NOVA

University of Newcastle Research Online

nova.newcastle.edu.au

Thorne, Hayden T.; Smith, Jordan J.; Morgan, Philip J.; Babic, Mark J.; Lubans, David R.; 'Video game genre preference, physical activity and screen-time in adolescent boys from low-income communities'. Published in Journal of Adolescence Vol. 37, Issue 8, p. 1345-1352 (2014)

Available from: <http://dx.doi.org/10.1016/j.adolescence.2014.09.012>

© 2014. This manuscript version is made available under the CC-BY-NC-ND 4.0 license
<http://creativecommons.org/licenses/by-nc-nd/4.0/>

Accessed from: <http://hdl.handle.net/1959.13/1068132>

1 Video Game Genre Preference, Physical Activity and Screen-Time in Adolescent
2 Boys from Low-Income Communities

3
4
5 Hayden T. Thorne, BEd¹, Jordan J. Smith, BEd¹, Philip J. Morgan, PhD¹, Mark J.
6 Babic, BEd¹, David R. Lubans, PhD^{1*}

7
8
9
10 *Corresponding author

11 David R. Lubans, PhD
12 Priority Research Centre in Physical Activity and Nutrition
13 School of Education
14 Faculty of Education and Arts
15 University of Newcastle
16 Callaghan NSW, Australia 2308
17 Email: David.Lubans@newcastle.edu.au
18 Telephone: +61 2 49212049
19 Fax: +61 2 49217407

20
21
22 ¹Priority Research Centre in Physical Activity and Nutrition, School of Education,
23 University of Newcastle, Callaghan, New South Wales, Australia

24
25
26 **Acknowledgements**

27
28 The authors would like to thank the students, teachers and schools that participated in
29 this study.

30
31
32 Word count (text only excluding abstract): 3386
33 Abstract word count: 280

34

35

36

37

38

1 **Abstract**

2 **Purpose:** To examine the association between the types of video games played by
3 adolescent boys and their participation in physical activity and recreational screen-
4 time.

5 **Method:** Participants were 320 boys (mean age = 12.7, $\pm$ 0.5 years) from 14
6 secondary schools located in low-income areas of New South Wales, Australia.
7 Outcomes included objectively measured height, weight and physical activity
8 (accelerometers) and self-reported screen-time and video game genre preference.
9 ANOVAs and linear mixed models were used to analyze the data.

10 **Results:** There was a significant game genre group effect for weekday counts per
11 minute [$F(3, 242) = 3.66, p = .01$] and moderate-to-vigorous physical activity [$F(3,$
12 242) = 2.70, $p < .05$]. Boys who preferred ‘sports and racing’ games were more active
13 than those who liked ‘strategy’ games. There were also significant game genre group
14 effects for weekday [$F(3, 316) = 4.03, p < .01$] and weekend [$F(3, 316) = 3.25, p =$
15 .02] screen-time. Boys who preferred ‘role playing’ and ‘strategy’ games reported
16 higher screen-time on weekdays and weekends, compared to those who preferred
17 ‘sports and racing’ games.

18 **Conclusion:** This cross-sectional study has demonstrated that boys who prefer ‘sports
19 and racing’ games are more active and report less screen-time than boys who prefer
20 other types of video games.

21

22 **Key words:** Physical activity; Sedentary behavior; Youth; Video game; Screen-time;
23 Obesity;

1 **Implications and contribution**

2 Adolescent boys' who enjoy 'sports and racing' games participate in more physical
3 activity preferences for different types of video games were associated with the time they
4 engaged in physical activity and their total screen-time. Further longitudinal studies are
5 needed to confirm these findings, but it appears that boys who enjoy 'role playing' and
6 'strategy' games engage in high levels of recreational screen-time.

