Online Gaming and Mental Health: Testing the Goldilocks Hypothesis in Australian Youth

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Abstract

Online video gaming (OG) is a highly popular activity, especially among adolescent males. Excessive OG can involve addiction-related clinical presentations, while lower-frequency gaming appears to support mental health. However, publication biases favour harm-centred accounts of OG, and benefits are frequently overlooked. The current study tested the 'goldilocks hypothesis' that light OG (0-2h/day) is protective while excessive OG (>4h/day) is harmful compared to non-gaming. Australian high-school students (*N* = 52,628) responded to a survey assessing demographics, mental health symptoms, disengaged coping, OG, and various social items which yielded factors representing family support, friend support, and sociability using principal components analysis. The main multinomial logistic regression model controlled for gender and psychosocial predictors, and male and female samples were also analysed separately. Overall, excessive and moderate OG predicted increased mental health risk while light OG showed no effect. However, in males, excessive OG predicted increased mental health risk whereas light OG was protective. In females, excessive and moderate (2-4h/day) OG predicted increased mental health risk whereas light OG showed no effect. Results supported the goldilocks hypothesis for males but not females, suggesting that light OG may improve male mental health, but not effect females. Lower disengaged coping, male gender, and higher family and friend supports were protective, while sociability and socio-economic status produced mixed effects. The current study outlines key implications for family and treatment settings, suggests that biopsychosocial factors may reflect greater importance for mental health than OG itself, and urges future research to acknowledge the beneficial potential of OG.

Keywords: online gaming, adolescents, mental health, gender, coping, social

Declaration

This thesis contains no material which has been accepted for the award of any other degree of diploma in any University, and, to the best of my knowledge, this thesis contains no material previously published except where due reference is made. I give permission for the digital version of this thesis to be made available on the web, via the University of Adelaide's digital thesis repository, the Library Search and through web search engines, unless permission has been granted by the School to restrict access for a period of time.

Signed,

Contribution Statement

Raw data for this project was provided by Resilient Youth Australia. My supervisor completed the ethics application and facilitated communication between myself and Resilient Youth Australia regarding methodology-related enquiries. Resilient Youth Australia also provided an outline of their survey construction and data collection methodologies, which I interpreted and wrote up in full. I formulated the research question under guidance from my supervisor, and independently extracted, scored, and analysed the data. Interpretation of results was undertaken in collaboration with my supervisor. I conducted the relevant literature search and wrote up all sections of the thesis.

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Thank you all sincerely,

Yianni.

Online video gaming (OG) is a highly popular activity among children and adolescents, and for many it is a platform for socialization, friendships, cooperation, and skill development (Lenhart, Smith, Anderson, Duggan, & Perrin, 2015). The most recent national Australian survey of child and adolescent wellbeing indicated that 94.7% of males and 75.2% of females aged 11-17 played any electronic games daily, and that 26.9% of males and 6.6% of females played for over 5 hours per day (Lawrence et al., 2015). With such prevalence, a clear view of its effects is critical, especially in sensitive contexts such as parenting, education, and the treatment of gaming-related clinical conditions (Han, Seo, Hwang, Kim, & Han, 2020). However, research illustrates an important point: gaming is frequently misunderstood to uniformly produce negative effects, while its potential benefits lack acknowledgement (Ferguson, 2007, 2015; Przybylski & Weinstein, 2017). This harm-centred bias surfaces from one dominant conceptual framework, *the displacement hypothesis*, which posits that media use displaces important functional domains (Neuman, 1988; Przybylski & Weinstein, 2017). Critically, OG itself provides a diverse means of enrichment (Przybylski, 2014; Przybylski & Mishkin, 2016; Przybylski, Weinstein, Murayama, Lynch, & Ryan, 2012; Ryan, Rigby, & Przybylski, 2006; Sublette & Mullan, 2012), and is effectively a social norm at its current rates of engagement (Lawrence et al., 2015). Przybylski and Weinstein (2017) argued *the digital goldilocks hypothesis* as an alternate framework, predicting that the right amount of gaming is beneficial to wellbeing, while excess and non-engagement are harmful, as supported by their findings. While this original study controlled for socio-economic status (SES), additional biopsychosocial predictors, such as gender, were not investigated and may influence the nature of effects.

Gaming, Key Criticisms, and Current Research

Video gaming takes multiple forms, including multi-player online and single-player offline, which appear to produce similar but unique effects (Przybylski & Mishkin, 2016), and are often combined under the general term of ‘gaming’ (Przybylski & Weinstein, 2017). More generally, gaming has been criticized on the basis that it produces harmful effects, especially in child and adolescent populations. Such criticisms typically centre on problematic gaming, which broadly incorporates negative outcomes such as increased aggression, violence and conduct issues (Etchells, Gage, Rutherford, & Munafò, 2016; Ferguson, 2015; Przybylski & Mishkin, 2016), addiction (Milani et al., 2018), reduced psychosocial functioning (Colder Carras et al., 2017; Ferguson, 2015; Hellström, Nilsson, Leppert, & Åslund, 2015), obesity and poor physical health (Boone, Gordon-Larsen, Adair, & Popkin, 2007; Chahal, Fung, Kuhle, & Veugelers, 2013), reduced academic performance (Ferguson, 2015), social isolation (Colder Carras et al., 2017), and displaced sleep (Chahal et al., 2013). These concerns are empirically valid, but only present a partial account of gaming, pay little focus to non-problematic gaming, and generally overlook potential benefits (Przybylski & Weinstein, 2017).

The behavioural cluster of aggression, violence, and conduct issues has received great focus in research, politics, and broader society. This partly stems from claims that violent video games contributed to the Columbine massacre (Ferguson, 2013; Porter & Starcevic, 2007), which elicited a ‘moral panic’ that violent games normalize and encourage violent conduct (Markey & Ferguson, 2017a, 2017b). However, this link is generally weak and inconclusive (Etchells et al., 2016; Ferguson, 2015; Lobel, Engels, Stone, Burk, & Granic, 2017; Porter & Starcevic, 2007), and for an unpersuasive state of research, the U.S. Supreme Court ruled against the regulation of violent game sales to minors in 2011 (Ferguson, 2013). The underlying sentiment of concern, however, continues to bias research towards harm-centred accounts (Ferguson, 2015; Markey & Ferguson, 2017a, 2017b), which potentially overlook key protective effects (Przybylski & Mishkin, 2016; Przybylski & Weinstein, 2017), and may subsequently inform biased parental attitudes, gaming-centred family tension, and reduced family cohesion which further implicates mental health (MH) and wellbeing (Bonnaire & Phan, 2017; Han et al., 2020; Merilainen, 2021).

Current research suggests that personal and contextual factors are most important for MH outcomes, especially daily engagement (Przybylski & Weinstein, 2017; Sublette & Mullan, 2012). For example, male gender is associated with increased gaming time, violent game choice, game addiction, and reward sensitivity (Dong, Wang, Du, & Potenza, 2018; Milani et al., 2018; Toker & Baturay, 2016). Disengaged coping strategies associate with problematic gaming (Li, Zou, Wang, & Yang, 2016; Milani et al., 2018), escape motives associate with increased engagement and poorer psychosomatic and musculoskeletal symptoms (Hellström et al., 2015), and engagement over 3-4 hours daily associates with poorer academic performance, depressive symptoms, self-esteem, and ill health (Colder Carras et al., 2017; Hellström et al., 2015; Przybylski & Weinstein, 2017; Toker & Baturay, 2016). Finally, problematic gaming has also been shown to associate with reduced family cohesion, which outlines a sensitive broader context for the potential implications of gaming (Bonnaire & Phan, 2017).

By contrast, social gaming is associated with fewer depressive symptoms in high-use cases and may protect against other symptoms of excessive gaming (Colder Carras et al., 2017). Fun and social motives associate with decreased psychosomatic and musculoskeletal symptoms and recovery motives predict stress recuperation (Hellström et al., 2015; Reinecke, 2009; Reinecke, Klatt, & Krämer, 2011). In a school-based study, compared to non-gamers, <1h daily gaming associated with reduced hyperactivity, conduct problems, and internalizing and externalizing problems, while single-player gamers exhibited fewer peer and emotional difficulties and greater academic engagement (Przybylski, 2014; Przybylski & Mishkin, 2016). One systematic review further outlined a range of positive aspects to video game play, including enjoyment, achievement, friendship, and community, and suggested that negative outcomes typically result from excessive use (Sublette & Mullan, 2012).

These findings outline a key distinction between problematic and non-problematic gaming, which are respectively implicated by various biopsychosocial factors, and associated with different wellbeing-related outcomes. This challenges the biased notion that gaming is implicitly harmful, and suggests that research should avoid harm-centred biases and attempt to outline functional and protective accounts to facilitate greater awareness and appropriate use (Przybylski & Weinstein, 2017). Due to bias, harm-centred accounts may feed negative media portrayals, public view, and gaming-centred family dynamics which in turn associate with the MH of young gamers (Bonnaire & Phan, 2017; Han et al., 2020). There is a clear need for research to address these points in broad scope, to address specific biopsychosocial factors associated with protective and harmful outcomes, and to construct a robust and detailed account for basing current perspectives on gaming.

Mental Health

Research generally indicates that excessive gaming is a key determinant of negative MH outcomes (Hellström et al., 2015; Przybylski & Weinstein, 2017). Given the high uptake of gaming during adolescence, the sensitive developmental processes of this period, and the potential MH implications of gaming, it is critical to determine whether gaming poses a significant risk to adolescent MH (Lenhart et al., 2015; Luciana, 2010). One meta-analysis found that the overall effect of video game use on MH was minimal (Ferguson, 2015), according to very weak correlations with depressive symptoms, aggression, reduced prosocial behaviour, attention deficit symptoms, and reduced academic performance. This general view effectively summarizes overall effects, but does not clarify the complex underlying patterns that appear to require alternate statistical methods (Przybylski & Weinstein, 2017), and may be more pertinent to applied contexts such as family and treatment settings (Bonnaire & Phan, 2017; Han et al., 2020).

Individual characteristics appear to play a critical role in how people utilize gaming and experience its effects, which is a pattern fundamental to environmental interaction according to the bioecological model of human development (Bronfenbrenner & Morris, 2007). For example, personality assessments found higher neuroticism, lower conscientiousness, and lower extraversion in problematic gamers (Braun, Stopfer, Müller, Beutel, & Egloff, 2016; Müller, Beutel, Egloff, & Wölfling, 2014), such traits vary by gender (Weisberg, Deyoung, & Hirsh, 2011), and male gender represents a significant biological predictor of addiction and social gaming respectively (Ferguson & Olson, 2013; Toker & Baturay, 2016). Effectively, identifying and controlling such factors is an important step in clarifying gaming-related outcomes, understanding important predispositions, and identifying at-risk individuals and populations for early intervention at clinical or family levels (Bonnaire & Phan, 2017; Han et al., 2020).

Coping strategies.

