0.86–0.96
High-risk gamers	0.69***	0.64–0.76
Problematic gamers	0.58***	0.50–0.67
Low quality sleep		
Low-risk gamers	1.08**	1.02–1.15
High-risk gamers	2.89***	2.64–3.15
Problematic gamers	4.75***	4.05–5.56
Sleeping less than 7 h/night		
Low-risk gamers	1.05	0.98–1.12
High-risk gamers	1.63***	1.47–1.80
Problematic gamers	2.75***	2.30–3.28
Low family support		
Low-risk gamers	1.08**	1.02–1.15
High-risk gamers	2.29***	2.10–2.50
Problematic gamers	2.67***	2.31–3.08
Low peer support		
Low-risk gamers	1.02	0.97–1.07
High-risk gamers	1.74***	1.60–1.90
Problematic gamers	1.67***	1.45–1.93

Note: BMI = body mass index, OR = odds ratio, CI = confidence interval. *$p < .05$, **$p < .01$, ***$p < .001$. # = adjusted for gender, age, material deprivation, and family structure.

= 1.60–2.06), eating desserts and sweets daily (OR = 1.57, 95 % CI = 1.44–1.73), eating salty snacks daily (OR = 1.53, 95 % CI = 1.37–1.70), vigorous physical activity (OR = 0.69, 95 % CI = 0.64–0.76), poorer sleep quality (OR = 2.89, 95 % CI = 2.64–3.15), sleeping less than 7 h (OR = 1.63, 95 % CI = 1.47–1.81), lower family support (OR = 2.29, 95 % CI = 2.10–2.50), and lower peer support (OR = 1.74, 95 % CI = 1.60–1.90).

Compared with non-gamers, problematic gamers reported worse health-related outcomes in all health-related outcomes considered, including lower mood (OR = 2.60, 95 % CI = 2.22–3.04), higher risk of depression (OR = 3.04, 95 % CI = 2.52–3.68), higher loneliness (OR = 3.80, 95 % CI = 3.23–4.48) and stress (OR = 3.08, 95 % CI = 2.64–3.58), more psychological (OR = 2.88, 95 % CI = 2.44–3.39) and somatic symptoms (OR = 2.56, 95 % CI = 2.17–3.02), lower life satisfaction (OR = 3.06, 95 % CI = 2.63–3.56), worse health (OR = 0.55, 95 % CI = 0.47–0.64), being overweight (OR = 1.62, 95 % CI = 1.37–1.91), eating breakfast daily (OR = 0.56, 95 % CI = 0.48–0.65), eating fruit daily (OR = 0.70, 95 % CI = 0.60–0.81), eating vegetables daily (OR = 0.65, 95 % CI = 0.55–0.77), drinking cola and soft drinks daily (OR = 2.86, 95 % CI = 2.40–3.39), eating desserts and sweets daily (OR = 2.27, 95 % CI = 1.96–2.63), eating salty snacks daily (OR = 2.22, 95 % CI = 1.90–2.61), vigorous physical activity (OR = 0.58, 95 % CI = 0.50-0.67), poorer sleep quality (OR = 4.75, 95 % CI = 4.05–5.56), sleeping less than 7 h (OR = 2.75, 95 % CI = 2.30–3.28), lower family support (OR = 2.67, 95 % CI = 2.31–3.08) and lower peer support (OR = 1.67, 95 % CI = 1.45–1.93).

4. Discussion

This study is among the first to examine the associations between gaming groups (non-gamers, low-risk gamers, high-risk gamers, problematic gamers) and health/well-being in a representative sample of adolescents while accounting for the harms of video game playing by following a nuanced, continuum-based conceptualization of PG. It is also one of the first to conjointly investigate a wide range of health factors (mental health, well-being, nutrition, physical health, sleep, and social well-being) that are of particular importance during adolescence (World Health Organization, 2021).