7

1 **Introduction**

2 Screen-based recreation or ‘screen-time’, which refers to the use of screen devices (such
3 as television, computers, gaming consoles, and tablets or smartphones) for the purposes
4 of entertainment, represents the largest single contributor to leisure-time sedentary
5 behavior among youth [1]. Current guidelines suggest limiting total screen-time to less
6 than two hours per day [2], however, many adolescent boys exceed this limit [3],
7 especially those living in low-income communities [4]. Excessive screen-time is
8 associated with a range of adverse physical and psychological health outcomes among
9 youth, including overweight and obesity, metabolic syndromes, insulin resistance and
10 depression [5-7].

11 Video gaming is a unique form of screen-time with adolescent boys spending
12 significantly more time video gaming than adolescent girls [5]. A study on time spent
13 playing video games in adolescents found males averaged 18.6 hours per week, more
14 than twice the weekly average for females [8]. As technology advances, the features
15 and mechanics of video games (including smarter artificial intelligence and improved
16 graphics and physics) become more elaborate, making video games an increasingly
17 popular form of entertainment. For example, the advances in console design
18 (improved processing, accessibility and downloading speeds) now feature internet
19 connectivity allowing gamers to interact with friends in a potentially limitless ‘online’
20 game space and they can also interact with, and even *speak to*, players from around
21 the globe.

22 Video gaming has also become increasingly appealing due to the variety of video
23 game genres available [9]. Adolescents are attracted to certain video game genres and
24 motivation for playing video games may be influenced by the users desire for challenge,
25 competition, fantasy, social interaction, diversion, and arousal [8, 10]. As video games

1 become more successful at meeting player motivations and interests, prevalence and
2 duration of video gaming may increase. However, certain video game genres have been
3 found to be more ‘addictive’ and ‘compulsive’. For example, a recent study found
4 adolescents who play ‘role playing’ games, particularly those playing online, were at
5 increased risk of video game dependency [11]. This research along with evidence on the
6 health consequences of excessive screen time provides a strong rationale for continued
7 investigation within this domain.

8 Although previous studies have examined the association between video gaming
9 and screen-time in adults [12], to our knowledge no one has examined the relationship
10 between adolescent boys’ engagement with specific video game *genres* and their physical
11 activity and screen-time. Therefore, the aim of this study was to examine the association
12 between video game genre preference and physical activity and screen-time among a
13 sample of adolescent boys from low-income communities. A secondary aim was to
14 examine the association between physical activity and screen-time in the study sample.

15 **Methods**

16 *Participants*

17 Participants for the present study were adolescent boys taking part in a school-based
18 obesity prevention intervention [13]. Ethics approval for the study was obtained from the
19 University of Newcastle, New South Wales (NSW), Australia and the NSW Department
20 of Education and Training ethics committees. State funded secondary schools located in
21 low-income areas of NSW, Australia were identified and invited to participate in the
22 ATLAS school-based obesity prevention intervention. Fourteen schools agreed to
23 participate and adolescent boys in year 7 (first year of secondary school) at each of the
24 study schools were screened for eligibility. Study participants were eligible if they
25 reported failing to meet national physical activity or screen-time guidelines for youth

1 (i.e., ≤ 60 minutes of moderate-to-vigorous physical activity [MVPA] per day or ≥ 2
2 hours of screen-time per day) [14]. Of the 997 students who completed eligibility-
3 screening, 850 were considered eligible and 361 boys consented to be included in the
4 study. Data for the present study is from baseline assessments conducted in November –
5 December, 2012. Of the 361 subjects assessed, $N = 320$ provided valid data for video-
6 game genre preference and formed the study sample for the present investigation.

7 *Measurements*

8 Assessments were conducted on school premises by trained research assistants. Physical
9 measurements were conducted in a sensitive manner and questionnaires were completed
10 in exam-like conditions using apple iPads. Demographic information including age,
11 cultural background, language spoken at home, residential postcode (to assess socio-
12 economic status) and indigenous status was reported by participants.

13 *Height and weight.* Height was measured using a portable stadiometer (Model no. PE087,
14 Mentone Educational Centre, Australia) and weight was measured in light clothing,
15 without shoes using a portable digital scale (Model no. UC-321PC, A&D Company Ltd,
16 Tokyo Japan). Body mass index was calculated using the equation (weight [kg] / Height
17 [m²]).

