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The impact of online social networking on adolescent psychological well-being (WB): a population-level analysis of Korean school-aged children

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ABSTRACT

This study examines the extent to which online media activities are associated with psychological well-being of adolescents. Data come from the Korean Youth Panel Survey (KYPS), a government-funded multiyear research project. Based on Wave 4 (2007) and Wave 5 (2008) of KYPS, the most recent data available, hierarchical linear models are estimated to probe the psychological effects of time spent online. While holding constant a host of time-lagged control variables at individual (student) and contextual (school) levels, the analysis shows that online social networking is adversely associated with the psychological status of Korean students, measured in terms of self-reported mental problems and suicidal thought. The bulk of previous research on the pros and cons of online social media use is based on cross-sectional data, thereby precluding causal inference. Using longitudinal data, the current research offers more conclusive evidence on the direction of causation.

Introduction

Despite a plethora of studies, specific consequences of media use and exposure to media contents remain empirically contested (Pantic, 2014; Strasburger, Jordan, & Donnerstein, 2010). In recent years, an increasing number of scholars have speculated on and researched the pros and cons of online social media, i.e. whether using social networking sites (SNS) and social networking technologies (SNT) has positive or negative outcomes. Even a cursory look at the existing literature suggests, however, that past efforts have raised more questions than provided concrete answers. A recent systematic review of the association between online communication and adolescent psychological well-being (WB) in fact points to 'a wealth of contradictory evidence suggesting both harmful and beneficial aspects' of Internet-based social media (Best, Manktelow, & Taylor, 2014).

According to a comprehensive survey ('Internet & American Life Project') conducted by the Pew Research Center (2010), 93% of all American teens (ages 12 through 17) go online regularly and 73% of them actively use SNS. They spend more time using online media than any other age group, and are the first cohort ever to be linked with Internet-based communication as an integral part of their upbringing (Best et al., 2014). The widespread online overdependence, or addiction, has prompted the American Psychiatric Association to include 'Internet use disorder' in the appendix of the fifth edition of the *Diagnostic Statistical Manual for Mental Disorders* (Kuss, Griffiths, & Binder, 2013). Terms like 'Facebook Depression' have also become a legitimate medical concern, especially for children and adolescents

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(O'Keefee, Clarke-Pearson, & Council on Communications & Media, 2011). Given the substantial and growing prevalence of wireless communication technologies and social media sites in the lives of young people today, understanding the mental health consequences of online social networking is of critical importance.

Negative aspects of media use and exposure to media contents

Media affect youth by shaping what they do and believe through adaptation and imitation. When it comes to video game violence specifically, the general aggression model suggests that sustained exposure produces short-term and long-term physiological arousal as well as aggressive thoughts and behaviours (Anderson & Bushman, 2002). In fact, studies have shown that violent contents and inter-active media (e.g. first-person shooter video games) can significantly encourage antisocial attitudes and aggressive tendencies among youths (Anderson et al., 2002; Bushman & Anderson, 2009; Lin, 2013; Savage, 2004), though this view has been challenged (see Ferguson & Olson, 2014). Media exposure is also found to be associated with such undesirable outcomes as negative self-perception (Roberts & Good, 2010; Tiggemann, 2006), eating disorder (Levine & Murnen, 2009) and substance abuse (Engels et al., 2009).

In more recent years, with the rapid advancement of media technology and electronic communication, cyberbullying has become a major problem as a new form of antisocial behaviour. Online communication is found to raise the likelihood of being a perpetrator of bullying (Sticca, Alsaker, & Perren, 2013). On the other hand, evidence also indicates that time spent online can increase the chances of being cyberbullied (Machmutow, Perren, Sticca, & Alsaker, 2012). According to one study, heavy Internet use increases the odds of being a repeated victim of online bullying (Juvonen & Gross, 2008). Prior research has further linked social media activities in particular and Internet use more broadly with a host of negative mental health issues such as poor psychological functioning and distress (Sampasa-Kanyinga & Lewis, 2015), low self-esteem (Fiovaranti, Dettore, & Casale, 2012), anxiety (Xiuqin et al., 2010), depression (van den Eijnden, Meerkerk, Vermulst, Spijkerman, & Engels, 2008), loneliness and even suicidal ideation (Mitchell, Danielle, Guidry, & Cukrowicz, 2015).

