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Increases in serious psychological distress among Ontario students between 2013-2017:  
Assessing the impact of time spent on social media

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## Abstract

**Objective:** The objective of the current research was to examine the association between time spent on social media and serious psychological distress between 2013-2017, a period when the rates of both were trending upward.

**Methods:** The current study analyzed population-based data from three waves of the Ontario Student Drug Use and Health Survey (OSDUHS; n=15,398). Multivariate logistic regression models were used to examine the association between time spent on social media and serious psychological distress controlling for theoretically relevant covariates. Interactions were tested to assess whether the association changed over time.

**Results:** The prevalence of serious psychological distress increased from 10.9% in 2013 to 16.8% in 2017 concomitantly with substantial increases in social media usage, especially at the highest levels. In the multivariate context, we found a significant interaction between social media use and the survey year which indicates that the association between time spent on social media and psychological distress has decreased from 2013-2017.

**Conclusions:** Although both social media use and psychological distress increased between 2013 and 2017, the interaction between these variables indicates that the strength of this association has decreased over time. This finding suggests that the higher rate of heavy social media use in 2017 compared to 2013, is not actually associated with the higher rate of serious psychological distress during the same time period. From a diffusion of innovation perspective, it is possible that more recent adopters of social media may be less prone to psychological distress. More research is needed to understand the complex and evolving association between social media use and psychological distress. Researchers attempting to isolate the factors associated with the recent increases in psychological distress could benefit from broadening their investigation to factors beyond time spent on social media.

**Keywords:** psychological distress, social media use, adolescence, social media interaction, repeated cross-sectional design, mental health

## Introduction

Recent increases in mental health problems, including depression and suicidality, have been noted in several Western countries, including the United States,<sup>1-4</sup> the United Kingdom,<sup>5-7</sup> and Canada.<sup>8-11</sup> These increases are particularly salient among adolescents and young adults<sup>1</sup> and have mostly taken place since 2012 following a period where reductions in mental health problems were observed.<sup>3,4,12,13</sup> Given that adolescent mental health problems are associated with a range of adult psychological outcomes and difficulties across the life course,<sup>14</sup> it is important to better understand possible explanations for these upward trends.

One possible explanation for increases in the prevalence of mental health problems among adolescents involves the rapid increases in adolescent social media usage.<sup>15-17</sup> A growing body of research has begun to examine the link between social media use and poor mental health outcomes.<sup>18,19</sup> While some of this research questions the strength and veracity of this relationship,<sup>20-23</sup> several cross-sectional studies have found an association between higher amounts of time spent using different types of social media platforms and lower levels of wellbeing,<sup>18,24-27</sup> as well as higher levels of psychological distress and depression.<sup>3,18,25,28-30</sup> Experimental studies provide additional evidence for a link between specific types of social media use and negative affect,<sup>26,31</sup> and recent longitudinal evidence demonstrates that social media use negatively impacts later mental health.<sup>32-36</sup>

Most of the existing research on the association between social media use and negative mental health outcomes either implicitly or explicitly assumes that the harms of social media use, and screen time more generally, increase proportionately with exposure over time.<sup>22,32</sup> From this perspective, time spent on social media is considered a poor substitute for the prosocial activities it replaces. Time spent on social media, in other words, is believed to displace healthy physical

activities such as exercise<sup>32,37,38</sup> and sleep<sup>25,30,39</sup> while facilitating an impersonal mode of communication that decreases close personal connections and increases adolescent depression.<sup>40,41</sup> Increasing social media use is also thought to increase exposure to exaggeratedly positive representations of others' lifestyles and experiences, contributing to a downward social comparison and increasing depressive symptoms.<sup>32,42-46</sup> If more time spent on social media is associated with negative mental health outcomes, then other factors being equal, as the amount of time spent on social media changes over time, these negative health outcomes should change in a corresponding manner.

Despite the preponderance of evidence associating social media use and negative mental health outcomes, research has yet to determine the extent to which increases in the amount of time adolescents spend on social media may be associated with the recent upward trend in mental health problems that have been observed on a population-level. Thus, the first objective of our research was to empirically evaluate the association between these two variables over time, controlling for potential confounders. Our second objective was to examine whether recent increases in mental health problems were moderated by the gender of our respondents. Given that females are more likely than males to report psychological distress, suicidality, and depression,<sup>47,48</sup> and because recent research indicates that the increased prevalence of psychological distress has been disproportionately experienced by females,<sup>1,3</sup> we examined this association.

