

AKADÉMIAI KIADÓ

Journal of Behavioral Addictions

10 (2021) 4, 953-966

DOI:

10.1556/2006.2021.00069

© 2021 The Author(s)

FULL-LENGTH REPORT



How COVID-19 stress related to schooling and online learning affects adolescent depression and Internet gaming disorder: Testing Conservation of Resources theory with sex difference

RUI SHE , KEIMAN WONG, JIAXI LIN, KINLONG LEUNG, YOUMIN ZHANG and XUE YANG*

Centre for Health Behaviours Research, JC School of Public Health and Primary Care, Faculty of Medicine, The Chinese University of Hong Kong, Hong Kong, China

Received: March 10, 2021 • Revised manuscript received: May 30, 2021; August 4, 2021 • Accepted: September 13, 2021

Published online: October 19, 2021

ABSTRACT

Background and aims: The COVID-19 pandemic poses a grim challenge to adolescents' daily life, including schooling and learning, which has great impacts on their mental and behavioral health. This study aimed to test the roles of stress related to schooling and online learning during COVID-19 (COVID-19 stress) in depression and Internet gaming disorder (IGD) among adolescents and the potential mediators of social support, academic stress, and maladaptive emotion regulation based on the framework of Conservation of Resources theory. Sex differences in these associations were further examined. **Methods:** A school-based survey was conducted among Chinese adolescents in 13 secondary schools in Hong Kong ($n = 3,136$) from September to November 2020 (48.1% males; mean age = 13.6 years old) using stratified random sampling. **Results:** The prevalence of probable depression and IGD was 60% and 15%, respectively. Results of structural equation modeling indicated that the proposed model fit the data well ($\chi^2/df = 7.77$, CFI = 0.92, IFI = 0.92, RMSEA = 0.05). COVID-19 stress was positively and indirectly associated with both depression and IGD through social support, academic stress, and maladaptive emotion regulation. Multi-group analyses identified that the associations between COVID-19 stress and academic stress, between academic stress and depression, and between social support and depression were stronger among females compared to males. **Discussion and conclusions:** Findings highlight the roles of academic stress, poor social support, maladaptive emotion regulation, and sex to understand how disruption and stress caused by COVID-19 increases adolescent depression and IGD. Psychosocial interventions based on these factors are highly warranted.

KEYWORDS

COVID-19, online learning, Internet gaming disorder, mental distress, Conservation of Resources theory

INTRODUCTION

The current coronavirus 2019 (COVID-19) pandemic has swept through the globe quickly and indiscriminately. Governments of many regions including Hong Kong have taken a series of measures in response, such as lockdowns, social distancing, and home confinement. The pandemic poses a grim challenge to many domains of a functioning society, including health care services, tourism, entertainment services, and educational institutions (Xiong et al., 2020). Profound impacts are found not only on individuals' health but also on how they learn, work, and live. One of the utmost challenges created by COVID-19 is the adaptation of education systems that were built around physical schools. At the worst time of the pandemic, more than 188 countries, encompassing around 91% of enrolled learners worldwide, closed their schools to try to contain the spread of the virus (OECD, 2020). School

*Corresponding author.

E-mail: sherryxueyang@cuhk.edu.hk

closures have affected more than 1.5 billion children and adolescents around the world (UNESCO, 2020). Institutions have been providing online courses and running e-classes to maintain learning progress among students. The disruption to regular life and schooling, online learning environment, and long period of isolation due to the COVID-19 pandemic can be sources of stress and pose great challenges to adolescents' mental, behavioral, and social well-being. They are particularly vulnerable because of their higher needs for social connections, and emotional and tangible support from peers, teachers, and other significant others at the developmental stage, as well as the lack of proper emotional reactions and coping strategies (Magson et al., 2021). It has been suggested that compared to adults, this pandemic may have longer-term and greater adverse effects on children and adolescents (Wang, Pan, et al., 2020). However, less attention has been paid to this vulnerable group (Ma et al., 2020).

COVID-19 and mental and behavioral problems of adolescents

Schooling and online learning-related stress due to the COVID-19 pandemic (referred to as COVID-19 stress) is bound to have a profound impact on adolescents' mental and behavioral health (Ellis, Dumas, & Forbes, 2020). Prevalent mental disorders among adolescents during the COVID-19 pandemic have been reported; the prevalence of probable depression and anxiety among Chinese adolescents ranged from 11.8% to 43.7% and 18.9%–37.4%, respectively (Chen et al., 2020; Duan et al., 2020; Zhou, Zhang et al., 2020). A longitudinal study conducted among Canadian adolescents observed significant increases in depressive and anxious symptoms after the implementation of control measures and online learning in response to pandemic (Magson et al., 2021). COVID-19-related worries, online learning difficulties and increased conflict with parents predicted increases in mental health problems, whereas feeling socially connected during the lockdown protected against poor mental health (Magson et al., 2021).

Internet gaming disorder (IGD) is another mental disorder and behavioral problem that may have increased during the COVID-19 pandemic and it is a common comorbidity of depression (Liu et al., 2018). IGD is defined as "persist and recurrent use of the Internet to engage in games, often with other players, leading to clinically significant impairment or distress" (American Psychiatric Association, 2013). During the pandemic, adolescents are likely to rely on Internet games for entertainment and social interaction with peers because of the impracticability of other hobbies and social activities, while parents may have failed to provide adequate supervision and guidance for their children (Ko & Yen, 2020). Internet gaming also acts as an escape and coping strategy for adolescents from the stressful real world (Kökönyei et al., 2019). Therefore, IGD risks may have increased to relieve stress associated with schooling and online learning during COVID-19. There was evidence showing that the frequency of Internet gaming and severity

of IGD had increased during the COVID-19 pandemic among Chinese (Dong, Yang, Lu, & Hao, 2020; Teng, Pontes, Nie, Griffiths, & Guo, 2021) and German adolescents (DAK Gesundheit, 2020), while other studies reported non-significant change in Internet gaming time during the school suspension (Chen, Chen, Pakpour, Griffiths et al., 2021). Studies also indicated plausible bidirectional associations between Internet-related behaviors including IGD and psychological distress (e.g., depression and insomnia) among adolescents before and during the pandemic (Chen, Chen, Hou et al., 2021; Chen, Chen, Pakpour, Lin, & Griffiths, 2021c; Fazeli et al., 2020; Lin, Potenza, Broström, & Pakpour, 2020; Teng et al., 2021). Given their high vulnerability to traumatic stress, depression, and IGD, adolescents' mental and behavioral health should be appropriately monitored in the midst of the impact of COVID-19.

Proposed mediators based on Conservation of Resources theory

It is important to identify the psychosocial mechanisms of how COVID-19 stress related to adolescents' schooling and online learning would increase the risk of depression and IGD. It is because such mechanisms are modifiable, and can be used to design interventions to alleviate the detrimental consequences of COVID-19. The present study explored three potential mediators that represented losses or gains of various psychosocial resources affected by COVID-19, including academic stress, emotion regulation, and social support, based on the framework of Conservation of Resources (COR) theory. The COR theory is a well-recognized psychological theory of stress and trauma (Hobfoll, 1989). According to COR, people are motivated to retain, protect, and build various resources to survive and maintain well-being. Resources are anything that a person values, such as objects (e.g., house, phone), conditions (e.g., stable employment, low stress), personal characteristics, (e.g., optimism, hope, positive coping), energies (e.g., knowledge), and social resources (e.g., social support, social connection) (Otto, Hoefsmit, van Ruysseveldt, & van Dam, 2019). Threatened or actual depletion of such resources are central mechanisms in the development of psychological distress during traumatic events and can have detrimental health-related consequences (e.g., depression) (Hobfoll, 1989). Individuals who are experiencing resource loss may also try to distract or escape from stress by engaging in problematic behaviors (Holmgreen, Tirone, Gerhart, & Hobfoll, 2017), such as IGD.

Relatedly, the COVID-19 pandemic brought huge life transformations for adolescents and engenders myriad losses in social resources (e.g., family and peer support) and personal resources (e.g., stress status and coping capacity). Specifically, school closures have a significant impact on adolescents' socialization with peers and teachers, and reduce social support (Duan et al., 2020). The pandemic and school closure also dramatically changed family routines and rituals, such as reallocation of household tasks, caregiver burden, and renegotiation of rules about home confinement



and schooling (Prime, Wade, & Browne, 2020). Although the time spent at home has increased, these disruptions may have led to increased family tension and there are reports of increased interparental conflicts during the pandemic (Larsen, Helland, & Holt, 2021; Magson et al., 2021). The lockdown may further isolate adolescents from their extended family or divorced/separated parents. As disruptions and stress related to schooling felt by parents may cascade down to children, adolescents may receive less family support, which is expected to be reflected in adolescents' misbehaviors and psychological wellbeing.