18 *Screen-time.* Recreational screen-time was measured using a modified version of the
19 Adolescent Sedentary Activity Questionnaire (ASAQ) [15]. The modified ASAQ asks
20 respondents to report the total time spent sitting using screens (of any kind) for anything
21 other than homework on each day of the week. Evidence shows that adolescents often use
22 multiple screen devices simultaneously [16, 17]. Consequently, self-reporting the time
23 spent using individual devices and summing the times for each may result in inflated
24 estimates of total screen-time. The modified ASAQ accounts for screen multi-tasking by
25 measuring the ‘total time’ spent using screens regardless of the number of screen devices

1 being used at once. Test-retest reliability for the screen-time items of the ASAQ have
 2 been found to be acceptable among a sample of adolescents (ICC .76 to .90) [15]
 3 *Physical activity.* Physical activity was measured in accordance with standardized
 4 protocols [18] using triaxial Actigraph accelerometers (model GT3X+), worn by
 5 participants during waking hours for seven consecutive days, except when bathing
 6 and swimming. Data were collected and stored in 5-second epochs. Valid wear time
 7 for *weekdays* was defined as a minimum of 3 days of monitoring (Monday – Friday)
 8 with ≥ 8 hours (i.e., 480 minutes) of total wear time recorded. For *weekends* valid
 9 wear time was defined as ≥ 8 hours of total wear time recorded on at least one
 10 weekend day (Saturday – Sunday). The mean activity counts per minute (CPM) were
 11 calculated to provide a measure of ‘overall’ activity, while thresholds for activity
 12 counts were used to categorize physical activity into sedentary, light, moderate and
 13 vigorous intensity activity [19]. Using these cut points, the time spent in MVPA was
 14 calculated.
 15 *Video game genre preference.* Participants were asked to list their three favorite video
 16 games and participants’ responses were then classified into genres using the Pan
 17 European Game Information (PEGI) online database [20]. As participants reported three
 18 of their favorite video games, the mode of the three video game genres was considered to
 19 indicate their genre preference. If all three genres were different, the genre of the first
 20 listed game was considered as their preference. The video game genres were collapsed
 21 into four genre ‘groups’ to simplify analyses. The following four genres were selected: i)
 22 ‘Action/Adventure’ – user plays as a character with puzzle-solving and/or real-time
 23 (direct control over characters)(e.g., Call of Duty); ii) ‘Sports and Racing’ – simulation of
 24 sport (e.g., FIFA 13) and simulation of racing (e.g., Forza Horizon); iii) ‘Strategy’ –
 25 **puzzle-solving games**, which can require problem solving and decision making to

progress through the game (e.g., Minecraft), and iv) ‘Role Playing’ – games where the participant creates a character or chooses a character that has specific abilities. Games may allow players a period of analysis before committing to a game action or real-time decision making (e.g. World of Warcraft). It is important to note that many games are not limited to a single genre and different versions of games belong to different genres. Therefore, the PEGI database of games was used to allocate game genres based on the most recent game edition.

Statistical analyses

Analyses were performed using IBM SPSS Statistics for Windows, Version 20.0 (2010 SPSS Inc., IBM Company Armonk, NY). The data were assessed for normality and the physical activity and screen-time variables were transformed using the logarithmic function. Analysis of variance (ANOVA) with Bonferroni post hoc procedures were used to examine the association between participants’ video game genre preference and their physical activity and screen-time. Multilevel linear mixed models were used to assess the cross-sectional relationships between physical activity (i.e., MVPA and counts per minute) and screen-time for weekdays and weekend days. Models included physical activity as the outcome variable, screen-time and body mass index as fixed factors, and school as a random factor. Alpha levels were set at $p < 0.05$.

- Table 1 -

Results

Participants were N = 320 adolescent boys aged 12.7 ± 0.5 years. The majority of participants were born in Australia (95.9%) and spoke English at home (97.1%).