## Methods

### *Sample*

The Ontario Student Drug Use and Health Survey (OSDUHS) is a biennial cross-sectional population survey that is representative of students in grades 7 to 12 from Ontario, Canada. The OSDUHS uses a stratified (region by school level) two-stage (school, class) cluster design with active-consent procedures. Self-completed anonymous questionnaires were group administered in classrooms, a method that has demonstrated a high level of validity.<sup>49,50</sup> The present secondary data analysis examined a subpopulation of 15,393 student respondents from three waves of the OSDUHS—2013 (Wave 1), 2015 (Wave 2), 2017 (Wave 3). Item non-response was less than two percent for each of the independent variables, and missing values were listwise deleted.<sup>51a</sup> Our final analytic sample consisted of 15,393 respondents. Each wave of the survey received ethics approval from the Research Ethics Boards of the Centre for Addiction and Mental Health (CAMH) and York University (protocol numbers are 068/2012 for 2013, 068/2014 for 2015, and 029/2016 for 2017). Further details about the methodological features of the OSDUHS are described in greater detail elsewhere.<sup>8</sup>

### *Dependent Variable*

*Psychological Distress.* The Kessler 6-item *Psychological Distress Scale* (K6)<sup>a</sup> is a screening instrument designed to detect symptoms of anxiety and depression, and has been validated among adolescent populations.<sup>52-55</sup> Respondents were asked “*In the last four weeks, how often did you...(1) feel nervous; (2) feel hopeless; (3) feel restless or fidgety; (4) feel so depressed that*

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<sup>a</sup> Supplemental analyses revealed that missing data were not significantly associated with either the outcome or focal independent variables. Missing values were therefore determined to meet the criteria for missing at random (see Allison, 2001).

*nothing could cheer you up; (5) feel that everything was an effort; (6) feel worthless.* Each item was scored from 0 (none of the time) to 4 (all the time), with a total score ranging from 0-24. Consistent with other studies using the K6 measure,<sup>56-58</sup> a cut-off score of 13 was used to create a dichotomous measure to indicate serious psychological distress (1=yes, 0=no).<sup>b</sup> Serious psychological distress indicates the presence of a probable mental disorder, and is associated with increased treatment utilization,<sup>59</sup> increased prescription medication use,<sup>1</sup> substance abuse<sup>60,61</sup> and an, increased mortality risk.<sup>62</sup>

### *Focal Independent Variable*

*Time Spent on Social Media.* Respondents were asked, “About how many hours a day do you usually spend on social media websites or apps, such as Facebook, Instagram, Snapchat, either posting or browsing?” Consistent with other studies measuring time spent on social media,<sup>24,25,30</sup> response options were coded into the following categories: none; less than 1 hour per day; 1 hour to less than 3 hours (reference group); 3 hours to less than 5 hours; 5 hours to less than 7 hours; 7 or more hours.

### *Covariates and Control Variables*

Change in psychological distress over time was modelled by including the wave of the survey as a covariate (1=2013, 2=2015, 3=2017).<sup>c</sup> Previous research has linked adolescent mental health

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<sup>b</sup> While it is standard practice to use an empirically validated cut-off score for psychological distress, all analyses were also estimated with psychological distress as a continuous (and logged) dependent variable. The substantive results from this sensitivity analysis were nearly identical to the results obtained from our logistic regression models, which increased our confidence that our results are robust and not dependent on the measurement of psychological distress. Results available on request.

<sup>c</sup> The results were also estimated with wave as a categorical indicator as part of a sensitivity analysis. The results did not change substantively and given that the prevalence of serious psychological distress increased linearly in our data, we decided to treat wave as a continuous variable. The results from the multivariate analysis (Table 2) with wave as a categorical variable, can be found in Table 2 of the Appendix.

outcomes to several demographic variables, including age,<sup>24,29,30</sup> sex,<sup>1,3,19,24</sup> ethnicity and foreign born status,<sup>19,63</sup> and socioeconomic status.<sup>64-68</sup> These variables were included as control variables in the multivariate analysis. Grade was used to measure age and was coded as a continuous variable (7-12), while sex (0=male, 1=female), ethnicity (white = reference group), and foreign-born status (0=born in Canada, 1=born in another country) were included as categorical variables. The MacArthur family SSS ladder, a validated measure of subjective social status, was included as a proxy for family socioeconomic status.<sup>69,70</sup> Recent research has also linked social media use and psychological distress to a lack of connectedness with peers<sup>40,71,72</sup> and with cyberbullying victimization.<sup>73,74</sup> These variables were included to control for potential confounding effects in the multivariate analysis. Students were asked to evaluate their relationships with peers at school, with higher values reflecting closer relationships to peers (1-4). Consistent with other research,<sup>19,29,73</sup> past year cyberbullying victimization was included as a dichotomous variable (0=no, 1=yes). Table 1 (Appendix) provides more details on the variables used in the analysis.

### *Analytic Strategy*

We first calculated descriptive statistics to determine the prevalence of serious psychological distress and time spent on social media across each wave of data. Next, we estimated a series of nested logistic regression models to estimate the association between time spent on social media and psychological distress controlling for relevant factors.<sup>d</sup> Two interaction terms were estimated to test whether the association between sex and serious psychological distress and the association

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<sup>d</sup> The purpose of the control variables was to account for potential confounders and to estimate the net effect of time spent on social media in the multivariate context. However, we were mindful of potential model overfitting, the possibility of collider variables, and potential issues with multicollinearity. A series of diagnostic tests were run, and the effects of time spent on social media on psychological distress was estimated with and without statistical controls. The results were almost identical, and the results were robust across different model specifications.



between time spent on social media and serious psychological distress changed between 2013-2017. The effect of all other variables was held constant in the interactions. All analyses corrected for characteristics of the sampling design (i.e., stratification, clustering and weighting), and were conducted using Stata v.16.1.