Approximately 34 % of the sample was classified as non-gamers. In this group, girls, older adolescents, and adolescents from families with at least two parents/step-parents were overrepresented. The second group comprised about half the sample (51.6 %) and was composed of adolescents classified as being at low risk of developing gaming problems, again with adolescents from families with at least two parents/step-parents being overrepresented and a higher prevalence of boys and younger adolescents. The high-risk gamers constituted one-tenth of the population (11.6 %), the majority being males (73 %) with younger ages (33 % 11-year-olds), but only 23 % living in single-parent households or other settings. Finally, problematic gamers constituted 3.1 % of the sample, again with a higher prevalence of males (74 %) and younger age categories (40 % 11-year-olds) and 26 % living in single-parent households or other settings. Interestingly, it appears that family affluence, measured as material deprivation at home, is not distributed in a way

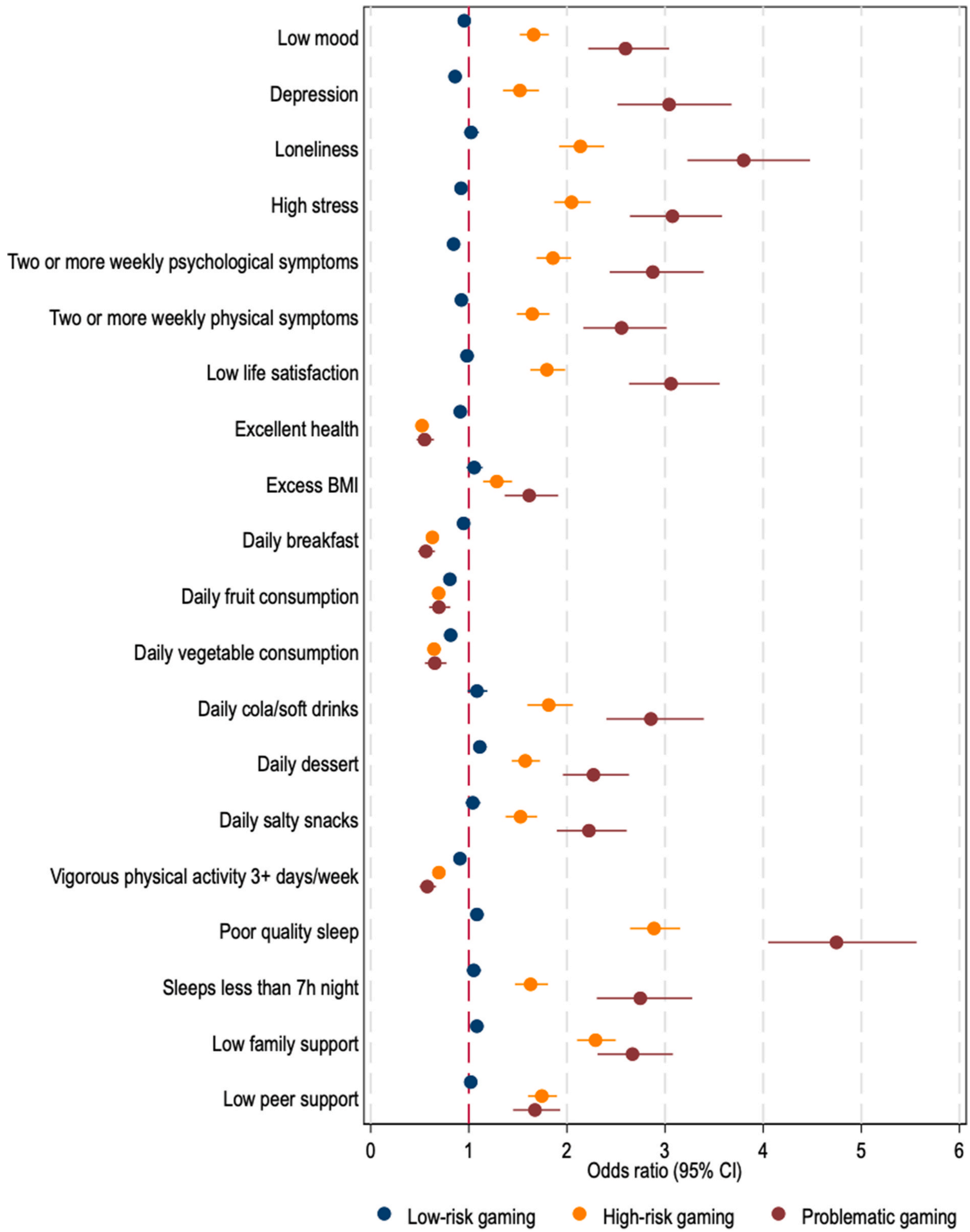

Fig. 1. Forest plot displaying odds ratios and 95% confidence intervals (CIs) for various health and wellbeing outcomes associated with low-risk, high-risk and problematic gaming in Italian youths. Reference group: non-gamers.

that clearly describes the phenomenon of gaming/PG among adolescents, meaning that some groups (e.g., non-gamers) may not be more economically disadvantaged than others (e.g., low-risk gamers). Analyses allowed for comparison of non-gamers with gamers (low-risk, high-risk, and problematic).

