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Digital media and depressive symptoms among Chinese adolescents: A cross-sectional study

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ABSTRACT

This study was designed to investigate the association between new digital media and depressive symptoms in a representative Chinese adolescent sample. An existing national data source was used, that surveyed 16,205 Chinese adolescents in 2013–2014. Adolescents who spent more time on screen activities or less time on non-screen activities were significantly more likely to have depressive symptoms. New digital media had a greater association on girls than boys regarding depression. The association of new digital media on depression also showed a decreased trend across economic regions with the lower economically developed western area showing the greatest link between digital media and depression, although this association was still significant in all economic regions.

1. Introduction

According to Wichtowski (2017), approximately 2.34 billion people globally used digital media in 2016, which is predicted to increase even further to 2.95 billion by 2020. In the United States, the internet has become an integral part of life with social media representing a sizable portion of that usage. Recent estimates report that three-quarters of adults used social media to connect with others and that their frequency of use was self rated as "quite frequent" (an average of 8.03 on a 10 point scale of frequency) (Correa et al., 2010). It is the contention here that this same phenomenon holds true in China. With its recent developments in economy and technology, the number of digital media users is in China has been increasing (Jiang et al., 2014). It has been reported that by the end of 2012, the popular new Chinese social media application Sina Weibo, had registered more than 500 million users (Fung et al., 2015). By the end of 2013, the number of internet users in China had exceeded 618 million, and internet users younger than 19 years of age accounted for 26% of that total (Yang and Zhu, 2016). Meanwhile, adolescents also spend more and more time in digital media (Jiang et al., 2014; Ye et al., 2018). The students aged 11–15 years spent more than 2 h per day viewing television and screen time has been growing along with further popularization of digital media (Bucksch et al., 2016). In China, a study also showed that 51.5% of adolescents spend more than 2 h on screen

time per day (Ye et al., 2018). The digital media (as compared to more traditional media such as TV) has profoundly changed the modern life of the average Chinese citizen, who can now shop, navigate to travel, browse information, consume various entertainment media, and communicate with one another in an unprecedented manner (Junco and Cole-Avent, 2010).

On the other hand, access to this digital media may have detrimental outcomes, such as distraction from pertinent tasks in the workplace or school, the spread of false information about individuals, online bullying, and reduced face-to-face social interactions. Therefore, this digital media may ultimately have a negative impact on mental health. Recent research has indicated that those who replace social interaction with virtual interactions may subsequently show increased social barriers and experience a greater sense of loneliness (Song et al., 2014; Bickham et al., 2015). These may ultimately lead to other physical and psychological problems.

Psychopathological issues, such as anxiety, depression, and suicidality, are key mental health issues in childhood and adolescence. These problems are often associated with social environment and functional impairment within the family and at school (Hölling et al., 2008). Although prevalence rates of psychopathological issues vary widely in adolescents depending on the different methods of assessment and study samples (Ryder et al., 2008), previous studies have reported that conduct

problems, depressive symptoms, and suicide in nearly all developed countries have escalated since the Second World War (Collishaw et al., 2004). Moreover, research among students has found that they experience poorer physical health compared to non-student controls, and even greater mental health issues, especially depressive symptom (Stewart-Brown et al., 2000; Voelker, 2016). In China, adolescents are also facing serious psychological difficulties. Specifically, depressive symptoms are highly prevalent in China and increasing, especially among children and adolescents (Lu et al., 2008; Lee et al., 2009; Chen et al., 2014). Recent evidence shows that the prevalence of depressive symptoms among Chinese students ranges from 11.7% to 22.9% (Xu et al., 2014). This represents a significant public health concern, given the established link between depression and suicide in China.

It has been found that daily hassles, cumulative life stress and negative life events, such as poverty, low social support, interpersonal conflicts or punishment, can significantly increase depression (Meadows et al., 2007; Delaney, 2017; Guang et al., 2017). In addition, other social and personal factors can exaggerate depressive symptoms to the extent that they create negative life events and strain on the individual, such as low socioeconomic status, gender, race (Assari, 2017), intimate partner violence victimization, and substance misuse (Kohl and Macy, 2008; Devries et al., 2014). As such, it has been found that one potentially effective means of confronting stress and strain related depression is to seek solace and help within social support networks, such as friends, family and faith (Wheaton, 1985; Chou and Chi, 2001; Soman et al., 2017). Social support is thought to help reduce depression through the provision of emotional substantiation, such as affection and empathy, as well as through encouragement, advice, practical help, and the facilitation of active coping techniques (Al-Gamal et al., 2018).