Also, limited access to academic resources (e.g., closed libraries and remote teachers' support) and poor execution of online teaching may substantially increase students' academic stress. For example, a study in university students reported that many students have expressed concerns towards school closures and online learning, such as uncertainty regarding exams, start and end dates of the semester, and their assessments (Moawad, 2020). Academic excellence is highly valued in Hong Kong culture and people in Hong Kong believe that entering an elite university leads to excellent job opportunities (Chan et al., 2017). Thus, academic stress might be especially prominent during school closure in Hong Kong. In addition, extensive cross-sectional and longitudinal studies before COVID-19 have shown that inadequate social support and academic stress were significant risk predictors of depression and IGD among adolescents (Jeong, Ferguson, & Lee, 2019; Schraml, Perski, Grossi, & Simonsson-Sarnecki, 2011; Plante, Gentile, Groves, Modlin, & Blanco-Herrera, 2018). Thus, it is expected that stress related to schooling and online learning would be associated with higher academic stress and lower social support, which in turn increase the risk of depression and IGD among adolescents.

Coping and emotional regulation is a well-documented personal resource that can determine the psychological and behavioral responses to stress (Netczuk-Gwoździewicz, 2017), which may be another important mediator between COVID-19 stress and depression/IGD. Maladaptive emotional regulation is particularly common if an individual possesses low control over modifying the stressor, such as a traumatic event (Lazarus & Folkman, 1987). Particularly, rumination (i.e., passive and repetitive focus on the causes and consequences of one's distress), catastrophizing (i.e., overestimating the negative consequences of an event), and self-blame (i.e., thought to blame self for something one has undergone) were found to be common during COVID-19 (Rettie & Daniels, 2020; Ye, Wu et al., 2020), and had strong associations with depression among young adults and adolescents in both pre-COVID-19 and COVID-19 studies (Breux et al., 2021; Jermann, Van der Linden, d'Acromont, & Zermatten, 2006). Adolescents who engage in more maladaptive emotion regulation may be more vulnerable to stress-related mental health problems during the pandemic (Weissman et al., 2021). Relatedly, we have identified one empirical study supporting the mediation role of maladaptive emotion regulation between various COVID-19-related stressors (e.g., disease and academic stressors) and mental health problems

in college students (Ye, Wu et al., 2020). On the other hand, the increased maladaptive emotional regulation due to COVID-19 stress and lack of alternative adaptive emotion regulation strategies may lead to excessive use of internet gaming and IGD since internet gaming can provide disengagement or escape from COVID-19 stress. Maladaptive emotional regulation was found to be a significant risk factor of IGD among children and adolescents in non-COVID research (Kökönyei et al., 2019). To our knowledge, no empirical research on the mediation role of emotion regulation in the relationship between COVID-19 stress and IGD has been conducted among adolescents. Therefore, this study aims to fill the research gap. It is expected that maladaptive emotion regulation would mediate the association between COVID-19 stress related to schooling and online learning, depression and IGD among adolescents.

Sex difference

Sex has been a well-documented factor that affects how individuals respond to stress and the prevalence of depression and IGD, which might be attributed to the differences in the neural activation pattern of sex hormones and psychosocial influences associated with culturally defined sex roles (McGivern, 2017). In general, girls are more likely to cope with stress using interpersonal relationships than boys and express distress in the form of depressive symptoms, whereas boys exhibit more maladaptive behavioral responses than girls (Hankin, Mermelstein, & Roesch, 2007; McGivern, 2017). In addition, a previous study in Chinese adolescents also suggested that girls were more likely to respond to academic stressors with higher levels of depressive symptoms than boys (Liu & Lu, 2012). Therefore, academic stress, support, and coping may have differential roles in the relationship between COVID-19 stress and depression/IGD across sexes but were rarely explored.

The present study

In the present study, we investigated the prevalence of probable depression and probable IGD in a large-scale and representative population of adolescents during the period of COVID-19 school closures. In addition, we examined the roles of COVID-19 stress related to schooling and online learning in depression and IGD and the three psychosocial mediators of these relationships, including social support, academic stress, and emotion regulation through the lens of COR theory. It was hypothesized that 1) COVID-19 stress would be positively associated with depression and IGD; 2) COVID-19 stress would be associated with lower social support, increased academic stress, and maladaptive emotion regulation, which in turn positively associated with both depression and IGD. In other words, social support, academic stress, and maladaptive emotion regulation would mediate the associations between COVID-19 stress and depression as well as IGD. In addition, we further examined the sex differences in the paths of the proposed mediation model.

METHODS

Study design and participants

A school-based survey was conducted among secondary school students in Hong Kong during the period from September to November 2020 when the schools were reopened after the government lifting policy to face-to-face classes suspension. The first case of COVID-19 in Hong Kong was reported on January 22, 2020 and all schools in Hong Kong had been closed since the Lunar New Year holiday (January 25, 2020). Hong Kong had several phases of rapid increase in the number of confirmed cases later on in March and July. During the time of investigation, the spread of the virus in local clusters had been controlled and schools were reopened, such that about 1,500 newly confirmed cases during the survey period including imported cases (Department of Health, 2021). Stratified random sampling of schools was implemented; one secondary school was randomly selected and invited from each of the 18 districts in Hong Kong. A total of 13 of the 18 schools accepted the invitation to participate in this study. All secondary 1 to 4 (7th to 10th year of formal education) students who lived in Hong Kong and attended face-to-face courses at the time of investigation from each selected school were invited. Shenzhen-Hong Kong cross-boundary students who lived in Shenzhen, mainland China, who attended online courses were not invited. Secondary 5 and 6 students were not invited due to schools' concerns about their academic stress and exam pressure. In total, 4,323 students from the 13 schools were invited, and 3,147 completed their questionnaires; 3,136 were included in our data analyses as 11 cases were excluded due to lack of key information of the study variables (i.e., sex).

Procedures

Students and parents were invited and informed about the survey and its purpose under school teachers' assistance. Participants were explained that participation was voluntary and anonymous, and rejection would not affect any right or service they would receive from the school. They were also guaranteed that only the research team can access their data. Two research assistants with a training background in psychology and at least six months of interviewing experience implemented the survey in classroom settings in the absence of teachers. The survey questionnaire had about 100 items, which took about 15 min to complete. No incentive was given to the participants.

Measures

Internet gaming disorder. IGD symptoms were measured by the 9-item DSM-5 IGD Symptoms checklist. It is a short, user-friendly, self-report measure assessing IGD symptoms of preoccupation, tolerance, withdrawal, unsuccessful attempts to limit gaming, deception or lies about gaming, loss of interest in other activities, use despite knowledge of harm,

use for escape or relief of negative mood, and harm based on DSM-5 criteria (American Psychiatric Association, 2013). To emulate the DSM's original format, "yes" or "no" response options were available for each item. A higher sum score indicates a higher level of IGD symptoms. A score of 5 is taken as the cutoff point for defining probable IGD (Ko et al., 2014). The Chinese version has been validated in adolescents by one of the authors. One study preliminarily validated and used the scale in Chinese children (Yang, Huang, & Wong, 2021), and another paper to validate the scale in Chinese adolescents has been under review. Both studies showed good psychometric properties of the scale. The scale reliability was good in the present study (Cronbach's $\alpha = 0.77$).

Depression. Depressive symptoms were assessed by the Chinese version of the 20-item Center for Epidemiologic Studies Depression Scale (CES-D). The scale was "designed to measure the current level of depressive symptomatology, with emphasis on the affective component, depressed mood" (Lewinsohn, Seeley, Roberts, & Allen, 1997). Participants rate how often they experienced the symptoms in the past seven days on a 4-point Likert scale, ranging from 0 (*rarely or none of the time*) to 3 (*almost or all of the time*). CES-D has been applied among Hong Kong adolescents and showed high internal consistency and concurrent validity (Lee et al., 2008; Yang, Lau, & Lau, 2018). The total score ranges from 0 to 60, with higher scores indicating greater depressive symptoms. People with CES-D scores ≥ 16 are classified as having probable depression. The Cronbach's α was 0.91.