An important finding was that low-risk gamers exhibited slightly better health-related outcomes (i.e., lower risk of depression, lower stress, and fewer psychological and physical symptoms) compared with those of non-gamers. In addition, this group of gamers was not characterized by reduced peer social support compared with that for non-gamers. These findings align with the digital Goldilocks hypothesis (Przybylski & Weinstein, 2017), which proposes that, in contemporary society, the use of digital technology is not inherently detrimental and may facilitate adolescent connections and peer relationships. Indeed, it is likely that low-risk gamers play in a normative way and can satisfy their need for socialization, which is not problematic per se (e.g., Angelini et al., 2024). As a result, they might experience the positive effects of playing with others and use video games as one of the possible activities to nurture social relationships, which non-gamers may find in activities other than playing video games. For example, it has been shown that social online video games do not have a negative impact on friendship quality and levels of face-to-face social support (Domahidi et al., 2018). Our results are also consistent with prior studies that used HBSC data and reported that adolescents who did not use social media exhibited lower life satisfaction compared with that for non-problematic, yet active users (Boniel-Nissim et al., 2022) and that gaming for social compensation might mitigate the experienced emotional distress during pandemic-related self-isolation (Giardina et al., 2021). In addition, these results appear to be in line with the Dualistic Model of Passion (Vallerand, 2015), which posits that individuals who exhibit harmonious passions (e.g., gaming) – characterized by a strong connection with an activity, mindful engagement, a secure sense of self-esteem, openness, and flexibility – do not present negative consequences and functional impairment (as in the case of obsessive passions). There is evidence that harmonious passion is related to lower levels of loneliness, higher well-being, and better life satisfaction (Mandryk et al., 2020; Przybylski et al., 2009). Thus, it is possible that students included in the low-risk group may have a harmonious engagement in gaming. However, in the present study, we could not ascertain whether the health and well-being outcomes observed were a direct effect of the different patterns of gaming. Therefore, further longitudinal or experimental studies are needed to test the direction of the associations.

Results nevertheless showed that high-risk and problematic gamers reported lower health and well-being than non-gamers did, the associations being especially pronounced in the PG group. More specifically, problematic gamers reported high levels of loneliness and stress, high risk of depression (and low mood), more psychological and somatic symptoms, low life satisfaction, and poor health. Taken together, these results are in line with previous studies (Ostinelli et al., 2021; Zhuang et al., 2023) that suggested that poor psychological health may increase the risk of PG (González-Bueso et al., 2018; Männikkö et al., 2020; Ostinelli et al., 2021), and could be conceptualized from different but coherent theoretical perspectives (Teng et al., 2021). For instance, the I-PACE (Brand et al., 2016, 2019) model includes psychopathology (e.g., depression, psychological symptoms, low mood) and specific needs among the core individual characteristics predisposing an individual to PG. This is consistent with recent results suggesting that psychological distress (e.g., depressive symptoms and negative affect) may increase the risk of PG (Dang et al., 2024; Király et al., 2023; Sit et al., 2023). In line with the compensatory hypothesis (Kardefelt-Winther, 2014), problematic gamers are likely to be people experiencing impaired psychological well-being (e.g., psychological distress) who engage in gaming to compensate for unmet needs (e.g., social need to decrease loneliness) and an escape from unwanted negative feelings (e.g., low life satisfaction). However, this engagement may result in excessive use of video games and, in turn, may increase the vulnerability to PG, leading to further negative internal states and physical consequences. In this vicious circle view, and given the impossibility of drawing conclusions about the directionality of the observed associations in the current study, a bidirectional association between PG and psychological health is plausible. This idea appears to be in line with the "common causes/comorbidity hypothesis" (Teng et al., 2021, p. 170) sustained by previous longitudinal studies (e.g., Jeong et al., 2019), whereby a dynamic and reciprocal relationship may exist between symptoms of psychopathology (e.g., anxiety, depression) and the severity of IGD, increasing the overall levels of an individual's vulnerability. Moreover, these results align well with the *ICD-11* criteria for PG (World Health Organization, 2019), according to which problematic gamers experience significant functional impairment in daily life due to gaming behaviour, including sleep problems. Consistent with the results of a meta-analysis (Kristensen et al., 2021), the results from the present study confirm that problematic gamers experience poorer sleep quality and sleep less than non-problematic peers do. Potential mechanisms generating sleep disturbances in problematic gamers may include psychological stimulation (i.e., excited mood due to gaming), light-emitting screens (i.e., light may overpower sleep-promoting hormones that are naturally elevated before bedtime), and maladaptive gaming habits (e.g., avoiding logging off, or arising in the middle of the night to continue gaming with multiplayer gamers from different time zones) (Achab et al., 2011; Hale et al., 2018; Rehbein et al., 2015; van der Lely et al., 2015). However, it should be kept in mind that the association between functional impairment and PG does not necessarily indicate a cause-and-effect relationship; rather, it is based on observed cross-sectional associations.

