



# Time spent on social media and alcohol use among adolescents: A longitudinal study

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## ABSTRACT

**Background and aims:** Research into the association between use of social media (SoMe) and alcohol use among adolescents is still in its infancy. The aim of the current longitudinal study was to examine if time spent on SoMe was prospectively associated with alcohol use among adolescents, and whether these associations differed for boys and girls.

**Design:** Prospective cohort study among Norwegian adolescents who completed e-questionnaires in the autumn of 2017 (t1), 2018 (t2), 2019 (t3) and 2020 (t4).

**Setting:** Norway.

**Participants:** A nation-wide sample of  $N = 3096$  adolescents (mean age at t1: 14.3 years (SD = 0.85), 43% boys).

**Measurements:** Self-report data were collected on adolescents' alcohol use, time spent on SoMe, parental monitoring, sensation-seeking, and positive and negative urgency, gender, and age.

**Findings:** Latent growth modelling adjusted for time invariant covariates (i.e., parental monitoring, sensation-seeking, and positive and negative urgency at t1) showed a positive association between time spent on SoMe and alcohol use at the start of the study; standardized  $b$  ( $\beta$ ) = 0.17 (95% CI: 0.09, 0.26). Time spent on SoMe at t1 was a strong positive predictor of increase in alcohol use  $\beta = 0.31$  (95% CI: 0.23, 0.40). There was also an association between degree of increase in alcohol use and increase in time on SoMe,  $\beta = 0.14$  (95% CI: 0.05, 0.24). Subsequent multigroup analysis found little evidence for gender differences ( $p > 0.05$ ).

**Conclusion:** The more time Norwegian adolescents aged 13–15 years spent on SoMe, the greater is their subsequent increase in alcohol use over time.

## 1. Introduction

Alcohol use, especially the consumption of large quantities on the same occasion, is a leading risk factor for reduced health among young people (Global Burden of Disease Pediatrics Collaboration, 2016), and is associated with increased risk of adverse outcomes in adulthood, such as poor mental health, substance use disorders, and decreased labor-market prospects (Hill, White, Chung, Hawkins, & Catalano, 2000). To reduce the negative impact of adolescent alcohol use, the crucial initial step is to identify modifiable risk factors for these behaviors. Social media (SoMe) have become an integral part of the lives of young people (Anderson & Jiang, 2018; Moreno, D'Angelo, & Whitehill, 2016). In Norway, 99% of teenagers use SoMe, such as Snapchat, Instagram and

Facebook; 80% use SoMe every day (Norwegian Media Authority, 2018), and they spend on average 2.6 h per day on active use (Brunborg, Burdzovic Andreas, & Kvaavik, 2017). There is growing concern that SoMe can have negative effects on young people's development (Moreno, Standiford, & Cody, 2018; Shafi, Romanowicz, & Croarkin, 2018), and one particular area of concern has been a potential link between use of SoMe platforms and alcohol use over time (Moreno & Whitehill, 2014; Savolainen et al., 2019; Winpenny, Marteau, & Nolte, 2014).

Social learning theory can provide a theoretical framework for studying the link between use of SoMe and the development of alcohol use in adolescence. According to Social Learning Theory, learning new behaviours typically occurs through observation and imitation, by observing the consequences experienced by others, or by description

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and instruction (Akers, Krohn, Lanza-Kaduce, & Radosevich, 1995; Bandura, 1977). Learning about alcohol use can therefore occur through direct observation of alcohol use and its consequences, or by hearing or reading stories about alcohol use. With the introduction of SoMe, young people now have additional arenas for social learning. Research suggests that young people are particularly likely to share alcohol content such as positive depictions and stories on SoMe, thereby exposing other adolescents to content that potentially promotes alcohol use (Boers, Afzali, & Conrod, 2020; Erevik, Pallesen, Andreassen, Vedaa, & Torsheim, 2018; Russell et al., 2021). Praise in the form of comments and “likes” to alcohol posts on SoMe can also be observed, and this can facilitate alcohol initiation and increase over time because the viewer learns that the consequences of drinking can be positive. A recent study found that more frequent SoMe logins were associated with more frequent exposure to alcohol on social media (Erevik et al., 2018). It may therefore be assumed that the more time an adolescent spends on SoMe, the greater is the risk that he or she will come across content that displays and reinforces alcohol use. This may in turn increase the risk of alcohol initiation and increased drinking over time.