COVID-19 stress. COVID-19 stress related to schooling and online learning was measured by two questions (i.e., "To what extent are you worried about how COVID-19 will impact your school year?" and "To what extent are you satisfied/dissatisfied with the school online course during the COVID-19 pandemic?"). The questions were constructed based on recent COVID-19 research (Ellis et al., 2020) by the research team which includes health psychologists and epidemiologists. Items were rated on 5-point Likert scales, with higher scores indicating higher levels of perceived disruption and stress of COVID-19 on students' schooling and online learning. The Cronbach's α in the current sample was 0.60 (acceptable) (Hua, Gu, Meng, & Wu, 2013) and the correlation coefficient was 0.43 ($P < 0.001$). For the construct validity, COVID-19 stress score showed a significantly positive correlation with the score of Academic Expectations Stress Inventory ($r = 0.14$; $P < 0.001$).

Social support. Four items were used to assess perceived support, including two items about support obtained from parents and two items for peer support, as previously reported in Chinese adolescents (Yang et al., 2020). The items were "How much support had you received from your parents/friends when you needed to talk with someone or needed emotional support?" and "How much support had you received from your family/friends when you needed



instrumental support (e.g., financial support)?” The items were rated on a 10-point scale ranging from 0 (none) to 10 (tremendous). Higher scores denote higher levels of social support. The Cronbach’s alpha was 0.79 in the present study.

Academic stress. Students’ Academic Stress Scale (Zhu, 2014) was used to test perceived academic stress in courses/class, homework/workload, exams/tests and academic performance, and school activities. Each question was scored from 1 (none) to 5 (always). Higher scores indicate higher perceived academic stress levels. It was developed and validated in Chinese adolescents (Zhu, 2014). It had a Cronbach’s alpha of 0.74.

Maladaptive emotional regulation. The maladaptive emotional regulation processes that characterize the individual’s negative styles of responding to stressful events were measured by three items (i.e., self-blame, rumination, and catastrophizing) of the short version of the Cognitive Emotion Regulation Questionnaire (CERQ-short) (Garnefski & Kraaij, 2006). The scale has been well validated in Chinese studies (Zhu et al., 2008; Tang, Chan, Ng, & Yip, 2016). Items were measured on a 5-point Likert scale ranging from 1 (never) to 5 (always). Higher scores indicate higher levels of maladaptive emotional regulation. The Cronbach’s alpha was relatively low but acceptable (0.53). Maladaptive emotion regulation was moderately correlated with the Dysfunctional Attitudes Scale ($r = 0.37$; $P < 0.001$) and CES-D scores ($r = 0.42$; $P < 0.001$), which supported the construct validity.

Background factors. Background factors included sex, age, whether being born in Hong Kong, living arrangements, and parental education levels.

Statistical analysis

Descriptive statistics were presented by sex. *T*-test (continuous variables) and chi-square test (categorical variables) were used to compare the levels of variables between males and females; effect sizes of such differences were represented by Cohen’s *d* and odds ratios. For the distribution of independent variables, mediators, and dependent variables, the values of skewness ranged from -0.045 (social support) to 1.09 (IGD) and the values of kurtosis ranged from -0.21 (depression) to 0.61 (IGD). Given the criteria of less than ± 1.0 , the distribution can be considered normal except for IGD score which was slightly left-skewed. Pearson correlation was performed to measure the associations between the interested variables.

Structural equation modeling (SEM) analysis with maximum likelihood estimation was used to test the hypothesized mediation model. Indicators for perceived social support, maladaptive emotion regulation, and depressive symptoms were created by item parceling method based on the scales’ subscales; the grouping of the original items for academic stress and IGD was based on the results of exploratory factor analysis (see supplementary Table 1). Of all participants, 209 (6.7%) had missing information on demographics or interested variables: 2.3% ($n = 69$) had

missing data for age, 2.1% ($n = 65$) for father’s educational level, 1.7% ($n = 52$) for mother’s educational level and less than 0.9% ($n = 27$) for remaining variables. Missing values were dealt with regression imputation, which is a commonly used method in previous studies (Rosenthal, Carroll-Scott, Earnshaw, Santilli, & Ickovics, 2012; Schmidt, Mueller, & Roder, 2011). Background variables that were significantly associated with IGD and depressive symptoms were controlled as covariates. Following a two-step approach, confirmatory factor analysis was firstly conducted to assess the goodness of fit of the measurement model and followed by SEM to test the structural model. Several fit indices were used to indicate good model fit: (1) Chi-square/degrees of freedom (χ^2/df) ratio ≤ 3 , (2) comparative fit index (CFI) ≥ 0.90 , (3) incremental fit index (IFI) ≥ 0.90 , (4) Tucker Lewis index (TLI) ≥ 0.90 , (5) root mean square error of approximation (RMSEA) ≤ 0.08 , and (6) standardized root mean square residual (SRMR) ≤ 0.08 (Hooper et al., 2008; Kline, 2015). As χ^2 is highly sensitive to sample size, small misspecification might lead to a rejection of the hypothesis in case of a large sample size as in this study, the interpretation of model fit was based on the overall assessment of the general pattern of all fit indices (Bagozzi & Yi, 1988; Bollen & Long, 1993). The path coefficients, direct and indirect effects, and the corresponding 95% confidence interval (CI) were estimated using bootstrapping, which is a non-parametric resampling procedure that involves repeated sampling from the data set ($n = 2000$) and could accommodate for non-normal and/or categorical data. The effect size (i.e., proportion of mediation [PM]) was reported.

To examine the significance of each structural path across sex groups, multi-group SEM analysis was conducted. A series of models with different paths (e.g., social support and depression) being constrained were compared to the unconstrained model with all paths freely estimated using chi-square difference tests. *P* values < 0.05 in the chi-square difference test ($\Delta\chi^2/\Delta df$) would denote a significant sex difference for the tested path. The SPSS 23.0 Statistics for Windows (IBM Corp. Released 2015, Armonk, NY: IBM Corp) and AMOS 23.0 (IBM SPSS Inc., Chicago, Illinois) were used for all statistical analyses.

Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki. Ethics approval was obtained from the Survey and Behavioral Ethics Committee of the corresponding author’s affiliated institution (Ref No. SBRE-18-433). Informed consent was obtained from both participants and their parents. The study procedures were carried out in accordance with the Declaration of Helsinki.

RESULTS

Descriptive characteristics

Information about participants’ characteristics is presented in Table 1. The mean age of the participants was 13.6 years



Table 1. Characteristics of the participants by sex

| Characteristics | Total (n = 3,136) | Male (n = 1,507) | Female (n = 1,629) | P-value* | Effect size |
|--|-------------------|------------------|--------------------|----------|--------------------------|
| <i>Background variables</i> | | | | | |
| Age (years), mean (SD) | 13.6 (1.3) | 13.7 (1.3) | 13.6 (1.3) | 0.241 | Cohen's <i>d</i> = 0.03 |
| Born in Hong Kong | | | | | |
| No | 17.0% | 16.1% | 17.8% | 0.186 | Odds ratio = 1.14 |
| Yes | 83.0% | 83.9% | 82.2% | | |
| Living arrangement with parents | | | | | |
| Both | 73.0% | 73.6% | 72.5% | 0.241 | Odds ratio = 0.93 |
| Mother | 16.1% | 15.6% | 16.6% | | |
| Father | 5.3% | 5.9% | 4.8% | | |
| Neither | 5.5% | 4.9% | 6.1% | | |
| Mother's educational level | | | | | |
| Primary school or below | 7.4% | 7.4% | 7.3% | 0.269 | Odds ratio = 0.92 |
| Middle school | 45.3% | 43.7% | 46.8% | | |
| College or undergraduate | 13.3% | 13.4% | 13.2% | | |
| Master or above | 2.5% | 3.0% | 2.1% | | |
| Don't know | 31.5% | 32.4% | 30.7% | | |
| Father's educational level | | | | | |
| Primary school or below | 10.1% | 10.3% | 10.0% | 0.013 | Odds ratio = 0.86 |
| Middle school | 46.9% | 43.7% | 49.8% | | |
| College or undergraduate | 11.9% | 13.0% | 10.9% | | |
| Master or above | 1.5% | 1.5% | 1.6% | | |
| Don't know | 29.5% | 31.5% | 27.7% | | |
| <i>Psychosocial variables, mean (SD)</i> | | | | | |
| COVID-19 stress | 6.4 (1.7) | 6.3 (1.8) | 6.6 (1.4) | <0.001 | Cohen's <i>d</i> = -0.15 |
| Social support | 21.6 (8.9) | 21.3 (9.1) | 22.0 (8.7) | 0.034 | Cohen's <i>d</i> = -0.08 |
| Academic stress | 18.1 (4.0) | 17.7 (4.2) | 18.6 (3.7) | <0.001 | Cohen's <i>d</i> = -0.23 |
| Maladaptive emotion regulation | 9.7 (2.2) | 9.5 (2.2) | 9.8 (2.2) | <0.001 | Cohen's <i>d</i> = -0.13 |
| <i>Depression</i> | | | | | |
| Total score | 19.9 (11.2) | 18.1 (10.7) | 21.6 (11.4) | <0.001 | Cohen's <i>d</i> = -0.32 |
| Prevalence (yes, %) | 60.3% | 54.3% | 65.8% | <0.001 | Odds ratio = 0.62 |
| <i>Internet gaming disorder</i> | | | | | |
| Total score | 2.1 (2.2) | 2.5 (2.3) | 1.7 (2.1) | <0.001 | Cohen's <i>d</i> = 0.39 |
| Prevalence (yes, %) | 14.8% | 19.6% | 10.4% | <0.001 | Odds ratio = 2.11 |