Implicit personal characteristics are an important consideration in the aetiological context of problematic gaming, particularly for identifying specific psychological risk and protective factors at the individual level. Accordingly, poor coping strategies are a key risk factor for problematic gaming habits and aversive outcomes in various broader domains. Specifically, avoidant coping strategies associate with depressive outcomes in adolescents (Seiffge-Krenke & Klessinger, 2000), higher reported postoperative pain (Schon, Gerlach, & Huppe, 2007), higher internalizing and externalizing problems in adolescents (Sun, Sun, Jiang, Jia, & Li, 2019), and gaming addiction risk (Milani et al., 2018). Furthermore, some also suggest that excessive gaming may itself be an expression of dysfunctional coping mechanisms (Müller et al., 2014).

Numerous studies support the idea of an interaction between character, coping, and gaming-related psychosocial outcomes. In one, avoidant coping strategies mediated the effect of stressful life events on gaming addiction, while neuroticism moderated this relationship (Li et al., 2016). Another also investigated coping with subtypes of internet addiction (Koo & Kwon, 2014), wherein effect sizes for coping and regulation related risk and protective factors were similar across addiction subtypes, except for gaming which associated more strongly with stress and coping. These findings support alignment between internet addiction subtypes, and importantly indicate that internal coping and regulation mechanisms may be particularly important for gaming addiction, especially alongside trait neuroticism and life stressors.

Other research on the relationship between coping and gaming indicates that individuals with clinically elevated MH symptoms tend to approach gaming with catharsis and autonomy motivations, rather than challenge and fun, socialization, or boredom motivations (Ferguson & Olson, 2013). Notably, motivation towards cathartic gaming presents as a facet of coping, which builds on the relationships between gaming, coping, and MH. Incorporating these notions into the goldilocks framework, light gaming may successfully aid coping without producing negative consequences, similar in effect to gaming aiding stress and strain recuperation (Reinecke, 2009), whereas in severe cases, elevated psychological disturbance may elicit excessive gaming as an unsuccessful and repeated attempt towards catharsis. Overall, coping mechanisms represent a key psychological factor in the relationship between gaming and MH outcomes, associate with key biopsychosocial factors, and provide an individual-level account of predisposition towards problematic and non-problematic conditions.

Social factors.

OG is a very popular social activity. One report found that 84% of boys and 59% of girls aged 13 to 17 reported playing video games on any device, and that gaming is popularly undertaken in-person with friends, online with in-person friends and online friends, and online with others who are not friends (Lenhart et al., 2015). Male gamers played more frequently with in-person and online friends, and 34% of teenage boys reported making an online friend while gaming. Further, 38% of teenage boys and 7% of girls reported that when first meeting a potential friend, one of the first pieces of information shared was their in-game name or identifier. Many games also contain varying degrees of teamwork and communication, which aligns with the finding that youth are commonly motivated towards gaming for social engagement (Ferguson & Olson, 2013; Olson, 2010). These observations reflect two important ideas: males express greater engagement in gaming and accordingly experience problematic gaming more frequently (Milani et al., 2018), and gaming can provide a valuable means of social support, which is a key social predictor of MH outcomes (Rothon, Goodwin, & Stansfeld, 2012).

Social factors play a key role in determining MH outcomes for online gamers. One study identified two distinct classes of excessive gamers based on high compared low online socialization, which differed vastly in gaming-related psychosocial symptom severity (Colder Carras et al., 2017). Socially engaged gamers expressed fewer symptoms of problematic gaming despite excessive use, which was attributed to social gameplay, community participation, and online friendships which act as key social supports (Ferguson & Olson, 2013; Lenhart et al., 2015; Sublette & Mullan, 2012). These social elements reflect social support which is a well-established protective factor for wellbeing (Ringdal, Bjørnsen, Espnes, Bradley Eilertsen, & Moksnes, 2021). While it is currently unclear whether general or context-specific social support is most important, social support reflects a key consideration for delineating risk and protective conditions, and for outlining potential social implications of gaming behaviours.

Perceived family support also protects against internet addiction, indicating that protective social factors extend beyond friend support (Wu et al., 2018). Additionally, teenagers whose parents are supportively involved in gaming express more civic involvement and prosocial behaviour than non-gamers and gamers with uninvolved parents (Ferguson & Garza, 2011). By comparison, one study revealed that teenagers explicitly desire positive and understanding parenting attitudes towards gaming, however, unsupportive, reactive-protective, and negative attitudes were commonly held by parents, reflecting a potentially detrimental family tension (Bonnaire & Phan, 2017; Merilainen, 2021). By contrast, poor family cohesion, problematic gaming, and poor MH share positive correlations and represent core foci for therapeutic interventions (Bonnaire & Phan, 2017; Han et al., 2020). Further, gaming addiction CBT interventions which target coping, social, impulse-control, and family factors facilitated improvements in MH and addiction symptoms (Han et al., 2020).

Current Study

OG possesses a clear potential for abuse, with problematic conditions accordingly listed in the ICD-11 as 'Gaming Disorder' and the DSM-5 as 'Internet Gaming Disorder' (American Psychiatric Association, 2013; World Health Organization, 2018), but also appears to support various benefits especially at light levels of engagement (Przybylski & Mishkin, 2016; Przybylski & Weinstein, 2017; Sublette & Mullan, 2012). Perhaps as a consequence of the "moral panic" and fear of harm surrounding gaming, research frequently biases towards negative effects (Ferguson, 2007, 2015; Markey & Ferguson, 2017a, 2017b), which risks overseeing gaming-related benefits and influencing unhelpful parenting and regulatory approaches that potentially facilitate more distress than gaming itself (Bonnaire & Phan, 2017; Han et al., 2020; Merilainen, 2021; Przybylski & Weinstein, 2017; Sublette & Mullan, 2012). The current study seeks to specifically address harm-centred biases through testing the goldilocks hypothesis, and to explore and control key contextual factors for the relationship between OG and MH.

Overall, a range of accounts outline various important biopsychosocial factors for gaming-related outcomes. These factors also outline areas for key implications, such as through informing family-based prevention and intervention approaches (Bonnaire & Phan, 2017; Han et al., 2020), time-bound rule-setting (Merilainen, 2021; Przybylski & Weinstein, 2017), social encouragement and engagement (Colder Carras et al., 2017), and multidimensional treatment approaches (Han et al., 2020). In line with these accounts, coping strategies, social factors, SES, and gender represent the core factor interests of the current study, for building on previous research by (Przybylski & Weinstein, 2017) that primarily controlled SES.

The aims of the current study are as follows: First, to clarify the relationship between daily OG and MH outcomes within the goldilocks framework while controlling for key biopsychosocial factors. Second, to investigate the effects of covariates on MH, particularly those important to OG contexts. Third, to investigate gender differences in the MH outcomes associated with OG and covariates under the goldilocks framework, which was only addressed to a limited degree in the original studies (Przybylski & Mishkin, 2016; Przybylski & Weinstein, 2017). Specifically, the following hypotheses will be tested: As the goldilocks hypothesis predicts, OG will predict both positive and negative MH outcomes at light and excessive levels of daily OG respectively, compared to the baseline of non-gaming, after controlling for covariates (H1); a greater proportion of males will play online games across all levels, and a greater proportion of females will be non-gamers (H2); coping, social factors, female gender, and SES will significantly predict MH outcomes (H3); poor coping will predict poorer MH (H3a); social factors will predict better MH (H3b), female gender will predict poorer MH (H3c); and higher SES will predict better MH (H3d).

Methods

Participants

Participants of the current study were derived from an Australian convenience sample generated by Resilient Youth Australia (RYA) as part of their Resilience Survey. The survey was administered within schools as part of a wellbeing and resilience reporting program and included public and private schools across regional and suburban areas of Australia.

The total sample consisted of 52,628 high school students from grades 7 to 12, aged from 11 to 19 years, after excluding specific groups and cases with missing data. 31,861 (60.5%) of participants were female and 20,767 (39.5%) were male. 1636 participants who reported ‘other’ or ‘prefer not to say’ for gender were not included due to psychosocial differences in this population (Rimes, Goodship, Ussher, Baker, & West, 2019), and to retain a simple research design. No primary school students were included, as the key question regarding OG was only administered to high school students. 765 students from New Zealand were excluded from the total sample due to differences between Australia and New Zealand in SES metrics. Table 1 summarizes the distribution of participants by region and compares to the regional distribution of the Australian population. 2023 students (996 males, 1,027 females) were included in the total sample whose postal code was not provided or did not align with national SES data. No information was available on participating schools to ensure anonymity, and participant locations were based on reported home postal code. These students were included in preliminary analyses but were excluded from the final logistic models.

Table 1

Sample Size and Regional Distribution Compared to the Australian Population Regional Distribution

Region	Sample Size	Sample Distribution	Australian Population (March 2020) [a]
Victoria (VIC)	29,608	56.3 %	26.1%
Queensland (QLD)	14,230	27.%	20.1%
New South Wales (NSW)	3,668	7.0%	31.8%
Other Not Specified	1,768	3.4%	N/A
Western Australia (WA)	1,636	3.1%	10.4%
Northern Territory (NT)	929	1.8%	1.0%
Tasmania (TAS)	344	0.7%	2.1%
South Australia (SA)	372	0.7%	6.9%
Australian Capital Territory (ACT)	73	0.1%	1.7%
Total	52,628	100%	100%

[a] Derived from the Australian Bureau of Statistics (2020)

Participant birthplace was 83.3% Australia, 2.6% China, 1.6% New Zealand, 1.7% U.K., and 10.8% elsewhere. 30.7% of students or their families spoke a language other than English at home. According to the socio-economic indexes for areas index of relative socio-economic advantage and disadvantage (SEIFA IRSAD), participant SES ranged from lowest to highest decile rankings (1-10) and was relatively advantaged (M = 6.69, SD = 2.83) compared to national average (Australian Bureau of Statistics, 2016).

Procedure

Schools elected to participate in the resilience survey for a per-student cost. In exchange, schools received a statistical report detailing student psychosocial metrics compared to national averages generated by RYA (Resilient Youth Australia, 2021). Students at included schools participated voluntarily, without incentive, and were informed that data would remain anonymous. Parents were informed of the study by schools, and students participated under a passive consent framework. Surveys were administered through a secure online format and completed under teacher supervision during class-time. Students were informed that staff assistance was available for correct understanding and completion. Overall, 60% of responses were collected during 2019 and 40% were collected during 2020. Ethics approval for the current study was provided by the University of Adelaide Human Research Ethics Committee. Analyses were conducted using SPSS version 23.

Materials

Resilience survey.

The 2019-2020 RYA Resilience Survey consisted of 8 demographic items, 61 core items, and 7 optional items relating to risk behaviour engagement. Demographic and core items were included as standard, while optional items were included at the discretion of schools. Core items targeted a variety of biopsychosocial domains and contained a combination of customised items based on expert opinion and standard instruments, including the Patient Health Questionnaire-4 (PHQ-4; Kroenke, Spitzer, Williams, & Lowe, 2009) and items from the Coping Strategies Inventory (CSI; Tobin, 2001; Tobin, Holroyd, Reynolds, & Wigal, 1989). Optional items assessed the frequency of specific risk-behaviours, including smoking, gambling, and OG. No identifiable participant information was collected.

Daily online gaming.