Potential benefits of media use

In contrast, other studies have challenged the evidence concerning the ill effects of, for example, computer game play on adolescent development (Durkin & Barber, 2002; Ferguson & Olson, 2014). Research indicates that certain kinds of media can actually produce positive or prosocial attitudes among youths and that online socializing, under specified conditions, can be beneficial for them (Bessier, Kiesler, Kraut, & Bonka, 2008). Far from creating developmental problems, video games may promote such positive attributes as cooperation and problem-solving skills (Adachi & Willoughby, 2012). According to a recent comprehensive review, playing active video games may even help increase health-promoting physical activities for the participants (Le Blanc et al., 2013).

The use and consequences of Internet-based social media, in particular, have been a topic of much contention, as they have been shown to be associated with both risks and benefits for young users. Benefits include enhanced capacity for (online) socializing, increased learning opportunities and greater access to health-promoting information, among others (O'Keefe et al., 2011). Several studies demonstrate that SNS and SNT may help raise self-esteem and increase sense of belong-ingness as well, which can indirectly have a positive impact on psychological WB (Best et al., 2014). Online media use may also widen users' social networks, strengthen their social relations and help them channel more social support. Socializing online can also lower feelings of loneliness among teens, thereby contributing to their subjective WB. In addition, social media websites can function to compensate for the participants' weak social skills, by enabling them to fulfil their desires for social interaction, friendship generation and identity exploration (Bonetti, Campbell, & Gilmore,

2010; Kowert, Domahidi, & Quandt, 2014). In short, it remains unclear whether and to what extent online media communication leads to positive or negative mental and psychological consequences for the most avid participants, i.e. adolescents.

Aim of this study

According to a report by the American Academy of Pediatrics, using social media websites is among the most common activity of today's children and adolescents. Despite this well-established fact, there has been a dearth of research focusing on the health effects of SNS (Ahn, 2011). For the most part, prior studies have also dealt with young adult populations, not children or adolescents (Sampasa-Kanyinga & Lewis, 2015). Moreover, due to inconsistent empirical evidence, 'much debate and polarization exist' (Best et al., 2014) in the interdisciplinary academic community regarding the mental health implications of online social media activities for youths. It is also the case that the vast majority of previous research rests on cross-sectional data, making it difficult, if not impossible, to draw causal inference (Pantic, 2014).

The purpose of this study is to contribute to extant scholarship by exploring the associations between Internet-based social media and psychological WB of adolescents based on a Korean probability sample. Unlike most previous attempts, the current research also analyses two waves of longitudinal data, allowing for better temporal ordering between the outcome measures (self-reported mental health and suicidality) and the main predictor (online social networking). Finally, this study takes a multilevel modelling approach to probe the research question at hand by conceptualizing and operationalizing covariates simultaneously at individual (student) and contextual (school) levels, which has rarely been the case in prior research.

The case of Korean adolescents

Korea is one of the most digitalized countries in the world and the first to pass the 100 percent penetration rate for wireless broadband among all OECD nations. Korea also has a relatively high prevalence of Internet addiction across multiple demographic categories. The phenomenon of 'excessive Internet use' (Young & Abreu, 2010) or 'Internet dependency' (Lavin, Marvin, McLarney, Nola, & Scott, 1999) has been a major concern particularly for Korea's youth because of its close association with psychiatric symptoms, such as depression and suicidal ideation (Ha et al., 2006; Jang, Hwang, & Choi, 2008; Kim et al., 2006) as well as interpersonal and behavioural problems (Seo, Kang, & Yom, 2009; Sung, Lee, Noh, Park, & Ahn, 2013). According to a government report, 99% of Korean teenagers used the Internet in 2011 (Korea Internet Security Agency, 2011), and about 12% of them are found to be addicted to it (National Information Society Agency, 2011). A recent study based on the Fifth Korean Youth Risk Behavior Web-based Survey, consisting of a large nationally representative sample, further indicates Internet addiction among youth as a serious public health problem in the country (Heo, Oh, Subramanian, Kim, & Kawachi, 2014).

The gravity of the situation is highlighted by the initiation of a government-sponsored programme called 'Jump Up Internet Rescue School,' a camp specifically designed to assist Internet-addicted youngsters (Koo, Wait, Lee, & Oh, 2011), in addition to hundreds of counselling centres (e.g. Youth Internet Addiction Prevention Program) designed to treat those who are at risk. With the ever-increasing popularity of social network services and online video games over the world, the problematic trend among Korean youth is only expected to continue, if not escalate, in the future. The Korean case thus presents itself as an important and relevant example for the examination of the mental health or psychological impact of Internet-based social media activities, with possible lessons and implications for other countries.