1 Approximately 12% of boys identified as being of Indigenous descent and the majority of
2 participants were classified as low-to-middle socio-economic status based on their
3 residential postcode. Accelerometer compliance was moderate with 237 (74%)
4 participants providing valid data for weekday physical activity and 183 (57.2%)
5 participants providing valid data for weekend physical activity.

6 *Video game genre preference and physical activity*

7 There was a significant effect of genre preference on weekday physical activity.
8 Significant effects were found both for overall activity $F(3, 242) = 3.66, p = .01$ and for
9 MVPA $F(3, 242) = 2.70, p < .05$. Post hoc tests indicated that boys who preferred sports
10 and racing games accumulated higher levels of overall activity ($M = 576 \text{ CPM} \pm 149$
11 versus $M = 460 \text{ CPM} \pm 112$) and more MVPA ($M = 72 \text{ mins/d} \pm 22$ versus $M = 58$
12 mins/d ± 16) than boys who liked strategy games. No significant differences were found
13 between any of the other genre groups nor were there any significant differences found
14 for weekend physical activity.

15 *Screen-time and video game genre preference*

16 Video game genre preference had a significant influence on both weekday $F(3, 316) =$
17 $4.03, p < .01$ and weekend $F(3, 316) = 3.25, p = .02$ screen-time. On weekdays, the ‘role
18 playing games’ group reported significantly higher screen-time than the ‘sports and
19 racing games’ group ($M = 197 \text{ mins/d}, \pm 145$ versus $M = 98 \text{ mins/d} \pm 59$). On weekends,
20 the ‘strategy games’ group reported significantly higher screen-time than those in ‘sports
21 and racing games’ group ($M = 206 \text{ mins/d} \pm 150$ versus $M = 123 \text{ mins/d} \pm 99$).

22 Differences between all other genre categories were not statistically significant.

23 *Association between physical activity and screen-time*

24 Unstandardized regression coefficients and 95% confidence intervals (CIs) for log
25 transformed variables are reported. After adjusting for BMI, the associations between

1 weekday screen-time and overall activity ($\beta = -0.04$, 95% CI = -0.09 to 0.01, $p = .13$) and
2 MVPA ($\beta = -0.04$, 95% CI = -0.10 to 0.02, $p = .19$) on weekdays were not statistically
3 significant. Significant inverse associations were found between weekend screen-time
4 and both overall activity ($\beta = -0.13$, 95% CI = -0.22 to -0.03, $p = .01$) and MVPA ($\beta = -$
5 0.13, 95% CI = -0.25 to -0.01, $p = .04$) on weekends.

6

7 - Table 2 –

8

9 **Discussion**

10 The primary aim of this study was to explore the association between video game genre
11 preference, physical activity and screen-time in a sample of adolescent boys attending
12 schools in low-income communities. We found that boys who preferred ‘sports and
13 racing’ games were more active during the week, compared to boys who reported a
14 preference for ‘strategy’ games. In addition, there was a significant game genre group
15 effect for weekday and weekend screen-time. Boys who preferred ‘role playing’ and
16 ‘strategy’ games’ reported significantly more screen-time than boys who preferred ‘sports
17 and racing’ games’.

18 The effect of genre preference on screen-time observed in the present study is
19 consistent with research conducted with adults [12]. Among a large sample of adult
20 gamers, it was found that gaming time differed significantly between genre groups [12].
21 Furthermore, the risk of experiencing “problem video game play” disorder, a condition
22 in which video gaming behavior is considered pathological, was found to be significantly
23 higher among those within specific genre categories, and highest among ‘role playing
24 gamers’[12]. Though dependent on the period of the week, our results showed higher
25 levels of screen-time among those with a preference for ‘strategy’ and ‘role playing’

1 games, compared with those preferring ‘sports and racing’ games. This may be explained
2 by the nature of the game play within each genre. For example, ‘strategy ’ and ‘role
3 playing’ games may require greater determination, calculations and time to succeed as
4 there may be more tedious challenges, AI, obstacles and plots in the game. Thus, a clear
5 contrast in the duration of game play required before the game is finished or can be saved
6 [21]. In the case of ‘role playing games’ it has been identified that character/avatar
7 development can be a long persistent process [22]. In addition, the ‘addictive’ nature of
8 specific genres might contribute to increased gaming duration through individuals losing
9 a sense of time as they engage in the fantasy elements of the game itself [22].

