iMed

SCIEPublish

Article

Prospective Associations Between Exercise and Screen Use in Early Adulthood

Jillian Garraway, Hanna Nguyen and Leonard A. Jason *

Center for Community Research, DePaul University, 990 West Fullerton Avenue, Chicago, IL 60614, USA; jgarrawa@depaul.edu (J.G.); hanna.nguyen00@outlook.com (H.N.)

* Corresponding author. E-mail: ljason@depaul.edu (L.A.J.)

Received: 19 August 2026; Revised: 10 October 2026; Accepted: 21 October 2026; Available online: 2 November 2026

ABSTRACT: Exercise and screen use may change during the transition to adulthood, but their prospective associations need to be distinguished from concurrent associations. This study examined whether baseline exercise predicted subsequent screen use and whether baseline screen use predicted subsequent exercise after accounting for both baseline behaviors. Data were drawn from a prospective cohort initially recruited at Northwestern University. Baseline assessments occurred from 2014–2018 and follow-up assessments from 2019–2026. Participants reported the frequency of heavy and light exercise and daily television, video, and computer or video game use using five-category items coded 0–4. Separate baseline-adjusted regression models included age, gender, individual follow-up duration, and follow-up calendar year. Fully adjusted analyses included 2139 participants for heavy exercise and 2144 for light exercise, with a mean follow-up of 6.6 years. Ordinal regression and additional sensitivity analyses assessed robustness. Each behavior showed positive continuity across assessments. Higher baseline heavy exercise predicted lower follow-up screen-use scores ($b = -0.093$, 95% CI [−0.124, −0.063]); the corresponding association for light exercise was smaller in numerical magnitude ($b = -0.044$, 95% CI [−0.075, −0.013]). Both associations remained significant after correction for four cross-behavior comparisons. Baseline screen use was not significantly associated with subsequent heavy or light exercise after adjustment. Ordinal and sensitivity analyses produced the same overall pattern. Exercise frequency was prospectively associated with later television, video, and gaming use, although effects were modest.

Keywords: Physical activity; Exercise; Screen use; Prospective cohort; Young adults

1. Prospective Associations Between Exercise and Screen Use in Early Adulthood

The transition from adolescence to adulthood involves changes in education, employment, living arrangements, and daily routines that can influence physical activity. A systematic review of longitudinal cohort studies documented an average decline in physical activity across this transition [1]. Average changes nevertheless obscure substantial variation among individuals. Longitudinal research has identified groups that maintain, increase, or decrease activity, with changes in activity domains accompanying different patterns [2]. Understanding behavioral continuity and associated factors therefore requires prospective evidence rather than an assumption that all young adults follow the same trajectory.

© 2026 The authors. This is an open access article under the Creative Commons Attribution 4.0 International License (https://creativecommons.org/licenses/by/4.0/).

Screen-based activities are often considered possible competitors for time otherwise spent exercising. However, screen use and exercise can coexist, and their association need not reflect direct displacement. A meta-analysis in children and adolescents found a small inverse association between sedentary behavior and physical activity [3]. Shared influences, including daily schedules, health, and access to recreation, may contribute to both behaviors. Furthermore, television viewing and gaming represent only part of contemporary screen use and cannot be equated with total sedentary time.

Prospective analyses should account for initial levels of both behaviors. Without baseline screen use, an association between baseline exercise and later screen use could reflect differences already present at the first assessment. Similarly, associations between screen use and subsequent exercise require adjustment for initial exercise. These reciprocal prospective associations are distinct from mediation. When a proposed mediator and outcome are assessed concurrently, their temporal ordering cannot be established, even if another variable was measured earlier [4].

The present study examined heavy and light exercise frequency and television, video, and computer or video gaming use across two assessments approximately six to seven years apart. The aims were to estimate continuity within each behavior and to examine both baseline exercise–follow-up screen-use and baseline screen-use–follow-up exercise associations, adjusting for the other baseline behavior and available demographic and timing variables. Heavy and light exercise were examined separately because the questionnaire distinguished them. The revised analyses address prospective associations rather than mediating mechanisms. Associations involving self-reported COVID-19 infection were treated as exploratory.