Methods

Sample

Data come from the Korean Youth Panel Survey (KYPS), a longitudinal study funded by the Korean Government and conducted by the National Youth Policy Institute, a state-run research centre (more details about the data are available at www.nypi.re.kr). Based on the prospective panel survey design, two cohorts were initially selected. Cohort 1 consists of 3449 eighth graders first surveyed in 2003; Cohort 2 consists of 2844 fourth graders sampled in 2004. This study uses the data based on the second (i.e. younger) cohort, which were released to the author with permission to use strictly for research purposes. Stratified multi-stage cluster sampling was carried out to select the survey respondents. The questionnaire has two parts: one for the students and another for one of the parents (guardians). The student survey was administered in class by an interviewer, while the parent survey was done through telephone interview. An independent ethics committee approved the survey protocol concerning human subject participation.

The KYPS based on the second cohort consists of five waves (2004–2008). The data for this study are specifically drawn from the latest two waves, Wave 4 (2007) and Wave 5 (2008) containing respondents who were between the ages of 12 and 15 years old in 2008. The survey items concerning the students' psychological WB, namely: mental health and suicidal ideation, are derived from Wave 5; all other (independent and control) variables, including two baseline measures of WB, are based on the earlier Wave 4 of data collection. Two thousand four hundred and forty-eight students and their parents completed both surveys in 2008, which equals the number of cases with valid weights sampled from randomly selected schools throughout Korea. After deleting cases with missing values, the final sample consists of 2099 students nested in 125 schools.

Measures

Outcome measures

Two dependent variables are *W5 Mental health* and *W5 Suicidal thought*. The former is based on the students' self-assessment of mental health coded on a five-point scale, with a higher value indicating better health. This variable is supplementary to the standard survey item that measures self-rated health and akin to the measure used in prior research on adolescent psychology and the use of SNS (see Sampasa-Kanyinga & Lewis, 2015). The answers were reverse-coded and then log transformed, given its skewed distribution to meet the requirements of inferential statistics. The other outcome variable taps the level of suicidality. In keeping with the extant literature on suicide research (Abrutyn & Mueller, 2014), the original responses are dichotomized. Reported models below estimate the odds of 'always' or 'frequently' having thought about inflicting deadly self-harm.

Main predictor

The key variable of interest that gauges the frequency of online communication or networking is *Social media*. The survey participants were asked about their levels of involvement in the following four Internet-based activities: 'chatting online or using online messenger service,' 'using e-mail,' 'participating in online community or club' and 'using an online bulletin board.' The responses were originally coded on a five-point Likert-type scale ranging from 'very frequently' (=5) to 'not at all' (=1), which were combined to create a single index (Cronbach's α = .69).

Control variables

To provide a conservative test of the association between computer-mediated social media activities and psychological WB, a number of confounders are adjusted for in the statistical analysis. A substantial literature suggests that contextual factors (e.g. social capital) play a significant role in shaping health outcomes (Goswami, Riedl, Kobler, & Kremar, 2013; Kumar, Calvo, Avendano, Sivaramakrishnan,

& Berkman, 2012; Moore et al., 2011; Sujarwoto & Tampubolon, 2013). In recognition of the fact that adolescent health is 'strongly affected by factors at personal, family, community, and national levels,' (Viner et al., 2012), this study takes into account two social capital variables conceptualized at family and community levels. *Relationship* measures the level of family integration or intimacy between students and their parents. *N_efficacy* gauges the degrees of residential safety, informal social control and neighbourhood trust as subjectively perceived by students. Regarding the latter variable, the concept of collective efficacy (Browning & Cagney, 2002), or community-level social capital, has frequently been used to predict mental and physical health. It captures a broader environmental or ecological dimension, which has been positively linked with a myriad of health-related behaviours and outcomes (Giordano, Merlo, Ohlsson, Rosvall, & Lindstrom, 2013; Hooghe & Vanhoutte, 2011; Maimon & Browning, 2012; Mohnen, Groenewegen, Volker, & Flap, 2011; Tomita & Burns, 2013).

Socio-demographic and other background variables are also included: gender, age and logged household income. Also considered are daily hours of computer use and night-time sleep. In addition, four critical risk factors are operationalized. KYPS inquired about delinquent peer network, measured as the (logged) total count of close friends who engage in various delinquent activities. Two dummy variables control for the experience of having been a victim of physical and online (cyber) bullying. Academic stress is also adjusted for, which assesses the degree of school work-related pressures. In running multilevel analysis, three additional variables are also calculated at the contextual level by aggregating individual responses across schools: specifically, the proportion of students who felt academically stressed, number of delinquent friends and mean household income.

