

Supplementary Online Content

Riehm KE, Feder KA, Tormohlen KN, et al. Association between time spent using social media and internalizing and externalizing problems among US youth. *JAMA Psychiatry*. Published online September 11, 2019. doi:10.1001/jamapsychiatry.2019.2325

eFigure. Participant selection from the complete PATH sample into the analytic sample.

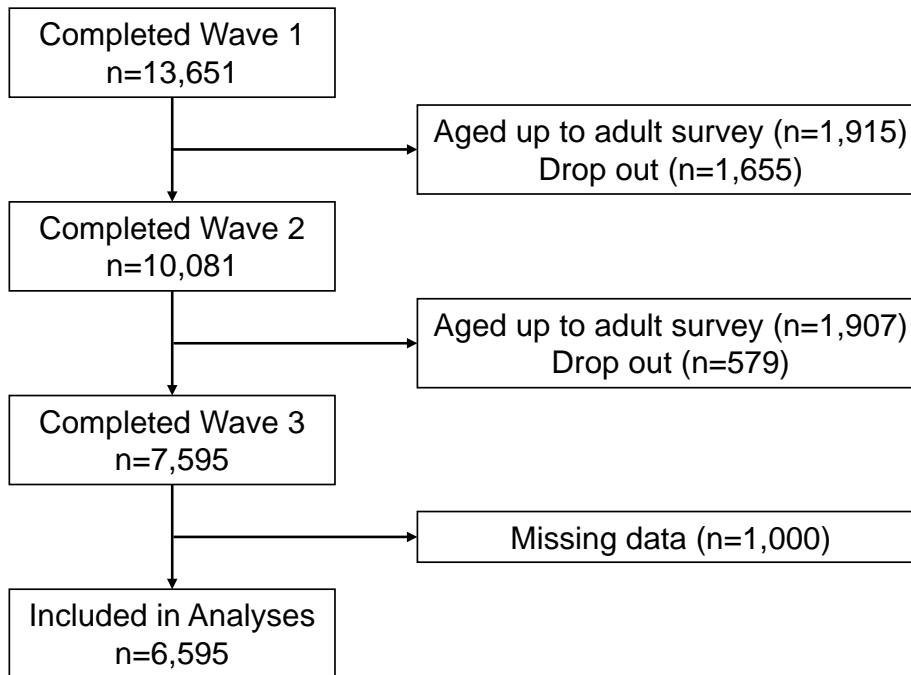
eTable 1. Items from the GAIN-SS scale used to assess internalizing and externalizing problems.

eTable 2. Unadjusted and adjusted relative risk ratios for each category of social media use in relation to internalizing and externalizing problems among U.S. youth in the PATH Study, 2013-2016, after multiple imputation with chained equations (n=7,234).

eMethods. Calculating population attributable fractions from adjusted models.

This supplementary material has been provided by the authors to give readers additional information about their work.

eFigure 1. Participant selection from the complete PATH sample into the analytic sample.



eTable 1. Items from the GAIN-SS scale used to assess internalizing and externalizing problems.

GAIN-SS Subscale	Items
Internalizing Problems ^a	1. Feeling very trapped, lonely, sad, blue, depressed, or hopeless about the future?
	2. Sleep trouble, such as bad dreams, sleeping restlessly, or falling asleep during the day?
	3. Feeling very anxious, nervous, tense, scared, panicked, or like something bad was going to happen?
	4. Becoming very distressed and upset when something reminded you of the past?
Externalizing Problems ^b	1. Lied or conned to get things you wanted or to avoid having to do something?
	2. Had a hard time paying attention at school, work, or home?
	3. Had a hard time listening to instructions at school, work, or home?
	4. Were a bully or threatened other people?
	5. Started physical fights with other people?
	6. Felt restless or the need to run around or climb on things?
	7. Gave answers before the other person finished asking the question?
<i>Notes:</i> ^a The prompt for the internalizing problems subscale was, “When was the last time that you had significant problems with...” ^b The prompt for externalizing problems subscale was, “When was the last time that you did the following things two or more times...”	

eTable 2. Unadjusted and adjusted relative risk ratios for each category of social media use in relation to internalizing and externalizing problems among U.S. youth in the PATH Study, 2013-2016, after multiple imputation with chained equations (n=7,234).