The duration of daily OG was measured using a single item on a 4-point scale: “I play online games”. Response categories included “never”, “up to 2 hours each day”, “2-4 hours each day”, and “more than 4 hours each day”. These categories respectively represent non-gaming (0h daily), light (0-2h), moderate (2-4h), and excessive (>4h) gaming conditions in line with previous research (Przybylski & Weinstein, 2017). Importantly, there was no measure of gaming device, singleplayer-multiplayer status, game genre, or any further details such as addiction status.

Mental health: The Patient Health Questionnaire-4.

The PHQ-4 is comprised of two subscales which measure anxiety and depression respectively: The Patient Health Questionnaire-2 and the Generalized Anxiety Disorder-2 (Kroenke et al., 2009). Each subscale consists of two items scored on a 4-point scale, for a total of 4 items which respectively measure the primary symptom criteria from the DSM-5 for depression and anxiety (American Psychiatric Association, 2013). An aggregate total from these items represents a valid measure of MH symptom severity (Kroenke et al., 2009). PHQ-4 total scores of 0-2, 3-5, 6-8, and 9-12 respectively correspond to normal, mild, moderate, and severe symptom categories (Kroenke et al., 2009). These symptom severity categories were used in place of total scores as the primary categorical measure of MH symptoms.

Coping Strategies Inventory: Adapted disengagement subscale.

The current study utilized a brief 4-item adaptation of the 36-item Disengagement Subscale from the full CSI (Tobin et al., 1989). As a tertiary factor, disengaged coping represents 2 of 4 secondary factors, emotional and problem disengagement, and 4 of 8 primary factors from the full inventory. The scale was shortened to 4 items by using 1 representative item from each of the 4 primary factors (Tobin, 2001). Table 2 details the primary factor composition, item wordings, and factor coefficients of the adapted scale. Minor adjustments were made to original item wording for clarity and suitability in the school sample (Tobin, 2001). This adaptation facilitated utility within the current survey but reduced internal consistency.

The Wishful Thinking sample item from the CSI was exchanged for another same-factor item to avoid religious terminology and improve cultural applicability, which possessed a higher primary factor loading of .50, compared to .44 (Tobin et al., 1989). Cronbach's alpha for the full disengagement subscale was .89, and primary factor alphas ranged from .72-.94. Test-retest reliabilities ranged from .68-.83 across the 8 CSI subscales. No existing reliability information was available for the adapted scale utilized, though it possessed a Cronbach's alpha of 0.66 in the sample population. This indicated acceptable internal consistency for the purpose of the current study, as a simple control for poor coping style.

Socio-economic status: SEIFA IRSAD deciles.

SEIFA IRSAD decile scores were used as a measure of SES by matching participants reported postal address against its national decile rankings (Australian Bureau of Statistics, 2016). Postal areas with rank 1 were in the lowest 10% for national SES (Australian Bureau of Statistics, 2016). The SEIFA IRSAD is produced by the Australian Bureau of Statistics (2016) based on national census data and is calculated based on a combination of household income, education level, employment status, occupation, housing, and other family circumstances. Importantly, this was not a direct measure of participant SES, but an SES measure of their home postal area.

Table 2

Coping Strategies Inventory Primary Factors, Items, and Factor Coefficients

Tertiary Factor	Primary Factor	Item	Tertiary Factor Loading	Primary Factor Loading
Disengagement	Self-Criticism	I criticize myself for what is happening.	.36	.70
	Problem Avoidance	I avoid thinking or doing anything about the problem.	.40	.34
	Wishful Thinking	I wish the problem would go away or somehow be over with.	n/a	.50
	Social Withdrawal	I spend more time alone.	.37	.56

Preliminary Analysis: Exploratory Factor Analysis of Social Factors

The survey contained a range of items related to social relationships, functioning, and support that were of interest as predictors of MH outcomes. There was no pre-determined factor structure or validated measure among these items. 23 such items were subject to principal component analysis to determine the underlying factor structure and create variables representing social factors to include in analyses. This was performed on the total sample of 52,628 participants.

The initial correlation matrix revealed that nearly all items were significantly intercorrelated from the weak to moderate level. Appendix A contains the full correlation matrix in Table A1, and a description of item codes and item wordings in Table A2. Kaiser-Meyer-Olkin measure of sampling adequacy was .922, Bartletts test of sphericity was significant, χ^2 (253, 52,628) = 439,604.56, $p < .001$, and all communalities were above .3, indicating good sampling, good factorability, and common variance respectively. Initially, 5 components were extracted with eigenvalues greater than 1, explaining 58.0% of variance cumulatively, and 33.1%, 7.4%, 6.7%, 5.6%, and 4.9% for components 1 to 5, respectively. Direct Oblimin oblique rotation was applied as components shared weak to moderate correlations ranging from .437 to -117 and provided the best-defined factor structure.

Table 3 presents a detailed summary of the final factor iteration with items, item codes, and relevant statistics. Through multiple iterations, 3 items (Ry3, Ry4, Ry14) constituting a factor of school and teacher support were removed, as these domains were not of interest to the theoretical model primarily concerning friends and family. One item, “I can talk about things if they upset me” (Ry11), was removed for dual factor loadings below 0.3. Two items (Sun11 and Sun12) exclusively representing a factor of bullying victimization were removed due to lack of theoretical relevance. One final item (Tru1) was removed for multiple factor loadings across the 3 remaining factors. Despite dual factor loadings for items Ry10 and Ry29, these were retained for having a stronger loading on one factor. The final factor structure returned 3 factors representing family support, trait sociability, and friend support. Following the final iteration, factor scores were calculated using the regression method within SPSS, such that higher scores represent higher levels of family support, sociability, and friend support respectively.

Table 3

Exploratory Factor Analysis Results: Family Support, Sociability, and Friend Support

			Factor Loadings		
Item	Item Code	Communality	Family Support	Sociability	Friend Support
I get love and support from my family.	Ry2	.698	.870		
I have a parent/carer who listens to me.	Ry8	.713	.860		
I have parents/carers who encourage me to do well.	Ry5	.654	.825		
I feel safe at home.	Ry13	.557	.751		
I have adults who set good examples for me.	Ry7	.609	.744		
I have an adult in my life who I can talk to about my worries.	Ry27	.547	.724		
I feel safe in the area where I live.	Ry15	.342	.478		
I give my time to help others.	Ry26	.556		.772	
I think it is important to help other people.	Ry24	.586		.747	
I forgive others who are mean to me.	For1	.440		.674	
I am trustworthy.	Tru2	.413		.571	
I get along with people who are different from me.	Ry10	.429		.470	
I have at least one good friend at school.	Ry6	.646			.827
I spend time with friends.	Sun5	.594			.787
I am good at keeping friends.	Ry9	.602			.667
My friends and I can disagree about things and still be friends.	Ry29	.403			.443
Eigenvalue			5.763	1.724	1.301
% Of Variance			36.0%	10.8%	8.1%

Note. Factor loadings below .350 are suppressed.

Results

Prevalence and Gender Differences: Online Gaming and Mental Health

Table 4 outlines prevalence rates within OG and MH categories for the current Australian adolescent sample and gender-based subsamples. Notably, the average prevalence of severe MH symptoms was 13.6% compared to 38.9% normal symptoms, and the average prevalence of >4h OG was 15.2%, compared to 31.7% 0-2h OG and 33.1% non-gaming. Generally, prevalence rates decreased across sequentially higher categories of MH and OG, however this was not true for OG in males, as non-gaming was least prevalent. There were also considerable between-gender prevalence differences within OG and MH that were greatest at the extreme levels. Specifically, male prevalence was 5.1 times higher within >4h OG, while female prevalence was 1.91 times higher within severe MH.

Overall, males engaged more in OG than females, and females expressed greater prevalence in higher MH symptom categories (See Table 4). This was supported by chi-square tests, which indicated significant associations between gender and OG, χ^2 = 10,691.47 (3, 52,628), $p < .001$, and between gender and MH categories, χ^2 = 1,871.73 (3, 52,628), $p < .001$. All cells were influential towards these results, following the general convention outlined by Sharpe (2015) as all standardized residuals exceeded 3. Direct *z*-test comparisons indicated significant between-gender differences within each level of OG and each MH category. Within OG, there were significantly more males at 0-2h, 2-4h, and >4h levels, while significantly more females were non-gamers. Females experienced poor MH more frequently at severe, moderate, and mild levels, while significantly more males presented in the normal category. These comparisons were significant at the $p < .05$ level using the Bonferroni correction method, in line with the cell comparison methods outlined by Sharpe (2015).

Table 4

Prevalence Rates Within Online Gaming and Mental Health

Measure	Category	Female *n* (% of Females)	Male *n* (% of Males)	Total *N*, (% of Total)	Average Prevalence
Online Gaming	>4h	1,577 (4.9%)	5,269 (25.4%)	6,846 (13.0%)	15.2%
	2-4h	2,227 (7.0%)	4,168 (20.1%)	6,395 (12.2%)	13.6%
	0-2h	9,274 (29.1%)	7,434 (35.8%)	16,708 (31.7%)	32.5%
	0h	18,783 (59.0%)	3,896 (18.8%)	22,679 (43.1%)	38.9%
	Total	31,861 (100%)	20,767 (100%)	52,628 (100%)	100%
Mental Health	Severe	5,668 (17.8%)	1,936 (9.3%)	7,604 (14.4%)	13.6%
	Moderate	6,514 (20.4%)	2,980 (14.3%)	9,494 (18.0%)	17.4%
	Mild	9,635 (30.2%)	5,752 (27.2%)	15,378 (29.2%)	28.7%
	Normal	10,044 (31.5%)	10,099 (48.6%)	20,143 (38.3%)	40.1%
	Total	31,861 (100%)	20,767 (100%)	52,628 (100%)	100%

Figure 1, Figure 2, and Figure 3 respectively represent the prevalence of MH symptoms across OG categories for total, male, and female samples, based on prevalence rates from Table 4. The general pattern across figures suggests that across higher levels of gaming, poor MH increased while normal MH decreased. This pattern was most pronounced in females. Importantly, however, 2-4h OG for total and male samples appeared to associate with a reduction in severe and moderate symptoms and an increase in normal MH, indicating that males may benefit at this level of gaming. Conversely, a sequentially greater proportion of females occupied poorer MH categories across higher OG rates and did not appear to experience potential benefit.