Lastly, deciphering the direction of causality between the two outcome variables and online social networking poses a significant obstacle when dealing with cross-sectional data. Using two waves from a longitudinal data-set, this study seeks to minimize, though not resolve, the problem of reverse causation. To that end, baseline measures of mental health and suicidality from the previous year are incorporated into statistical modelling. Inclusion of these time-lagged variables serve to offer more conclusive evidence on the potential causal link between using online SNS at time $t - 1$ and the psychological WB of adolescents at time t. Detailed variable descriptions and coding schemes are provided in Tables 1 and 2.

Table 1. Descriptive statistics for the variables used.

Variable names	Mean/proportion	SD	Min.	Max.
Level-1 ($N = 2099$)				
W5 Mental health (ln)	1.47	.23	0	1.61
W4 M_health	2.31	1.02	1	5
W5 Suicidal thought	8%	–	0	1
W4 Suicide	1.88	.27	1	5
Social media	2.28	.88	1	5
Computer	2.50	1.09	1.00	5
Sleep	7.68	1.27	1	15
D_Peers	.83	1.11	0	5.22
Female	47%	–	0	1
H_income	5.71	.62	0	8.61
Cohort 95	15%	–	0	1
N_efficacy	19.51	5.05	6	30
Relationship	14.20	3.19	4	20
A_stress	2.96	1.01	1	5
Phys_bullied	2%	–	0	1
Cyber_bullied	15%	–	0	1
Level-2 ($N = 125$)				
Stress	2.93	.57	1	5
Delinquency	.77	.54	0	3.18
Income	5.71	.32	4.62	6.73

Data source: Korean Youth Panel Survey (2007, 2008).
Note: The figures presented are survey-adjusted and weighted to account for the probability of selection.

Table 2. Definitions and coding schemes for variable construction.

Variable name	Definition
Dependent variable	
W5 Mental health (ln)	Self-rated mental health based on the statement 'I have psychological or mental problems' original responses reverse-coded (e.g. 5 = 'very untrue,' 3 = 'neither true nor untrue' or 1 = 'very true') and then log transformed due to right-tail skewed distribution
W5 Suicidal thought	'Sometimes I feel suicidal for no apparent reason' (e.g. 5 = 'always,' 4 = 'frequently,' 3 = 'sometimes,' 2 = 'seldom' or 1 = 'never') measured from Wave 5. Recoded so that 'always' and 'frequently' = 1; 0 otherwise
Independent variables (Level 1)	
Social media	'How often do you (a) chat online or use online messenger services; (b) use email; (c) participate in an online community or club; (d) or use an online bulletin board? Answers coded on a five-point scale (e.g. 5 = very often or 1 = hardly at all)
W4 Suicide	'Sometimes I feel suicidal for no apparent reason' (e.g. 5 = 'always,' 3 = 'sometimes' or 1 = 'never') measured from Wave 4
W4 M_health	An index variable based on answers to the following three survey items: 'I sometimes feel extremely anxious with no apparent reason'; 'I sometimes feel extremely lonely with no apparent reason'; and 'I sometimes feel extremely sad and gloomy with no apparent reason' (Cronbach's α = .89). Responses are added and averaged, ranging in value from 1 ('strongly disagree') to 5 ('strongly agree')
Computer	'How often do you use the computer on a daily basis?' Recoded on a five-point scale (1 = 0 h, 2 = 1 h, 3 = 2 h, 4 = 3 h or 5 = between 4 and 10 h)
Female	Yes = 1
Sleep	'On average, how many hours a day do you sleep?'
D_Peers	Logged total number of friends who were involved in the following delinquent acts: collectively bullying others, severely teasing or bantering others, threatening other friends; beating other people; and/or watching obscene materials/adult contents, smoking, drinking, robbing, stealing and running away from home (α = .84)
Cohort 95	If born in the year 1995, then coded as 1; 0 otherwise
Relationship	'My parents and I spend much time together'; 'My parents always treat me with love and affection'; 'My parents and I understand each other well'; and/or 'My parents and I candidly talk about everything.' Each item coded on a five-point scale, where e.g. 5 = 'very true,' 3 = 'neither true nor untrue' or 1 = 'very untrue.' Combined scores for the composite variable vary between 4 and 20 (α = .84)
N_efficacy	'My neighbors have close relationships with each other'; 'My neighbors trust each other'; 'Elderly neighbors will scold me if I smoke or drink in the neighborhood'; 'My neighbors will intervene or report to the police if I am assaulted by other kids in the neighborhood'; 'I will let elderly neighbors (teachers) know if my friends smoke or drink in the neighborhood'; and/or 'I will intervene or report to the police (teachers) if my friends are assaulted in the neighborhood.' Answers to each question coded on a five-point scale (e.g. 5 = strongly agree or 1 = strongly disagree). Added values range between 6 and 30 (α = .83)
H_income	(Ln) monthly household income
A_stress	'I get stressed by poor school grades.' Answers coded on a five-point scale (e.g. 1 = never, 3 = sometimes or 5 = always)
Phys_bullied	'In the past year, have you ever been collectively bullied?' (Yes = 1; 0 otherwise)
Cyber_bullied	Whether the respondent felt s/he was bullied online during the past year (Yes = 1)
(Level 2)	
Stress	Proportion of students who felt stressed due to academic grades (individual responses averaged across schools)
Delinquency	Logged number of delinquent friends averaged across schools
Income	Average household income across schools

Data source: Korean Youth Panel Survey (2007, 2008).