Although multiple factors contribute to depression, there is growing interest in the potential influence of electronic devices on depressive symptoms (Augner and Hacker, 2012; Kross et al., 2013; Berryman et al., 2017). One reason for this might be that the content of electronic media, such as movies, television and games, may cause lingering fear and anxiety among young people. Children who report experiencing media induced fear are often hard to appease (Cantor et al., 2010). As such, psychological theory has acknowledged that emotion regulation is an important part of mental health, particularly given that prolonged experiences of fear, and the fear of fear, are associated with anxiety and distress (Hoge et al., 2017).

Further, some have argued that the use of social media, more specifically, can increase the likelihood of depression in adolescents (Chou and Edge, 2012; Kross et al., 2013). One reason for this is the growing concern over "social media addiction". According to Huang (2014), 15% of adolescents in China demonstrate social media addiction, which is characterized by the excessive desire for social, informational, and entertainment gratification. This addiction and compulsive use pattern may subsequently lead to the reduction of emotion regulation, thereby increased the risk of depression.

Another reason could be that an increase in digital media reduces face-to-face interactions among users. Evidence shows that digital media increases social isolation (Whaite et al., 2018) and reduces social contact (Hall, 2018). This is consistent with the time displacement argument (Kraut et al., 1998), where time spent on digital media detracts from time spent engaged in true social interactions. As a result, over time they may not establish deep relationships in lieu of superficial "click to friend" accruals, and concurrently overestimate the number of meaningful relationships they truly have while spending less quality time with others while online, which may culminate in a reduction of consequential social interactions that provide social support. This type of social disengagement is not only associated with poor quality of life, but also diminished physical and psychological health (Kraut et al., 1998). This suggests that individuals are typically happier and healthier, both physically and psychologically, when they experience greater social contact rather than engaged in media consumption (Cable et al., 2016). Given that Sagioglou and Greitemeyer (2014) found more negative mood among those who

spent greater time on Facebook, which was mediated by a feeling of not having done anything significant with their time, the lack of meaningful connections with others and subsequent lack of potential personal contact and support might make this time "insignificance" seem even greater and compound the potential for perceived isolation, loneliness, and depressive symptoms.

The potential for harm in this context is exaggerated by the fact that individuals may turn to digital media sources as a way of alleviating their negative mood, stress, anxiety, feelings of isolation, loneliness, and depression but instead encounter situations that have the opposite outcome. This may occur for a number of reasons, including searching or focusing on negative stories, events, or posts which "feeds" their current negative state; upward comparisons of the self where profiles, photos, and posts of others appear more appealing and happier than their own leading to envy or threatened esteem; a perceived relative deprivation where others seem to have more "friends" or "likes" which creates feelings of low social position and value; or a lack of recent comments for their own postings which stimulates perceived isolation, belief in a lack of friends, and negative affect (Blease, 2015; Tandoc et al., 2015; Woods and Scott, 2016). And this digital media can serve a positive function where individuals can seek help from others, in many instances that help is not received or they may actually experience ridicule, taunting, or bullying which exacerbates rather than reduces their discomfort and stress (Daine et al., 2013).

Whether digital media has positive or negative effects depends on the nature of the how it shapes the balance of strong and weak network ties that adolescents maintain (Kraut et al., 1998). Adolescents with strong ties will typically receive greater levels of social support from that network (Wellman and Wortley, 1990). Traditionally, strong social ties were established and supported through physical proximity. However, while social media can expand networks and provide interactions from those far off which would not have been possible prior to the development of social media sites, the lack of physical proximity may account for the generally weaker social ties found through many social media friendships (Kraut et al., 1998). Screen time may need to be increased in particular when an individual feel that they need to share with a wide number of internet "friends", but may be ironically less likely to deepen those friendship ties as intended. As such, contact and interactions may be briefer, shallow, superficial in nature, less intimate and hence less supportive, which may increase depressive symptoms among adolescent.

Empirical support for this phenomenon is considerable and growing. Notably, using a nationally representative surveys of adolescents in the United States, Twenge et al. (2017) examined the trend of depressive symptoms, suicide-related outcomes and suicide rates among adolescents in grades 8 through 12 in relation to digital media use. They found that adolescents who spent more time on digital media activities, including using social media, were significantly more likely to have high depressive symptoms or to have at least one suicide-related outcome, while those who spent more time on non-screen activities, including in-person social interactions, were less likely to experience these outcomes. In addition, the correlations between psychopathological issues and digital media screen activities were higher among females than among males. These results demonstrate a clear pattern linking screen activities with higher levels of depressive symptoms and suicide-related outcomes compared to non-screen activities (Twenge et al., 2017).