10 Alternatively, it is possible that youth with a preference for ‘sporting’ games are attracted
11 to this genre due to an existing interest in sport and physical activity. Consequently, these
12 individuals may seek out opportunities to engage in ‘real’ physical activity in their leisure
13 time and simply supplement this interest with video games delivering the same subject
14 matter. Interestingly, recent research has demonstrated that screen-time is inversely
15 associated with motivation to limit screen-time [23]. Accordingly, boys that enjoy sports
16 and racing games may be aware of the consequences of excessive screen-time and/or
17 value active alternatives resulting in self-regulation of screen-time behavior. Whether the
18 differences in total screen-time observed between genre groups can be explained by
19 differences in video gaming time *alone*, or by differences in the overall patterns of
20 screen-use across multiple mediums is beyond the scope of this study. However,
21 considering that television use is the largest single contributor to total screen-time [24], it
22 is likely that time spent video gaming occurs in addition to engagement with other screen
23 devices and may be reflective of a more sedentary behavior profile.

24 In addition to an effect on screen-time our findings show that genre preference
25 has an influence on physical activity. Both ‘overall’ activity levels and the quantity of

1 MVPA on weekdays was found to be significantly higher among those who preferred
2 ‘sports and racing’ games group compared with those who preferred ‘strategy’ games.
3 The mean difference in MVPA between these two groups was approximately 14 minutes
4 per day, representing a difference of close to a quarter of the daily recommendation [2].
5 According to the displacement hypothesis, time spent in sedentary behaviors displaces
6 time that could be spent engaging in health-enhancing physical activity [25]. However,
7 many studies have found a weak association between sedentary time and physical activity
8 in adolescents [26, 27], suggesting that youth can be active and exceed the screen-time
9 recommendations [27, 28]. It must be noted that despite the abundance of research on the
10 association between physical activity and screen-time, there is limited research on the
11 association between physical activity and the unique aspects of screen-time, such as
12 video game genre preference. Our findings therefore, address an important gap in the
13 literature. As mentioned previously, adolescents with a preference for sport-focused
14 video games likely do so due to their existing interest in sport and physical activity. This
15 interpretation is supported by evidence from a study of sports gamers, which showed that
16 the majority of sports gamers played sport and that most reported their favorite sporting
17 game was based on the same sport as the one they actually played [29]. This may explain
18 to difference in levels participation in physical activity between the genre groups. The
19 lack of a significant finding on weekend days may be the result of a loss of power as
20 accelerometer compliance on weekends was considerably worse than on weekdays (i.e.,
21 57% versus 74%). More research is required to confirm the effect, or lack thereof, of
22 game genre preference on weekend physical activity.

23 A secondary aim was to examine the association between screen-time and
24 physical activity to determine whether screen-time displaces time spent being active.
25 Finally, significant inverse associations were observed between screen-time and both