## Results

Table 1 presents the prevalence of serious psychological distress and time spent on social media for Ontario students between 2013 and 2017. Serious psychological distress significantly increased during this time, rising from 10.9% in 2013 (95% CI: 9.6%-12.3%), to 14.5% in 2015 (95% CI: 12.8%-16.4%), to 16.8% in 2017 (95% CI: 14.6%-19.3%). During these same time periods, social media use also increased, especially at the highest levels. The percentage of students who reported spending between 5 and 7 hours on social media per day increased from 6.6% in 2013 (95% CI: 5.5%-7.6%), to 9.8% in 2015 (95% CI: 8.7%-11.1%), to 12.7% in 2017 (95% CI: 10.8%-14.8%). Similar increases were observed for students who reported spending 7 or more hours per day on social media, which increased from 3.7% in 2013 (95% CI: 3.0%-4.5%), to 6.2% in 2015 (95% CI: 5.2%-7.5%), to 7.4% in 2017 (95% CI: 6.0%-9.1%).

**[Insert Table 1 about here]**

Table 2 presents the results from the multivariate logistic regression models. The trend in serious psychological distress was captured by the wave variable. The odds of distress increased across the three waves of data in all models (Model A to D); after controlling for the effect of all other factors (Model D), the odds of distress increased by 18% ( $p < 0.001$ ). Several of the control variables were also notable predictors of serious psychological distress. In the multivariate

context, the odds of distress were lower for students who reported having close social relationships with other students at school (AOR=.50;  $p<0.001$ ) and for students who reported higher levels of subjective family socioeconomic status (AOR=.82;  $p<0.001$ ). Conversely, the odds of distress were higher for older students (AOR=1.12;  $p<0.001$ ) and for students who reported cyberbullying victimization (AOR=2.39,  $p<0.001$ ).

Sex was a significant predictor of serious psychological distress across all models. In the multivariate model (Model D), female students were at 2.6 times the odds of male students for serious psychological distress ( $p<0.001$ ). An interaction between wave and sex tested whether the increases in serious psychological distress varied for male and females. The interaction was not statistically significant ( $F=.12$ ;  $p>0.05$ ). Auxiliary analyses confirm that the odds of serious psychological distress for females relative to males, presented separately by wave (see Table 4, Appendix), had overlapping confidence intervals and the change over time was not statistically significant.

**[Insert Table 2 about here]**

Time spent using social media, was significantly associated with serious psychological distress (Model C) and this association remained significant in the multivariate context (Model D). Compared to those who reported using social media between 1 and 3 hours per day (the reference group), and controlling for all other factors, the odds of distress increased with the amount of time spent using social media per day. However, the interaction between social media use and wave was statistically significant ( $F=2.76$ ;  $p<0.05$ ), suggesting that social media use had a differential relationship with serious psychological distress over time (see Table 4, appendix

for results stratified by wave). Figure 1 displays the predicted probability of time spent on social media and serious psychological distress over time, holding the effect of all other variables at their mean value. The results from this interaction demonstrate a non-linear effect over time. At the lowest levels of social media use, the predicted probability of serious psychological distress increased across the three waves; however, for students who reported spending 7 or more hours on social media per day, the predicted probability of serious psychological distress decreased from 22% to 17% between 2013 and 2017.<sup>e</sup>

**[Insert Figure 1 about here]**

## **Discussion**

Evidence for increased psychological distress and depression among adolescents and young adults has been reported in North America and Great Britain.<sup>1-4,30,75</sup> These increases have been accompanied by corresponding increases in suicide-related behaviors,<sup>2,3,76,77</sup> providing ancillary evidence that the recent upward trend in self-reported mental health problems is not an artifact of an increased willingness to disclose negative affect in anonymous surveys, but part of a broader increase in mental health problems among adolescents.<sup>6</sup> Our results add to this emergent literature and show a substantial increase in the proportion of students in grades 7 to 12 in Ontario, Canada who reported serious psychological distress between 2013 and 2017. This

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<sup>e</sup> The findings from Figure 1 can be further evidenced by examining the supplemental material, found in the Appendix. In Table 3, descriptive statistics reveal that the percentage of Ontario students reporting serious psychological distress increased for students who reported less than 1 hour of social media use per day while the percentage decreased for those who reported 7 or more hours of social media use per day between 2013-2017, as compared to the reference group. Table 4 presents the adjusted odds ratios from the multivariate logistic regression model (Table 2), stratified by wave. Compared to those who reported using social media 1 or fewer hours per day (the reference group, whose probability of distress increased between 2013-2017), the AOR of those who reported using social media 7 or more hours per day decreased from 3.47 in 2013 to 1.38 in 2017.

increase of 65% is unprecedented, and translates to more than 150,000 students who suffered from a probable mental health disorder in 2017.<sup>8</sup> Given the adverse outcomes associated with serious psychological distress,<sup>1,60-62</sup> it is extremely important to identify the mechanisms contributing to these recent increases.