Cross-sectional studies from several different countries have reported a positive association between the amount of time spent on SoMe and alcohol use by young people (Brunborg et al., 2017; Gutierrez & Cooper, 2016; Sampasa-Kanyinga & Chaput, 2016; Savolainen et al., 2019). This relation has also been investigated in prospective studies, though the results are mixed. One study reported no association between frequency of visiting Facebook and drinking six months later in a sample of US adolescents (Huang et al., 2014). A study of Australian adolescents (Smout et al., 2021) reported that time spent on SoMe at baseline did not predict development in drinking frequency from 13 to 16 years of age. However, a Norwegian study found that increase in time spent on SoMe was positively associated with an increase in episodic heavy drinking (Brunborg & Burdzovic Andreas, 2019). Similarly, a longitudinal study (Ng, Cable, & Kelly, 2021) of 10–15 year old adolescents from the UK reported that those who increased their time spent on SoMe use also increased their drinking frequency and binge drinking frequency over the three year follow-up period. Finally, a recent study of Canadian adolescents (Boers et al., 2020) found that more time on SoMe on average from grade 7 until grade 11, was associated with greater increase in alcohol use during the same time period.

The discrepancy in findings is possibly due to differences in measurement of SoMe use and alcohol use; in the number of follow-up assessments; in participants' age range; in analytical approach, and differences in the consideration of potential confounding factors. Hence, more research is needed that investigates the prospective relation between time on SoMe and alcohol use. According to the Differential Susceptibility of Media Effects Model (DSMM) (Valkenburg & Peter, 2013), the effect of media is dependent on personal characteristics (e.g., gender and personality). Investigating whether the effect of SoMe on alcohol use differs for subgroups of adolescents is therefore important. Recent reviews have pointed out the potentially important role of gender and the need for a strengthened focus on gender in SoMe research (Orben, 2020; Schönning, Hjetland, Aarø, & Skogen, 2020). Girls typically spend more time on SoMe than boys, and there are gender differences in the type of activity and SoMe platforms used (Pujazon-Zazik & Park, 2010; Twenge & Martin, 2020), thus there is reason to believe that there are gender differences in the effect of SoMe on alcohol use. However, no previous longitudinal study has examined gender differences in the potential link between SoMe use and alcohol use. Different online activities might have different consequences for adolescent alcohol use (Svensson & Johnson, 2020). However, there is evidence that overall time on SoMe is correlated with time on specific SoMe activities (Thorisdottir, Sigurvinsdottir, Asgeirsdottir, Allegrante, & Sigfusdottir, 2019), so that overall time can serve as a proxy for time spent on more specific activities.

Against this backdrop, the aim of the current study was to examine if time spent on SoMe is longitudinally associated with alcohol use among

adolescents. We estimated the latent growth of alcohol use and social media use over four years in a large sample of Norwegian adolescents who were between 13 and 15 years old at baseline. The primary objective was to estimate the relation between time spent on SoMe at the start of the study and degree of increase in alcohol use over the following three years. The cross-sectional association at the start of the study, and the association between degree of change over time in both constructs were also assessed. We also examined if the strength of the associations were attenuated by including time invariant covariates: parental monitoring, sensation-seeking, and positive and negative urgency. Finally, we examined potential gender differences concerning these associations using multigroup latent growth models.

## 2. Method

### 2.1. Design

This research is based on the nation-wide, population-based MyLife study, where adolescents have been annually followed up by means of e-surveys for four years.