1 'overall' activity and MVPA on weekends. However, the associations for weekdays were
2 not statistically significant. Numerous studies have examined the association between
3 physical activity and screen-time in youth, but the findings have been equivocal [30, 31].
4 A longitudinal study conducted in the U.S. over a two year period, found that a reduction
5 in screen-time was associated with an increase in the frequency of physical activity
6 during early adolescence [32]. Conversely, a recent study of Spanish adolescents found
7 video gaming was *positively* associated with light physical activity on weekend days [33].
8 Although, the association between *weekday* screen-time and physical activity in the
9 present study was not statistically significant, significant inverse associations were found
10 between *weekend* screen-time and physical activity. While this may appear to be
11 contradictory, these findings actually support rather than contest evidence of a
12 displacement effect. Youth are subject to similar environmental circumstances during
13 weekdays, spending a considerable portion of their time at school, predominantly without
14 access to video games or other screen-devices. In addition, they are exposed to physical
15 education on a compulsory basis meaning that they may accumulate more physical
16 activity during this time [34]. Differences in activity levels on weekdays may arise during
17 the afternoon period prior to dinner when youth can choose whether to spend their time
18 sedentary or active. However, this represents only a small portion of the day. Conversely,
19 weekends are characterized by considerably more discretionary time during which youth
20 have access to the variety of screen-based media available in the family home. In this
21 respect, there is greater scope for variation in activity levels due to the large degree of
22 choice available to adolescents. For example, MVPA is commonly achieved through
23 sport participation [35], which generally occurs on weekends. An adolescent may achieve
24 the recommended quantity of MVPA through sports participation alone whereas a non-
25 participant would have to engage in unorganized physical activity of similar duration to

gain a comparable amount of MVPA. By consequence, weekends allow for the association between physical activity and screen-time to be observed outside of the imposed stimuli present during weekdays. Our findings, at least for weekends, support those of other investigators suggesting that screen-time displaces physical activity.

Strengths of the present study include objective assessment of physical activity and correction for media multi-tasking through the use of the modified ASAQ. However, the former also introduced a limitation. Due to poor compliance with physical activity monitoring on weekends, analyses of the associations between genre preference and physical activity during this period may have been underpowered, resulting in the lack of a significant finding. In addition, there was a large disparity between the number of subjects in each of the video game genre groups, with the vast majority (68%) of boys ascribed to the ‘action/adventure games’ group and considerably smaller numbers forming the remaining groups. This may have also influenced our power to detect significant differences. Lastly, study participants were adolescent boys from low-income communities and therefore, were not representative of the wider population. Therefore, these findings must be interpreted with caution and may not be generalizable to other groups.

Conclusion

Our findings suggest that video game genre preference has an effect on weekday and weekend screen-time and weekday physical activity. Furthermore, our data indicates that time spent engaged in screen-based recreation on weekends may displace physical activity in adolescent boys living in low-income communities.

References

1. Salmon, J., et al., *Health risks, correlates, and interventions to reduce sedentary behavior in young people*. American journal of preventive medicine, 2011. **41**(2): p. 197-206.
2. *Australia's physical activity recommendations for 12-18 year olds*. 2004, Department of Health and Ageing: Canberra.
3. Appel, M., *Are heavy users of computer games and social media more computer literate?* Computers & Education, 2012. **59**(4): p. 1339-1349.
4. Hardy, L.L., *SPANS 2010: NSW Schools Physical Activity and Nutrition Survey: Executive Summary*. 2011, The University of Sydney.
5. Goldfield, G.S., et al., *Video Game Playing Is Independently Associated with Blood Pressure and Lipids in Overweight and Obese Adolescents*. PLoS ONE, 2011. **6**(11): p. e26643.
6. Mark, A.E. and I. Janssen, *Relationship between screen time and metabolic syndrome in adolescents*. Journal of Public Health, 2008. **30**(2): p. 153-160.
7. Sardinha, L.B., et al., *Objectively Measured Time Spent Sedentary Is Associated With Insulin Resistance Independent of Overall and Central Body Fat in 9- to 10-Year-Old Portuguese Children*. Diabetes Care, 2008. **31**(3): p. 569-75.
8. Greenberg, B.S., et al., *Orientations to Video Games Among Gender and Age Groups*. Simulation & Gaming, 2010. **41**(2): p. 238-259.
9. Sherry, J.L., et al., *Child Development and Genre Preference: Research for Educational Game Design*. Cyberpsychology, Behavior, and Social Networking, 2013. **16**(5): p. 335-339.
10. Myers, D., *A Q-study of game player aesthetics*. Simulation & Gaming, 1990. **21**: p. 375-396.
11. Rehbein, F., M. Kleimann, and T. Mößle, *Prevalence and Risk Factors of Video Game Dependency in Adolescence: Results of a German Nationwide Survey*. Cyberpsychology, Behavior, and Social Networking, 2010. **13**(3): p. 269-277.
12. Elliot, L., et al., *Video Game Genre as a Predictor of Problem Use*. Cyberpsychology, Behavior, and Social Networking, 2012. **15**(3): p. 155-161.
13. Smith, J.J., et al., *Rationale and study protocol for the 'Active Teen Leaders Avoiding Screen-time' group randomized controlled trial: An obesity prevention intervention for adolescent boys from schools in low-income communities*. Contemporary Clinical Trials, 2014. **37**: p. 106-119.
14. Department of Health and Ageing, *The National Physical Activity Guidelines for Australians*, D.o.H.a. Ageing, Editor. 2013, Australian Government: Canberra.
15. Hardy, L.L., M.L. Booth, and A.D. Okely, *The reliability of the Adolescent Sedentary Activity Questionnaire (ASAQ)*. Preventive Medicine, 2007. **45**(1): p. 71-74.
16. Foehr, U.G., *Media multitasking among American youth: Prevalence, predictors and pairings*. Vol. 7592. 2006: Henry J. Kaiser Family Foundation Menlo Park, CA.
17. Rey-López, J.P., et al., *Reliability and validity of a screen time-based sedentary behaviour questionnaire for adolescents: The HELENA study*. The European Journal of Public Health, 2012. **22**(3): p. 373-377.