Analytic strategy

KYPS contains data consisting of individual respondents (students) nested in a higher level units (schools), which poses a statistical problem when running OLS regression because of the violation of the independence assumption. Multilevel or hierarchical linear models are thus estimated to adjust for the correlated error that exists with the clustered sampling. Two-level random intercept models are fitted to estimate the relationship between online networking and psychological WB, as measured by self-reported mental health and suicidality. For the former outcome variable, the model is expressed as:

$$Y_{ij} = \beta_{0j} + \sum_{q=1}^{Q} \beta_{qj} X_{qij} + r_{ij},$$

where Y_{ij} is the predicted value of mental health; β_{0j} is the intercept; β_{qj} ($q = 0, 1, \ldots, Q$) are level-1 coefficients; and X_{qij} is the value of covariate q associated with student i in school j. The error term r_{ij} is the level-1 random effect, which is assumed to be independently and normally distributed with constant variance σ^2. The slope for the main predictor variable (*Social media*) is allowed to vary across schools, while those for other covariates are fixed.

$$\beta_{qj} = \gamma_{q0} + \sum_{s=1}^{S_q} \gamma_{qs} W_{sj} + u_{qj},$$

where γ_{qs} ($q = 0, 1, \ldots, S_q$) are level-2 coefficients; W_{sj} is a level-2 predictor; and u_{qj} is a level-2 random effect.

For the suicidality variable, since it is dichotomous, Hierarchical Generalized Linear Models (with a Bernoulli logit function) are estimated. The model specification is as follows:

$$\log\left(\frac{\Phi_{ij}}{1 - \Phi_{ij}}\right) = \beta_{0j} + \sum_{q=1}^{Q} \beta_{qj} X_{qij}$$

where β_{0j} is the intercept, X_{qij} is the value of covariate q associated with student i in school j and β_q is the partial fixed effect of that covariate on the log odds of suicidality. The level-2 model is denoted as:

$$\beta_{0j} = \gamma_{00} + \sum_{S=1}^{S} \gamma_S W_{Sj} + u_{0j} \quad u_{0j} \sim N\left(0, \tau_{00}\right),$$

where γ_{00} is the intercept and γ_S are the level-2 coefficients for the effects of s covariates W on the log odds of suicidal ideation (u_{0j} is the school-level error term, with a normal distribution and variance of τ_{00}). Both analyses use recommended weights to account for the unequal probability of selection of student subjects across school clusters. All non-dichotomous level-1 variables are group-mean centred, and all level-2 covariates are grand-mean centred. Statistical modelling is performed using HLM 7 (Raudenbush, Bryk, Congdon, & du Toit, 2011).

Results

Table 3 (*W5 Mental health*) and Table 4 (*W5 Suicidal thought*) provide two sets of results from running multilevel models. First, according to Table 3, Model 1 consists of only the time-lagged control variables taken from the earlier wave, several of which are found to be significant. Spending more time on the computer is negatively related to mental health in the following year. Being physically bullied, but not cyberbullied, is another significant risk factor. Also critical is academic stress: those who are more worried because of achievement-related pressures report themselves as being more problematic mentally. On the other hand, sleeping adds to WB. Two social capital variables measuring family integration and neighbourhood collective efficacy are also significant. Students who have a better relationship with their parents are psychologically better off. And those who have more positive attitudes and beliefs concerning their respective residential community are also healthier.

Model 2 introduces the main predictor (*Social media*). Inclusion of this variable does not alter the strengths or magnitudes of the relationships between the outcome measure and the control variables, except for computer use which falls below the conventional level of significance. While holding constant multiple socio-demographic, social capital and other control variables, online social networking is adversely related to the self-reported WB of Korean students. Since the variable *Social media* was allowed to vary randomly, the magnitude of this association is not constant but fluctuates across school settings.

Table 3. Associations between online social networking and self-reported mental health.