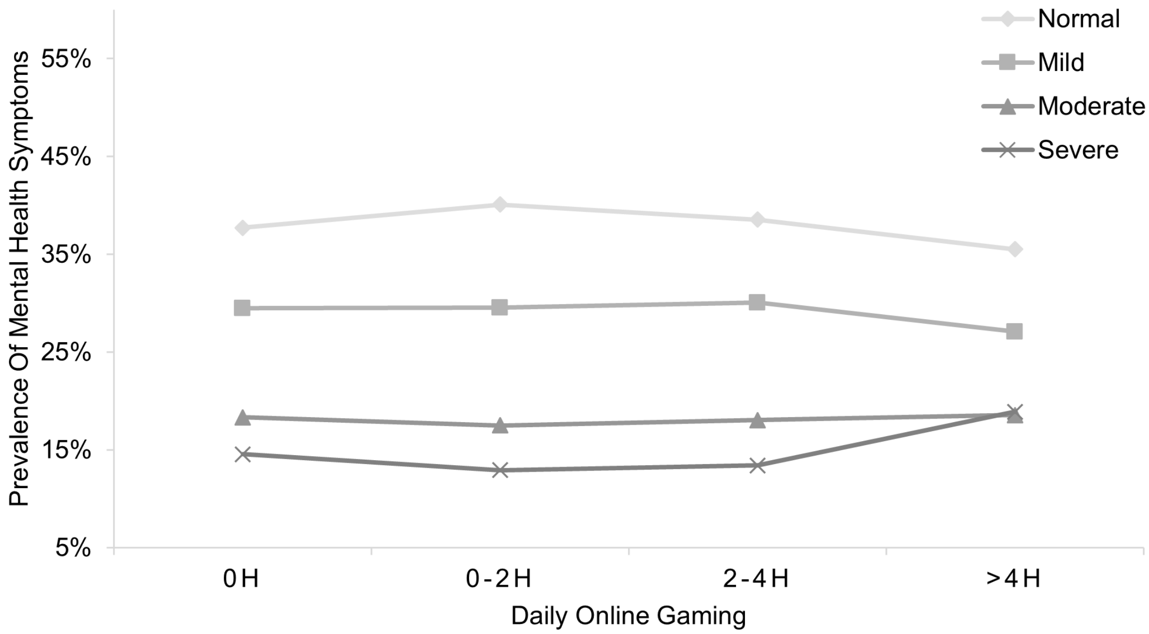

Figure 1. Total prevalence rates of mental health symptoms within each category of online gaming engagement.

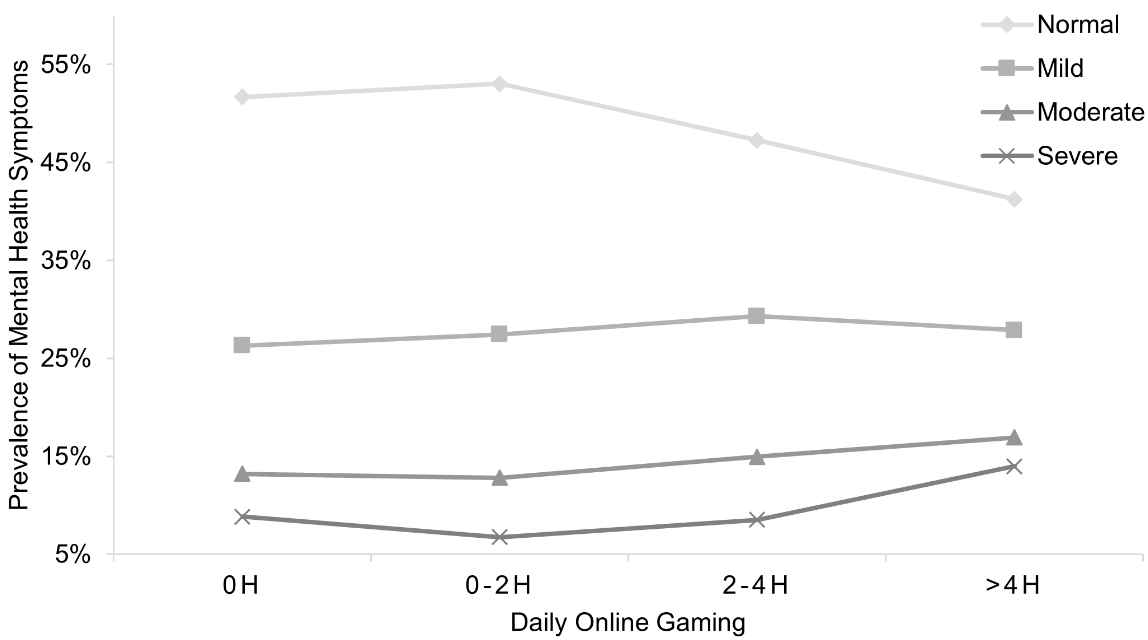

Figure 2. Male prevalence rates of mental health symptoms within each category of online gaming.

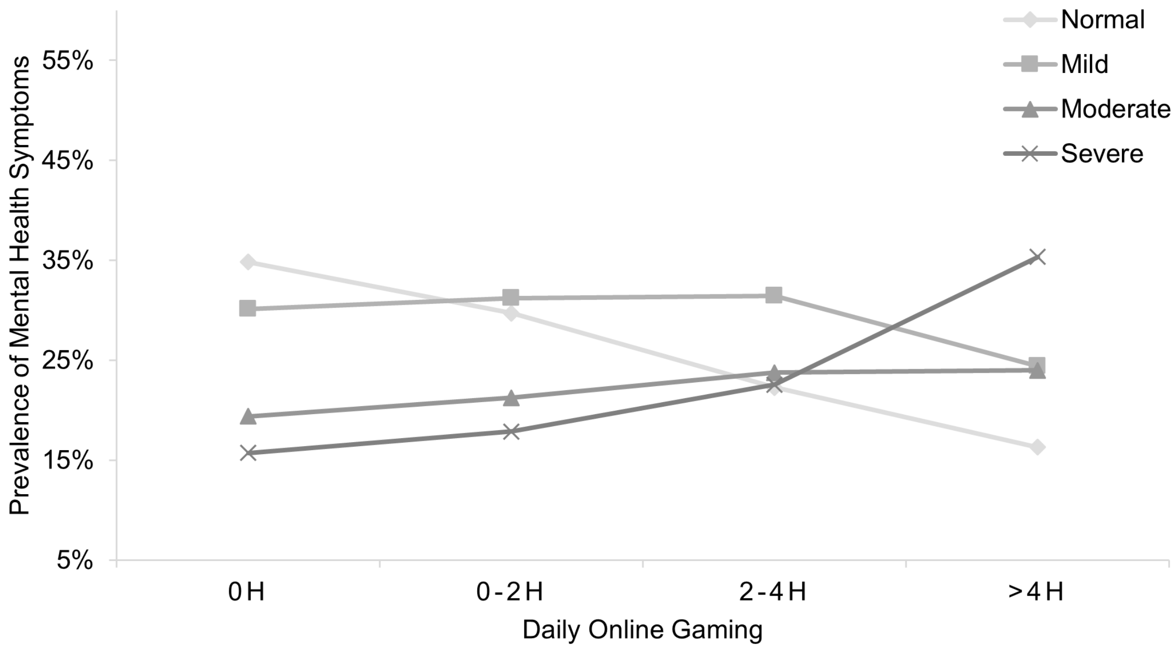

Figure 3. Female prevalence rates of mental health symptoms within each category of online gaming.

Descriptive Statistics, Assumptions Testing, and Variable Transformations

Table 5 contains descriptive statistics for the initial variables of interest. Total sample OG was negatively skewed towards non-gaming. This largely represents female non-gamers, who constituted 35.7% of the full sample, and does not represent the considerable differences between male and female gaming patterns. Categorical MH and total PHQ-4 score distributions were positively skewed towards normal symptoms, and females appeared to experience poorer MH than males on average. SES deciles were negatively skewed, indicating that the sample was socio-economically advantaged relative to the Australian population average, and females had a slightly higher mean rank. Disengaged coping scores were normally distributed among sample populations, and females expressed slightly higher mean score than males. Family and friend support distributions were highly negatively skewed, and sociability was moderately negatively skewed; on family, sociability, and friend factor scores respectively, 61%, 54.2%, and 60% of participants scored above the mean. Females also scored marginally higher on sociability than males.

Table 5

Descriptive Statistics by Sample for All Variables

Variable	Sample	*M*	*SD*	Min - Max	Skew (*SE* Skew)	Kurtosis (*SE* Kurtosis)	Sample Size
Daily Online Gaming	Total	3.05	1.04	1 – 4	-0.80 (.011)	-0.56 (.021)	52,628
	Male	2.48	1.06	1 – 4	-0.11 (.017)	-1.24 (.034)	20,767
	Female	3.42	0.83	1 – 4	-1.44 (.014)	1.45 (.027)	31,861
PHQ-4 Total	Total	4.23	3.48	0 – 12	0.62 (.011)	-0.61 (.021)	52,628
	Male	3.38	3.26	0 – 12	0.94 (.017)	0.05 (.034)	20,767
	Female	4.78	3.51	0 – 12	0.45 (.014)	-0.81 (.027)	31,861
Mental Health Severity	Total	2.09	1.07	1 - 4	0.55 (.011)	-0.98 (.021)	52,628
	Male	1.84	0.99	1 - 4	0.90 (.017)	-0.37 (.034)	20,767
	Female	2.25	1.08	1 - 4	0.35 (.014)	-1.17 (.027)	31,861
SES Decile	Total	6.69	2.83	1 – 10	-0.43 (.011)	-1.04 (.022)	50,605
	Male	6.21	2.73	1 – 10	-0.23 (.017)	-1.06 (.034)	19,771
	Female	7.00	2.85	1 – 10	-0.58 (.014)	-0.93 (.028)	30,834
Coping Score	Total	9.55	2.76	4 – 16	0.11 (.011)	-0.48 (.021)	52,628
	Male	9.13	2.79	4 – 16	0.22 (.017)	-0.37 (.034)	20,767
	Female	9.82	2.71	4 – 16	0.06 (.014)	-0.51 (.027)	31,861
Family Support	Total	0[1]	1[1]	-3.99 – 1.03	-1.20 (.011)	0.88 (.021)	52,628
	Male	-0.03	0.99	-3.99 – 1.03	-1.19 (.017)	1.06 (.034)	20,767
	Female	0.02	1.01	-3.98 – 1.03	-1.21 (.014)	0.79 (.027)	31,861
Sociability	Total	0[1]	1[1]	-4.66 – 2.41	-0.69 (.011)	0.49 (.021)	52,628
	Male	-0.18	1.06	-4.63 – 2.41	-0.57 (.017)	0.30 (.034)	20,767
	Female	0.12	0.94	-4.66 – 2.13	-0.73 (.014)	0.57 (.027)	31,861
Friend Support	Total	0[1]	1[1]	-4.77 – 1.65	-1.31 (.011)	1.80 (.021)	52,628
	Male	-.001	1.02	-4.77 – 1.65	-1.35 (.017)	2.00 (.034)	20,767
	Female	.001	0.99	-4.77 – 1.59	-1.29 (.014)	1.66 (.027)	31,861

Note. *SE* = standard error

[1] Factor scores are calculated with a mean of 0 and *SD* of 1 by default.

Factor scores, SES deciles, and disengaged coping scores were screened for inclusion as continuous variables, while gender and OG remained categorical predictors. For continuous variables, the assumption of linearity in the logit was tested using the Box-Tidwell method outlined by Stoltzfus (2011). Linearity in the logit was violated for all continuous predictors in the main model, as the interaction terms of each predictor and its natural logarithm returned significant results at the $p < .05$ level; a detailed table of these results is presented in Appendix B. Natural log, square, and square root variable transformations were also tested, but did not correct distributions to satisfy this assumption. Due to this violation, continuous variables were transformed into quartile rankings and included as categorical predictors.

VIF and Tolerance statistics among categorical predictors indicated that multicollinearity was not present in any of the 3 samples. The maximum observed VIF values across models were for family support; VIF = 1.38 (total), 1.39 (males), and 1.38 (females). Spearman rank correlations also indicated no moderate or strong correlations among IVs, providing further evidence against multicollinearity.