It has been argued that increased use of electronic devices, including social media use, has contributed to simultaneous increases in mental health problems such as psychological distress in recent years.<sup>24,27,78</sup> Our results provide support for the proposal that time spent on social media increased concomitantly with increased psychological distress for both males and females. However, the interaction of year and social media use suggests that the relationship between heavy social media use and psychological distress is complex. Even though both social media and psychological distress have increased from 2013 to 2017, the interaction indicates that the association between the two is decreasing over time. Those students who had the lowest levels of time spent on social media showed increases in psychological distress, while those with the highest levels of time spent on social media showed decreases in psychological distress, between 2013-2017. These data suggest that while social media use and serious psychological distress are associated with one another at each point in time, overall increases in social media use, and more specifically increases in heavy social media use, do not appear to account by themselves for the recent increases in serious psychological distress.

The influence of social media use on mental health may be complicated and could reflect other, underlying causal pathways. Kelly et al. (2018) have suggested that several paths could be involved, and that poor sleep, limited in-person social interactions, reduced physical activity, increased exposure to online harassment, reduced self-esteem, and poor body image may mediate the pathway between social media use and increased mental health problems such as anxiety

and/or depression.<sup>25</sup> Other researchers have confirmed the association of high levels of social media use with poor sleep and lack of exercise.<sup>25,30,32,38,39,48</sup> In a recent longitudinal study, Heffer and colleagues (2018), observed that, rather than social media use predicting depression, depression predicted social media use, but only among females.<sup>21</sup> Thus, the nature of the causal pathway between social media use and mental health problems is unclear and it is possible that the relationship is a reciprocal one.<sup>79,80</sup> Given the importance of temporal sequencing and the complexity of factors that may be responsible for the upward trend in psychological distress, more studies using panel data, where individuals are tracked at multiple points in time, are needed to better understand causal pathways and opportunities for prevention.

It is also possible that the changing impact of social media use on psychological distress is related to the novelty of the technology at the time, and the people initially attracted to it. “Early adopters” of social media, in diffusion of innovation terms,<sup>81</sup> may have been individuals already experiencing some predisposition to distress. Certainly, Heffer et al.’s (2018) results may support this interpretation, and Zink et al. (2019) observed reciprocal relationships between screen time and emotional disorder symptoms in adolescents.<sup>21,80</sup> As heavy use of social media has become a more salient and normalized feature of adolescent life,<sup>f</sup> later adopters of social media may include larger numbers of individuals less prone to distress. Changes in the frequency of time spent on social media do not account for the quality of social media use or for the relative impact that different types of social media use may have on psychological distress. Active social media use, where adolescents use social media to directly communicate with one

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<sup>f</sup> The normalization of social media use has been facilitated by the ubiquity of internet access and smartphone ownership. According to the 2018 Canadian Internet Use Survey, 98.6% of adolescents aged 15-24 reported having access to the internet and 88.1% reported owning a smartphone. Available online at: Statistics Canada, 2019. Canadian Internet Use Survey. Released at 8:30 a.m. Eastern time in The Daily, Tuesday, October 29, 2019. Statistics Canada catalogue no. 11-001-X

another and facilitates social connectedness and social capital, may promote psychological wellbeing.<sup>82</sup> Passive social media use, on the other hand, is characterized by an absence of interpersonal communication, and has been associated with lower levels of psychological wellbeing.<sup>42,43,83</sup> Without more data, including validated measures of different types of social media use,<sup>84</sup> over a longer time period, it is difficult to draw definitive conclusions. Future research will need to track changes in the patterns of social media use as well as changes in the association between social media use and psychological distress over time. If the recent increases in mood disorders are part of a generational shift among a new cohort of adolescents, as has been recently suggested,<sup>30</sup> then the prevalence of serious psychological distress may continue to increase.

Other researchers have suggested that the negative effect of social media use on wellbeing may be observed primarily among females.<sup>3,24</sup> Our results suggest that increased social media use was associated with increased psychological distress among both males and females in Ontario and increases in severe psychological distress were observed among both male and female students. While we see differences in the base rate of psychological distress, a finding consistent with other studies,<sup>8,12</sup> we observed increases in psychological distress among both male and female students between 2013-2017. Future research examining the etiology of the increases in psychological distress among adolescents should not automatically concede the existence of gender-specific effects without first testing for them.