* P-value is the test for differences between males and females. Note: Effect size of between-group comparison was presented using Cohen's *d* for continuous variables and odds ratio for categorical variables.

and 51.9% were females. Of all the participants, 73.0% lived with both parents while 21.4% lived in a single-parent family. 15.8% of the participants' mothers and 13.4% of their fathers had obtained an educational level of college or above. Males' fathers reported higher educational levels; the sex differences in other socio-demographic characteristics were non-significant.

As for COVID-19 stress, 43.5% of the participants expressed worry about schooling, and 28.1% were dissatisfied/strongly dissatisfied with online learning provided by their schools during COVID-19. Compared to males, females perceived higher levels of COVID-19 stress, academic stress, and were more likely to adopt maladaptive emotion regulation despite reported higher levels of social support.

The prevalence of probable depression was 60.3% and 14.8% of the participants were classified as having probable IGD. Females had a significantly higher prevalence of probable depression and higher levels of depressive symptoms than males, while males were more likely to report probable IGD and IGD symptoms; the effect sizes of sex

differences in depression and IGD were moderate (Cohen's *d* > 0.3 and all *P* < 0.001).

Correlation analysis

Bivariate correlation analyses showed that all the independent variables, mediators, and dependent variables were significantly correlated with each other (range for the absolute value of *r*: 0.06–0.42, all *P* < 0.01), except for the association between COVID-19 stress and IGD (*r* = -0.01, *P* > 0.05) (Table 2).

Structural equation modeling

The measurement model yielded a good fit: $\chi^2/df = 12.36$, CFI = 0.94, IFI = 0.94, TLI = 0.90, RMSEA = 0.06, SRMR = 0.05. All the parcel indicators were significantly loaded on the latent variables, with standardized factor loading ranging from 0.16 to 0.95 (all *P* < 0.001). The structural model fitted the data well: $\chi^2/df = 7.77$, CFI = 0.92, IFI = 0.92, TLI = 0.90, RMSEA = 0.05, SRMR = 0.04.



Table 2. Pearson's correlations between studied variables

| Measure | 1 | 2 | 3 | 4 | 5 |
|---|---------|---------|--------|--------|--------|
| 1. COVID-19 stress | – | | | | |
| 2. Social support | –0.07** | – | | | |
| 3. Academic stress | 0.06** | –0.11** | – | | |
| 4. Maladaptive emotion regulation | 0.08** | –0.11** | 0.30** | – | |
| 5. Depression (total score) | 0.13** | –0.41** | 0.40** | 0.42** | – |
| 6. Internet gaming disorder (total score) | –0.01 | –0.13** | 0.17** | 0.14** | 0.27** |

** $P < 0.01$.

As shown in Fig. 1, COVID-19 stress was positively associated with perceived academic stress ($B = 0.13$, $\beta = 0.15$, $P < 0.001$) and maladaptive emotion regulation ($B = 0.18$, $\beta = 0.15$, $P < 0.001$) while negatively associated with social support ($B = -0.51$, $\beta = -0.09$, $P = 0.001$). Perceived academic stress ($B = 0.47$, $\beta = 0.29$, $P < 0.001$) and maladaptive emotion regulation ($B = 0.50$, $\beta = 0.41$, $P < 0.001$) were positively associated with depression, whereas social support was negatively associated with depression ($B = -0.07$, $\beta = -0.27$, $P < 0.001$). Similarly, perceived academic stress ($B = 0.36$, $\beta = 0.16$, $P < 0.001$), maladaptive emotion regulation ($B = 0.32$, $\beta = 0.19$, $P < 0.001$), and social support ($B = -0.04$, $\beta = -0.12$, $P < 0.001$) were significantly associated with IGD. In addition, the direct effect of COVID-19 stress was significant and positive on depression ($B = 0.06$, $\beta = 0.04$, $P = 0.022$) but not significant on IGD ($P > 0.05$).

Bootstrapping analyses indicated that COVID-19 stress was indirectly associated with depression ($\beta = 0.13$, 95% CI = 0.08–0.18, $P < 0.001$) and IGD ($\beta = 0.06$, 95% CI = 0.04–0.09, $P < 0.001$) via perceived academic stress, social support, and maladaptive emotion regulation. The specific mediation effect of perceived academic stress ($\beta = 0.04$, $P < 0.001$,

PM = 24.7%), social support ($\beta = 0.02$, $P = 0.02$, PM = 13.9%), and maladaptive emotion regulation ($\beta = 0.07$, $P < 0.001$, PM = 35.9%) on the relationship between COVID-19 stress and depression was significant, respectively. The specific mediation effect of perceived academic stress ($\beta = 0.02$, $P < 0.001$), social support ($\beta = 0.01$, $P = 0.037$), and maladaptive emotion regulation ($\beta = 0.03$, $P < 0.001$) on the relationship between COVID-19 stress and IGD was significant, respectively. Since the direct effect of COVID-19 stress on IGD was negative and the indirect effect was positive, PM was not calculated for this inconsistent mediation effect.

Multi-group analysis by sex

Multi-group SEM analyses showed that sex significantly moderated the associations between COVID-19 stress and perceived academic stress ($\Delta\chi^2/\Delta df = 4.62/1$, $P = 0.032$), between academic stress and depression ($\Delta\chi^2/\Delta df = 7.34/1$, $P = 0.007$), and between social support and depression ($\Delta\chi^2/\Delta df = 4.33/1$, $P = 0.037$) (Table 3). To be specific, the associations between COVID-19 stress and academic stress ($\beta = 0.10$ for males versus 0.18 for females, all $P < 0.05$), between academic stress and depression ($\beta = 0.24$ for males versus 0.34 for females, all $P < 0.001$) as well as between social support and depression ($\beta = -0.26$ for males versus -0.33 for females, all $P < 0.001$) were stronger among females compared to males.

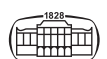
DISCUSSION

The present study is the first attempt to investigate the relationships of COVID-19 stress related to schooling and online learning with both depression and IGD and their potential mediators and moderators in a large and representative sample of adolescents. This is also the first study applying the framework of COR theory to understand the