2. Methods

2.1. Study Design and Participants

This two-wave observational analysis used data from a prospective study of infectious mononucleosis and subsequent health outcomes among students recruited at Northwestern University [5]. Students were invited through freshman email recruitment. The parent study enrolled students without a reported history of infectious mononucleosis at baseline. This analysis used baseline and stage 5 behavioral assessments and retained participants based on the saved selection indicator in the supplied dataset. Participants with later infectious mononucleosis or ME/CFS-related classifications were included in the primary analyses; a restricted health-status sensitivity analysis examined whether their inclusion materially influenced the results.

The supplied file contained 4684 records, of which 4501 met the saved selection rule. Of these, 4429 had at least one baseline behavioral item, and 2246 had at least one follow-up behavioral item. A follow-up survey indicator was present for 2671 participants, demonstrating that survey participation and availability of the exercise and screen-use items were not equivalent. Among participants with any baseline behavioral data, 2620 had the follow-up survey indicator, and 2202 had at least one follow-up behavioral item. The latter represents 49.7% of those with baseline behavioral data. Table 1 reports the available participant flow and model-specific sample sizes.

Baseline questionnaire timestamps spanned 2014–2018, and revised follow-up interview dates spanned 2019–2026. All interviews in this period were retained. Individual elapsed time was calculated from the baseline questionnaire timestamp and follow-up interview date. In the fully adjusted heavy-exercise sample, mean elapsed time was 6.61 years (SD = 1.37). Timing was virtually identical in the light-exercise sample.

Table 1. Participant availability and analytic samples.

Stage	Number
Records in supplied file	4684
Retained by saved selection indicator	4501
Excluded by saved selection indicator	183
At least one baseline behavioral item among retained records	4429
Follow-up survey indicator among retained records	2671
At least one follow-up behavioral item among retained records	2246
Follow-up survey indicator among those with baseline behavioral data	2620
Any follow-up behavioral item among those with baseline behavioral data	2202
Heavy exercise behavioral complete cases	2183
Light exercise behavioral complete cases	2188
Heavy exercise fully adjusted primary sample	2139
Light exercise fully adjusted primary sample	2144

Note: Counts overlap and are not all sequential exclusions. Follow-up behavioral retention among participants with baseline behavioral data was 2202/4429 (49.7%).

2.2. Exercise and Screen Use

The study used three brief items from the source manuscript, derived from the Modifiable Activity Questionnaire (MAQ). The original MAQ was developed to assess physical activity [6]. The measures were analyzed separately, rather than combined into a scale. Heavy exercise referred to exercise lasting at least 20 min that was hard enough to cause heavy breathing and a rapid heartbeat during the preceding 14 days. Examples included basketball, jogging, and fast bicycling. Light exercise referred to exercise lasting at least 20 min without those responses, for example, walking. These labels reflect participants' questionnaire responses rather than objectively measured intensity or metabolic equivalents. Both items were coded 0 = none, 1 = 1–2 days, 2 = 3–5 days, 3 = 6–8 days, and 4 = 9 or more days.

The screen-use item asked about daily television and video viewing or computer and video gaming during a normal week, using school-related wording concerning use before or after school. Responses were coded 0 = none, 1 = one hour or less, 2 = 2–3 h, 3 = 4–5 h, and 4 = 6 or more hours. We use "screen use" as shorthand for these specific activities. The item did not comprehensively assess smartphone use, social media, occupational screen exposure, or total sedentary behavior.

2.2.1. Covariates and Exploratory Variables

The primary models were adjusted for baseline age, baseline gender, elapsed follow-up time, and follow-up calendar year. These variables were chosen for their conceptual relevance to behavioral patterns and differing assessment contexts. Age values outside 16–35 years were treated as invalid for this college cohort. Gender was represented categorically, with separate indicators for female and nonbinary responses and male as the reference category. Missing responses and "prefer not to answer" were excluded from fully adjusted models. The nonbinary category was very small, preventing meaningful interpretation of its coefficient. Calendar year was entered categorically, and elapsed time was entered in years.

Additional analyses incorporated the available baseline fatigue composite and restricted the sample using recorded mononucleosis and ME/CFS-related classifications. The COVID-19 variable reflected participants' self-reports of having contracted COVID-19. COVID-19 interaction analyses were exploratory.