Although several studies have examined the impact of digital media on depressive symptoms in adolescents, relatively few have focused on Chinese adolescents. There are numerous and significant differences in economy, culture and education between China and western countries, as well as clear differences in adolescent depression and suicide behavior (Zhang et al., 2017). Therefore, it may not be appropriate to make inferences about how digital media impacts negative outcomes among Chinese adolescents from findings that utilize samples from western countries.

The first goal of the present study was to investigate potential factors that might impact depression among Chinese adolescents. Specifically,

comparisons will be made between traditional screen time (watching TV), digital media screen time (online), non-screen time (sporting, reading and cultural activities) and the experience of depressive symptoms among adolescents. In addition, the present study will examine the potential influence of gender, grade level in school, hometown, number of children in the family and socioeconomic status on depressive symptoms. The second purpose was to determine if media screen time and non-screen time had unique influences on depressive symptoms among adolescents in areas of varying economic standing in China – specifically comparing Western China (low standing), Central China (moderate standing), and Eastern China (high standing).

2. Method

2.1. Data source

The data used in this study was from the 2013–2014 China Education Panel Survey (CEPS), which is part of a large scale panel data collection through Renmin University of China. Based on the 2013–2014 academic year, CEPS started with two groups (grade 7 and grade 9), comprising an age range from 12 to18. A multistage probability sampling method was used to select 28 county-level units randomly from across the country. Subsequently, 112 schools and 438 classes were randomly selected from those county-level units, and all students in the selected classes were sampled.

After cleaning date, the number of participants entered into the model was 16205, with 8150 (50.29%) boys, 8055 (49.71%) girls, 8161 (50.36%) in grade 7 and 8044 (49.64%) in grade 9.

2.2. Measurements of the variables used in this study

2.2.1. Depression

Depressive symptoms were measured using the question "Have you felt depressed over the past seven days?" (Cai et al., 2017) The answer had four options: "never" = 1, "little" = 2, "sometimes" = 3, or "usually" = 4. Higher ratings represented more serious depression.

2.2.2. Non-screen time

Non-screen time was measured using three separate questions based on unique activities: sports/exercise, reading, and cultural activities. Time spent on sports activities was measured using the question "Last weekend, what was your average time spent on sports activities per day." Response choices were recoded as follows: "never" = 1, "1 hour" = 2, "2 hours" = 3, "3 or more hours" = 4. Reading hours was identified using the question "Last weekend, what was your average time spent reading per day." Response choices were recoded as follows: "never" = 1, "1 hour" = 2, "2 hours" = 3, "3 or more hours" = 4. Finally, cultural activities was measured using the question "How often do you visit museums, zoos, science museums with classmates?" Response choices were recoded as follows: "never" = 1, "once a year" = 2, "once a half year" = 3, "once a month or more" = 4. Higher scores one each item indicated greater time spent on non-screen cultural activities.

2.2.3. Traditional screen time

The use of traditional media screen time was measured using two questions based on TV viewing. The first question asked about viewing time through the question "Last weekend, how often did you watch TV on average per day?" Response choices were recoded as follows: "1 hour or less" = 1, "2 hours" = 2, "3 or more hours" = 3. Higher scores indicated greater time spent on traditional screen activities. The second identified parental control of TV viewing using the question "Are you parents strict with you of watching TV?" Response choices were recoded as follows: "lax" = 1, "average" = 2, "strict" = 3. A lower score was used to indicate greater traditional screen time usage.

2.2.4. Digital media

The use of digital media was measured using the question "Last weekend, how often did you use the Internet or play computer games on average per day?" Response choices were recoded as follows: "1 hour or less" = 1, "2 hours" = 2, "3 or more hours" = 3. Higher scores indicated greater digital media.

2.2.5. Demographic moderators and controls

The demographic variables in the questionnaire included gender (boy = 1; girl = 2), grade (grade 7 = 0; grade 9 = 1), hometown (rural = 1; urban = 2), only-child (yes = 1; no = 2), socioeconomic status (poor = 1; average = 2; rich = 3) and region (1 = eastern area; 2 = central area; 3 = western area). Based on previous studies, these demographic variables were also important variables in explaining depression (Assari, 2017). Table 1 contains descriptive statistics for all variables.

