Additional file 2 : eMethods and eTables

Contents

eMethods 1. Missing Data

Outcome: Daily Smartphone Use

Data availability decreased over time in both groups, reflecting a combination of monotone attrition and intermittent missingness (eTable 1).

To evaluate the missing data mechanism, logistic regression analyses were conducted at each follow-up time point to examine associations between baseline characteristics and missing smartphone use data. Candidate predictors included age, sex, academic level, group allocation, baseline depressive symptoms, academic motivation dimensions, self-esteem, and social environment measures.

Extrinsic introjected motivation at baseline was associated with missingness at 1 week (β = 0.69; P = .024; McFadden R^2 = 0.107). Academic level was associated with missingness at 6 months (β = 1.48; P = .019; McFadden R^2 = 0.082) and postintervention follow-up (β = 1.36; P = .031; McFadden R^2 = 0.069). No other baseline variables were significantly associated with missingness.

Effect sizes were modest. Because predictors of missingness were measured at baseline and available in the analytic dataset, the missing-at-random (MAR) assumption was considered plausible.

Longitudinal mixed-effects models were estimated using maximum likelihood, allowing inclusion of all available outcome observations without imputing missing outcome data under MAR.

Covariates

Five values were missing for age and four for baseline depressive symptoms. A conditional single imputation approach was applied for these covariates. Linear prediction scores were calculated using available baseline variables, participants were categorized into quartiles based on predicted values, and missing values were replaced by the mean within the corresponding quartile. Sensitivity analyses excluding participants with imputed covariates yielded comparable results.

eMethods 2. Covariance Structure and Sensitivity Analyses

Linear mixed-effects models were estimated using independent, autoregressive (AR[1]), and unstructured covariance structures. Model selection was based on Akaike information criterion (AIC), Bayesian information criterion (BIC), and parsimony considerations.

Fixed-effect estimates, including the group × quadratic time interaction, were stable across covariance structures. Based on model fit indices and parsimony, the independent covariance structure was retained for the primary analysis.

eTable 1. Availability of Daily Smartphone Use Data by Time Point and Study Group (n = 137)

Time Point	Intervention (n = 65) n (%)	Control (n = 72) n (%)	Total (n = 137) n (%)
Baseline (T0)	59 (90.8%)	66 (91.7%)	125 (91.2%)
1 Week (T1)	48 (73.8%)	53 (73.6%)	101 (73.7%)
6 Months (T2)	35 (53.8%)	34 (47.2%)	69 (50.4%)
Postintervention (T3)	28 (43.1%)	43 (59.7%)	71 (51.8%)

etable 2. Model Fit Comparison Across Covariance Structures

Model	AIC	BIC
Independent	4515.7	4562.6
AR(1)	4522.9	4565.9
Unstructured	4519.4	4581.9

eTable 3. Fixed Effects From Primary Mixed-Effects Model (Independent Structure)

Predictor	Estimate (95% CI)	P Value
Group × time (linear)	1.7 (−6.5 to 9.8)	.68
Group × time²	59.4 (34.1 to 84.7)	<.001
Age (per SD)	22.6 (4.5 to 40.6)	.02
Depression (per SD)	27.8 (9.5 to 46.0)	<.01