2.2.2. Statistical Analyses

Separate regression systems were fitted for heavy and light exercise. For each system, follow-up exercise was regressed on baseline exercise, baseline screen use, and covariates; follow-up screen use was regressed on the same baseline predictors and covariates. Thus, both outcomes were adjusted for their own baseline value, and all four cross-behavior associations were evaluated. These are baseline-adjusted prospective regressions corresponding to the observed paths in a two-wave cross-lagged framework. They do not isolate within-person effects from stable between-person differences and were not interpreted as causal mediation.

Ordinary least squares models estimated unstandardized changes in outcome category scores per one-category increase in the predictor. HC3 heteroskedasticity-robust standard errors were used to calculate 95% confidence intervals and two-sided significance tests for the ordinary least squares models. Treating the five categories as numeric provides a readily interpretable score-based summary but assumes equal category spacing; thus, it does not produce effects in minutes or hours. Ordered logistic regression using the same predictors served as a sensitivity analysis compatible with ordinal outcomes. The proportional-odds assumption was not formally established, so these models provide supporting sensitivity evidence rather than definitive measurement validation.

Primary inference focused on the four cross-behavior coefficients. Two-sided p values were adjusted using the Holm procedure across these four tests; unadjusted values are also reported. Within-behavior continuity estimates were descriptive secondary results. No formal test compared the heavy-and-light-exercise coefficients. Complete-case analyses were used, with separate model-specific sample sizes; missing covariate or behavioral values were not imputed. Completers and non-completers were compared on available baseline characteristics to evaluate possible selection bias.

Sensitivity analyses added baseline fatigue, restricted follow-up to 2020–2025, restricted the sample to participants with recorded absence of mononucleosis and ME/CFS-related classifications, and used inverse-probability weights for observed follow-up. The weighting model included baseline exercise, screen use, age, gender, and fatigue. Participants missing information needed for a sensitivity analysis were excluded from that analysis. These checks assess robustness under their respective assumptions; none eliminates unmeasured confounding or nonrandom attrition. Concurrent follow-up associations were examined separately. COVID-19 interactions with each baseline predictor were exploratory, without treating nonsignificant results as evidence of equivalence.

2.2.3. Ethics

The study received approval from the DePaul University Institutional Review Board, and participants provided informed consent.

3. Results

3.1. Participant Availability and Descriptive Findings

Complete data on the four behavioral items required for each regression system were available for 2183 participants in the heavy-exercise analysis and 2188 in the light-exercise analysis. Adding demographic and timing covariates yielded 2139 and 2144 participants, respectively (See Table 1). Table 2 presents behavioral category-score distributions in the corresponding behavioral complete-case samples. Mean heavy-exercise scores were 1.91 at baseline and 1.98 at follow-up; light-exercise scores were 2.77 and 2.62. Mean screen-use scores were 1.66 at baseline and 2.19 at follow-up. These descriptive differences concern ordinal category scores and should not be read as precise changes in exercise days or screen-use hours.

Participants with follow-up behavioral data differed from those without such data on some baseline characteristics. Among participants with known gender and baseline behavioral data, 62.8% of completers

versus 52.9% of non-completers reported female gender. Completers were slightly younger and reported slightly higher baseline light exercise; standardized mean differences were approximately −0.09 for age and 0.09 for light exercise. Differences in baseline heavy exercise, screen use, and fatigue were smaller, with absolute standardized mean differences below 0.05.

Table 2. Behavioral category scores.

Analysis Sample and Measure	Baseline M (SD)	Follow-Up M (SD)
Heavy exercise sample (n = 2183): heavy exercise	1.91 (1.31)	1.98 (1.32)
Heavy exercise sample: screen use	1.66 (0.95)	2.19 (0.95)
Light exercise sample (n = 2188): light exercise	2.77 (1.32)	2.62 (1.24)
Light exercise sample: screen use	1.66 (0.95)	2.19 (0.95)

Note: All scores range from 0 to 4. Means summarize category scores, not raw days or hours. Samples require complete baseline and follow-up exercise and screen-use items but do not yet exclude missing covariates.