2.3. Statistical methods

The main analyses in the present research included bi-variate analysis and linear regression analysis. In the bi-variate analysis, the associations between all samples and depression were examined. In the regression analysis, non-screen time, traditional media screen time, and digital media were used as predictors of depression. Separate models were also examined for boys and girls separately. The sample was further divided into categories (western area, central area and eastern area) that reflect varying levels of economic development in China. Through bi-variate analysis and linear regression analysis, we examined the relationships between media screen time and non-screen time and depression in adolescents across these economic regions.

3. Results

3.1. Bi-variate analyses

Overall, 1351 (8.34%) of the 16205 participants reported that they "usually" had feelings of depression in the past seven days, 3430 (21.17%) thought they "sometimes" felt depression in the past seven days, while 4906 (30.27%) said they had "little" feelings and 6518 (40.22%) reported that they "never" felt depression in the past seven days. This indicates that a fairly large proportion of students in China experience depressive symptoms.

Self-reported depression was associated with a number of characteristics (see Table 2): year in school, being an only-child, SES and region were all significant associated with depression ($p < 0.001$). Further, there were clear differences in depression when comparing across the time

Table 1
Descriptive statistics of the sample (N = 16,205).

Variable	Mode		Value
Hometown	1.46	.50	1 = Rural; 2 = Urban
Only-child	1.56	.50	1 = Yes; 2 = No
SES	2.00	.49	1 = Poor; 2 = Average; 3 = Rich
Region	1.70	.84	1 = Eastern Area; 2 = Central Area; 3 = Western Area
Sports and exercise	1.78	1.00	1 = Never; 2 = 1 hour; 3 = 2 hours; 4 = 3 or more hours
Reading hours	2.03	1.03	1 = Never; 2 = 1 hour; 3 = 2 hours; 4 = 3 or more hours
Cultural activities	1.90	.96	1 = Never; 2 = Once a year; 3 = Once a half year; 4 = Once a month or more
TV watching hours	1.63	.82	1 = 1 hour or less; 2 = 2 hours; 3 = 3 or more hours
Parental control of TV watching	2.35	.66	1 = lax; 2 = average; 3 = Strict
Online hours	1.47	.76	1 = 1 hour or less; 2 = 2 hours; 3 = 3 or more hours
Depressive symptom	1.98	.97	1 = Never; 2 = Little; 3 = Sometimes; 4 = Usually

Table 2
Relevant variables on depressive symptoms.

Independent variables	Sample (N = 16205)	Depression (Column %)				P Value
		Never (n = 6518)	Little (n = 4906)	Sometimes (n = 3430)	Usually (n = 1351)	
Screen activities						
TV watching hours						<.001
1 hour or less	9554 (58.96%)	61.66	56.75	57.32	58.11	
2 hours	3150 (19.44%)	18.75	20.69	19.91	17.02	
3 or more hours	3501 (21.60%)	19.59	22.56	22.77	24.87	
Parental control of TV watching						<.001
Lax	1645 (10.15%)	9.54	9.38	10.64	14.66	
Aaverage	7238 (44.67%)	42.24	46.56	46.97	43.67	
Strong	7322 (45.18%)	48.22	44.07	42.39	41.67	
Online hours						<.001
1 hour or less	11253 (69.44%)	71.91	69.83	67.32	61.51	
2 hours	2277 (14.05%)	13.64	13.82	14.75	15.10	
3 or more hours	2675 (16.51%)	14.45	16.35	17.93	23.39	
Non-Screen activities						
Sports and exercise						<.001
Never	8745 (53.96%)	50.49	54.95	55.36	63.58	
1 hour	3836 (23.67%)	25.47	24.03	22.24	17.58	
2 hours	2066 (12.75%)	14.05	11.84	12.92	9.33	
3 or more hours	1558 (9.61%)	9.99	9.17	9.48	9.77	
Reading hours						<.001
Never	6384 (39.40%)	36.30	37.93	43.24	49.89	
1 hour	4961 (30.61%)	32.17	32.55	27.20	24.72	
2 hours	2856 (17.62%)	18.96	17.53	17.08	12.88	
3 or more hours	2004 (12.37%)	12.57	11.99	12.48	12.51	
Cultural activities						<.001
Never	7191 (44.38%)	39.18	45.94	50.00	49.44	
Once a year	4536 (27.99%)	28.37	28.64	26.86	26.72	
Once a half year	3305 (20.39%)	23.17	19.69	17.43	17.10	
Once a month or more	1173 (7.24%)	9.28	5.73	5.71	6.74	
Controlled variable						
Gender						.382
Boy	8150 (50.29%)	50.72	48.84	50.44	53.15	
Girl	8055 (49.71%)	49.28	51.16	49.56	46.85	
Year in school						<.001
Seventh grade	8161 (50.36%)	56.01	49.96	43.91	40.93	
Ninth grade	8044 (49.64%)	43.99	50.04	56.09	59.07	
Hometown						.051
Rural	8699 (53.68%)	50.61	57.79	55.92	47.89	
Urban	7506 (46.32%)	49.39	42.21	44.08	52.11	
Only-child						<.001
Yes	7191 (44.38%)	49.11	39.87	40.79	47.00	
No	9014 (55.62%)	50.89	60.13	59.21	53.00	
SES						<.001
Poor	1962 (12.11%)	8.88	12.64	14.84	18.80	
Average	12274 (75.74%)	77.08	76.74	74.75	68.17	
Rich	1969 (12.15%)	14.04	10.62	10.41	13.03	
Region						<.001
Eastern area	8876 (54.77%)	61.35	50.96	49.50	50.26	
Central area	3393 (20.94%)	18.61	24.07	21.98	18.13	
Western area	3936 (24.29%)	20.04	24.97	28.51	31.61	