### 2.2. Data source and sampling

MyLife recruited a nationwide, and geographically and socio-economically heterogeneous, sample of Norwegian adolescents that so far has completed e-questionnaires in the autumn of 2017 (t1), 2018 (t2), 2019 (t3) and 2020 (t4). The study design, ethical approval, recruitment and consent procedures are described in detail in the MyLife cohort profile (Brunborg et al., 2019). The sampling strategy involved selecting low, middle, and high standard of living municipalities/city districts from Norway's five geographical regions, 42 in total, and drawing one middle school from each municipality/city district. Among the 42 schools invited to participate in the study, 33 responded positively. Parental consent was obtained from 3512 students. Every individual in this core sample was invited to take part at each e-questionnaire assessment. Response rates were 85% in 2017 (t1), 81% in 2018 (t2), 75% in 2019 (t3), and 66% in 2020 (t4). In total, 3425 (98%) participated at least once, whereof 48% participated at all four time-points. The analytical sample for the current study comprised 3096 adolescents (mean age at t1 = 14.3 (SD = 0.85), 43.2% boys) who had non-missing responses for at least two out of four alcohol use assessments. The MyLife project was approved by the Norwegian Data Protection Authority (reference no.: 15/01495) after ethical evaluation by The National Committee for Research Ethics in the Social Sciences and the Humanities (reference no.: 2016/137). An updated list of publications from the MyLife study is available on the project page on ResearchGate (The MyLife project group, 2022).

### 2.3. Measures

*Alcohol use* at all four assessments was measured using a slightly adjusted version of the AUDIT-C, the first three items of the Alcohol Use Disorders Identification Test (Saunders, Aasland, Babor, De La Fuente, & Grant, 1993). Participants were asked to indicate how often they had consumed alcohol in the past 12 months, how many units of alcohol they typically consumed per drinking occasion, and how many times they had consumed five or more units of alcohol in a single day. The response options were coded to fit with the scoring of AUDIT-C, and sum scores ranged from 0 to 12.

*Time spent on social media* at all four assessments was measured by two items. The first item asked about past 30-day frequency of active use of SoMe with the examples Facebook, Snapchat and Instagram. There were six response options that ranged from “Not at all” to “5–7 days per week”. Respondents were also asked to indicate how many hours per day they usually spent on SoMe, with the specification “active use, not just logged on”. There were seven response options that ranged from “less

than one hour» to «10 h of more». The product of frequency (days per month) and quantity (average hours/day) was divided by 30 to reflect the average number of hours spent on SoMe per day.

2.4. Time invariant covariates

Four time invariant covariates were measured at t1, but were replaced with t2 values if t1 values were missing. This was done to reduce the number of missing values under the assumption of stability in these characteristics over time.

Parental monitoring was assessed by one question based on established measures (Kerr & Stattin, 2000; Stattin & Kerr, 2000): “How much do your parents know about what you do in your free time?”. The three response options “They think they know what I’m doing”, “Usually they don’t know what I’m doing”, “Sometimes they know what I’m doing”, were coded 1 to indicate low parental monitoring. The remaining options; “They pretty often they know what I’m doing”, and “They always know what I’m doing” were coded 0.

Sensation seeking was assessed with the 4-item Brief Sensation Seeking Scale (Stephenson, Hoyle, Palmgreen, & Slater, 2003; Vallone,

Allen, Clayton, & Xiao, 2007). Responses to individual items (e.g., “I like to do frightening things”) were made using 5-point Likert type responses ranging from 1 (“Completely disagree”) to 5 (“Completely agree”). Scores on individual items were averaged to compute overall scale scores. Cronbach’s alpha for the scale was 0.79.

Positive and negative urgency were measured with the short version of the UPPS-P Impulsive Behavior Scale (Cyders, Littlefield, Coffey, & Karyadi, 2014). Four items assess positive urgency (e.g., “When I am in a great mood, I tend to get into situations that could cause me problems”), and four items assess negative urgency (e.g., “When I feel bad, I often do things I later regret in order to make myself feel better now”). The items were rated on a four-point scale ranging from strongly disagree to strongly agree, and the scores were averaged to compute overall scale scores. Cronbach’s alpha was 0.83 for both positive and negative urgency items.