The results also showed that, compared with non-gamers, adolescents who reported PG were more likely to be overweight/obese and to declare worse food preferences or consumption patterns (e.g., consuming more sugar drinks/salty snacks regularly, eating lower amounts of vegetables and fruits, skipping breakfast). These results are consistent with previous evidence (Chan et al., 2022; Pelletier et al., 2020). Potential mechanisms to explain higher rates of overweight and obesity/unhealthy diet habits of problematic gamers may include an increased risk of metabolic syndrome in adolescents due to sedentary behaviours over long periods (e.g., being in a sitting, reclining, or lying posture while playing video games) (Oliveira & Guedes, 2016), short-sighted decision-making processes (e.g., maximizing gaming time and striving for need satisfaction) (Barlow et al., 2016), and in-game advertisements and brand presence in the gaming community (Goodman et al., 2020). Furthermore, in line with two systematic reviews (Chan et al., 2022; Pelletier et al., 2020), the results from the present study confirmed that PG is associated with reduced moderate and vigorous physical activity. This provides support for the displacement hypothesis (Neuman, 1988), which posits that more time spent gaming may leave less time for physical activity, thus leading individuals to lose interest in other leisure-time activities and hobbies (e.g., sports and outdoor activities), which is a symptom of IGD (APA, 2013). However, it is also possible that less physically active adolescents tend to play more (Hygen et al., 2022).

The finding that problematic gamers reported lower levels of family support (compared with that for non-gamers) aligns with previous research showing that adolescents living in families in which members do not help each other manage life difficulties and do not openly communicate about problems may display higher tendencies to develop maladaptive patterns of gaming (Colasante et al., 2022; Nielsen et al., 2020). Indeed, family environments characterized by low cohesion and warmth can lead adolescents to use video games excessively as a dysfunctional coping strategy (Bonnaire et al., 2019; Pivetta et al., 2024). Furthermore, this study also found that problematic gamers exhibited lower levels of peer support. It is possible that adolescents receiving low support from their peers may turn to video games in an attempt to alternatively satisfy their need for relatedness, ultimately developing dysfunctional gaming habits (Bender & Gentile, 2020).

4.1. *Strengths and limitations*

Although this study has important strengths, such as the use of a large sample and the representative nature of the data (results weighted to represent the Italian adolescent population), the use of simultaneous dimensions (mental health, well-being, nutrition, physical health, sleep, and social well-being), and the continuum of self-reported gaming problems (i.e., no gaming, low/high risk of PG, PG), there are some limitations that should be acknowledged and considered in future research.