Variable	Internalizing problems only		Externalizing problems only		Comorbid problems	
	RRR (95% CI)	aRRR (95% CI)	RRR (95% CI)	aRRR (95% CI)	RRR (95% CI)	aRRR (95% CI)
Time spent on social media per day						
None	ref.	ref.	ref.	ref.	ref.	ref.
≤ 30 mins	1.25 (0.92,1.69)	1.19 (0.86,1.63)	1.34 (1.04,1.73)	1.22 (0.93,1.60)	1.37 (1.08,1.74)	1.24 (0.97,1.58)
> 30 mins, ≤ 3 hrs	1.82 (1.35,2.44)	1.31 (0.96,1.78)	1.61 (1.18,2.18)	1.36 (0.99,1.89)	2.25 (1.80,2.81)	1.51 (1.20,1.89)
> 3 hrs, ≤ 6 hrs	2.57 (1.85,3.57)	1.64 (1.17,2.31)	1.45 (1.06,1.97)	1.30 (0.94,1.78)	3.05 (2.39,3.89)	1.92 (1.47,2.50)
> 6 hrs	2.60 (1.77,3.81)	1.62 (1.06,2.46)	1.61 (1.07,2.43)	1.43 (0.91,2.24)	4.02 (3.06,5.27)	2.26 (1.66,3.08)
Sex						
Female	–	ref.	–	ref.	–	ref.
Male	–	0.38 (0.31,0.46)	–	1.21 (1.00,1.46)	–	0.51 (0.43,0.60)
Race						
White only	–	ref.	–	ref.	–	ref.
Black only	–	0.68 (0.53,0.87)	–	0.82 (0.65,1.05)	–	0.69 (0.54,0.89)
Other ^a	–	1.01 (0.74,1.36)	–	0.89 (0.72,1.11)	–	0.89 (0.73,1.08)
Parental education						
Less than high school	–	ref.	–	ref.	–	ref.
High school or equivalent	–	1.30 (1.00,1.70)	–	1.04 (0.80,1.35)	–	1.15 (0.88,1.50)
Some college or associates degree	–	1.14 (0.89,1.47)	–	1.32 (1.06,1.64)	–	1.35 (1.07,1.69)
Bachelor's degree	–	0.91 (0.67,1.22)	–	1.42 (1.08,1.87)	–	1.17 (0.89,1.54)
Advanced degree	–	0.85 (0.59,1.24)	–	1.74 (1.28,2.36)	–	1.19 (0.86,1.64)
Age						
12 to 14	–	ref.	–	ref.	–	ref.
15 to 17	–	0.98 (0.81,1.19)	–	0.91 (0.76,1.08)	–	0.83 (0.72,0.97)
BMI	–	1.00 (0.99,1.02)	–	0.99 (0.97,1.00)	–	1.00 (0.98,1.01)
Lifetime alcohol use						
No	–	ref.	–	ref.	–	ref.
Yes	–	1.08 (0.89,1.31)	–	1.00 (0.85, 1.18)	–	1.19 (1.03,1.37)
Lifetime marijuana use						
No	–	ref.	–	ref.	–	ref.
Yes	–	0.91 (0.65,1.27)	–	0.63 (0.45,0.88)	–	0.72 (0.54,0.96)
Lifetime internalizing problems	–	1.56 (1.44,1.69)	–	1.00 (0.93,1.07)	–	1.48 (1.37,1.59)
Lifetime externalizing problems	–	0.97 (0.91,1.03)	–	1.43 (1.35,1.51)	–	1.36 (1.28,1.44)

Notes: Adjusted relative risk ratios are adjusted for all covariates in Table 1. Reference category is no internalizing or externalizing problems. All variables were measured at Wave 1, except time spent on social media per day, which was measured at Wave 2. ^a The “other” race category includes participants identifying as American Indian or Alaska Native, Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, other Asian, Native Hawaiian, Guamanian or Chamorro, Samoan, and other Pacific Islander. aRRR = adjusted relative risk ratio; BMI = body mass index; CI = confidence interval; RRR = relative risk ratio.

eMethods. Calculating population attributable fractions from adjusted models.

The following algorithm was used to estimate the respective proportions of high internalizing and high externalizing symptoms in the U.S. adolescent population that would not have occurred in each of the four counterfactual reductions in social media proposed.

1. Using our adjusted multinomial logistic regression model, we estimated the predicted probability of experiencing each outcome – high internalizing problems only, high externalizing problems only, both problems, or neither – for each respondent in our dataset.
2. For each participant, we added the probability of high internalizing only to the probability of both internalizing and externalizing to estimate to the total predicted probability of that participant experiencing high internalizing symptoms. Similarly, we computed for each participant the predicted total probability of externalizing problems.
3. We multiplied these predicted probabilities by participants' respective survey weights, and summed over all participants. This produced an estimate of the expected total number of internalizing and externalizing cases in the real U.S. adolescent population.
4. We then built a new dataset where participants' social media use was reassigned to match the appropriate counterfactual scenario. For example, for scenario 1, participants who reported more than 6 hours of social media use per day were reassigned to a value of at least 3 but no greater than 6 hours per day of social media use.
5. We then re-estimated the predicted probabilities and case counts using the new, counterfactual dataset by repeating steps 1-3. This produced an estimate of the expected total number of internalizing and externalizing cases in a counterfactual U.S. adolescent population.
6. We took the difference between estimated case counts in the counterfactual and real populations. This estimated how many cases would be eliminated in the counterfactual scenario.
7. Finally, we then divided this difference by the estimated case count in the real population. This estimated the proportion of cases that would be eliminated in the counterfactual scenario.