2.5. Analysis

We employed latent growth modelling in a structural equation framework (Willett & Sayer, 1994) to examine the relation between two

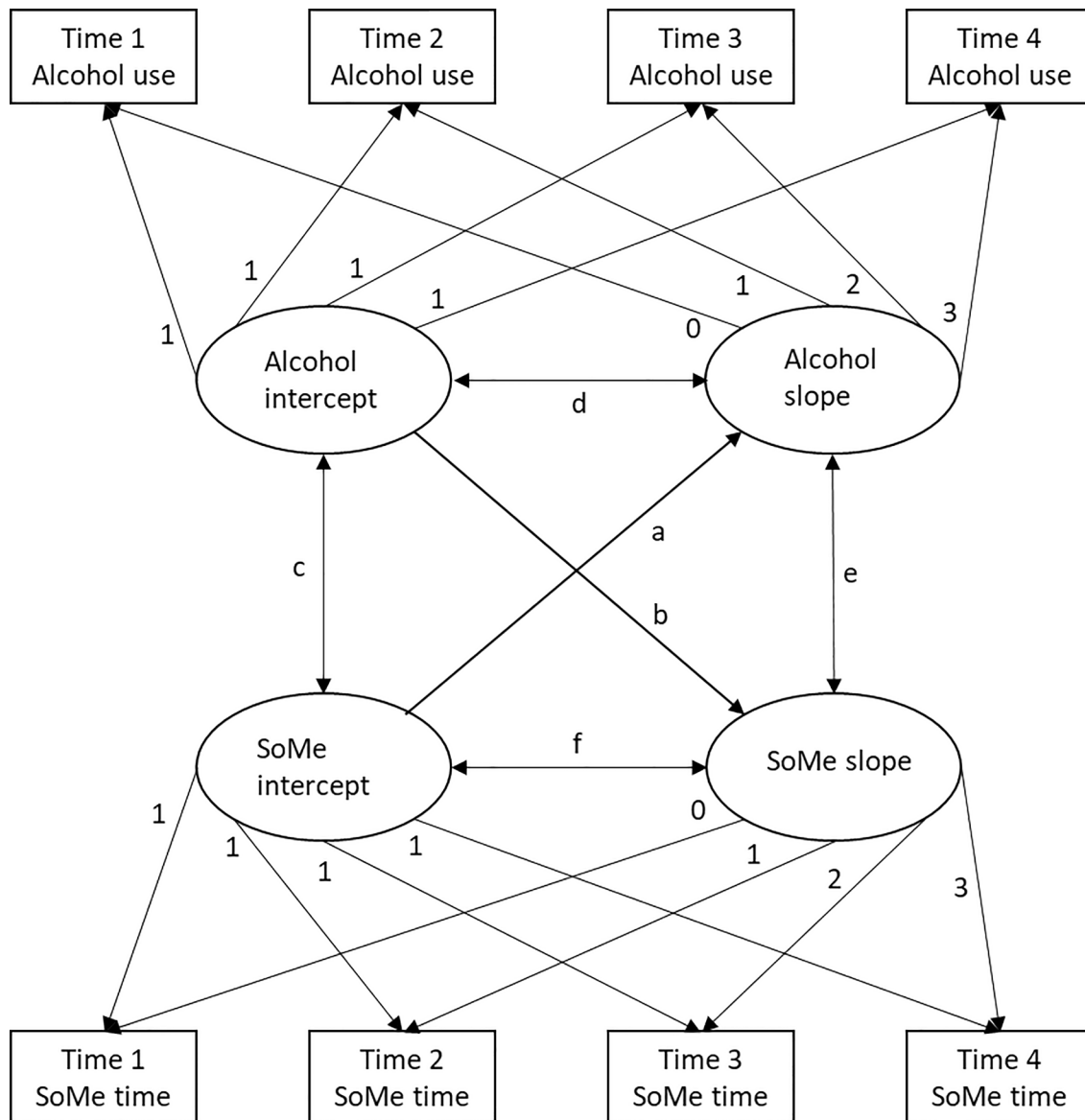


Fig. 1. Hypothesised multivariate latent growth curve model for simultaneous growth in alcohol use and time spent on social media time for Norwegian adolescents. One-headed arrows are hypothesised directional regression paths, while two-headed arrows are covariances.

parallel processes, change over time in alcohol use and time spent on SoMe with an approach similar to that of Curran and colleagues (Curran, Stice, & Chassin, 1997). The model is presented in Fig. 1. Path *a* was estimated to examine if earlier amount of SoMe would predict later rate of change in alcohol use. Path *b* was estimated to examine the opposite scenario: if earlier alcohol use would predict later rate of change in time spent on social media. Path *c* was estimated to assess the initial cross-sectional relation. Paths *d* and *f* were estimated to assess the covariance between initial levels and change over time. Path *e* was estimated to examine the association between change over time in both variables. The error terms for alcohol use and time spent on SoMe for the same time point were allowed to covary (e.g., the error term for alcohol use at t1 was allowed to covary with the error term for SoMe at t1).