Student level (N = 2,099)	School level (N = 125)	Model 1		Model 2		Model 3		Model 4	
		β	(SE)	β	(SE)	β	(SE)	β	(SE)
Intercept β_0 (Level-1)	γ_{00}	1.479	(.008)***	1.474	(.008)***	1.469	(.008)***	1.47	(.008)***
Computer, β_1	γ_{10}	−.012	(.005)*	−.008	(.006)#	−.009	(.005)#	−.009	(.005)#
Sleep, β_2	γ_{20}	.009	(.004)*	.009	(.004)*	.009	(.004)*	.009	(.004)*
Female, β_3	γ_{30}	−.013	(.01)#	−.011	(.01)	.000	(.01)	.001	(.01)
Cohort 95, β_4	γ_{40}	.025	(.015)#	.027	(.014)#	.026	(.014)#	.026	(.014)#
H_income, β_5	γ_{50}	.010	(.009)	.009	(.009)	.008	(.009)	.008	(.009)
Relationship, β_6	γ_{60}	.006	(.002)**	.007	(.002)**	.005	(.002)**	.005	(.002)**
N_efficacy, β_7	γ_{70}	.003	(.001)*	.003	(.001)**	.002	(.001)*	.002	(.001)#
Phys_bullied, β_8	γ_{80}	−.158	(.061)**	−.155	(.061)*	−.144	(.058)*	−.137	(.059)*
Cyber_bullied, β_9	γ_{90}	−.018	(.014)	−.012	(.014)	−.011	(.014)	−.010	(.014)
D_Peers, β_{10}	γ_{100}	−.007	(.005)	−.005	(.005)	−.002	(.005)	−.001	(.005)
A_stress, β_{11}	γ_{110}	−.025	(.005)***	−.022	(.005)***	−.012	(.005)**	−.012	(.005)**
W4 M_health, β_{12}	γ_{120}					−.045	(.005)***	−.045	(.005)***
Social media, β_{13}	γ_{130}			−.019	(.007)**	−.015	(.006)*	−.016	(.006)*
(Level-2)									
Stress, γ_{01}								−.045	(.018)*
Delinquency, γ_{02}								−.000	(.017)
Income, γ_{03}								.010	(.221)
Within-school variance (σ^2)		.048		.047		.046		.046	
Between-school variance (τ_{00})		.001*		.001***		.001***		.001***	
Deviance (-2 LL)		−379.69		−389.66		−469.41		−474.60	

Source: Korean Youth Panel Survey (2007, 2008).
Notes: Parameter estimates are weighted using the KYPS W4 person-weights (adjusted for attrition and selection at W5). Reported estimates are from the unit-specific models with robust standard errors. The slope for *Social media* is allowed to vary randomly across schools; the effects of all other covariates are fixed.
#*p* < .1 (two-tailed test).
**p* < .05 (two-tailed test).
***p* < .01 (two-tailed test).
****p* < .001 (two-tailed test).

In drawing causal inference, it is possible that the respondents who are psychologically unhealthier are more likely to engage in online media activities, not vice versa. To address this problem of endogeneity, a composite measure that gauges mental health status from the previous year (*W4 M_health*) is added into the regression equation.

As indicated by Model 3, even after controlling for this baseline measure, the association between online activities and mental health remains robust, though the effect size and level of significance are slightly diminished. In the final model (Model 4), school-level characteristics are introduced, among which only the academic stress variable is significant. Net of all the individual-level measures, attending a school with a higher proportion of schoolmates who feel academically stressed is related to lower psychological WB at the student level. In models not shown, cross-level interactions were examined between online social networking and the three school-level predictors. The results, however, were not significant.

Table 4 reports findings from estimating the associations between online networking and suicidal ideation, adjusting for the same background variables at student and school levels as above. In terms of student-level controls, several differences are shown. The first and foremost is the gender effect: girls are much more likely than boys to think about suicide. As was the case with self-rated mental health, being physically bullied is a significant risk factor. A related new finding is that the experience of having been cyberbullied also increases the odds of suicidality. Academic stress continues to have a negative

Table 4. Associations between online social networking and adolescent suicidality (KYPS, 2007, 2008).