Correlations

Table 6 presents a correlation matrix of all variables for total, male, and female samples respectively. Overall, gender differences in the strength of correlations were marginal, and all correlations shared direction across samples. OG, disengaged coping, and MH symptoms shared significant positive correlations that varied from weak between OG and both coping and MH symptoms, to moderate between MH symptoms and disengaged coping for females. Gaming, MH symptoms, and disengaged coping also shared weak negative correlations with other variables. SES, family support, sociability, and friend support shared weak positive correlations that varied in strength by gender.

Table 6

Spearman Rank Correlations Between Variables within Overall, Male, and Female Samples

Variable	Sample	SES Quartile	Disengaged Coping	Family Support	Sociability	Friend Support	Online Gaming
Disengaged Coping	Overall Male Female	-.047 -.056 -.072	1				
Family Support	Overall Male Female	.147 .104 .165	-.276 -.212 -.329	1			
Sociability	Overall Male Female	.147 .103 .146	-.094 -.079 -.135	.401 .428 .379	1		
Friend Support	Overall Male Female	.073 .039 .096	-.222 -.191 -.245	.374 .400 .359	.336 .353 .330	1	
Online Gaming	Overall Male Female	-.168 -.141 -.104	.045 .105 .118	-.151 -.139 -.157	-.172 -.142 -.115	-.046 -.024 -.074	1
Mental Health Severity	Overall Male Female	-.049 -.056 -.094	.460 .370 .499	-.379 -.342 -.426	-.153 -.181 -.185	-.289 -.279 -.303	.009* .098 .115

Note. All unmarked correlations are significant at the $p < .001$ level (2-tailed).

* $p = .041$.

As expected, social factors shared the strongest correlations due to the underlying factor structure but did not indicate significant multicollinearity. There were also multiple apparent gender differences in the strength of correlations across sets of variables. Despite the expectation that higher SES quartiles would correlate positively with OG, a negative relationship was observed.

Model Fitting Information

The main multinomial logistic model included quartile transformed variables, gender (male, female), and OG as predictors. Due to the observed gender differences in OG and MH severity, two additional models were run to explore male and female samples separately. Despite a large total sample size in the main model (*n* = 50,605), a large proportion of cell combinations between predictor and outcome variable categories contained zero frequencies (Total = 11,709; 41.8%). Zero frequency counts were 6,729 (46.2%) in the male only model, and 4,980 (37%) in the female only model. Zero counts were largely a consequence of low-frequency categories within MH and OG, and the high number of combinations between predictor and outcome categories. The high proportion of zero frequency cells reduces the validity of Pearson and likelihood ratio model goodness of fit tests but does not impact other statistics (IBM, 2020). Median splits would have reduced zero frequencies, however quartiles were retained to avoid reduced correlations, lowered prediction accuracy, and potentially inflated error rates across models (DeCoster, Gallucci, & Iselin, 2011).

For the three multinomial logistic regression models, model fitting information and goodness of fit tests produced mixed results. Across models, likelihood ratio tests were significant, indicating good model fit in the main model, χ^2 (57, 50,605) = 20,196.06, $p < 0.001$); male only model, χ^2 (54, 19,771) = 5,599.18, $p < 0.001$; and female only model, χ^2 (54, 30,834) = 12,983.87, $p < 0.001$. In the main model, significant Pearson and Deviance goodness of fit tests indicated poor model fit, Pearson χ^2 (20,955, 50,605) = 23,196.15, $p < 0.001$, Deviance χ^2 (20,955, 50,605) = 21,656.03, $p < 0.001$. In the male only model, Pearson goodness of fit test indicated poor fit, χ^2 (10,875, 19,771) = 11,687.29, $p < 0.001$, while Deviance indicated good fit, χ^2 (10,875, 19,771) = 11,059.89, $p = .105$, and in the female only model tests indicated poor fit, Pearson χ^2 (10,026, 30,834) = 10,357.65, p = 0.01, Deviance χ^2 (10,026, 30,834) = 10,352.67, p = .011. AIC and BIC were highest in the main model because of its greater detail (AIC = 41,996.31, BIC = 42,526.22), lower in the female only model (AIC = 22,291.15, BIC = 22,766.32), and lowest in the male only model (AIC = 19,569.70, BIC = 20,019.55).

Table 7 Presents test statistic results for each of the predictors within each multinomial logistic model. SES did not significantly predict MH in the male model but was significant in the main and female models. All other predictors were significant across models.

Table 7

Test Statistics for Predictors Within Each Multinomial Logistic Regression Model.

Variable	Model	χ^2 (df)	*df*	*p*
Gender	Main	1,621.99	3	<.001
Daily Online Gaming	Main	116.99	9	<.001
	Male	67.19	9	<.001
	Female	67.94	9	<.001
Coping Score	Main	7,690.78	9	<.001
	Male	2,266.73	9	<.001
	Female	5,506.73	9	<.001
Family Support	Main	2,995.98	9	<.001
	Male	897.69	9	<.001
	Female	2,060.84	9	<.001
Friend Support	Main	891.45	9	<.001
	Male	355.74	9	<.001
	Female	553.63	9	<.001
Sociability	Main	64.30	9	<.001
	Male	46.37	9	<.001
	Female	31.03	9	<.001
SES	Main	32.06	9	<.001
	Male	9.50	9	.392
	Female	29.79	9	<.001

Table 8 presents 3 different Pseudo R^2 values for each model as estimates of model goodness-of-fit: Cox and Snell, Nagelkerke, and McFadden (Smith & McKenna, 2013). Accordingly, Pseudo R^2 estimates suggest that the main model successfully predicts 15.2% - 35.5%, of variance in MH outcomes; the male-only model successfully predicted 11.8% - 24.7% of variance in MH outcomes; and that the female-only model successfully predicted 15.5% - 34.4% of variance in MH outcomes.

Main Analyses

Table 9 and Table 10 present results from the multinomial logistic regression models. Table 9 presents the results of the main model (n = 50,605), and Table 10 presents results of the male (n = 19,771) and female (n = 30,834) models. RRRs specifically represent the relative risk of being in mild, moderate, or severe MH categories compared to normal, at certain predictor categories compared to the specified predictor reference category. Predictor reference categories are non-gaming for OG, male for gender, and 1st quartiles for other variables.

Table 8

Pseudo-R^2 Values for Each Multinomial Logistic Regression Model

Model	Cox and Snell	Nagelkerke	McFadden
Main	.329	.355	.152
Male	.247	.271	.118
Female	.344	.368	.155

Gender overall.

In the main model, female gender was significantly predictive of poorer MH symptoms compared to male gender. This difference was most pronounced in higher DV comparisons. Females, compared to males, were at increased risks of mild, moderate, and severe MH symptoms of 94%, 175%, and 315% respectively, compared to normal MH.

Online gaming.

In the main model (Table 9), 2-4h and >4h OG significantly predicted increased risk of poor MH compared to non-gaming. >4h OG, compared to non-gaming, significantly predicted 10%, 20% and 64% increased risk of mild, moderate, and severe MH symptoms respectively compared to normal MH, and 2-4h OG was significantly associated with 13% and 12% greater risk of mild and moderate symptoms respectively compared to normal. There were no significant effects associated with 0-2h OG across any level of MH symptoms, or for 2-4h OG at the severe MH symptom level, suggesting no difference between these levels and non-gaming in MH outcomes, and therefore no overall beneficial effect.

In gender-specific models (See Table 10), results did not follow the same pattern as for the main model. For males, only two comparisons were significant. >4h OG significantly predicted a 36% increased risk of severe MH, and 0-2h OG significantly predicted a 29.9% reduced risk of severe MH symptoms, compared to non-gaming. For females, the risk associations of OG were more pronounced, and there was no evidence of risk reduction in any comparisons. Specifically, >4h OG was associated with higher risk of both moderate (31%) and severe (87%) symptoms, and 2-4h OG was associated with a 17% increased risk of mild MH symptoms.

Table 9

Main Multinomial Logistic Regression Results: The Relative Mental Health Risks Associated with Gender, Online Gaming, Coping, Social Factors, and Socio-economic Status

Variable (Reference)	Category	Mild vs. Normal RRR (95% CI) Main Model	Moderate vs. Normal RRR (95% CI) Main Model	Severe vs. Normal RRR (95% CI) Main Model
Gender (Male)	Female	**1.94 (1.83-2.04)****	**2.75 (2.57-2.94)****	**4.15 (3.83-4.49)****
Online Gaming (0h)	>4h	**1.10 (1.01-1.19)***	**1.20 (1.08-1.32)****	**1.64 (1.47-1.83)****
	2-4h	**1.13 (1.04-1.22)****	**1.12 (1.02-1.24)***	1.09 (0.97-1.21)
	0-2h	1.04 (0.98-1.10)	1.00 (0.94-1.07)	0.97 (0.90-.05)
Disengaged Coping (1st QTile)	4th QTile	**4.15 (3.86-4.48)****	**14.62 (13.22-16.18)****	**19.44 (17.43-21.69)****
	3rd QTile	**3.59 (3.36-3.83)****	**8.32 (7.56-9.16)****	**5.15 (4.61-5.76)****
	2nd QTile	**2.21 (2.08-2.35)****	**3.59 (3.26-3.95)****	**1.51 (1.33-1.70)****
Family Support (1st QTile)	4th QTile	**0.37 (0.35-0.40)****	**0.18 (0.17-0.20)****	**0.09 (0.08-0.10)****
	3rd QTile	**0.56 (0.52-0.60)****	**0.32 (0.29-0.34)****	**0.16 (0.14-0.18)****
	2nd QTile	**0.75 (0.69-0.80)****	**0.50 (0.46-0.55)****	**0.31 (0.28-0.33)****
Friend Support (1st QTile)	4th QTile	**0.57 (0.53-0.61)****	**0.40 (0.37-0.44)****	**0.29 (0.26-0.32)****
	3rd QTile	**0.72 (0.67-0.77)****	**0.51 (0.47-0.55)****	**0.37 (0.34-0.41)****
	2nd QTile	**0.82 (0.76-0.88)****	**0.68 (0.63-0.74)****	**0.52 (0.47-0.56)****
Sociability (1st QTile)	4th QTile	**0.87 (0.81-0.94)****	**0.87 (0.80-0.95)****	1.02 (0.92-1.13)
	3rd QTile	1.02 (0.95-1.09)	1.00 (0.92-1.09)	1.05 (0.95-1.15)
	2nd QTile	0.98 (0.91-1.05)	0.94 (0.87-1.01)	**0.85 (0.78-0.93)****
SES (1st QTile)	4th QTile	1.02 (0.95-1.09)	0.94 (0.87-1.02)	0.95 (0.86-1.04)
	3rd QTile	1.06 (1.00-1.13)	1.00 (0.93-1.08)	0.93 (0.85-1.02)
	2nd QTile	1.04 (0.97-1.11)	**1.10 (1.01-1.19)***	**1.10 (1.00-1.20)***

Note. QTile = quartile. RRR = relative risk ratio. 95% CI = 95% confidence interval.

* $p < .05$. ** $p < .01$. Bolded comparisons are significant at the minimum $p < .05$ level.