3.1.1. Behavioral Continuity and Prospective Associations

All behaviors showed positive continuity across waves after adjustment (Table 3). Baseline heavy exercise predicted subsequent heavy exercise (b = 0.289, 95% CI [0.247, 0.330]), and baseline light exercise predicted subsequent light exercise (b = 0.172, 95% CI [0.132, 0.213]). Baseline screen use predicted follow-up screen use in both systems (b = 0.202 and 0.207, respectively). The fully adjusted models explained 10.5% of variance in heavy-exercise scores, 4.5% in light-exercise scores, 7.1% in screen-use scores in the heavy-exercise system, and 5.9% in screen-use scores in the light-exercise system. These percentages describe the entire model, not the contribution of a single predictor.

Higher baseline heavy exercise was associated with lower follow-up screen use after adjustment for baseline screen use and covariates (b = −0.093, 95% CI [−0.124, −0.063], Holm-adjusted $p < 0.001$). Baseline light exercise also predicted lower follow-up screen use (b = −0.044, 95% CI [−0.075, −0.013], Holm-adjusted $p = 0.018$). Baseline screen use did not significantly predict subsequent heavy exercise (b = −0.040, 95% CI [−0.099, 0.018], Holm-adjusted $p = 0.354$) or light exercise (b = −0.036, 95% CI [−0.093, 0.021], Holm-adjusted $p = 0.354$). The confidence intervals remain compatible with modest associations in either direction.

Table 3. Fully adjusted prospective associations.

Model	Baseline → Follow-Up	*n*	b	95% CI	*p*	Holm *p*
Heavy exercise	Exercise → exercise	2139	0.289	[0.247, 0.330]	<0.001	—
Heavy exercise	Screen use → exercise	2139	−0.040	[−0.099, 0.018]	0.177	0.354
Heavy exercise	Exercise → screen use	2139	−0.093	[−0.124, −0.063]	<0.001	<0.001
Heavy exercise	Screen use → screen use	2139	0.202	[0.158, 0.245]	<0.001	—
Light exercise	Exercise → exercise	2144	0.172	[0.132, 0.213]	<0.001	—
Light exercise	Screen use → exercise	2144	−0.036	[−0.093, 0.021]	0.216	0.354
Light exercise	Exercise → screen use	2144	−0.044	[−0.075, −0.013]	0.006	0.018
Light exercise	Screen use → screen use	2144	0.207	[0.164, 0.251]	<0.001	—

Heavy-exercise models include baseline heavy exercise and baseline screen use; light-exercise models include baseline light exercise and baseline screen use. All models also include age, gender, elapsed follow-up time, and categorical follow-up calendar year. Model labels identify the exercise variable included, rather than participant groups. b is an unstandardized category-score coefficient. Confidence intervals use HC3 robust standard errors. Holm correction applies to the four cross-behavior tests only; dashes indicate that Holm-adjusted p values are not reported for the secondary within-behavior associations.

3.1.2. Sensitivity and Exploratory Analyses

Ordered logistic models produced the same overall pattern. Higher baseline heavy exercise predicted lower odds of a higher follow-up screen-use category (OR = 0.816, 95% CI [0.766, 0.869]); the corresponding estimate for light exercise was OR = 0.919 (95% CI [0.864, 0.977]). Baseline screen use was not significantly associated with follow-up heavy exercise (OR = 0.933, 95% CI [0.860, 1.012]) or light exercise (OR = 0.953, 95% CI [0.878, 1.035]). Table 4 summarizes additional sensitivity estimates for the exercise-to-screen-use associations. Adding fatigue, restricting the assessment window, restricting recorded illness status, and weighting for follow-up availability did not change the overall interpretation. The reverse screen-use-to-exercise associations remained nonsignificant in these analyses.

At follow-up, screen use was inversely associated with concurrently reported heavy exercise (b = −0.089, 95% CI [−0.150, −0.027]) and light exercise (b = −0.073, 95% CI [−0.134, −0.013]) after baseline and covariate adjustment. Because both variables were measured at the same wave, these findings cannot establish temporal direction. Exploratory models involving perceived COVID-19 infection included 2083 participants for heavy exercise and 2088 for light exercise. None of the four interaction tests were statistically significant (unadjusted *p* values 0.302–0.827).