Our data demonstrate significant increases in serious psychological distress among Ontario students in grades 7 to 12 between 2013 and 2017. While social media use increased simultaneously, we found that the association of heavy social media use with serious psychological distress appeared to decrease over time. This decline may be a positive indicator

for the future, in suggesting that the negative effect of heavy social media use may be moderating with time. As well, the disassociation of distress and social media use may suggest that the rise in serious distress among adolescents may not be strongly tied with social media use. A closer examination of distress needs to include other social factors, including the increased prevalence of negative news events from around the world. It is possible that adolescents are not just reacting to social media but rather to ‘real world’ distress. Future research to elucidate mechanisms underlying these trends might explore outcomes associated with different social media platforms (e.g., Instagram, Snapchat, Reddit, TikTok) and/or activities performed while using social media (e.g., browsing, posting, direct messaging). This research could help inform the potential moderating role that different types of social media use has on adolescent mental health.

Our results are limited by the cross-sectional nature of the data, and their reliance on self-reported surveys. Thus, causal conclusions cannot be drawn, and the results may be subject to bias found with self-report, an issue underscored by recent research suggesting that self-reported estimates of social media use may not be reflective of actual time spent.<sup>85</sup> Another limitation related to the cross-sectional nature of our data is that we cannot assess whether higher social media use predicts psychological distress or vice versa. There is some evidence of a reverse association.<sup>21,79</sup> The possibility of reverse causation provides additional support to our conclusion that it is important to be cautious about the association between social media use and the recent increases in serious psychological distress. These increases appear to have multiple sources, and more research is needed to understand and address the increased prevalence of psychological distress among adolescents.

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Table 1: Prevalence of Severe Psychological Distress and Time Spent on Social Media for Ontario Students, 2013-2017 OSDUHS (n=15,398)

|  | 2013 OSDUHS<br>(n=4933)<br>% (95% CI) | 2015 OSDUHS<br>(n=4886)<br>% (95% CI) | 2017 OSDUHS<br>(n=5579)<br>% (95% CI) |
|--|---------------------------------------|---------------------------------------|---------------------------------------|
| <b><i>Serious Psychological Distress</i></b> |                                       |                                       |                                       |
| No   | 89.1% (87.7%-90.5%)                   | 85.5% (83.6%-87.2%)                   | 83.2% (80.7%-85.4%)                   |
| Yes  | 10.9% (9.6%-12.3%)                    | 14.5% (12.8%-16.4%)                   | 16.8% (14.6%-19.3%)                   |
| <b><i>Daily Social Media Use</i></b>         |                                       |                                       |                                       |
| None   | 7.5% (6.1%-9.1%)                      | 6.4% (5.0%-8.1%)                      | 6.4% (5.2%-7.8%)                      |
| < 1hr  | 25.9% (24.0%-27.9%)                   | 19.6% (17.6%-21.7%)                   | 13.9% (11.9%-16.3%)                   |
| 1 hr to <3hr                                 | 39.3% (37.3%-41.4%)                   | 36.1% (34.0%-38.3%)                   | 33.3% (29.8%-37.1%)                   |
| 3 hr to <5hr                                 | 17.0% (15.3%-18.9%)                   | 21.9% (19.7%-24.2%)                   | 26.3% (24.0%-28.6%)                   |
| 5 hr to <7hrs                                | 6.6% (5.6%-7.6%)                      | 9.8% (8.7%-11.1%)                     | 12.7% (10.8%-14.8%)                   |
| 7 > hrs                                      | 3.7% (3.0%-4.5%)                      | 6.2% (5.2%-7.5%)                      | 7.4% (6.0%-9.1%)                      |

Table 2: Multivariate Main Effects Logistic Regression Predicting Severe Psychological Distress, 2013-2017 OSDUHS (n=15,398)