Table 10

Male and Female Multinomial Logistic Regression Results: The Relative Mental Health Risks Associated with Online Gaming, Coping, Social Factors, and Socio-economic Status

		Mild vs. Normal		Moderate vs. Normal		Severe vs. Normal	
Variable		RRR (95% CI)		RRR (95% CI)		RRR (95% CI)	
(Reference)	Category	Males	Females	Males	Females	Males	Females
Online Gaming (0h)	>4h	1.07 (0.96-1.20)	1.12 (0.94-1.34)	1.12 (0.98-1.29)	**1.31** (1.09-1.58)**	**1.36** (1.15-1.60)**	**1.87** (1.55-2.26)**
	2-4h	1.08 (0.96-1.20)	**1.17* (1.03-1.34)**	1.06 (0.91-1.23)	1.14 (0.99-1.33)	0.94 (0.79-1.13)	1.09 (0.93-1.28)
	0-2h	0.99 (0.90-1.10)	1.05 (0.98-1.13)	0.92 (0.81-1.05)	1.03 (0.95-1.11)	**0.77** (0.65-0.91)**	1.01 (0.92-1.11)
Disengaged Coping (1st QTile)	4th QTile	**3.46** (3.10-3.87)**	**4.95** (4.47-5.49)**	**10.94** (9.34-12.81)**	**18.59** (16.26-21.25)**	**9.07** (7.74-10.64)**	**33.85** (29.02-39.48)**
	3rd QTile	**3.24** (2.94-3.57)**	**3.92** (3.60-4.27)**	**7.01** (6.02-8.17)**	**9.50** (8.38-10.76)**	**2.87** (2.42-3.40)**	**7.95** (6.82-9.26)**
	2nd QTile	**2.09* (1.91-2.30)**	**2.32** (2.14-2.51)**	**3.24** (2.77-3.78)**	**3.90** (3.44-4.42)**	0.99 (0.82-1.20)	**2.14** (1.82-2.52)**
Family Support (1st QTile)	4th QTile	**0.42** (0.37-0.47)**	**0.34** (0.31-0.38)**	**0.19** (0.16-0.22)**	**0.17** (0.15-0.19)**	**0.14** (0.11-0.17)**	**0.07** (0.06-0.08)**
	3rd QTile	**0.59** (0.53-0.66)**	**0.52** (0.47-0.58)**	**0.34** (0.30-0.39)**	**0.29** (0.26-0.33)**	**0.20** (0.17-0.23)**	**0.14** (0.12-0.16)**
	2nd QTile	**0.77** (0.70-0.86)**	**0.71** (0.64-0.79)**	**0.53** (0.47-0.59)**	**0.48** (0.43-0.54)**	**0.32** (0.28-0.37)**	**0.29** (0.26-0.32)**
Friend Support (1st QTile)	4th QTile	**0.58** (0.52-0.65)**	**0.56** (0.50-0.62)**	**0.37** (0.32-0.43)**	**0.42** (0.37-0.47)**	**0.30** (0.25-0.36)**	**0.29** (0.26-0.33)**
	3rd QTile	**0.74** (0.66-0.82)**	**0.70** (0.64-0.77)**	**0.48** (0.42-0.55)**	**0.52** (0.47-0.58)**	**0.42** (0.36-0.49)**	**0.35** (0.31-0.39)**
	2nd QTile	**0.81** (0.73-0.90)**	**0.83** (0.75-0.92)**	**0.60** (0.53-0.68)**	**0.75** (0.67-0.83)**	**0.48** (0.41-0.56)**	**0.54** (0.48-0.61)**
Sociability (1st QTile)	4th QTile	**0.82** (0.74-0.92)**	0.93 (0.84-1.03)	**0.83* (0.72-0.97)**	0.92 (0.82-1.04)	0.94 (0.78-1.12)	1.10 (0.97-1.26)
	3rd QTile	0.99 (0.89-1.10)	1.05 (0.95-1.16)	1.03 (0.90-1.17)	1.02 (0.91-1.14)	1.02 (0.87-1.20)	1.09 (0.97-1.23)
	2nd QTile	0.95 (0.87-1.05)	1.02 (0.93-1.13)	**0.87* (0.77-0.98)**	1.01 (0.90-1.13)	**0.71** (0.61-0.82)**	0.95 (0.84-1.07)
SES (1st QTile)	4th QTile	1.01 (0.90-1.14)	1.02 (0.94-1.12)	0.97 (0.84-1.13)	0.96 (0.86-1.06)	0.93 (0.77-1.13)	0.97 (0.87-1.09)
	3rd QTile	1.08 (0.99-1.18)	1.06 (0.97-1.15)	0.95 (0.84-1.07)	1.04 (0.94-1.15)	0.92 (0.79-1.06)	0.95 (0.85-1.07)
	2nd QTile	1.01 (0.92-1.11)	1.07 (0.97-1.18)	0.99 (0.88-1.11)	**1.19** (1.07-1.33)**	1.03 (0.89-1.18)	**1.17* (1.03-1.32)**

Note. QTile = quartile. RRR = relative risk ratio. 95% CI = 95% confidence interval.

* $p < .05$. ** $p < .01$. Bolded comparisons are significant at the minimum $p < .05$ level.

Gender-specific OG engagement rates also represent proportions of adolescent males and females associated with increased or reduced risk of MH symptoms. Regarding severe MH risk, a greater proportion of males experienced OG-related risk reduction (35.8%) than risk increase (25.4%), while a small proportion of females experienced risk increase (4.9%) and no females experienced risk-reduction (0%). Importantly, these proportions represent broad-level effects that are contingent on underlying differences in risk sizes detailed in Table 10. Notably, this summary also does not represent the additional mild and moderate MH symptom risks experienced by females.

Disengaged coping.

Across all models, higher quartiles of disengaged coping, compared to 1st quartile, were associated with greater risk towards mild, moderate, and severe MH symptoms, compared to normal MH symptoms. In the main model, disengaged coping significantly predicted MH symptoms at all levels. Effects were strongest in the 4th quartile, where risk increased in effect across higher levels of MH symptoms. Across mild, moderate, and severe comparisons, 4th quartile disengaged coping was associated with 315%, 1,362%, and 1,844% increased risk, respectively, compared to the 1st quartile of disengaged coping. This sequential pattern of increasing risk across higher MH severity levels was not observed for the 2nd and 3rd quartile comparisons, however corresponding RRRs still indicated an increased risk of poorer MH compared to normal ranging from 51% - 732%.

For females only, all comparisons were significant, and for males, all except 1 comparison was significant (2nd quartile, severe MH). In females, 4th quartile disengaged coping sequentially increased in risk effect across higher MH symptom categories, such that 4th quartile disengaged coping was associated with increased risks towards mild, moderate, and severe MH symptoms of 395%, 1,759% and 3,285% respectively, compared to normal MH. Lower quartile comparisons were significant but less pronounced, with MH risk increases ranging from 114%-850% across comparisons.

For males, RRRs were less pronounced than for females. Male 4th quartile disengaged coping, compared to 1st quartile, was significantly associated with increased risks towards mild, moderate, and severe MH symptoms of 246%, 994%, and 807%, respectively. Notably, 3rd quartile disengaged coping was associated with a 187% increased risk towards severe MH symptoms, but a 601% increase towards moderate symptoms, which demonstrates a different pattern of risk compared to females.

Family support, friend support, and sociability.

Higher quartiles of both family support and friend support, compared to 1st quartiles, were associated with significantly reduced risk of mild, moderate, and severe MH symptoms across all 3 models. This was true for all respective comparisons presented in tables 9 and 10, and these risk-reductive effects were generally stronger in sequentially higher quartile comparisons and in sequentially higher MH symptom comparisons.

Across models, family support was stronger than friend support in predicting reduced risk of poor MH symptoms, and females appeared to experience stronger MH risk reduction than males specifically within family support but not friend support. In the main model, MH risk reduction ranged from 33.3% - 1,011.1% due to family support and from 21.9% - 244.8% due to friend support. In the male model, MH risk reduction ranged from 29.8% - 614.2% due to family support and from 23.4% - 233.3% due to friend support. In the female model, MH risk reduction ranged from 40.8% - 1,328.5% due to family support and from 20.4% - 244.8% due to friend support.

Sociability was a significant predictor in all models, however, only produced significant interquartile comparisons within the main and male models, which were considerably weaker in effect than family and friend factors. In these models, 4th and 2nd sociability quartiles significantly predicted lower risk of poor MH, compared to 1st quartile sociability. The strength of this risk-reductive effect ranged from 14.9% - 17.6% in the main model, and from 14.9% - 40% in males. Notably, sequentially higher quartiles did not produce stronger MH effects according to the same patterns as friend support, family support, and disengaged coping. Rather, there was no clear pattern to the MH effects of sociability in males or overall. In females, null results imply that sociability did not predict increased MH risk specifically when comparing higher quartiles to 1st quartile sociability. Sociability may have significantly predicted MH in other non-measured interquartile and MH comparisons as it was associated with a significant overall effect, though this was not investigated as sociability RRRs did not indicate any clear patterns of theoretical interest.

Socio-economic status.

SES was a significant predictor of MH in the main and female models, but not in the male model. Overall, these significant effects show that 2nd quartile SES was associated with increased risk of poor MH compared to 1st quartile. In females, compared to 1st quartile SES, the 2nd quartile was associated with 19% and 17% increased risk of moderate and severe MH outcomes, respectively, while no other comparisons were significant. This result appeared to underpin the significant results in the main model, which indicated 10% risk increases in the same comparisons. Overall, there were no other significant comparisons associated with SES quartiles.

Discussion

The current study explored the relationship between daily OG and MH outcomes while controlling for the important biopsychosocial factors of gender, disengaged coping, family support, friend support, sociability, and SES. Gender was controlled in an initial model, then two subsequent models explored this relationship in males and females separately. The current results extend previous research by Przybylski and Weinstein (2017) through controlling additional biopsychosocial factors, quantifying specific risk and protective conditions relative to non-gaming, and exploring gender patterns within OG and other predictors. Furthermore, the current study consolidates and reflects standing biopsychosocial accounts, and outlines key theoretical and practical implications for family settings, future research, and the aetiology and treatment of problematic gaming conditions. These implications are particularly relevant to Australian adolescents as the prevalent gaming population in Australia, based on the current large and nationally representative sample (Brand, Todhunter, & Jervis, 2017).

Main Findings

Overall, Australian adolescent moderate (2-4h) and excessive (>4h) gamers experienced increased risk of poor MH compared to non-gamers, and contrary to the goldilocks hypothesis, light OG (0-2h) was not protective. However, considering known gender differences in gaming engagement and outcomes (Lenhart et al., 2015; Milani et al., 2018; Toker & Baturay, 2016), male and female effect patterns were investigated separately. Compared to non-gamers, both genders experienced increased MH risk due to excessive OG, while at light engagement, males experienced MH benefit whereas females experienced no effect. Furthermore, females experienced increased risk at moderate engagement, outlining an additional risk condition. Accordingly, the current findings support the goldilocks hypothesis for males but not for females, which directly builds upon previous research that did not capture this effect (Przybylski & Weinstein, 2017).