Table 3. Results of multiple-group structural equation modeling across sex

| | χ^2 | df | CFI | RMSEA | ΔCFI | ΔRMS EA | $\Delta\chi^2$ | Δdf | P -value |
|-----------------------------------|----------|------|------|-------|--------------|--------------------|----------------|-------------|--------------|
| Unconstrained model | 1837.43 | 415 | 0.92 | 0.03 | – | – | – | – | – |
| Constrained model | | | | | | | | | |
| Model 1 (COVID-19 to SS) | 1838.52 | 416 | 0.92 | 0.03 | 0.00 | 0.00 | 1.08 | 1 | 0.298 |
| Model 2 (COVID-19 to AS) | 1842.05 | 416 | 0.92 | 0.03 | 0.00 | 0.00 | 4.62 | 1 | 0.032 |
| Model 3 (COVID-19 to MER) | 1840.27 | 416 | 0.92 | 0.03 | 0.00 | 0.00 | 2.84 | 1 | 0.092 |
| Model 4 (SS to Depression) | 1844.78 | 416 | 0.92 | 0.03 | 0.00 | 0.00 | 7.34 | 1 | 0.007 |
| Model 5 (AS to Depression) | 1841.77 | 416 | 0.92 | 0.03 | 0.00 | 0.00 | 4.33 | 1 | 0.037 |
| Model 6 (MER to Depression) | 1837.78 | 416 | 0.92 | 0.03 | 0.00 | 0.00 | 0.35 | 1 | 0.556 |
| Model 7 (SS to IGD) | 1839.96 | 416 | 0.92 | 0.03 | 0.00 | 0.00 | 2.53 | 1 | 0.112 |
| Model 8 (AS to IGD) | 1837.61 | 416 | 0.92 | 0.03 | 0.00 | 0.00 | 0.18 | 1 | 0.668 |
| Model 9 (MER to IGD) | 1840.42 | 416 | 0.92 | 0.03 | 0.00 | 0.00 | 2.99 | 1 | 0.084 |
| Model 10 (COVID-19 to depression) | 1838.35 | 416 | 0.92 | 0.03 | 0.00 | 0.00 | 0.92 | 1 | 0.338 |
| Model 11 (COVID-19 to IGD) | 1837.75 | 416 | 0.92 | 0.03 | 0.00 | 0.00 | 0.32 | 1 | 0.571 |

Abbreviations: COVID-19 = Schooling and online learning-related stress due to the COVID-19 pandemic; SS = social support; AS = academic stress; MER = maladaptive emotion regulation; IGD = Internet gaming disorder. p values < 0.05 are presented in bold. The specific path in parentheses was constrained to be equal across sex groups for each tested model.



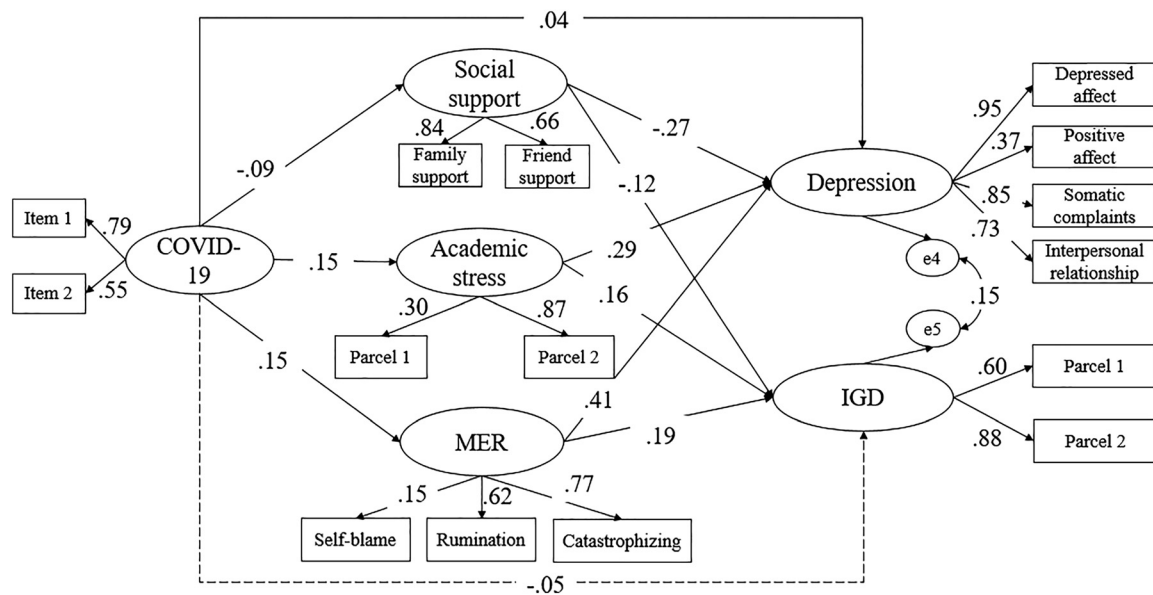


Fig. 1. The structural equation modeling of the association between COVID-19 stress with depression and IGD via social support, academic stress, and maladaptive emotion regulation. *Abbreviations:* COVID-19: Schooling and online learning-related stress due to the COVID-19 pandemic; MER = maladaptive emotion regulation; IGD = Internet gaming disorder. *Note:* Latent variables are shown in ovals and observed variables in rectangles. Solid lines represent the significance of the structural path (all $P < 0.05$) while dash lines represent non-significant paths. Standardized coefficients are presented. For simplicity, the significant background covariates (i.e., age, whether being born in Hong Kong, living arrangement, and father's education level) of outcomes, correlations, and error covariances of the mediators are not presented

development of adolescent depression and IGD during the COVID-19 pandemic. In addition, this is one of the few studies investigating the prevalence of adolescent depression and IGD in this period. The proposed hypotheses and model were generally supported by the data, while intriguing findings were also identified.

We found high levels of COVID-19 stress in the current sample, as about half of the students expressed worry about schooling due to COVID-19 and about 30% expressed dissatisfaction with online learning courses provided by their schools. This is not surprising as high academic expectations and demands are common in Asian societies and the need to succeed educationally is considered to be of primary importance (Chan et al., 2017). The prevalence is identical to a recent study in Hong Kong reporting that 29.5% of university students were dissatisfied with online learning during the pandemic (Lingnan University, 2020). Thus, the urgent need to improve online teaching quality in Hong Kong and reduce worries about disrupted schooling is highlighted. More efforts from schools and relevant stakeholders are warranted to help students adapt to online education. Effective measures shall include, but not limited to, providing guidelines in effective online learning and clear plans for course assessments, improving access to educational resources through various online platforms, upscaling of technology infrastructure, and building professional competency in teachers in delivering online teaching (Wang, Zhang, Zhao, Zhang, & Jiang, 2020). In addition, particular attention should be paid to students from low-income families who may struggle with a lack of infrastructures,

such as computers and high-speed internet, at home, or those with learning disabilities or special educational needs.

Furthermore, 60% and 15% of the sampled participants were classified as having probable depression and IGD, respectively. The level of depression was higher than the previous finding among secondary students in Hong Kong (44%) (Chan & Fung, 2014) and higher than the prevalence observed among adolescents in mainland China during the COVID-19 pandemic using the same tool (40%) (Zhou, Yuan, et al., 2020). This discrepancy may highlight the great risk of depression and urgent needs for mental health promotion among adolescents in Hong Kong. One might argue that it could be attributed to the variations in the sampling method, or progress of pandemic control and cultural-social situations in the two regions. On the other hand, the prevalence of IGD in the current study is comparable to that reported in Hong Kong adolescents before the pandemic [e.g., 13% (Wang, Ho, Chan, & Tse, 2015) and 15.6% (Wang et al., 2014)]. It seems that the prevalence of IGD did not increase substantially during the pandemic. Continuous surveillance of IGD at different phases of the pandemic is warranted to monitor the changes of IGD over time and prevent the potential long-term impact of COVID-19 on adolescents' behavioral health. While online gaming may be beneficial in moderation during this crisis, it is important to promote its balanced use during the pandemic to support physical and psychological wellbeing (King, Delfabbro, Billieux, & Potenza, 2020). Consistent with previous studies (Hankin et al., 2007; Wu, Li, Lau, Mo, & Lau, 2016), sex was moderately associated with mental and behavioral health

outcomes; while females had a greater risk of depression, males had a higher prevalence of IGD. Also, females seemed to be more vulnerable amid the COVID-19 pandemic, evidenced by their higher levels of COVID-19 stress, academic stress, and maladaptive emotion regulation. However, the effects were relatively small, thus interpretation of the findings should be cautious.

Moreover, the present study added evidence supporting that the associations between COVID-19 stress and the risks of depression as well as IGD were mediated by personal, academic, and psychosocial factors. In the context of COR theory, the COVID-19 pandemic might be associated with reduced interpersonal and personal resources, such as impaired social support, heightened academic stress, and maladaptive emotion regulation, and resource loss can be associated with higher risks of mental and behavioral problems, such as depression and IGD. Previous studies have extensively applied this theory to understand mental health (e.g., depression, anxiety, and post-traumatic stress disorder) after traumatic events and the mediation role of psychosocial resource losses (e.g., social support and coping) (Benight, Swift, Sanger, Smith, & Zeppelin, 1999; Smith & Freedy, 2000). A recent study also reported that social support, coping, and resilience mediated the association between COVID-19-related stressful experiences (e.g., risk of infection and disruptions to work or study) and acute stress disorder among college students in China (Ye, Yang et al., 2020). While little research has applied COR to understand IGD, prior non-COVID literature reported similar mediation findings that stressful life events were indirectly associated with Internet addiction through maladaptive coping among Chinese adolescents (Tang et al., 2014). Another non-COVID study also showed that social support mediated the association between stress and Internet addiction among college students (İbrahim, 2019). This study expanded prior similar research by including both interpersonal resource (i.e., social support) and intrapersonal resource losses (i.e., maladaptive emotion regulation and academic stress) to explain the levels of depression and IGD in the context of COVID-19. The mediation findings suggest that COVID-19 may have multiple pathways to affect adolescents' mental and behavioral health. Therefore, the complication in dealing with the challenges in various aspects of daily life that arise from COVID-19 is highlighted.