|                             | Model A:<br>Demographic<br>Variables | Model B:<br>Social<br>Relationships | Model C:<br>Time Spent on<br>Social Media | Model D:<br>Multivariate<br>Model |
|-----------------------------|--------------------------------------|-------------------------------------|---|-----------------------------------|
|                             | AOR (95% CI)                         | AOR (95% CI)                        | AOR (95% CI)                              | AOR (95% CI)                      |
| Wave                        | 1.27***<br>(1.16-1.38)               | 1.24***<br>(1.14-1.36)              | 1.19***<br>(1.08-1.30)                    | 1.18***<br>(1.08-1.30)            |
| Female                      | 3.45***<br>(2.91-4.08)               | 2.99***<br>(2.49-3.59)              | 3.04***<br>(2.56-3.61)                    | 2.64***<br>(2.19-3.20)            |
| Grade                       | 1.18***<br>(1.12-1.25)               | 1.15***<br>(1.10-1.21)              | 1.16***<br>(1.10-1.23)                    | 1.12***<br>(1.07-1.18)            |
| Foreign Born                | 1.09<br>(.73-1.50)                   | 1.11<br>(.71-1.64)                  | 1.13<br>(.77-1.65)                        | 1.13<br>(.75-1.72)                |
| Ethnicity                   |                                      |                                     |   |                                   |
| White                       | Ref                                  | Ref                                 | Ref                                       | Ref                               |
| Black                       | 1.18<br>(.85-1.64)                   | 1.09<br>(.78-1.52)                  | .99<br>(.74-1.34)                         | .93<br>(.69-1.26)                 |
| S/E Asian                   | 1.09<br>(.83-1.43)                   | 1.05<br>(.78-1.42)                  | .97<br>(.73-1.28)                         | .93<br>(.68-1.28)                 |
| S Asian                     | .97<br>(.69-1.37)                    | 1.07<br>(.76-1.50)                  | .94<br>(.66-1.34)                         | 1.04<br>(.73-1.48)                |
| Other                       | 1.48***<br>(1.22-1.80)               | 1.29*<br>(1.04-1.59)                | 1.36**<br>(1.12-1.65)                     | 1.20<br>(.96-1.50)                |
| Family Status               |                                      | .82***<br>(.78-.86)                 |   | .82***<br>(.78-.86)               |
| Close Relationships         |                                      | .51***<br>(.46-.54)                 |   | .50***<br>(.46-.55)               |
| Cyberbullying Victimization |                                      | 2.68***<br>(2.05-3.50)              |   | 2.39***<br>(1.80-3.16)            |
| Time on Social Media        |                                      |                                     |   |                                   |
| None                        |                                      |                                     | .98<br>(.72-1.32)                         | .93<br>(.65-1.32)                 |
| < 1hr                       |                                      |                                     | 1.16<br>(.90-1.54)                        | 1.08<br>(.84-1.40)                |
| 1 hr to <3hr                |                                      |                                     | REF                                       | REF                               |
| 3 hr to <5hr                |                                      |                                     | 1.68***<br>(1.33-2.11)                    | 1.55***<br>(1.24-1.95)            |
| 5 hr to <6hrs               |                                      |                                     | 2.39***<br>(1.91-2.99)                    | 2.08***<br>(1.59-2.71)            |
| 7 > hrs                     |                                      |                                     | 3.24***<br>(2.51-4.18)                    | 2.74***<br>(2.08-3.62)            |

AOR=adjusted odds ratio; \*p<0.05, \*\*p<0.01, \*\*\*p<0.001

## Appendix

Table 1. Descriptive Statistics on Independent Variables, 2013-2017 OSDUHS (n=15,398)

|                                   | <i>Variable Coding</i>    | M (%) | 95% CI      |
|-----------------------------------|---------------------------|-------|-------------|
| <i>Demographic Variables</i>      |                           |       |             |
| Grade                             | Scale (range: 7-12)       | 9.9   | 9.8-10.0    |
| Female                            | Binary (0=male; 1=female) | 48.9% | 47.3%-50.6% |
| Ethnicity                         | Categorical               |       |             |
| White                             |                           | 59.3% | 56.0%-62.6% |
| Black                             |                           | 7.5%  | 5.9%-9.5%   |
| South East Asian                  |                           | 8.2%  | 7.1%-9.4%   |
| South Asian                       |                           | 7.6%  | 6.5%-8.8%   |
| Other                             |                           | 17.4% | 15.8%-19.2% |
| <i>Subjective Family Status</i>   | Scale (range 1-10)        | 7.0   | 6.9-7.0     |
| <i>Close Social Relationships</i> | Likert Scale (range: 1-4) | 3.3   | 3.2-3.3     |
| <i>Cyberbully Victimization</i>   | Binary (0=no; 1=yes)      | 19.9% | 18.9%-21.1% |
| <i>Time Spent on Social Media</i> | Ordinal Measure           |       |             |
| Do not use                        |                           | 26.7% | 25.0%-28.4% |
| < 1 hr daily                      |                           | 17.2% | 16.2%-18.3% |
| 1 hr to < 3 hrs daily             |                           | 19.1% | 17.9%-20.3% |
| 3 hrs to < 5 hrs daily            |                           | 21.6% | 20.4%-23.0% |
| 5 hrs to <7 hrs daily             |                           | 9.7%  | 8.8%-10.6%  |
| 7 > hrs daily                     |                           | 5.7%  | 5.1%-6.5%   |



Table 2: Multivariate Main Effects Logistic Regression Predicting Severe Psychological Distress, 2013-2017 OSDUHS (n=15,398)