In support of the second hypothesis, significantly more males engaged in OG across conditions, whereas more females were non-gamers. Gender engagement differences were most pronounced within excessive OG, where males were approximately 5 times more prevalent than females. Conversely, 59% of females played no OG daily, compared to 18.8% of males. Alongside these engagement differences, male and female excessive gamers (4.9% of females vs 25.4% of males) also experienced different risk levels, such that females experienced over twice the associated MH risk compared to males. Additionally, female risk spanned mild, moderate, and severe MH categories across both moderate and excessive OG. These findings support the notion that more males play excessively and experience problematic gaming (Milani et al., 2018; Przybylski & Weinstein, 2017; Toker & Baturay, 2016), and adds that both moderate and excessive female gamers experience greater OG-related MH risks than males. This carries further gender-based implications that build onto previous research (Przybylski & Weinstein, 2017), such that time-based gaming rules in family contexts should consider gender differences in OG-related risk.

The third hypothesis that disengaged coping, social, gender, and demographic factors would predict MH outcomes was mostly supported. Higher disengaged coping predicted poorer outcomes overall and had a more pronounced effect in females. Higher family and friend support predicted better MH outcomes, and the effects of family support were similarly more pronounced in females. Female gender predicted poorer MH outcomes overall, however sociability and SES produced mixed results. Sociability was protective only for males and was much weaker in effect compared to coping and other social factors. Contrary to broader findings (Isaacs, Enticott, Meadows, & Inder, 2018), higher SES did not predict better MH. Conversely, females in the second SES quartile experienced increased MH risk compared to first quartile, and males experienced no significant effect of SES.

Given the large sample size, these mixed effects deserve careful consideration, however their exact source is altogether unclear. It may be that the relationship between SES and MH was modulated by other predictors, or that the current SES estimates poorly represented individuals' SES, as the current measure reflected home area rather than individual-specific data (Australian Bureau of Statistics, 2016). Regarding sociability, the stronger effects of family and friend support may have better represented the mechanisms through which sociability may influence MH, and thus suppressed its effects.

Online Gaming Engagement

The current study effectively demonstrates that in the context of OG, gender and daily engagement are important basic controls for MH outcomes, especially for outlining specific risk and protective conditions. These context-dependent implications outline the potential for aggregate results to be misleading. For example, where research outlines a weak negative relationship between gaming and MH (Ferguson, 2015), current findings specify that MH outcomes relate to specific contextual conditions. Overlooking these conditions risks oversimplification and may directly influence harm-centred biases by neglecting potential benefits (Przybylski & Weinstein, 2017; Sublette & Mullan, 2012). For mapping these patterns, the current study demonstrates the goldilocks hypothesis as a suitable framework for males, however females may require an alternate framework due to differential effect patterns. This carries the key implication of the current study: Important contexts, such as research and parenting, should avoid harm-centred biases towards OG and appropriately acknowledge its beneficial potential specific to males, the non-detrimental nature of light gaming in females, and consider that concerns should be specifically directed towards the current empirically supported risk conditions, alongside those previously demonstrated (Przybylski & Weinstein, 2017).

OG and family support also shared a weak negative correlation, which aligns with previous research (Bonnaire & Phan, 2017), and outlines the family-related implications of excessive gaming. It is unclear whether this reflects displacement (Neuman, 1988), or gaming-centred family tension (Bonnaire & Phan, 2017; Merilainen, 2021), and therefore requires additional research. Despite its mixed MH effects, sociability shared a weak negative correlation with OG, which supports personality trait associations with excessive gaming (Müller et al., 2014), and demonstrates the importance of character in excessive gaming aetiology. OG also more weakly correlated with disengaged coping, supporting coping-based predispositions to problematic gaming (Milani et al., 2018). Notably, friend support shared a weaker negative correlation with OG than other social factors, which may reflect the social nature of OG (Lenhart et al., 2015), but also suggests that less gaming may improve social domains, or conversely that improved social domains may reduce daily engagement.

Overall, the current study demonstrates that playtime and gender are key factors for OG-related MH outcomes. Furthermore, biopsychosocial correlates outline aetiological and treatment considerations for problematic OG, particularly including disengaged coping, and low family support and sociability. These findings are valuable to families, health professionals, policy makers, gamers, and the public, especially for refining understanding of OG, and challenging harm-centred biases.

Disengaged Coping, Family Support, and Friend Support

Results support the importance of disengaged coping, family support, and friend support as predictors of MH and as controls in OG research. The risk effect of disengaged coping aligns with broader coping research (Seiffge-Krenke & Klessinger, 2000; Sun et al., 2019), as with the protective effects of friend support (Ringdal et al., 2021), and family support (Bonnaire & Phan, 2017; Rothon et al., 2012). These factors were stronger predictors than OG and support the idea that gaming may be secondary to biopsychosocial factors for the aetiology and treatment of problematic gaming (Braun et al., 2016; Han et al., 2020; Kuss & Griffiths, 2012). Specifically, the current findings support CBT interventions that target coping and social factors, rather than gaming exclusively, for reducing related addiction symptoms (Han et al., 2020; Ke & Wong, 2018). Findings also imply an order of importance based on differential predictive strength: Disengaged coping, family support, and friend support as primary, secondary, and tertiary interests respectively, reflecting the sequential importance of internal, proximal, and distal factors for human development (Bronfenbrenner & Morris, 2007).

Family dimensions are particularly relevant for the practical implications of the current study, especially concerning the negative correlation observed between family support and OG, which appears to reflect gaming-centred family tension (Bonnaire & Phan, 2017; Merilainen, 2021). While teenagers desire parental understanding towards gaming, parents frequently perceive gaming as implicitly negative (Merilainen, 2021). This outlines both the scope of harm-biases towards gaming and a key implication of the current study. Between adolescents and parents, the current findings could be used to facilitate a mutual understanding of the potential benefits and harms of OG, which could ameliorate gaming-centred tension and improve family support. This aligns with family cohesion as important in CBT treatments (Han et al., 2020), and critically prioritises family support as potentially more important than gaming itself for adolescent MH outcomes.

Gender and Biopsychosocial Implications

Females experienced stronger negative MH effects with higher disengaged coping. This aligns with related factors associated with female gender, including trait neuroticism, ruminative style, and poor coping and regulatory mechanisms (Braun et al., 2016; Leach, Christensen, Mackinnon, Windsor, & Butterworth, 2008; Liu, Zhang, & Chen, 2020; Strickhouser, Zell, & Krizan, 2017; Weisberg et al., 2011). Beyond this alignment, the female-specific effect of disengaged coping implies that existing coping-focused CBT interventions may be particularly beneficial for females (Han et al., 2020). Females also experienced greater risk-reduction from higher family support, which aligns with broader findings (Leach et al., 2008), and similarly implies that family-based interventions may be particularly effective for females (Han et al., 2020). Females also experienced significantly higher prevalence of poor MH than males in the current study, which aligns with national and international MH trends (Campbell, Bann, & Patalay, 2021; Lawrence et al., 2015).

The sources of these gender patterns are subject to the nature-nurture debate. Nurture-based accounts generally posit that OG-related gender differences are socially based, such as through male-dominated OG culture (Lopez-Fernandez, Williams, Griffiths, & Kuss, 2019). While a valid perspective, it overlooks the nature-based neurobiological account that male reward systems are more responsive to game stimuli (Dong et al., 2018), which may underpin the gender differences observed. Male-prominent engagement patterns also extend into Australian youth sports (VicHealth, 2021), which shares competition and skill development aspects with

OG further associated with male gender (Camiré, 2015; Demetrovics et al., 2011). Beyond this dichotomy, the biopsychosocial model offers a framework to consolidate multiple perspectives.

Broader literature accounts, alongside the current results, suggest various biopsychosocial factors important to OG and MH. Key biological factors include gender and its modulating effects on other factors (Campbell et al., 2021; Leach et al., 2008), and personality, genetic, and neurobiological predispositions (Braun et al., 2016; Dong et al., 2018; Li et al., 2016). Key psychological factors include internal control, coping, attentional, and emotional regulatory mechanisms and motivations (Ferguson & Olson, 2013; Han et al., 2020; Koo & Kwon, 2014; Liu et al., 2020; Milani et al., 2018). Key social factors include family support, cohesion, and parenting attitudes (Bonnaire & Phan, 2017; Han et al., 2020; Merilainen, 2021), friend support and social gaming (Colder Carras et al., 2017), and OG culture (Lopez-Fernandez et al., 2019). The current study demonstrates the relative importance of some such biopsychosocial factors, suggests that the multidimensional formulation of risk and protective factors should guide further research, and outlines that parenting and practice approaches would benefit from considering such evidence-based perspectives.

Future research may benefit by investigating other psychosocial outcomes within the goldilocks framework, as the current study achieved for MH. Some current interests include aggression, academic performance, and physical symptoms (Ferguson, 2015; Kuss & Griffiths, 2012; Przybylski & Mishkin, 2016). Other outcomes may exhibit similar goldilocks-like patterns or gender differences, may clarify violence-related concerns (Markey & Ferguson, 2017b), and may outline gaming-related benefits towards other outcomes. Alternatively, displacement effects may present towards outcomes such as reading performance (Neuman, 1988). Additionally, future research may investigate other non-binary gender categories, which may present comparable differences in effect.

Model Prediction

Overall, the statistical models predicted between 11.8% – 36.8% of variance in MH outcomes, as reflected by different pseudo-R^2 indices used to estimate logistic model effects (Smith & McKenna, 2013). The mixed Pearson and Deviance goodness-of-fit results were likely due to cell zero-frequencies described, and did not impact further statistical tests (IBM, 2020). Controlling additional biopsychosocial factors would further improve the prediction of future models. One such control may be online socialization (Colder Carras et al., 2017), which was substituted with friend support for similar MH effects (Ringdal et al., 2021), however controlling both may benefit future research to determine their relative importance.

Measures

The disengaged coping scale has not been previously validated in the current 4-item form. This adaptation reduced Cronbach's alpha to .66 from the original .89, as a common effect of reduced scale size (Tavakol & Dennick, 2011). This also reflected that each item represented a different primary factor from the full disengaged coping scale (Tobin et al., 1989). Adding one additional item for each respective factor would modestly increase scale size and likely improve measurement error and internal consistency in future research. However, the current scale compared favourably to a related 8-item measure with a Cronbach's alpha of .59 (Addison et al., 2007), supporting the current scale. Results also support the concurrent validity of the current coping scale in Australian adolescents, as higher disengaged or avoidant coping generally predicts poorer MH (Seiffge-Krenke & Klessinger, 2000; Tobin et al., 1989).

Compared to national prevalence of high to very high adolescent psychological distress, the current survey indicated approximately 6% lower prevalence rates across gender groups (Lawrence et al., 2015). Using the K10 Kessler Psychological Distress Scale (Kessler et al., 2002), national prevalence was 19.9% on average, 14.4% in males, and 25.9% in females. In the current sample, respective rates were 13.6%, 9.3%, and 17.8% by comparison for high distress. These discrepancies appear to reflect systematic measurement differences between the K10 and PHQ-4 rather than actual prevalence differences in psychological distress, as both scales express good validity and reliability for different core applications (Kessler et al., 2002; Kroenke et al., 2009), therefore supporting national generalisability of the current sample.