We first specified an unadjusted model (i.e., gender and age at t1 were the only covariates). To reduce the effect of potential confounding, parental monitoring, sensation-seeking and positive and negative urgency were added to the model as time-invariant predictors of all four latent variables. In the analyses, age at t1 was centred at the mean, while sensation-seeking, and positive and negative urgency were converted to z-scores.

Gender differences were tested with a multigroup extension of the adjusted model. A constrained model, in which paths *a* to *f* were constrained to be equal for girls and boys, was compared to an unconstrained model with a  $\chi^2$  difference test. Gender differences were further examined by releasing one of the constraints at time and computing  $\chi^2$  difference tests.

The latent curve modelling was conducted in Mplus version 8 (Muthén & Muthén, 1998-2017); all other analysis was computed in Stata version 16 (Stata, 2019). Because the distributions of the continuous alcohol use variables were skewed to the right, we report 95% confidence intervals and *p*-values based on heteroskedasticity robust standard errors (the MLR estimator in Mplus). Missing values were handled by full information maximum likelihood under the missing at random assumption.  $\chi^2$  difference tests were computed with MLR scaling factor adjusted degrees of freedom.

### 3. Results

Pairwise correlations, range and *N* for each variable, and descriptive statistics are presented in Table 1. Mean alcohol use at t1 was low (0.26 on the scale from 0 to 12), but it became higher with each assessment. Average alcohol use was virtually identical for boys and girls, but higher for adolescents with low parental monitoring. Alcohol use was positively correlated with sensation-seeking, and both positive and negative urgency. Time spent on SoMe increased over time and was at all time

points positively correlated with sensation-seeking, and positive and negative urgency. Girls spent more time on SoMe than boys. Adolescents with low parental monitoring also spent slightly more time on SoMe. At all four assessments, alcohol use was positively cross-sectionally correlated with time spent on SoMe (t1:  $r = 0.22$ ; t2:  $r = 0.27$ ; t3:  $r = 0.27$ ; t4:  $r = 0.26$ ).

The unadjusted latent growth model, where gender and age at t1 were the only covariates, fit the observed data adequately,  $\chi^2(30) = 623.62$ ,  $p < 0.001$ ; RMSEA = 0.080, CFI = 0.869, SRMR = 0.076. Estimated alcohol use at t1 (the alcohol use intercept) was low,  $b = 0.23$  [95% CI: 0.20, 0.27], while the change in alcohol use over time (alcohol use slope) was positive, indicating increase with time ( $b = 0.42$  [0.33, 0.50]). The estimated number of hours per day spent on SoMe at t1 was 2.78 [2.49, 3.07], with an increase per year of 0.23 h [0.19, 0.26]. There was a positive association between the SoMe intercept and the alcohol use intercept (standardised  $b(\beta) = 0.25$  [0.17, 0.30]) suggesting a positive cross-sectional association at t1. Time spent on SoMe at t1 was a significant positive predictor of alcohol use slope,  $\beta = 0.33$  [0.26, 0.40], suggesting that greater amount of time spent on SoMe at t1 was associated with greater increase in alcohol use over time. The SoMe and alcohol use slopes were also positively associated ( $\beta = 0.12$  [0.03, 0.21]), which indicates that those who increased their time spent on SoMe also increased their alcohol use. In the unadjusted model, the association between alcohol use intercept and SoMe slope was statistically significant and negative ( $\beta = -0.14$  [-0.25, -0.03]), suggesting that high alcohol use at t1 is associated with less increase in time spent on SoMe over time.