Student level (N = 2,099)	School level (N = 125)	Model 1 OR	(95%CI)	Model 2 OR	(95%CI)	Model 3 OR	(95%CI)	Model 4 OR	(95%CI)
Intercept β_0 (Level-1)	γ_{00}	.04	(.03–.06)***	.04	(.03–.06)***	.04	(.03–.05)***	.04	(.03–.05)***
Computer, β_1	γ_{10}	1.02	(.85–1.22)	.97	(.81–1.15)	.94	(.79–1.12)	.94	(.79–1.11)
Sleep, β_2	γ_{20}	1.02	(.89–1.16)	1.02	(.90–1.16)	1.04	(.91–1.19)	1.04	(.92–1.19)
Female, β_3	γ_{30}	2.58	(1.78–3.74)***	2.28	(1.57–3.32)***	2.02	(1.38–2.96)***	1.96	(1.35–2.83)***
Cohort 95, β_4	γ_{40}	.77	(.48–1.26)	.77	(.48–1.24)	.72	(.42–1.22)	.71	(.42–1.19)
H_income, β_5	γ_{50}	.98	(.78–1.23)	.99	(.79–1.24)	1.01	(.80–1.28)	1.00	(.79–1.27)
Relationship, β_6	γ_{60}	.88	(.83–.94)***	.88	(.83–.94)***	.91	(.85–.97)**	.91	(.85–.97)**
N_efficacy, β_7	γ_{70}	1.00	(.96–1.04)	.99	(.96–1.03)	.99	(.96–1.03)	.99	(.96–1.03)
Phys_bullied, β_8	γ_{80}	3.38	(1.41–8.09)**	3.41	(1.36–8.55)**	3.03	(1.25–7.39)*	2.67	(1.09–6.54)*
Cyber_bullied, β_9	γ_{90}	1.92	(1.34–2.72)**	1.86	(1.31–2.64)**	1.79	(1.23–2.61)**	1.77	(1.22–2.59)*
D_Peers, β_{10}	γ_{100}	1.09	(.92–1.29)	1.08	(.92–1.27)	1.01	(.85–1.19)	1.00	(.85–1.19)
A_stress, β_{11}	γ_{110}	1.41	(1.20–1.66)***	1.37	(1.16–1.62)***	1.21	(1.02–1.43)*	1.22	(1.02–1.45)*
W4 Suicide, β_{12}	γ_{120}					1.76	(1.50–2.07)***	1.76	(1.51–2.06)***
Social media, β_{13}	γ_{130}			1.38	(1.13–1.69)**	1.35	(1.10–1.66)**	1.36	(1.10–1.67)**
(Level-2)									
Stress, γ_{01}								2.26	(1.12–4.54)*
Delinquency, γ_{02}								.83	(.49–1.55)
Income, γ_{03}								.72	(.34–1.55)
Between-school variance (τ_{00})		.10*		.09		.13		.12	
ICC (%)		3.1		2.9		3.9		3.6	

Note: Parameter estimates are from unit-specific models and weighted using the KYPS W4 person-weights (adjusted for attrition and selection at W5).
*$p < .05$ (two-tailed test).
**$p < .01$ (two-tailed test).
***$p < .001$ (two-tailed test).

effect, while quality parental relations provide protection against suicidal ideation. Model 2 introduces the main predictor (*Social media*), which is, once again, shown to be statistically significant. Including a baseline measure of suicidality from the previous year (*W4 Suicide*) does not diminish its impact, as indicated by Model 3. Moving onto the last and full model, aggregate (school level) academic stress is positively related to suicidality, over and above individual-level characteristics. And, consistent with earlier findings from Table 3, time spent online has a deleterious effect on adolescent psychological WB: for every one-unit increase in online social networking, the odds of suicidality rise by more than a third.

Discussion

The central finding of this study is that, net of control variables at two different levels of analysis, there is a strong and negative relationship between online activities (chatting, e-mailing, participating in communities or clubs and using bulletin boards) and self-reported mental health and suicidal idea-tion among a nationally representative sample of Korean students. Several protective and risk factors have emerged. Consistent with the social capital argument (e.g. Kim & Kawachi, 2006; Sujarwoto & Tampubolon, 2013), relational intimacy with parents and the quality of residential neighbourhood (i.e. collective efficacy) are found to be positively related to psychological WB. This finding supports the theoretical notion that health outcomes are partly shaped by social or network variables (see Umberson, Crosnoe, & Reczek, 2010).

A substantial amount of research has been conducted on physical and online bullying. Cyberbullying, in particular, has received much scholarly attention, which has been liked with a host of negative

outcomes such as depression, emotional distress, substance abuse, externalized hostility and even suicidal tendencies, often for victims as well as perpetrators (Espelage & Holt, 2013; Litwiller & Brausch, 2013; van Geel, Vedder, & Tanilon, 2014). The current study demonstrates that cyberbullying is indeed a powerful predictor of adolescent suicidality. Academic stress is shown to be a robust factor as well, at both student and school levels. On the one hand, being academically stressed is associated with lower WB. On the other hand, being surrounded by academically burdened schoolmates, independently of one's own stress level, negatively influences a student's WB. Prior research, for the most part, has not fully taken advantage of multilevel analysis. This study illustrates that adolescent psychological health must be understood as a function of both individual and contextual characteristics.