It is worth noting that the strongest indirect effect of COVID-19 stress on depression/IGD was maladaptive emotion regulation, followed by social support and academic stress. It highlights the importance of understanding maladaptive emotion regulation in the relationships between COVID-19 stress and adolescent depression/IGD. Indeed, maladaptive emotion regulation, such as rumination and catastrophizing, is common especially in face of a novel infectious disease like COVID-19 which is full of uncertainty (Dubey, Podder, & Pandey, 2020; Restubog, Ocampo, & Wang, 2020). It will be more relevant during adolescence, which is a phase of gradual transition from childhood to adulthood, and the emotional and cognitive control systems are yet to be developed at this developmental stage (Theurel &

Gentaz, 2018). In turn, such maladaptive regulation processes have been well documented to be a risk factor of both depression (Farb, Anderson, & Segal, 2012) and addictive behaviors including IGD (Evren, Evren, Dalbudak, Topcu, & Kutlu, 2018). Thus, the strong mediation effect of maladaptive emotion regulation between COVID-19 stress and depression/IGD is expected, indicating maladaptive emotion regulation as a key pathway between COVID-19 stress and depression/IGD. In addition to the maladaptive emotion regulation, adolescents may adopt some positive strategies (e.g., positive reappraisal), which should be explored in future studies.

The direct effect of COVID-19 stress on depression was significant and positive, but not significant on IGD. The partially indirect effect of COVID-19 stress with a small standardized effect on depression suggested that other underlying mechanisms besides the three tested mediators may exist. For instance, some studies reported that the incidence of child abuse and neglect has substantially increased amid the COVID-19 pandemic, which can exacerbate children and adolescents' mental health problems (Cuartas, 2020; Thomas, Anurudran, Robb, & Burke, 2020). Other studies confirmed that resilience and alexithymia were significant mediators in the association between exposure to COVID-19-related stress and depression among Chinese college students (Tang, Hu, Yang, & Xu, 2020; Ye, Yang et al., 2020). Such potential mediators need to be tested in future work to better understand the psychosocial mechanisms between COVID-19 stress and adolescent depression.

Furthermore, these direct and indirect associations could be moderated by sex. To be specific, the positive associations between COVID-19 stress and academic stress and between academic stress and depression were significantly stronger among females than males. This suggests that COVID-19 stress may have a stronger impact on academic stress and subsequently mental distress for females. The findings are consistent with previous reports showing that females are particularly vulnerable to the negative impacts of education disruption caused by school closures (OECD, 2020). Females may be more likely to be asked to take care of household duties than males during school disclosure, which would further subtract time from their home-based studies and increase academic stress (OECD, 2020). Females also seem to place a greater amount of academic expectations on themselves and respond with higher levels of depressive symptoms to academic stress than males (DuongTran, Lee, & Khoi, 1996). Similarly, a pre-COVID study reported that the association between academic stress and depressive symptoms was stronger among females in Chinese high school students (Liu & Lu, 2012). In addition, we found that social support had a stronger association with depression among females, corroborating prior literature that interpersonal relationship plays a significant role in female adolescents' mental health (Hankin et al., 2007).

These findings have important theoretical and practical implications for research and social practice. The confirmed mediation model provides empirical support for the extended application of COR theory in the context of the COVID-19 pandemic and in understanding adolescent depression and

IGD. Practically, the high prevalence of depression and IGD observed in this study and significant associations between IGD and depression documented in recent studies signify the public health concerns regarding youth during the COVID-19 pandemic (Chen et al., 2020; Lin et al., 2020). Communities, schools, and parents need to be aware of the potential psychological and behavioral risks of students, be prepared to detect possible health problems, and provide social support to effectively address these issues simultaneously. School social workers and counselors who develop health programs to treat students' depression and IGD should recognize that COVID-19 stress might increase the risk of IGD and depression through diminished psychosocial resources. Hence, psychological interventions to boost social support, reduce academic stress, and modify maladaptive emotion regulation might be effective to protect adolescents from depression and IGD during COVID-19. Specifically, as a more prominent mediator, modification of maladaptive emotion regulation and skill training for more adaptive strategies should be prioritized to help adolescents adapt to the changing educational environment, such as stress reduction interventions and cognitive-behavioral therapies. In addition, sex differences should be considered when implementing related psychological and behavioral health interventions to improve efficacy. The confirmed moderation role of sex suggests that reducing maladaptive emotion regulation associated with COVID-19 may be a more effective strategy to reduce the risk of IGD for male students than for female students. In contrast, special attention should be given to females' academic stress and social support during the COVID-19 pandemic considering the stronger psychological consequences found among females. Essential support for daily life and online learning should therefore be provided (e.g., via the Internet or social media).

The study has several limitations. First, the cross-sectional design cannot determine causal inferences and readers should be cautious against interpreting the exploratory SEM results in a causal sense. Adolescents with depression and IGD might further isolate themselves and lead to a reduction in social support and an increase in academic stress. For instance, a recent longitudinal study in Hong Kong suggested that IGD tended to have a negative impact on adolescents' academic performance (Kwok, Leung, Poon, & Fung, 2021). Thus the associations between academic stress/social support and IGD/depression might be reciprocal. The findings were therefore intended for the generation of future research questions and provision of preliminary insights. Future longitudinal studies are warranted to establish the causal relationship between variables. Second, given the large sample size, associations of small effect sizes could be statistically significant (e.g., weak associations between COVID-19 stress and mediators); both statistical significance and effect sizes should be taken into consideration when interpreting the results. Third, as data for this study were gathered from young adolescents in secondary grade 1-4 from participating schools in Hong Kong, there might be selection bias hence attempts to generalize findings to student populations among older adolescents or in other cultures should be cautious. However, the sex (males: 48.1 vs. 51.9%) and age distribution (prevalence of aged 12 years old:

21.8 vs. 23.4%; 13 years old: 21.7 vs. 23.6%; 14 years old: 26.2 vs. 23.0%; 15 years old: 20.2 vs. 16.1%) in the current sample was comparable to the latest census data of secondary grade 1-4 students in Hong Kong (Education Bureau Government of the Hong Kong Special Administrative Region, 2020). Four, depression and IGD were measured by self-reported and non-clinical diagnostic assessment tools, which might be subjected to recall bias and social desirability bias. The dichotomous responses of IGD scale may be unable to provide detailed information about the frequency and severity of IGD symptoms. Five, there were limitations related to the measures. Self-constructed items were used to measure COVID-19 stress, and only the stress related to schooling and online learning which is specific to the student population was measured. Other universally important COVID-related stressors (e.g., worry about family's finances and risk of the self and family being infected by the COVID-19 virus) were not investigated. Future work should develop and apply well-validated and multi-item scales to monitor the multiple impacts of COVID-19 on adolescents' daily life. Also, only family and peer support were assessed. Other forms of social support (e.g., teacher's support) that may be especially important for adolescents during the pandemic should be investigated in future studies. In addition, the emotion regulation scale had relatively low reliability and only tested three common emotion regulation strategies. Other strategies, such as positive reframing, may also play a role during the pandemic and the full CERQ scale should be explored in future work.

CONCLUSIONS

This study is a timely investigation of depression and IGD among Chinese adolescents in Hong Kong with a large sample size during the COVID-19 pandemic. The findings provide evidence regarding the roles of COVID-19 stress related to schooling and online learning in mental and behavioral health, the application of COR theory to understand the mechanisms of the relationships, and the sex differences in these relationships. Results indicated that adolescents' risk of depression and IGD could be influenced by COVID-19 in various ways, including lowered social support, increased academic stress, and intensified maladaptive emotion regulation processes, and these associations varied between males and females. Although stress and disruptions to daily life are inevitable during the pandemic, psychosocial interventions and preventive measures targeting these modifiable mediators have the potential to help reduce the risk of depression and IGD and facilitate students to adapt to the COVID-19 era.