spent on media screen time versus non-screen time. Specifically, students with greater screen time reported greater levels of depression than those with elevated non-screen time. For example, nearly 25% of adolescents with 3 or more hours of either online screen time or TV time per day reported being "usually" depressed, whereas less than 10% who spent 3 or more hours on non-screen activities per day reported being "usually" depressed.

3.2. Linear regression analysis

Regression analyses were also run to compare depression across traditional screen time, digital media, and non-screen time (Table 3). Model 1 only included the demographic control variables and showed that grade, being an only-child, SES and region had significant effect on adolescent depression ($p < 0.001$). Adolescents in ninth grade were significantly more likely to have depression, as were those who had siblings and had lower SES. Model 2 included non-screen activities, traditional screen activities, new screen activities and control variables. It was found that non-screen time, traditional screen time, and new screen

time all significantly predicted depression ($p < 0.01$). Specifically, greater TV screen time (both hours watching and lax parental control) and online screen time were linked to greater depression, while greater frequency of sports activities, reading, and cultural activities had a protective impact on adolescent depression (Fig. 1).

Models 3 and 4 represent regression analyses for boys and girls respectively. The results showed that girls were more likely affected by media screen time than boys. For example, more lax parental control of TV watching was significantly related to increased depression among girls ($p < 0.01$) but not boys ($p > 0.05$). Similarly, reading hours was linked to decreased depression among girls ($p < 0.01$) but not among boys ($p > 0.05$). Further, elevated TV and online screen time were both more strongly linked to elevated depression, while all three non-screen activities were more strongly associated with decreased depression among girls compared to boys.

Throughout China, there are significant differences in economic development between eastern regions and western or inland provinces (Pratt, 2014). Due to policies and other reasons, the level of economic

Table 3
Linear regressions of screen activities and non-screen activities on depression symptoms.

Variable	Model 1 (Total sample)	Model 2 (Total sample)	Model 3 (Boys)	Model 4 (Girls)
Controlled variable				
Gender	−.029	.002		
Grade	.204***	.181***	.184***	.176***
Hometown	.028	.040*	.040	.040
Only-child	.071***	.051***	.040	.062*
SES	−.128***	−.111***	−.120***	−.099***
Region				
Central area	.065***	.044*	.069*	.020
Western area	.216***	.233***	.238***	.228***
Non-screen activities				
Sports and exercise		−.030***	−.023*	−.039**
Reading hours		−.028***	−.023	−.034**
Cultural activities		−.055***	−.053***	−.057***
Traditional screen activities				
TV watching hours		.027**	.022	.031*
Parental control of TV watching		−.041***	−.031	−.051**
Digital screen activities				
Online hours		.098***	.087***	.120***
Sample	16205	16205	8150	8055
Pseudo R^2	.027	.041	.039	.045

Note. *-$p<0.05$, **-$p<0.01$, ***-$p<0.001$.
Model 1 includes control variables from all samples.
Model 2 includes all variables from all samples.
Model 3 includes all variables in the male samples.
Model 4 includes all variables in the female samples.

development is getting lower and lower from the east to the west. For example, from 1978 to 2000, eastern regions experienced an average economic growth rate of 14%, whereas western regions' average annual growth rate was 6.9% (Jackson, 2006).