The adjusted latent growth model, where gender, age at t1, parental knowledge, sensation-seeking, and positive and negative urgency were covariates, fit the observed data well,  $\chi^2(42) = 298.52$ ,  $p < 0.001$ ; RMSEA = 0.044, CFI = 0.951, SRMR = 0.028. The model estimates are shown in Fig. 2. There were only small changes from the unadjusted model. There was still a positive association between the SoMe intercept and the alcohol use intercept  $\beta = 0.17$  [0.09, 0.26]. The estimate for alcohol use slope on time spent on SoMe at t1 was almost identical  $\beta = 0.31$  [0.23, 0.40], and the SoMe and alcohol use slopes were still positively correlated  $\beta = 0.14$  [0.05, 0.24]. The only substantive difference between the unadjusted and adjusted models was that in the adjusted model, the path from alcohol use intercept to the SoMe slope was no longer statistically significant ( $p > 0.05$ ).

Next, we tested gender differences with multigroup analysis. First, the  $\chi^2$  model fit for the adjusted model with all the six paths of interest constrained to be equal for girls and boys was compared to that of an unconstrained model, where all the paths were free to differ by gender. The  $\chi^2$  difference was not statistically significant,  $\Delta\chi^2(\Delta df = 7.78) =$

**Table 1**  
Descriptive statistics and pairwise correlations for all the study variables.

No.	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Time 1: Alcohol use														
2.	Time 2: Alcohol use	0.43													
3.	Time 3: Alcohol use	0.37	0.58												
4.	Time 4: Alcohol use	0.28	0.41	0.68											
5.	Time 1: Time spent on social media	0.22	0.22	0.26	0.26										
6.	Time 2: Time spent on social media	0.13	0.27	0.26	0.21	0.54									
7.	Time 3: Time spent on social media	0.09	0.18	0.27	0.23	0.48	0.59								
8.	Time 4: Time spent on social media	0.12	0.17	0.22	0.26	0.41	0.45	0.56							
9.	Gender (0 = female, 1 = male)	-0.01	-0.01	0.01	0.01	-0.28	-0.27	-0.25	-0.21						
10.	Age (Time 1)	0.21	0.29	0.30	0.30	0.08	0.06	0.03	-0.01	-0.02					
11.	Low parental monitoring	0.15	0.13	0.11	0.09	0.09	0.07	0.04	0.08	0.10	0.00				
12.	Sensation-seeking	0.16	0.23	0.25	0.24	0.16	0.14	0.14	0.08	0.09	0.04	0.11			
13.	Positive urgency	0.15	0.18	0.18	0.13	0.20	0.17	0.17	0.11	-0.03	0.04	0.14	0.30		
14.	Negative urgency	0.11	0.11	0.12	0.11	0.21	0.14	0.16	0.13	-0.04	0.02	0.12	0.24	0.55	
	Range	0-12	0-12	0-12	0-12	0-8.4	0-8.4	0-8.4	0-8.4	0-1	12.8-16.8	0-1	1-5	1-4	1-4
	N	2731	2744	2590	2271	2714	2736	2586	2267	3096	3096	3041	2978	2987	2968
	M	0.26	0.88	1.77	2.85	2.22	2.34	2.57	2.62	0.43	14.25	0.08	2.95	1.66	1.98
	SD	0.98	1.81	2.37	2.75	2.17	2.06	1.96	1.87	0.50	0.85	0.28	1.02	0.74	0.83
	Skewness	5.41	2.71	1.28	0.53	1.26	1.17	0.97	0.85	0.28	0.23	3.03	-0.13	1.05	0.51