First, although our study is best placed to show the size and direction of the associations between gaming and adolescents' health/well-being, it is limited in its ability to examine causal mechanisms due to its cross-sectional design. Longitudinal studies are needed to evaluate these claims. Second, PG was assessed with a tool (the IGDS9-SF; Pontes & Griffiths, 2015) that, despite being widely used (King et al., 2020), may have limited accuracy in providing distinctions between individuals that would translate to specific levels of severity and harm. Further studies that adopt other measurement approaches should be conducted to complement our approach (e.g., dose-dependent associations of screen time and health/well-being; Khan et al., 2021). In addition, health and well-being were measured by using either a single item or a few items, indicating that our findings should be interpreted with caution and that more detailed measures of these outcomes are warranted for future replications. The measures used were those available in the HBSC study protocol (Inchley et al., 2021) and did not include other relevant information, such as gaming-related variables. For example, recent research indicates that specific structural elements in games (e.g., complex reward systems, loot-boxes, and in-game purchases) may be crucial in heightening PG (Rehbein et al., 2021) and loss of control over gaming (Flayelle et al., 2023). Furthermore, the social context and motivations driving adolescents' engagement in gaming may be considered as plausible moderating factors in the association between gaming and well-being (Hartanto et al., 2021). For instance, it has been shown that adolescents who play with friends for enjoyment reported better well-being outcomes than do those who play alone or to cope with everyday stressors (Sauter et al., 2021). Future research should further concentrate on these gaming-related variables to better understand and distinguish their effects. Third, the evidence in this study stemmed only from Italian participants. Consistent with the Normalization Theory, risk behaviours (e.g., substance use) that the majority of the population in a certain society or culture accept become normalized and tend to be no longer viewed as problematic (Boer et al., 2020; Haskuka et al., 2018). As this theory has already been applied in the field of adolescent social media use (e.g., Boer et al., 2020; Boniel-Nissim et al., 2022) and PG (van der Neut et al., 2023), it is possible that the societal acceptance of gaming could influence whether adolescent gamers perceive certain gaming behaviours as problematic or not. Consequently, the associations between reported harms of PG and the well-being of adolescent gamers may be different in countries where gaming is relatively prevalent. Therefore, the findings need to be replicated in other cultures. Another important limitation of the present study is that the target population involved only students attending schools, thus providing limited evidence on gaming in the larger group of youths (e.g., youth with social withdrawal who were not attending school at the time of data collection). Fourth, the socioeconomic measure used in the HBSC study estimated material deprivation at home but not financial resources (e.g., spending money) that could have affected access to video games, consoles, and/or PCs. It also did not measure subjective appraisals of relative socioeconomic position.

5. Conclusions

The results of the present study, based on data from almost 90000 adolescents, reveal that playing video games is a healthy leisure activity for most youths (at least in terms of lower risk of depression, lower stress, fewer psychological and somatic symptoms, and no reduction in perceived peer social support). This conclusion supports the need to avoid stigma-related judgments of adolescent gamers. However, in a significant minority of vulnerable users, their problematic use was clearly associated with negative consequences (e.g., worse health/well-being and psychosocial maladjustment), functional impairment (e.g., sleep interference), and unhealthy lifestyles (e.g., lower physical activity and poorer nutrition). From a practical point of view, our findings suggest that interventions and preventive programs should be tailored to specific patterns of gaming and their effects on health. Although it is important to develop evidence-based interventions that help adolescents manage the functional impairments deriving from PG, a preventive/promotive approach is also needed to raise awareness about the potential benefits of video games on adolescent development. Since our findings indicate that problematic engagement in video games may play the most important role in explaining its detrimental consequences, interventions should facilitate a shift from maladaptive to harmonious engagement. For example, professionals may support adolescents in selecting and playing video games that allow them to cultivate their passions, establish and maintain social relationships, and develop a sense of competence (Koban et al., 2022; Zhao et al., 2023), in balance with other important life activities and responsibilities typical of their developmental stage.

CRediT authorship contribution statement

Natale Canale: Writing – original draft, Validation, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Frank J. Elgar:** Writing – review & editing, Validation, Supervision, Software, Resources, Investigation, Formal analysis, Conceptualization. **Erika Pivetta:** Writing – original draft, Validation, Methodology, Data curation, Conceptualization. **Tommaso Galeotti:** Writing – original draft, Validation, Methodology, Data curation. **Claudia Marino:** Writing – review & editing, Validation, Supervision, Methodology, Investigation, Data curation, Conceptualization. **Joël Billieux:** Writing – review & editing, Validation, Supervision. **Daniel L. King:** Writing – review & editing, Validation, Supervision. **Michela Lenzi:** Writing – review & editing, Validation. **Paola Dalmasso:** Writing – review & editing, Project administration, Methodology, Data curation. **Giacomo Lazzeri:** Writing – review & editing, Validation, Project administration, Methodology, Data curation. **Paola Nardone:** Writing – review & editing, Validation, Project administration, Methodology, Investigation, Funding acquisition, Data curation. **Arianna Camporese:** Writing – review & editing, Validation. **Alessio Vieno:** Writing – review & editing, Validation, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization.

Ethics committee approval

In 2022, the Italian HBSC study protocol and questionnaire were formally approved by the Ethics Committee of the Italian National Institute of Health (protocol: AOO-ISS-22/11/2021–0040602 Class: PRE BIO CE01.00).

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Declaration of competing interest

Joël Billieux serves as an editorial board member for Computers in Human Behaviors. Please note, however, that he was not involved at any stage during the editorial process. All other authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability statement

The data presented in this study are available in accordance with the 2022 Italian HBSC data access policy. Requests should be directed to the Italy Principal Investigator, Dr. Paola Nardone:paola.nardone@iss.it

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