In order to determine whether the impact of media screen time and non-screen time on depression were different across varying economic level areas, the sample was divided into three according to the survey area: western (lowest economic level), middle (moderate economic

level), and eastern (highest economic level). According to Table 4 a significant difference in depression was found between the three economic regions ($p < 0.001$), with the highest ratings in the western and lowest ratings in the eastern area. Differences were also evident in select non-screen and screen time activities. Specifically, for non-screen activities, hours spent reading was lowest in the central but greatest in the western area, while engaging in cultural activities was lowest in the central and greatest in the eastern area. For traditional screen time, parental controls were the most lax in the central area, but most strict in western area. Online screen time was greatest in the eastern and lowest in the western area.

Linear regression analyses were conducted to examine the impact of traditional screen time, digital media, and non-screen time on adolescent depression across the three different economic level areas. The three models represent the regressions in the western, central, and eastern areas (see Table 5) and show some similarities and differences in predictors of depression. In the least economically developed western area, depression was linked to lax parental TV controls and elevated online screen time, but was buffered by increased time in sports and exercise as well as time spent in cultural activities. In the moderate economically developed central area, depression was predicted only by online screen time, and reduced by elevated reading and cultural activity time. In the most economically developed eastern area, depression was greater among those with elevated TV time, lax parental TV control, and online screen time, but was reduced with greater sports and exercise time and cultural activities.

When comparing across the three regions, it appears that digital media time – specifically time spent online – had the greatest and most consistent impact on depression. The OR shows that this influence increased with decreased economic development from the eastern to the western areas. The influence of traditional media time on depression was not as strong as digital media, and was inconsistent across the areas. For example, TV time was related to depression only in the east while lax parental TV control was significant in the eastern and western areas, but more so in the western area. Non-screen activities were also somewhat inconsistent. Specifically, time spent on cultural activities significantly reduced depression in all three areas but more so in the eastern than the central than the western areas. Sports and exercise buffered depression in the western area to a greater extent than the eastern area, but not at all in
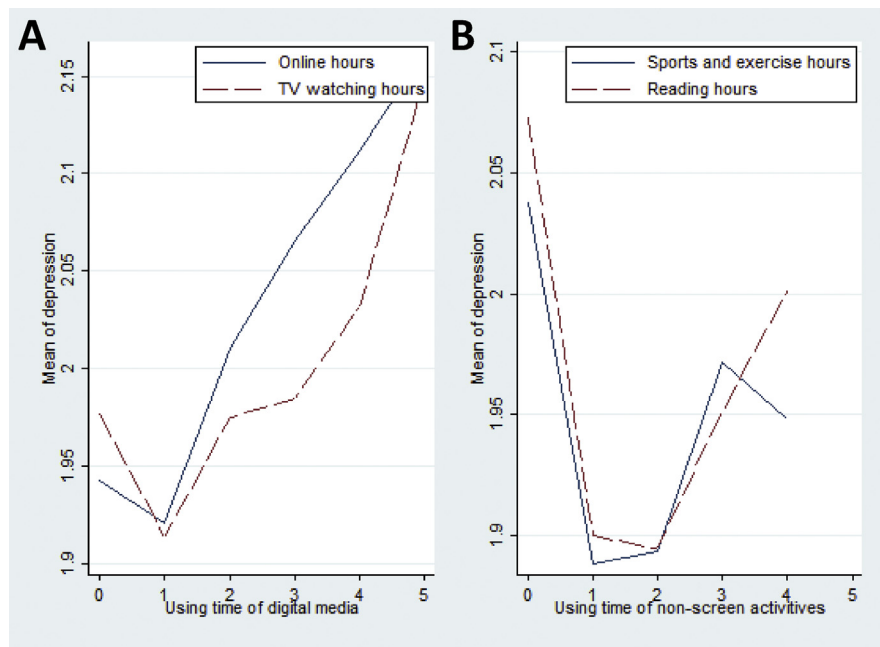

Fig. 1. (a) the relationship between hours a day of digital media use and depression and (b) the relationship between hours a day of non-screen activities use and depression. Note. Demographic variables have been controlled.