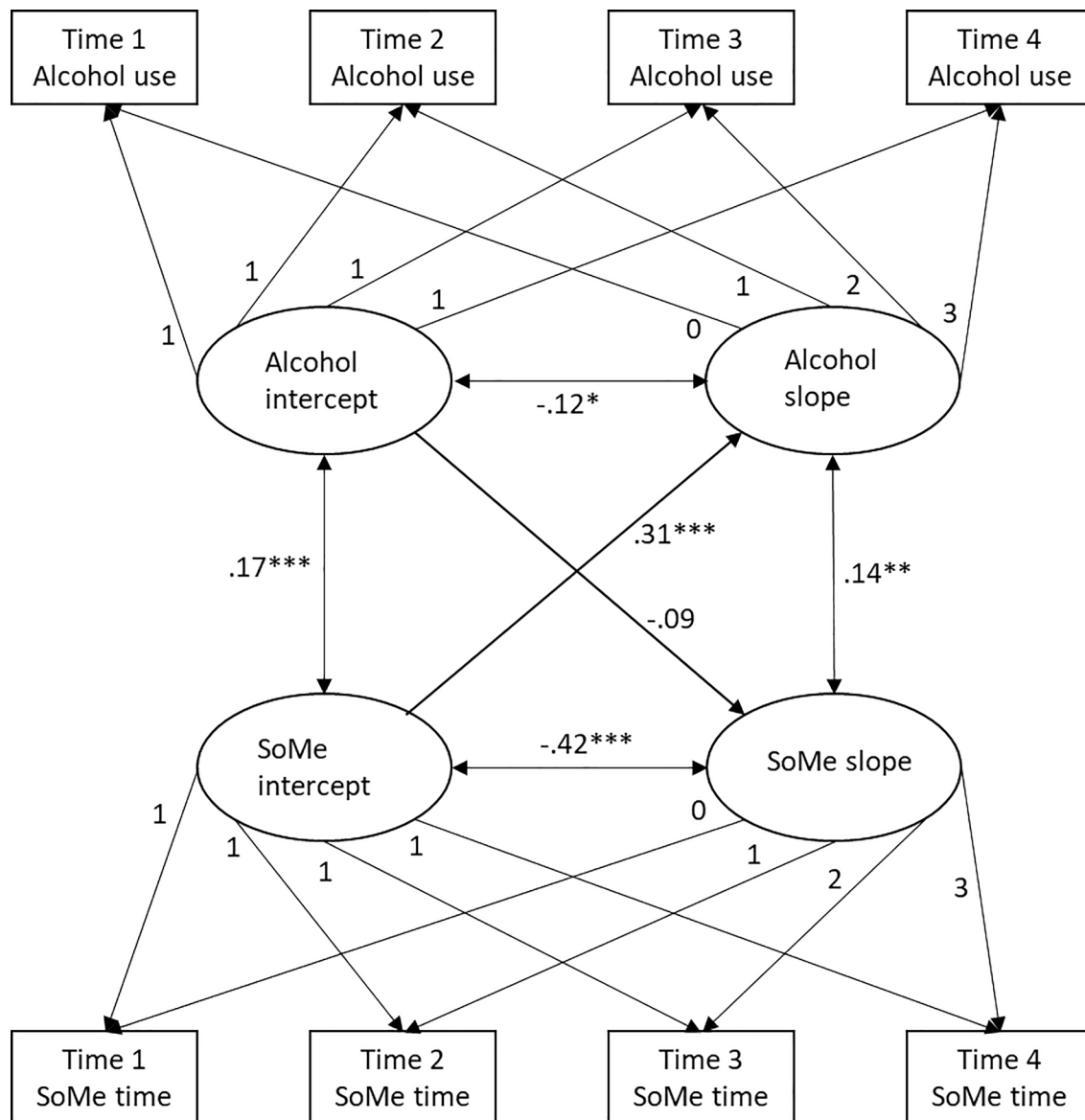


Fig. 2. Multivariate latent growth curve model for simultaneous growth in alcohol use and social media time for Norwegian adolescents. One-headed arrows are regression paths, while two-headed arrows are covariances. All estimates are standardized path coefficients. Adjusted for gender, age at t1, parental monitoring, sensation-seeking, and positive and negative urgency. Error terms and estimates for covariates are not shown for simplicity. \* $p < 0.05$  \*\* $p < 0.01$  \*\*\* $p < 0.001$ .

4.10,  $p = 0.770$ . We further explored gender differences by unconstraining one path at a time in follow-up models, however the fit was not significantly different from the fully constrained model in any of the models (smallest  $p = 0.242$ ).

#### 4. Discussion

We found a prospective relation where more time spent on social media at age 13–15 years was associated with greater increase in alcohol use over the next three years, up to age 16–18 years. Greater increase in alcohol use was also found for adolescents with greater increase in time on SoMe. Our results are in line with previous cross-sectional studies (Brunborg et al., 2017; Gutierrez & Cooper, 2016; Sampasa-Kanyinga & Chaput, 2016; Savolainen et al., 2019) and previous prospective studies (Boers et al., 2020; Brunborg & Burdzovic Andreas, 2019; Ng et al., 2021), although some previous studies have also reported no prospective relationship (Huang et al., 2014; Smout et al., 2021). This is the first longitudinal study to examine gender differences in these associations. The gender differences were small, which is surprising given gender

differences in time spent on SoMe, preferred types of SoMe activities, and preferred platforms (Pujazon-Zazik & Park, 2010; Twenge & Martin, 2020).