Funding sources: This study was funded by the Health and Medical Research Fund [#16171001].

Author's contribution: Conceptualization: RS, XY; data curation: KW, JL, YZ; formal analysis: RS, JL; funding acquisition:



XY; investigation: KW; methodology: RS; writing – original draft: RS; writing – review & editing: XY, KL.

Conflict of interest: The authors declare that they have no conflict of interest.

Acknowledgment: We would like to thank Ms. Cindy Choi for her assistance in data collection, and all the participants who dedicated their time to completing this study.

SUPPLEMENTARY MATERIAL

Supplementary data to this article can be found online at <https://doi.org/10.1556/2006.2021.00069>.

REFERENCES

- American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). <https://doi.org/10.1176/appi.books.9780890425596>.
- Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, 16(1), 74–94. <https://doi.org/10.1007/BF02723327>.
- Benight, C. C., Swift, E., Sanger, J., Smith, A., & Zeppelin, D. (1999). Coping self-efficacy as a mediator of distress following a natural disaster. *Journal of Applied Social Psychology*, 29(12), 2443–2464. <https://doi.org/10.1111/j.1559-1816.1999.tb00120.x>.
- Bollen, K. A., & Long, J. S. (1993). Testing structural equation models (Vol. 154). Sage.
- Breaux, R., Dvorsky, M. R., Marsh, N. P., Green, C. D., Cash, A. R., Shroff, D. M., ... Becker, S. P. (2021). Prospective impact of COVID-19 on mental health functioning in adolescents with and without ADHD: Protective role of emotion regulation abilities. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, 10.1111/jcpp.13382. Advance online publication. <https://doi.org/10.1111/jcpp.13382>.
- Chan, S., & Fung, T. C. T. (2014). Reliability and validity of K10 and K6 in screening depressive symptoms in Hong Kong adolescents. *Vulnerable Children and Youth Studies*, 9(1), 75–85. <https://doi.org/10.1080/17450128.2013.861620>.
- Chan, Y., Chan, Y. Y., Cheng, S. L., Chow, M. Y., Tsang, Y. W., Lee, C., & Lin, C. Y. (2017). Investigating quality of life and self-stigma in Hong Kong children with specific learning disabilities. *Research in Developmental Disabilities*, 68, 131–139. <https://doi.org/10.1016/j.ridd.2017.07.014>.
- Chen, I., Chen, C. Y., Pakpour, A. H., Griffiths, M. D., Lin, C. A. O., Li, X. D., & Tsang, H. W. H. (2021a). Problematic internet-related behaviors mediate the associations between levels of internet engagement and distress among schoolchildren during COVID-19 lockdown: A longitudinal structural equation modeling study. *Journal of Behavioral Addictions*, 10.1556/2006.2021.00006. Advance online publication. <https://doi.org/10.1556/2006.2021.00006>.
- Chen, C. Y., Chen, I. H., Hou, W. L., Potenza, M. N., O'Brien, K. S., Lin, C. Y., & Latner, J. D. (2021b). The relationship between children's problematic internet-related behaviors and psychological distress during the onset of the COVID-19 pandemic: A longitudinal study. *Journal of Addiction Medicine*, 10.1097/ADM.0000000000000845. Advance online publication. <https://doi.org/10.1097/ADM.0000000000000845>.
- Chen, C. Y., Chen, I. H., Pakpour, A. H., Lin, C. Y., & Griffiths, M. D. (2021c). Internet-related behaviors and psychological distress among schoolchildren during the COVID-19 school hiatus. *Cyberpsychology, Behavior and Social Networking*, 10.1089/cyber.2020.0497. Advance online publication. <https://doi.org/10.1089/cyber.2020.0497>.
- Chen, F., Zheng, D., Liu, J., Gong, Y., Guan, Z., & Lou, D. (2020). Depression and anxiety among adolescents during COVID-19: A cross-sectional study. *Brain, Behavior, and Immunity*, 88, 36–38. <https://doi.org/10.1016/j.bbi.2020.05.061>.
- Cuartas, J. (2020). Heightened risk of child maltreatment amid the COVID-19 pandemic can exacerbate mental health problems for the next generation. *Psychological Trauma: Theory, Research, Practice, and Policy*, 12(S1), S195–S196. <https://doi.org/10.1037/tra0000597>.
- DAK Gesundheit. (2020). DAK study: Gaming, social media & corona. Retrieved from <https://www.dak.de/dak/gesundheit/dak-studie-gaming-social-media-und-corona-2295548.html/>.
- Department of Health, The Government of the Hong Kong Special Administrative Region. (2021). *Press Release*. Retrieved from https://www.dh.gov.hk/english/press/2020/press_2020.html.
- Dong, H., Yang, F., Lu, X., & Hao, W. (2020). Internet addiction and related psychological factors among children and adolescents in China during the coronavirus disease 2019 (COVID-19) epidemic. *Frontiers in Psychiatry*, 11, 00751. <https://doi.org/10.3389/fpsy.2020.00751>.
- Duan, L., Shao, X., Wang, Y., Huang, Y., Miao, J., Yang, X., & Zhu, G. (2020). An investigation of mental health status of children and adolescents in China during the outbreak of COVID-19. *Journal of Affective Disorders*, 275, 112–118. <https://doi.org/10.1016/j.jad.2020.06.029>.
- Dubey, N., Podder, P., & Pandey, D. (2020). Knowledge of COVID-19 and its influence on mindfulness, cognitive emotion regulation and psychological flexibility in the Indian community. *Frontiers in Psychology*, 11, 589365. <https://doi.org/10.3389/fpsyg.2020.589365>.
- DuongTran, Q., Lee, S., & Khoi, S. (1996). Ethnic and gender differences in parental expectations and life stress. *Child and Adolescent Social Work Journal*, 13(6), 515–526. <https://doi.org/10.1007/BF01874304>.
- Education Bureau Government of the Hong Kong Special Administrative Region. (2020). Student enrolment statistics 2019/20.
- Ellis, W. E., Dumas, T. M., & Forbes, L. M. (2020). Physically isolated but socially connected: Psychological adjustment and stress among adolescents during the initial COVID-19 crisis. *Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement*, 52(3), 177. <https://doi.org/10.1037/cbs0000215>.
- Evren, B., Evren, C., Dalbudak, E., Topcu, M., & Kutlu, N. (2018). Relationship of internet addiction severity with probable ADHD and difficulties in emotion regulation among young adults. *Psychiatry Research*, 269, 494–500. <https://doi.org/10.1016/j.psychres.2018.08.112>.