Table 4
Variables distribution in each of the three major China areas.

Variable	The western area (n = 3936)		The central area (n = 3393)		The eastern area (n = 8876)		P-value
	mean	S.D.	mean	S.D.	mean	S.D.	
Depression	2.134	.998	2.009	.932	1.894	.968	65.86***
Sports and exercise	1.816	1.020	1.638	.933	1.819	1.014	2.26
Reading hours	2.072	1.046	1.920	1.011	2.052	1.030	2.93*
Cultural activities	1.939	1.051	1.479	0.807	2.093	1.029	68.97***
TV watching hours	1.598	.799	1.717	.851	1.604	.808	0.81
Parental control of TV watching	2.411	.630	2.319	.654	2.335	.667	17.4***
Online hours	1.351	.674	1.424	.730	1.541	.800	93.42***

Note. *-$p<0.05$, **-$p<0.01$, ***-$p<0.001$.

Table 5
Linear regressions of depressive symptoms on screen activities and non-screen activities for each of the three major China areas.

Variable	Western Area	Middle Area	Eastern Area	All Area
Controlled variable				
Gender	−.008	−.030	.019	.000
Grade	.203***	.199***	.167***	.183***
Hometown	−.022	.040	.062**	.056**
Only-child	.051	.042	.046*	.059***
SES	−.138***	−.127***	−.088***	−.127***
Non-screen activities				
Sports and exercise	−.057***	−.018	−.021*	−.028***
Reading hours	−.031	−.039*	−.023*	−.026***
Cultural activities	−.046**	−.052*	−.060***	−.057***
Traditional screen activities				
TV watching hours	−.016	.032	.045***	.028**
Parental control of TV watching	−.062*	.007	−.050***	−.035**
Digital screen activities				
Online hours	.130***	.093***	.090***	.087***
Sample	3936	3393	8876	16205
Pseudo R²	.040	.029	.031	.032

Note. *-$p<0.05$, **-$p<0.01$, ***-$p<0.001$.

the central area, whereas reading hours buffered depression only in the central area.

4. Discussion

Overall, the results of the present study show that greater media screen time is related to depression among Chinese adolescents, although online screen time is a stronger predictor. In fact, the influence of traditional screen time was more inconsistent in the present sample, with TV time predicting depression only in the eastern area and lax parental TV control buffering depression only in the eastern and western areas. Further, the present study highlights that non-screen time can decrease depression, although the exact nature and strength of this relationship varies across economic regions. None the less, as a whole, these findings supported the present hypotheses and are in line with outcomes found in western samples (Augner and Hacker, 2012; Twenge et al., 2017).

With respect to the heightened impact of digital media time on depression, there is little doubt that most individuals have become increasingly dependent on electronic information delivery, communication, and social media, which may result in less time spent in face-to-face social interactions. In this respect, virtual contact and communication may paradoxically increase a sense of loneliness and isolation as these forms of contact can often become less personal and intimate (Kim et al., 2009). As result this pattern may then increase negative mood, instigate anxiety, decrease self-esteem and feelings of social worth, and ultimately increase depression. Add to this that increased use of digital media to alleviate these problems may, in fact, increase addiction to electronic devices and communication, as well as reduce sleep time and quality, which can impact physical and mental health (Hysing et al., 2015).

Digital media typically replaces time spent in cultural activities and interpersonal transactions with solitary time and seclusion. The strong personal ties that are created through personal and intimate contact do not develop to the same degree in these instances, which reduces social support that is crucial in combatting depression. This is evident in the current sample where, in all three economic regions, increased social interactions were associated with lower levels of depression. In a similar way, engaging in sports/exercise – which often involves social interactions among adolescents – was linked to lower depression in the eastern and western areas of the present sample. Therefore, digital media can be considered as an important potential source that contributes to depression – more so than traditional media TV screen time – but non-screen activities can potentially buffer against depression in Chinese adolescents.