18. Trost, S.G., K.L. McIver, and R.R. Pate, *Conducting Accelerometer-Based Activity Assessments in Field-Based Research*. Medicine & Science in Sports & Exercise, 2005. **37**(11 Supplement): p. S531-S543.
19. Evenson, K.R., et al., *Calibration of two objective measures of physical activity for children*. Journal of Sports Sciences, 2008. **26**(14): p. 1557-1565.
20. Lemmens, J.S., P.M. Valkenburg, and J. Peter, *The Effects of Pathological Gaming on Aggressive Behavior*. Journal of Youth and Adolescence, 2011. **40**(1): p. 38-47.
21. Lee, M.-S., et al., *Characteristics of Internet Use in Relation to Game Genre in Korean Adolescents*. Cyberpsychology & Behavior, 2007. **10**(2): p. 278-285.
22. Billieux, J., et al., *Why do you play World of Warcraft? An in-depth exploration of self-reported motivations to play online and in-game behaviours in the virtual world of Azeroth*. Computers in Human Behavior, 2013. **29**(1): p. 103-109.
23. Lubans, D.R., et al., *Development and evaluation of the Motivation to Limit Screen-time Questionnaire (MLSQ) for adolescents*. Preventive Medicine, 2013. **57**(5): p. 561-566.
24. Rideout, V.J., U.G. Foehr, and D.F. Roberts, *Generation M [²]: Media in the Lives of 8-to 18-Year-Olds*. Henry J. Kaiser Family Foundation, 2010.
25. Ballard, M., et al., *Correlates of video game screen time among males: Body mass, physical activity, and other media use*. Eating Behaviors, 2009. **10**(3): p. 161-167.
26. Ekelund, U., et al., *Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents*. Journal of the American Medical Association, 2012. **307**(7): p. 704-712.
27. Biddle, S.J.H., T. Gorely, and D.J. Stensel, *Health-enhancing physical activity and sedentary behaviour in children and adolescents*. Journal of Sports Sciences, 2004. **22**(8): p. 679-701.
28. Salmon, J., D. Dunstan, and N. Owen, *Should we be concerned about children spending extended periods of time in sedentary pursuits even among the highly active?* International Journal of Pediatric Obesity, 2008. **3**(2): p. 66-68.
29. Stein, A., K. Mitgutsch, and M. Consalvo, *Who are sports gamers? A large scale study of sports video game players*. Convergence: The International Journal of Research into New Media Technologies, 2013. **19**(3): p. 345-363.
30. de Jong, E., et al., *Association between TV viewing, computer use and overweight, determinants and competing activities of screen time in 4- to 13-year-old children*. International Journal of Obesity, 2011. **13**(10): p. 244.
31. Cao, H., et al., *Screen-time, physical activity and mental health among urban adolescents in China*. Preventive Medicine, 2011. **53**(4-5): p. 316-320.
32. Motl, R.W., et al., *Naturally occurring changes in time spent watching television are inversely related to frequency of physical activity during early adolescence*. Journal of Adolescence, 2006. **29**(1): p. 19-32.
33. Devis-Devis, J., et al., *Brief report: Association between socio-demographic factors, screen media usage and physical activity by type of day in Spanish adolescents*. Journal of Adolescence, 2012. **35**(1): p. 213-218.
34. Nader, P.R., et al., *Moderate-to-vigorous physical activity from ages 9 to 15 years*. Journal of American Medical Association, 2008. **300**(3): p. 295-305.
35. Fairclough, S.J., et al., *Associations between children's socioeconomic status, weight status, and sex, with screen-based sedentary behaviours and sport*