|                             | Model A:<br>Demographic<br>Variables<br>AOR (95% CI) | Model B:<br>Social<br>Relationships<br>AOR (95% CI) | Model C:<br>Time Spent on<br>Social Media<br>AOR (95% CI) | Model D:<br>Multivariate<br>Model<br>AOR (95% CI) |
|-----------------------------|--|---|---|---|
| Year                        |  |   |   |   |
| 2013                        | REF  | REF   | REF   | REF   |
| 2015                        | 1.42***<br>(1.17-1.72)                               | 1.43***<br>(1.18-1.74)                              | 1.30**<br>(1.07-1.58)                                     | 1.34**<br>(1.09-1.64)                             |
| 2017                        | 1.62***<br>(1.26-1.93)                               | 1.57***<br>(1.30-1.89)                              | 1.42***<br>(1.18-1.71)                                    | 1.41**<br>(1.16-1.72)                             |
| Female                      | 3.46***<br>(2.92-4.09)                               | 2.99***<br>(2.50-3.59)                              | 3.04***<br>(2.56-3.61)                                    | 2.64***<br>(2.19-3.20)                            |
| Grade                       | 1.18***<br>(1.12-1.25)                               | 1.15***<br>(1.10-1.21)                              | 1.16***<br>(1.10-1.23)                                    | 1.13***<br>(1.07-1.18)                            |
| Foreign Born                | 1.10<br>(.77-1.58)                                   | 1.11<br>(.75-1.65)                                  | 1.13<br>(.77-1.65)  | 1.14<br>(.75-1.73)                                |
| Ethnicity                   |  |   |   |   |
| White                       | Ref  | Ref   | Ref   | Ref   |
| Black                       | 1.18<br>(.85-1.64)                                   | 1.09<br>(.78-1.54)                                  | 1.00<br>(.74-1.35)  | .94<br>(.69-1.30)                                 |
| S/E Asian                   | 1.07<br>(.82-1.41)                                   | 1.04<br>(.77-1.40)                                  | .95<br>(.74-1.26)   | .92<br>(.67-1.26)                                 |
| S Asian                     | .97<br>(.69-1.36)                                    | 1.07<br>(.76-1.49)                                  | .94<br>(.66-1.33)   | 1.03<br>(.73-1.47)                                |
| Other                       | 1.48***<br>(1.23-1.19)                               | 1.29*<br>(1.04-1.60)                                | 1.36**<br>(1.13-1.65)                                     | 1.20<br>(.96-1.49)                                |
| Family Status               |  | .82***<br>(.78-.86)                                 |   | .82***<br>(.78-.86)                               |
| Close Relationships         |  | .51***<br>(.46-.54)                                 |   | .50***<br>(.46-.55)                               |
| Cyberbullying Victimization |  | 2.68***<br>(2.05-3.50)                              |   | 2.38***<br>(1.81-3.15)                            |
| Time on Social Media        |  |   |   |   |
| None                        |  |   | .98<br>(.72-1.32)   | .93<br>(.65-1.32)                                 |
| < 1hr                       |  |   | 1.16<br>(.90-1.54)  | 1.08<br>(.84-1.40)                                |
| 1 hr to <3hr                |  |   | REF   | REF   |
| 3 hr to <5hr                |  |   | 1.67***<br>(1.33-2.10)                                    | 1.55***<br>(1.24-1.95)                            |
| 5 hr to <6hrs               |  |   | 2.38***<br>(1.90-2.99)                                    | 2.07***<br>(1.59-2.70)                            |
| 7 > hrs                     |  |   | 3.22***<br>(2.50-4.17)                                    | 2.73***<br>(2.07-3.61)                            |

AOR=Adjusted Odds Ratio; \*p<0.05, \*\*p<0.01, \*\*\*p<0.001

Table 3: Percent of Ontario Students Reporting Serious Psychological Distress by Explanatory Factors, 2013-2017 OSDUHS (n=15,393)