Our results are in line with Social Learning Theory (Akers et al., 1995; Bandura, 1977) which suggests that adolescents learn alcohol use by observing and mimicking the behaviour of others, and by observing the consequences of others' behaviour. Adolescents might be inspired by their peers, and repeated exposure to alcohol- and party-related content shared by peers could motivate initiation or increase in drinking (Akers et al., 1995; Moreno et al., 2016). Indeed, Boers et al. (2020) found support for the notion that positive social norms towards alcohol use, possibly resulting from such exposure, mediates the association between social media use and alcohol use. An alternative explanation for the link between SoMe and alcohol use is that adolescents are frequently exposed to alcohol advertising on social media (Carah & Brodmerkel, 2021), which is associated with increased risk of adolescent drinking (Anderson, de Bruijn, Angus, Gordon, & Hastings, 2009). Alcohol advertising is illegal in Norway, but this is difficult to fully enforce on SoMe.

In line with DSMM (Valkenburg & Peter, 2013), future research

should explore potential effect modifiers, beyond gender, such as personality differences and different socio-economic status groups. Future experimental studies could investigate if reducing SoMe time would also reduce adolescent alcohol use. Future studies could also examine the effects of reductions in exposure to alcohol advertising on SoMe and exposure to positive alcohol content shared between peers on SoMe. Such experimental studies could prove informative for prevention efforts aiming to limit adolescent alcohol use and associated negative consequences.

The current study accounted for several potential confounding factors, and to our knowledge it is the first prospective study to examine gender differences. The sample was both diverse and sizeable, enabling more precise estimates. We also used an established measure of alcohol use and incorporated the full range of time spent on SoMe and were not restricted to “every day” as the top response category. However, there are limitations that need to be noted. We did not assess time on different social media activities or the type of content the adolescents were exposed to. Future studies should investigate more closely which activities are associated with alcohol use, for instance communication with friends versus passive scrolling. There is also need for closer inspection of what types of exposure are more likely to influence adolescents, for instance the relative effects of exposure to peer alcohol use, exposure to alcohol advertising, and exposure to strangers and influencers’ favourable representations of alcohol use. This is no small challenge because of difficulties in measuring social media activities and exposures. Adolescents are likely to engage in many different social media activities, and the SoMe algorithms ensure that the exposure is personalized. It is also a “moving target”, as it is continually evolving, making it challenging to incorporate in longitudinal studies. All our variables were measured with self-report, which can cause measurement error (e.g., due to socially desirable responding and biased recall). It is difficult to speculate how this may have affected our main results, but measurement error tends to bias regression estimates downward. Data collected in 2020 might have been affected by the COVID-19 pandemic lockdown, however this is uncertain given that adolescents do not usually drink alcohol on licensed premises. As with most longitudinal studies, not all participants or their parents agreed to take part, and not all participants participated at all time points. We should therefore remain cautious in generalizing the results to the entire Norwegian adolescent population or beyond.

## 5. Conclusion

This study of Norwegian adolescents found a prospective relation between time spent on SoMe and subsequent increase in alcohol use. This effect was largely unaffected by adjustment for potential confounding factors, and the gender differences were small. Future research should investigate the need for more regulation aimed at reducing alcohol advertising and positive alcohol related content shared on social media, as this might have a preventive effect on adolescent alcohol use and related negative consequences.

### CRedit authorship contribution statement

**Geir Scott Brunborg:** Conceptualization, Formal analysis, Methodology, Writing – original draft. **Jens Christoffer Skogen:** Conceptualization, Investigation, Methodology, Writing – original draft. **Jasmina Burdzovic Andreas:** Conceptualization, Formal analysis, Methodology, Writing – original draft.

### Declaration of Competing Interest

There are no conflicts of interest by any author.

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