Table 4. Sensitivity analyses of exercise predicting screen use.

Sensitivity Analysis	Heavy *n*	Heavy b	Light *n*	Light b
Add baseline fatigue	2138	−0.090	2143	−0.042
Restrict follow-up to 2020–2025	2128	−0.093	2133	−0.044
Restrict recorded illness status	1607	−0.082	1613	−0.043
Inverse-probability weighted analysis	2138	−0.093	2143	−0.041

Note: All estimates retain baseline behavior and demographic/timing adjustment. All exercise-to-screen-use estimates were significant at unadjusted $p < 0.05$; screen-use-to-exercise estimates were nonsignificant in these analyses. The illness restriction required recorded absence of mononucleosis before and after college and absence of ME/CFS-related classifications; missing classification data were excluded. Weighted estimates do not incorporate uncertainty.

4. Discussion

This study found modest prospective associations between baseline exercise frequency and later television, video, and gaming use after accounting for both baseline behaviors and available demographic and timing variables. In contrast, baseline screen use was not significantly associated with subsequent exercise in the adjusted models. Each behavior showed positive continuity across the follow-up interval. The findings support a description of behavioral tracking and prospective association; they do not establish that screen use mediates exercise maintenance.

Exercise and screen use were inversely associated at follow-up, but their simultaneous measurement precludes determining which preceded the other. The prospective regressions provide clearer temporal ordering between baseline predictors and later outcomes, while still allowing confounding by stable individual characteristics and intervening experiences. Neither analysis shows that reducing screen use increases exercise.

Higher baseline exercise may identify individuals whose later leisure patterns include somewhat less television viewing or gaming. Possible explanations include preferences for active recreation, social contexts, schedules, or shared health-related influences. These explanations were not directly measured and should remain hypotheses. Likewise, the dataset does not establish that heavy exercise was embedded in structured routines or that a particular behavioral coupling process occurred.

Effect magnitude warrants particular attention. A one-category increase in baseline heavy exercise corresponded to approximately 0.09 of a category lower follow-up screen-use score, and the light-exercise estimate was approximately 0.04 of a category lower. These are small score differences in a large sample.

Because the response categories have unequal underlying ranges, the coefficients cannot be converted directly to changes in daily viewing hours or exercise days. The models also explained limited variance.

Behavioral continuity over several years is consistent with an established longitudinal literature on physical activity during the transition to adulthood [1,2]. Nevertheless, positive baseline–follow-up associations do not mean that exercise was continuously maintained between assessments. Participants could have increased, decreased, or interrupted exercise during the intervening years. This study contributes evidence on the reciprocal prospective associations of brief heavy-and-light exercise items with a specific screen-use measure in a college-origin cohort.

Assessment timing also matters. Follow-up interviews occurred from 2019 through 2026, spanning periods before, during, and after the most acute pandemic restrictions. Baseline assessments and elapsed follow-up times also varied. Calendar-year and duration adjustments, together with the 2020–2025 sensitivity analysis, reduced concern that the principal findings depended on a small number of interviews outside that window. However, calendar year does not capture local restrictions, remote work or education, opportunities for exercise, or individual exposure to pandemic disruption.

Limitations and Future Research

Several limitations constrain the findings. First, brief self-report items are susceptible to recall bias and social-desirability-related information bias. Participants may also have classified similar activities differently as heavy or light exercise, creating a misclassification of intensity. Because all behavioral measures were self-reported, common-method influences may contribute to their associations. There was no contemporaneous device-based validation or test–retest assessment in this analysis. Correlations across a six-year interval reflect both behavioral continuity and measurement properties and cannot serve as estimates of questionnaire reliability.

Second, the screen-use item measured television, video, and gaming rather than total recreational screen exposure. It may underrepresent smartphone and social-media use, and the school-related wording may function differently after the transition to employment or other adult roles. Measurement validity for the original MAQ cannot be assumed for the abbreviated exercise items or the added screen-use item. The five-category scales also impose coarse measurement and unequal underlying category intervals. Robust standard errors and ordinal sensitivity analyses address some modeling concerns but do not resolve these measurement limitations.