participation. International Journal of Pediatric Obesity, 2009. 4(4): p. 299-305.

Table 1. Characteristics of study sample (N = 320)

Characteristics	M	SD
Age, y	12.7	0.5
Born in Australia, n (%)	306	95.6
English language spoken at home, n (%) ^a	309	96.9
Cultural background, n (%) ^b		
Australian	248	78.0
European	49	15.4
African	4	1.3
Asian	6	1.9
Middle eastern	2	0.6
Other	9	2.8
Socioeconomic position, n (%) ^c		
1-2	88	27.7
3-4	182	57.3
5-6	28	8.8
7-8	16	4.4
9-10	6	1.9
Weight, kg	53.4	14.1
Height, cm	160.4	8.6
BMI, kg.m ⁻²	20.5	4.1
BMI z score	0.5	1.3
Weight status, n (%)		
Underweight	7	2.2
Healthy weight	200	62.5
Overweight	66	20.6
Obese	47	14.7
Screen-time, mins/d		
Weekdays	128.9	90.0
Weekends	168.7	129.8
Physical activity, cpm		
Weekdays	523	145
Weekends	418	233
MVPA, mins/d		
Weekdays	65	20
Weekends	44	31

Note. Values are mean, SD unless otherwise reported

^a One participant did not report language spoken at home

^b Two participants did not report cultural background

^c Socioeconomic position determined by population decile using Socio-Economic Indexes For Areas of relative socioeconomic disadvantage based on residential postcode (1 = lowest, 10 = highest). Two participants did not report residential postcode

Table 2. Screen-time and physical activity according to video game genre preference (one-way ANOVA).

Variable	Genre group				<i>F</i>	<i>p</i>	<i>Post hoc*</i>
	AA M (SD)	SR M (SD)	SG M (SD)	RP M (SD)			
Screen-time (mins/d)							
Weekdays	126.7 (84.1)	98.1 (59.4)	152.0 (99.5)	196.8 (145.3)	4.03	<.01	RP > SR
Weekends	168.3 (123.4)	123.1 (99.3)	206.0 (149.6)	238.0 (186.0)	3.25	.02	SG > SR
Physical activity (cpm)							
Weekdays	522 (145)	576 (149)	460 (112)	486 (156)	3.66	.01	SR > SG
Weekends	425 (249)	442 (238)	350 (171)	402 (186)	0.61	.61	
MVPA (mins/d)							
Weekdays	65 (21)	72 (22)	58 (16)	60 (14)	2.70	<.05	SR > SG
Weekends	46 (32)	49 (35)	35 (23)	36 (17)	.94	.42	

Note. AA = action/adventure games; SR = sports/racing games; SG = strategy games; RP = role playing games

* $p < .05$