The empirical results reported herein should be considered in the light of some limitations. First, the outcome measures were based on single survey items. Using an index or a composite variable consisting of multiple responses would provide more accurate and nuanced insights. Second, the main independent variable of interest, online social networking, was confined to four types of social media activities, as available in the KYPS. The boundary can be extended to include other forms of Internet-based activities such as playing online games. In recent years, a number of popular SNS have emerged (e.g. Facebook, MySpace and Twitter) and questions specifically related to them should be addressed in future studies. The main predictor was also measured using a five-point scale. Rather than the general frequency of social media use, it might be more informative to have access to the exact number of hours spent online.

Third, school-level variables were created by aggregating individual-level responses. Though this is a conventional practice in the literature, a better research design would consist of a separate questionnaire for the school administrators in obtaining objective data on school characteristics. Despite these shortcomings, a major contribution of this study is that it examined the temporal, i.e. causal, association between psychological WB and online media use in a multilevel analytical framework, a topic that has eluded many studies in social epidemiology due to the cross-sectional nature of the data on which they are based (Giordano, Bjork, & Lindstrom, 2012).

Conclusion

Increasingly, Internet use poses a mental health threat to youth because prolonged exposure and dependence can make them susceptible to cyberbullying and other forms of online harassment, which can further produce detrimental outcomes such as depression, anxiety, loneliness and substance abuse (Gamez-Guadix, Orue, Smith, & Calvete, 2013; O'Keefee et al., 2011). Given their limited capacity for self-regulation, susceptibility to peer pressure and lack of privacy, the risks involved are of special concern (O'Keefee et al., 2011). A dramatic rise in the spread of advanced information and communication technology has in fact created a new psychological disorder among young people all over the world. Despite the lack of scholarly agreement on its definition and measurement, the problem of IAD ('Internet addiction disorder') is globally recognized today (Young & Abreu, 2010). Being connected to the Internet provides digital technology users with 'multiple layers of reward,' which explains their self-perpetuating behaviours (Cash, Rae, Steel, & Winkler, 2012). Whatever the sources of motivation, as this study suggests, overdependence on online media activities can impose significant mental and psychological costs.

Despite the growing volume of investigations on the subject matter, the exact nature of the linkage between online networking and physical and mental health of adolescents remains unclear, at best (Best et al., 2014). In fact, the 'relationship between SNS use and mental problems to this day remains controversial' (Pantic, 2014). In the light of this fact, the current research contributes to the literature by shedding additional light on the relationship between online social media use and psychological WB in the context of Korean adolescents. A recent systematic review reveals that only 12% of the articles covered were based on longitudinal data (Best et al., 2014). Using secondary analysis of a population-level panel survey, this study sought to minimize, to some extent, the problem of endogeneity

by establishing clearer causal ordering through the use of time-lagged covariates, including baseline measures for the two outcome variables from an earlier wave of data collection.

Implications for future research

Concerning the direction of future research, scholars have paid increasing attention to 'adolescence and social determinants of health' (Viner et al., 2012). The point is that adolescent health and health-related behaviours are partly a function of factors that lie over and above individual attributes and characteristics, including those related to family, school, community and even nation. This study highlighted part of this argument by incorporating into data analysis school- and community-related variables. More efforts are needed to better understand how, for instance, such contextual characteristics influence the consequences, as well as causes, of Internet use and online networking.

One possible hypothesis would be to test whether the association between social media use and mental health is mediated and/or moderated by, say, measures of school atmosphere or neighbourhood attachment. Several systematic reviews on adolescent Internet use and health stress that one of the top priorities is to move from correlational to causal analysis (Ahn, 2011; Best et al., 2014; Pantic, 2014; Strasburger et al., 2010), which means going beyond cross-sectional to longitudinal data collection. That there is 'a lack of evidence exacting the specific direction of the relationship between SMT [social media technology] and wellbeing' (Best et al., 2014) primarily has to do with data limitations. The importance of health effects of online media on children and adolescents cannot be overstated. Despite the challenges involved, more studies with higher quality information and measurements are clearly warranted.

Disclosure statement

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Notes on contributor

Harris Hyun-soo Kim is an associate professor of Sociology at Ewha Womans University in Korea. His main research interests are social network analysis, civic enagement, sociology of health, and ethnic economies. He is currently the Principal Investigator of a three-year project funded by the Korean government designed to investigate the social determinants of adolescent health in Laos. The current study was funded by the Korean Ministry of Education and the SSK grant from the National Research Foundation of Korea (NRF-2015S1A3A2046566).

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