Third, follow-up behavioral data were available for approximately half of participants with baseline behavioral information, creating potential attrition and selection bias. Gender composition differed between completers and non-completers. Complete-case analysis can introduce further selection when covariates are missing. Inverse-probability weighting produced similar estimates under assumptions concerning observed predictors of follow-up availability, but it cannot correct for selection driven by unmeasured factors; uncertainty in estimated weights was not incorporated. Complete recruitment and contact records are needed to distinguish noncontact, refusal, loss to follow-up, and item nonresponse more precisely.

Fourth, residual confounding remains possible. Available adjustment did not comprehensively account for socioeconomic conditions, work and study demands, living arrangements, recreational access, or health changes across follow-up. The restricted illness-status analysis was reassuring about robustness but relied on recorded classifications and selected participants partly on post-baseline information; it should not be interpreted as eliminating health-related confounding. Findings from a single university-origin cohort may not generalize to young adults outside that setting.

Finally, two widely separated waves cannot characterize intermediate trajectories or distinguish within-person changes from stable differences between people. Future studies should use at least three suitably spaced waves, updated measures covering contemporary screen activities, objective physical-activity

assessment, and more complete social and health covariates. Intervention studies are needed to determine whether changing screen use influences subsequent exercise.

5. Conclusions

Across a mean follow-up of 6.6 years, higher baseline heavy and light exercise frequency was associated with modestly lower subsequent television, video, and gaming use after baseline and covariate adjustment. Baseline screen use was not significantly associated with later exercise. These findings describe prospective associations and behavioral continuity in a college-origin cohort, without establishing mediation, continuous exercise maintenance, or benefits of screen-use reduction.

Author Contributions

J.G. contributed to analysis, investigation, writing, and visualization. H.N. contributed to analysis, manuscript review and editing, and visualization. L.A.J. contributed to conceptualization, methodology, analysis, investigation, resources, manuscript review and editing, visualization, supervision, project administration, and funding acquisition.

Ethics Statement

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the DePaul University Institutional Review Board of DePaul University (24 October 2019; #LJ090310PSY).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The dataset has not been publicly deposited but can be made available by request to the corresponding author.

Funding

This work was supported by the National Institute of Allergy and Infectious Diseases (grant number AI 105781).

Declaration of Competing Interest

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

References

1. Corder K, Winpenny E, Love R, Brown HE, White M, Sluijs EV. Change in physical activity from adolescence to early adulthood: A systematic review and meta-analysis of longitudinal cohort studies. *Br. J. Sports Med.* **2019**, *53*, 496–503. DOI:10.1136/bjsports-2016-097330
2. Aira T, Vasankari T, Heinonen OJ, Korpelainen R, Kotkajuuri J, Parkkari J, et al. Physical activity from adolescence to young adulthood: Patterns of change, and their associations with activity domains and sedentary time. *Int. J. Behav. Nutr. Phys. Act.* **2021**, *18*, 85. DOI:10.1186/s12966-021-01130-x
3. Pearson N, Braithwaite RE, Biddle SJH, van Sluijs EMF, Atkin AJ. Associations between sedentary behaviour and physical activity in children and adolescents: A meta-analysis. *Obes. Rev.* **2014**, *15*, 666–675. DOI:10.1111/obr.12188
4. Cole DA, Maxwell SE. Testing Mediational Models with Longitudinal Data: Questions and Tips in the Use of Structural Equation Modeling. *J. Abnorm. Psychol.* **2003**, *112*, 558–577. DOI:10.1037/0021-843X.112.4.558

5. Jason LA, Cotler J, Islam MF, Sunnquist M, Katz BZ. Risks for Developing Myalgic Encephalomyelitis/Chronic Fatigue Syndrome in College Students Following Infectious Mononucleosis: A Prospective Cohort Study. *Clin. Infect. Dis.* **2021**, *73*, e3740–e3746. DOI:10.1093/cid/ciaa1886
6. Kriska AM, Knowler WC, LaPorte RE, Drash AL, Wing RR, Blair SN, et al. Development of Questionnaire to Examine Relationship of Physical Activity and Diabetes in Pima Indians. *Diabetes Care* **1990**, *13*, 401–411. DOI:10.2337/diacare.13.4.401