|                                   | 2013 OSDUHS<br>% (95% CI) | 2015 OSDUHS<br>% (95% CI) | 2017 OSDUHS<br>% (95% CI) |
|-----------------------------------|---------------------------|---------------------------|---------------------------|
| <b>Sex</b>                        |                           |                           |                           |
| Male                              | 5.8% (4.5%-7.4%)          | 7.2% (5.8%-8.8%)          | 9.1% (6.9%-11.9%)         |
| Female                            | 16.3% (14.8%-18.5%)       | 22.2% (19.6%-25.3%)       | 24.8% (22.3%-27.5%)       |
| <b>Grade</b>                      |                           |                           |                           |
| Grade 7                           | 4.2 % (2.5%-7.0%)         | 6.8% (4.2%-10.7%)         | 10.6% (7.7%-14.3%)        |
| Grade 8                           | 10.4% (7.0%-15.2%)        | 12.2% (7.6%-18.8%)        | 12.1% (9.4%-15.5%)        |
| Grade 9                           | 13.7% (10.7%-17.4%)       | 11.2% (8.5%-14.6%)        | 14.0% (9.6%-20.0%)        |
| Grade 10                          | 11.5% (8.6%-15.1%)        | 15.0% (12.5%-18.0%)       | 17.6% (14.2%-21.6%)       |
| Grade 11                          | 11.1% (8.1%-15.2%)        | 19.2% (16.0%-23.0%)       | 19.0% (14.3%-24.6%)       |
| Grade 12                          | 11.4% (8.6%-15.0%)        | 18.3% (14.8%-22.4%)       | 21.7% (16.0%-28.8%)       |
| <b>Ethnicity</b>                  |                           |                           |                           |
| White                             | 9.5% (7.8%-11.7%)         | 13.5% (11.5%-15.8%)       | 15.2% (13.0%-17.7%)       |
| Black                             | 13.3% (8.7%-19.8%)        | 13.8% (8.8%-20.9%)        | 18.7% (10.6%-30.8%)       |
| South East Asian                  | 12.1% (7.8%-18.4%)        | 15.9% (11.9%-20.8%)       | 12.7% (9.7%-16.6%)        |
| South Asian                       | 9.0% (6.0%-13.3%)         | 14.9% (9.2%-23.1%)        | 13.5% (8.4%-20.9%)        |
| Other                             | 15.9% (12.1%-20.7%)       | 17.6% (13.5%-22.6%)       | 22.2% (17.2%-28.3%)       |
| <b>Subjective Family Status</b>   |                           |                           |                           |
| 1 out of 10                       | 25.5% (4.4%-71.4%)        | 54.4% (16.1%-88.1%)       | 56.5% (25.6%-83.1%)       |
| 5 out of 10                       | 19.4% (14.0%-26.2%)       | 22.1% (16.9%-28.2%)       | 26.0% (18.5%-35.2%)       |
| 10 out of 10                      | 5.2% (2.3%-11.3%)         | 14.1% (7.8%-24.1%)        | 18.6% (7.9%-37.7%)        |
| <b>Close Social Relationships</b> |                           |                           |                           |
| Strongly Disagree                 | 48.1% (33.6%-62.9%)       | 47.3% (35.1%-59.9%)       | 55.9% (48.5%-63.1%)       |
| Disagree                          | 26.9% (21.3%-33.3%)       | 30.5% (24.2%-37.6%)       | 35.8% (29.9%-42.2%)       |
| Agree                             | 11.5% (9.6%-13.6%)        | 14.9% (12.5%-17.7%)       | 15.6% (12.4%-19.5%)       |
| Strongly Agree                    | 4.7% (3.6%-5.9%)          | 8.3% (6.1%-11.0%)         | 9.2% (7.7%-11.0%)         |
| <b>Cyberbully Victimization</b>   |                           |                           |                           |
| No                                | 7.3% (6.1%-8.7%)          | 10.5% (9.1%-12.0%)        | 14.2% (10.8%-18.3%)       |
| Yes                               | 25.9% (22.0%-30.2%)       | 30.5% (25.3%-36.1%)       | 27.3% (21.1%-34.5%)       |
| <b>Time Spent on Social Media</b> |                           |                           |                           |
| None                              | 4.4% (2.2%-8.4%)          | 8.9% (5.7%-13.8%)         | 8.9% (6.2%-12.7%)         |
| < 1hr                             | 6.8% (5.0%-9.2%)          | 9.0% (6.6%-12.2%)         | 14.2% (9.4%-20.9%)        |
| 1 hr to <3hr                      | 7.3% (5.8%-9.1%)          | 11.3% (9.2%-13.9%)        | 11.4% (9.4%-13.7%)        |
| 3 hr to <5hr                      | 17.5% (13.6%-22.1%)       | 18.0% (13.7%-23.1%)       | 19.4% (16.7%-22.5%)       |
| 5 hr to <6hrs                     | 25.5% (18.4%-34.1%)       | 21.0% (15.9%-27.1%)       | 27.3% (21.3%-34.1%)       |
| 7 > hrs                           | 34.2% (25.1%-44.6%)       | 33.9% (26.4%-42.3%)       | 26.2% (21.0%-32.2%)       |

Table 4: Differences in gender and social media use and serious psychological distress among Ontario students, 2013-2017 OSDUHS (n=15,398)

|                         | <u>Year of Survey</u> |             |      |             |      |             |
|-------------------------|-----------------------|-------------|------|-------------|------|-------------|
|                         | 2013                  |             | 2015 |             | 2017 |             |
|                         | AOR                   | 95% CI      | AOR  | 95% CI      | AOR  | 95% CI      |
| <i>Female</i>           | 2.44                  | (1.74-3.43) | 2.89 | (2.21-3.77) | 2.59 | (1.88-3.59) |
| <i>Social Media Use</i> |                       |             |      |             |      |             |
| <1 hour                 | REF                   | REF         | REF  | REF         | REF  | REF         |
| 1-3 hours               | .94                   | (.60-1.49)  | .99  | (.63-1.55)  | .75  | (.46-1.20)  |
| 3-5 hours               | 2.18                  | (1.39-3.41) | 1.22 | (.74-2.02)  | 1.03 | (.63-1.67)  |
| 5-6 hours               | 2.67                  | (1.39-3.41) | 1.54 | (.90-2.65)  | 1.62 | (.85-3.08)  |
| 7+ hours                | 3.47                  | (1.85-6.49) | 2.66 | (1.57-4.50) | 1.38 | (.78-2.45)  |

AOR=Adjusted Odds Ratio; \*p<0.05, \*\*p<0.01, \*\*\*p<0.001

The AORs presented here are the multivariate odds ratios after controlling for the effect of age, sex, ethnicity, foreign born status, subjective social status and cyberbully victimization.