At the same time, it is also important to recognize that with the development of science and technology, the dependence on electronic equipment will likely continue to grow (Jiang et al., 2014; Ye et al., 2018). With the continuous growth in the electronic media industry and the ever improvement in the technological capabilities of devices, they will undoubtedly remain a vital part of life. As such, there are many advantages to digital media opportunities that cannot be dismissed or ignored, such as the ability to search for information, to assist in daily activities, to provide rapid communication (especially over longer distances) in an unprescidented manner. In fact, the present data shows that depressive symptoms were less common in the eastern area where digital media usage was greatest. One possible reason may be that, given the higher economic standing in the east of China, adolescents in that region may have greater opportunities to own electronic devices, services may be more readily available, and their use may be more common and ingrained in that subculture. In contrast, the impact of digital media on depression was greatest in the west, despite the lowest frequency of use. This may be reflective of the newness or novelty of such technology given the relatively lower economic standing of the region. There may be fewer opportunities to own such devices, fewer services, less experience by parents or caregivers (who may not understand how the technology is/can be used in a negative way, or put less constraints as they do on TV time), or poorer understanding by the users themselves on the potential dangers of digital media.

Interestingly, the number of hours watching TV was only predictive of depression among those in the eastern region. One reason for this might be that living in more economically developed areas, which typically contain larger cities, likely requires parents to spend more time working outside of the home. This likely leads to less time with the children leaving them feeling more isolated for longer periods of time. With parents out of the home more often there may be less monitoring, which was shown in the present data to lessen depression, so these adolescents spend more time consuming traditional media and less time in contact with others in face-to-face interactions. In China this may be particularly true in families of migrant workers who have moved from rural to urban areas which are more crowded, stressful, and impersonal, and as such adolescents from these families may feel even more cut off from family/ friend networks and community services, which would exaggerate perceived loneliness and isolation. TV may then become an ineffective means of coping with their strain, ultimately leading to elevated depression.

The present study also showed that digital media had a greater impact on depression among girls compared to boys. Overall this is consistent with the evidence showing greater depression and suicide among women compared to men in China. However, the fact that the non-screen activities, and stricter traditional media controls, buffered depression in girls so consistently is an encouraging outcome. This may potentially assist future approaches to addressing depression and suicide among this population, to the extent that the encouragement of face to face interactions, and activities outside of media consumption, may improve social ties, provide social support, deepen relationships, improve self-esteem, and promote greater mental health in the end. The fact that sports/exercise and cultural activities were also related to lower depression among boys is also encouraging, although stricter TV controls was not related to lower depression among boys. This might be due to socialization differences where girls in China are raised to be more "obedient" to authority. But none the less, promotion of more non-screen activities among boys should serve to help lessen the potential for depression and suicide among this population in China.

4.1. Limitations

Because the current data is a cross-sectional, and did not utilize experimental methods to control and observe the relevant variables, the direction of the reported relationships are not definitive (Heffer et al., 2019). One alternate explanation could be that adolescents may feel depression for unknown reasons, and these adolescents are likely to spend more time on screen activities as a means of coping. Most likely the relationship between media screen time and depression reflects a self-perpetuating cycle (Hysing et al., 2015) where the two are reciprocally determined. However, the current explanations are in line with previous research on this topic which have used a variety of research methods across various samples. For example, many studies have linked electronic equipment use with declines in subjective mood and life satisfaction (Shaw and Gant, 2004; Chou and Edge, 2012; Andreassen et al., 2016), as well as the stimulation of other mental health issues Waldman et al. (2006). Romano et al. (2013) also proved that the subset of those individuals who then experience a negative impact on positive mood after internet exposure may then be triggered into further escape-motivated internet use, suggesting a possible mechanism maintaining internet use in internet addicts. Such studies suggest that at least some of the causal arrow points from social media use to mental health issues (Twenge et al., 2017).

It should also be noted that the present study was limited in the number of variables considered in the models regarding the predictors of depression, which is undoubtedly more complex than any single study can identify. For example, some research has found that media screen time can reduce sleep time which may then impact longer term physical and psychological well, including depression (Zhai et al., 2015). Similarly, the present study did not examine specific emotions stimulated by screen time, including positive emotions, which might alter (either positively or negatively) the development of depression in adolescents. None the less, the present study does have important implications for understanding how digital media can impact depression among Chinese adolescents and alternately how increasing social interactions through non-screen time can buffer these negative outcomes. Further, this pattern is similar to adolescents in other cultures from previous research, which might provide new directions for research and treatment of Chinese adolescent depressive symptoms.

Declarations

Author contribution statement

Jie Zhang: Conceived and designed the experiments; Wrote the paper.
Hang Hu: Performed the experiments; Wrote the paper.
Dwight Hennessy: Contributed reagents, materials, analysis tools or data; Wrote the paper.
Sibo Zhao: Analyzed and interpreted the data.
Yiwen Zhang: Performed the experiments.

Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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