The current study transformed continuous variables into quartiles to resolve violations of the linearity in the logit assumption. As a result of such categorization, correlations typically reduce in size, prediction accuracy is reduced, and results can sometimes indicate spurious findings (Bennette & Vickers, 2012). Such effects may have influenced the mixed results of sociability and SES, whereas other predictors expressed robust effects. Cubic splines and fractional polynomials offer alternatives to fitting non-linear data and are particularly beneficial for greater detail (Bennette & Vickers, 2012). These models may have benefited the current results for sociability and SES, but are also prone to overfitting, spurious dips and inflection points, and can be difficult to interpret (Bennette & Vickers, 2012). Conversely, quartiles sufficiently fit coping and support factors to outline clear general effects for the purpose of the current study as high-accuracy predictions were unnecessary. Where predictive accuracy is critical, alternative models may provide greater utility.

Limitations

It appears that OG produces differential MH effects depending on gender and daily engagement. However, it is difficult to determine causation from the directionally uncontrolled statistical methods used. Accordingly, OG engagement may vary as a function of MH status and other key determinants. Gender differences in influential factors, such as disengaged coping, family factors, or MH (Bonnaire & Phan, 2017; Leach et al., 2008; Milani et al., 2018), also may consequently influence OG behaviour. Investigating directionality was beyond the scope of the current study, however experimental data supports the current results in treatment settings (Han et al., 2020).

The current sample was biased towards Victoria, Queensland, and New South Wales, which together accounted for 90.3% of the sample. Despite this bias, national statistics indicate relative regional consistency in the prevalence of high psychological distress, averaging 13% and ranging from 11.1% (NT) to 14% (QLD) (Australian Bureau of Statistics, 2018). Comparable statistics were not available for adolescents, this regional stability in MH supports the generalizability of the current results concerning MH. Additionally, this eastern bias may have accounted for the relative socio-economic advantage of the current population but does not appear to have otherwise effected generalizability.

It is unclear how data collected during 2020 were impacted by the COVID-19 pandemic. National and regional restrictions varied by location, timing, and extent, and school-by-school sampling coincided with varying stages of COVID-19 restrictions. No items from the current survey directly addressed COVID-19 impact or specific completion date, which prevented direct or proxy measurement of impact. Existing research outlines that screen-time increased for approximately 75% of Australians effected by COVID-19 restrictions (Oswald, Rumbold, Kedzior, Kohler, & Moore, 2021), which generally associated with poorer MH except if applied towards social connections, and aligns with the current risk-effects observed for increased screentime in the context of OG.

Conclusion

The current study outlines specific risk, non-risk, and protective conditions associated with OG based on daily engagement and gender, and directly builds on existing research through highlighting unique gender-specific effects and controlling additional key biopsychosocial factors within the goldilocks framework (Przybylski & Mishkin, 2016; Przybylski & Weinstein, 2017). As OG-related effects varied from risk to protective based on certain conditions, the current study challenges the biased notion that OG is unidirectionally harmful, but only supported the goldilocks hypothesis for males. Disengaged coping, family support, and friend support were also stronger MH predictors than OG, supporting interventions that target social and coping factors above gaming itself (Han et al., 2020; Ke & Wong, 2018). Results carry key implications for family settings towards the importance of family support, suggesting time-focused parenting regulation, and supporting coping and family-focused therapies as potentially effective gaming addiction treatments (Bonnaire & Phan, 2017; Han et al., 2020; Merilainen, 2021). Overall, the current study demonstrated the importance of contextual factors for OG in a nationally representative Australian adolescent sample and supports current perspectives within the biopsychosocial model for gaming research. Commensurate with broader literature, contextual biopsychosocial factors are paramount for delineating potential benefit from harm, and it appears that these factors, may be more important for OG-related MH outcomes than gaming itself.

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Appendix A: Factor Analysis Correlation Matrix and Corresponding Item Codes

Table 11

Correlation Matrix of All Items Included in Exploratory Factor Analysis

Item	Ry2	Ry3	Ry4	Ry5	Sun5	Ry6	Ry7	Ry8	Ry9	Ry10	Ry11	Ry13	Ry14	Ry15	Tru1	Tru2	For1	Ry24	Ry26	Ry27	Ry29	Sun11	Sun12
Ry2		.338	.303	.666	.246	.242	.566	.655	.313	.234	.302	.552	.331	.360	.358	.243	.201	.283	.204	.534	.231	-.161	-.157
Ry3	.338		.667	.345	.184	.196	.355	.342	.247	.250	.278	.250	.412	.253	.323	.206	.223	.284	.255	.324	.215	-.111	-.103
Ry4	.303	.667		.371	.185	.213	.345	.322	.235	.249	.255	.241	.391	.247	.301	.202	.214	.283	.246	.302	.233	-.112	-.104
Ry5	.666	.345	.371		.250	.256	.573	.617	.310	.247	.280	.513	.333	.355	.335	.253	.193	.295	.209	.498	.249	-.144	-.146
Sun5	.246	.184	.185	.250		.464	.258	.265	.432	.262	.257	.210	.234	.195	.331	.186	.151	.176	.192	.234	.278	-.108	-.071
Ry6	.242	.196	.213	.256	.464		.270	.258	.454	.258	.211	.233	.265	.208	.336	.200	.140	.195	.151	.221	.339	-.156	-.120
Ry7	.566	.355	.345	.573	.258	.270		.610	.352	.283	.309	.505	.376	.385	.372	.284	.231	.311	.257	.502	.261	-.143	-.142
Ry8	.655	.342	.322	.617	.265	.258	.610		.358	.263	.360	.525	.355	.373	.400	.246	.212	.272	.225	.632	.248	-.147	-.139
Ry9	.313	.247	.235	.310	.432	.454	.352	.358		.426	.319	.306	.355	.298	.436	.340	.249	.264	.247	.308	.369	-.204	-.157
Ry10	.234	.250	.249	.247	.262	.258	.283	.263	.426		.311	.219	.299	.241	.321	.304	.304	.325	.322	.229	.302	-.119	-.095
Ry11	.302	.278	.255	.280	.257	.211	.309	.360	.319	.311		.264	.305	.258	.424	.208	.243	.210	.245	.416	.214	-.089	-.070
Ry13	.552	.250	.241	.513	.210	.233	.505	.525	.306	.219	.264		.436	.488	.346	.262	.198	.268	.167	.431	.255	-.193	-.185
Ry14	.331	.412	.391	.333	.234	.265	.376	.355	.355	.299	.305	.436		.464	.418	.268	.296	.311	.240	.319	.301	-.276	-.214
Ry15	.360	.253	.247	.355	.195	.208	.385	.373	.298	.241	.258	.488	.464		.342	.251	.235	.262	.194	.325	.255	-.170	-.156
Tru1	.358	.323	.301	.335	.331	.336	.372	.400	.436	.321	.424	.346	.418	.342		.318	.346	.283	.276	.404	.331	-.171	-.139
Tru2	.243	.206	.202	.253	.186	.200	.284	.246	.340	.304	.208	.262	.268	.251	.318		.269	.384	.322	.248	.305	-.101	-.085
For1	.201	.223	.214	.193	.151	.140	.231	.212	.249	.304	.243	.198	.296	.235	.346	.269		.351	.337	.214	.262	-.100	-.064
Ry24	.283	.284	.283	.295	.176	.195	.311	.272	.264	.325	.210	.268	.311	.262	.283	.384	.351		.481	.287	.310	-.099	-.091
Ry26	.204	.255	.246	.209	.192	.151	.257	.225	.247	.322	.245	.167	.240	.194	.276	.322	.337	.481		.278	.242	**-.004**	**.006**
Ry27	.534	.324	.302	.498	.234	.221	.502	.632	.308	.229	.416	.431	.319	.325	.404	.248	.214	.287	.278		.249	-.097	-.102
Ry29	.231	.215	.233	.249	.278	.339	.261	.248	.369	.302	.214	.255	.301	.255	.331	.305	.262	.310	.242	.249		-.151	-.129
Sun11	-.161	-.111	-.112	-.144	-.108	-.156	-.143	-.147	-.204	-.119	-.089	-.193	-.276	-.170	-.171	-.101	-.100	-.099	**-.004**	-.097	-.151		.536
Sun12	-.157	-.103	-.104	-.146	-.071	-.120	-.142	-.139	-.157	-.095	-.070	-.185	-.214	-.156	-.139	-.085	-.064	-.091	**.006**	-.102	-.129	.536	

Note. Item codes and wordings are detailed in Table A2.

Unmarked correlations are significant at the $p < .001$ level. Bolded correlations are not significant at the $p < .05$ level.

Table 12

Item Codes and Corresponding Item Text for All Items Included in Exploratory Factor Analysis

Item Code	Item Wording
Ry2	I get love and support from my family.
Ry3	I have a teacher at my school who cares about me.
Ry4	I have a least one teacher who encourages me.
Ry5	I have parents/carers who encourage me to do well.
Sun5	I spend time with friends.
Ry6	I have at least one good friend at school.
Ry7	I have adults who set good examples for me.
Ry8	I have a parent/carer who listens to me.
Ry9	I am good at keeping friends.
Ry10	I get along with people who are different from me.
Ry11	I can talk about things if they upset me.
Ry13	I feel safe at home.
Ry14	I feel safe at school.
Ry15	I feel safe in the area where I live.
Tru1	I am able to trust people.
Tru2	I am trustworthy.
For1	I forgive others who are mean to me.
Ry24	I think it is important to help other people.
Ry26	I give my time to help others.
Ry27	I have an adult in my life who I can talk to about my worries.
Ry29	My friends and I can disagree about things and still be friends.
Sun11	In the last school term I have been bullied at school.
Sun12	In the last school term I have been bullied online.

Appendix B: Box-Tidwell Test Results

Table 131

Box-Tidwell Test Results for the Assumption of Linearity in the Logit

	Model Fitting Criteria			Likelihood Ratio Tests		
Effect	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	df	*p*
Intercept	109,265.75	109,663.19	109,175.75	0.00	0	
SES Decile * ln (SES Decile)	109,268.68	109,639.61	109,184.68	8.92	3	.030 [a]
Disengaged Coping * ln (Disengaged Coping)	109,950.09	110,321.03	109,866.09	690.34	3	<.001 [a]
Family Support * ln (Family Support)	109,349.23	109,720.17	109,265.23	89.48	3	<.001 [a]
Sociability * ln (Sociability)	109,287.31	109,658.24	109,203.31	27.55	3	<.001 [a]
Friend Support * ln (Friend Support)	109,303.21	109,674.14	109,219.21	43.45	3	<.001 [a]
SES Decile	109,268.38	109,639.32	109,184.38	8.63	3	.035
Disengaged Coping	109,996.09	110,367.03	109,912.09	736.34	3	<.001
Family Support	109,339.53	109,710.46	109,255.53	79.77	3	<.001
Sociability	109,286.06	109,657.00	109,202.06	26.31	3	<.001
Friend Support	109,301.86	109,672.79	109,217.86	42.10	3	<.001
Online Gaming	109,314.01	109,631.96	109,242.01	66.26	9	<.001
Gender	110,823.70	111,194.64	110,739.70	1,563.95	3	<.001

[a] Significance at the $p < .05$ level indicates linearity violation