- Farb, N. A. S., Anderson, A. K., & Segal, Z. V. (2012). The mindful brain and emotion regulation in mood disorders. *Canadian Journal of Psychiatry. Revue canadienne de psychiatrie*, 57(2), 70–77. <https://doi.org/10.1177/070674371205700203>.
- Fazeli, S., Mohammadi Zeidi, I., Lin, C. Y., Namdar, P., Griffiths, M. D., Ahorsu, D. K., & Pakpour, A. H. (2020). Depression, anxiety, and stress mediate the associations between internet gaming disorder, insomnia, and quality of life during the COVID-19 outbreak. *Addictive Behaviors Reports*, 12, 100307. <https://doi.org/10.1016/j.abrep.2020.100307>.
- Garnefski, N., & Kraaij, V. (2006). Cognitive emotion regulation questionnaire—development of a short 18-item version (CERQ-short). *Personality and Individual Differences*, 41(6), 1045–1053. <https://doi.org/10.1016/j.paid.2006.04.010>.
- Hankin, B. L., Mermelstein, R., & Roesch, L. (2007). Sex differences in adolescent depression: Stress exposure and reactivity models. *Child Development*, 78(1), 279–295. <https://doi.org/10.1111/j.1467-8624.2007.00997.x>.
- Hobfoll, S. E. (1989). Conservation of resources. A new attempt at conceptualizing stress. *The American Psychologist*, 44(3), 513–524. <https://doi.org/10.1037//0003-066x.44.3.513>.
- Holmgreen, L., Tirone, V., Gerhart, J., & Hobfoll, S. E. (2017). Conservation of resources theory. *The Handbook of Stress and Health: A Guide to Research and Practice*, 443–457.
- Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural equation modelling: Guidelines for determining model fit. *Articles*, 2.
- Hua, J., Gu, G., Meng, W., & Wu, Z. (2013). Age band 1 of the movement assessment battery for children—second edition: Exploring its usefulness in mainland China. *Research in Developmental Disabilities*, 34(2), 801–808. <https://doi.org/10.1016/j.ridd.2012.10.012>.
- İbrahim, T. (2019). Association between depression, anxiety, stress, social support, resilience and internet addiction: A structural equation modelling. *Malaysian Online Journal of Educational Technology*, 7(3), 1–10. <https://doi.org/10.17220/mojet.2019.03.001>.
- Jeong, E. J., Ferguson, C. J., & Lee, S. J. (2019). Pathological gaming in young adolescents: A longitudinal study focused on academic stress and self-control in South Korea. *Journal of Youth and Adolescence*, 48(12), 2333–2342. <https://doi.org/10.1007/s10964-019-01065-4>.
- Jermann, F., Van der Linden, M., d'Acremont, M., & Zermatten, A. (2006). Cognitive emotion regulation questionnaire (CERQ). *European Journal of Psychological Assessment*, 22(2), 126–131. <https://doi.org/10.1027/1015-5759.22.2.126>.
- King, D. L., Delfabbro, P. H., Billieux, J., & Potenza, M. N. (2020). Problematic online gaming and the COVID-19 pandemic. *Journal of Behavioral Addictions*, 9(2), 184–186. <https://doi.org/10.1556/2006.2020.00016>.
- Kline, R. B. (2015). *Principles and practice of structural equation modeling*. Guilford Publications.
- Kököneyi, G., Kocsel, N., Király, O., Griffiths, M. D., Galambos, A., Magi, A., . . . Demetrovics, Z. (2019). The role of cognitive emotion regulation strategies in problem gaming among adolescents: A nationally representative survey study. *Frontiers in Psychiatry*, 10, 273. <https://doi.org/10.3389/fpsy.2019.00273>.
- Ko, C. H., & Yen, J. Y. (2020). Impact of COVID-19 on gaming disorder: Monitoring and prevention. *Journal of Behavioral Addictions*, 9(2), 187. <https://doi.org/10.1556/2006.2020.00040>.
- Ko, C. H., Yen, J. Y., Chen, S. H., Wang, P. W., Chen, C. S., & Yen, C. F. (2014). Evaluation of the diagnostic criteria of Internet gaming disorder in the DSM-5 among young adults in Taiwan. *Journal of Psychiatric Research*, 53, 103–110. <https://doi.org/10.1016/j.jpsy.2014.02.008>.
- Kwok, C., Leung, P., Poon, K., & Fung, X. (2021). The effects of internet gaming and social media use on physical activity, sleep, quality of life, and academic performance among university students in Hong Kong: A preliminary study. *Asian Journal of Social Health and Behavior*, 4(1), 36–44. https://doi.org/10.4103/shb.shb_81_20.
- Larsen, L., Helland, M. S., & Holt, T. (2021). The impact of school closure and social isolation on children in vulnerable families during COVID-19: A focus on children's reactions. *European Child & Adolescent Psychiatry*, 1–11. Advance online publication. <https://doi.org/10.1007/s00787-021-01758-x>.
- Lazarus, R. S., & Folkman, S. (1987). Transactional theory and research on emotions and coping. *European Journal of Personality*, 1(3), 141–169. <https://doi.org/10.1002/per.2410010304>.
- Lee, S. W., Stewart, S. M., Byrne, B. M., Wong, J. P., Ho, S., Lee, P. W., & Lam, T. (2008). Factor structure of the center for epidemiological studies depression scale in Hong Kong adolescents. *Journal of Personality Assessment*, 90(2), 175–184. <https://doi.org/10.1080/00223890701845385>.
- Lewinsohn, P. M., Seeley, J. R., Roberts, R. E., & Allen, N. B. (1997). Center for Epidemiologic Studies Depression Scale (CES-D) as a screening instrument for depression among community-residing older adults. *Psychology and Aging*, 12(2), 277–287. <https://doi.org/10.1037//0882-7974.12.2.277>.
- Lin, C. Y., Potenza, M. N., Broström, A., & Pakpour, A. H. (2020). Internet gaming disorder, psychological distress, and insomnia in adolescent students and their siblings: An actor-partner interdependence model approach. *Addictive Behaviors Reports*, 13, 100332. <https://doi.org/10.1016/j.abrep.2020.100332>.
- Lingnan University. (2020). LU study reveals over 60% of Hong Kong university students have found online learning not as effective as face-to-face teaching during COVID-19 pandemic [Press release]. Retrieved from <https://ln.edu.hk/research-and-impact/research-press-conferences/lu-study-reveals-over-60-of-hong-kong-university-students-have-found-online-learning-not-as-effective-as-face-to-face-teaching-during-covid-19-pandemic>.
- Liu, Y., & Lu, Z. (2012). Chinese high school students' academic stress and depressive symptoms: Gender and school climate as moderators. *Stress and Health: Journal of the International Society for the Investigation of Stress*, 28, 340–346. <https://doi.org/10.1002/smi.2418>.
- Liu, L., Yao, Y. W., Li, C. R., Zhang, J. T., Xia, C. C., Lan, J., . . . Fang, X. Y. (2018). The comorbidity between internet gaming disorder and depression: Interrelationship and neural mechanisms. *Frontiers in Psychiatry*, 9, 154. <https://doi.org/10.3389/fpsy.2018.00154>.
- Ma, H., Hu, J., Tian, J., Zhou, X., Li, H., Laws, M. T., . . . Shao, J. (2020). A single-center, retrospective study of COVID-19



- features in children: A descriptive investigation. *BMC Medicine*, 18(1), 123. <https://doi.org/10.1186/s12916-020-01596-9>.
- Magson, N. R., Freeman, J. Y. A., Rapee, R. M., Richardson, C. E., Oar, E. L., & Fardouly, J. (2021). Risk and protective factors for prospective changes in adolescent mental health during the COVID-19 pandemic. *Journal of Youth and Adolescence*, 50(1), 44–57. <https://doi.org/10.1007/s10964-020-01332-9>.
- McGivern, R. (2017). Stress response: Sex differences q.
- Moawad, R. A. (2020). Online learning during the COVID-19 pandemic and academic stress in university students. *Revista Românească pentru Educație Multidimensională*, 12(1 Sup2), 100–107. <https://doi.org/10.18662/rrem/12.1sup2/252>.
- Netczuk-Gwoździewicz, M. (2017). Personal resources in coping with stress among paramedics Part 1. *Zeszyty Naukowe/Wyższa Szkoła Oficerska Wojsk Lądowych im. gen. T. Kościuszki*.
- OECD. (2020). The impact of COVID-19 on student equity and inclusion: Supporting vulnerable students during school closures and school re-openings. <https://doi.org/10.1787/d593b5c8-en>.
- Otto, M. C. B., Hoefsmit, N., van Ruysseveldt, J., & van Dam, K. (2019). Exploring proactive behaviors of employees in the prevention of burnout. *International Journal of Environmental Research and Public Health*, 16(20), 3849. Retrieved from <https://www.mdpi.com/1660-4601/16/20/3849>.
- Plante, C., Gentile, D., Groves, C., Modlin, A., & Blanco-Herrera, J. (2018). Video games as coping mechanisms in the etiology of video game addiction. *Psychology of Popular Media Culture*, 8. <https://doi.org/10.1037/ppm0000186>.
- Prime, H., Wade, M., & Browne, D. T. (2020). Risk and resilience in family well-being during the COVID-19 pandemic. *American Psychologist*, 75(5), 631–643. <https://doi.org/10.1037/amp0000660>.
- Restubog, S., Ocampo, A., & Wang, L. (2020). Taking control amidst the chaos: Emotion regulation during the COVID-19 pandemic. *Journal of Vocational Behavior*, 119, 103440. <https://doi.org/10.1016/j.jvb.2020.103440>.
- Rettie, H., & Daniels, J. (2020). Coping and tolerance of uncertainty: Predictors and mediators of mental health during the COVID-19 pandemic. *American Psychologist*, 10.1037/amp0000710. Advance online publication. <https://doi.org/10.1037/amp0000710>.
- Rosenthal, L., Carroll-Scott, A., Earnshaw, V. A., Santilli, A., & Ickovics, J. R. (2012). The importance of full-time work for urban adults' mental and physical health. *Social Science & Medicine*, 75(9), 1692–1696. <https://doi.org/10.1016/j.socscimed.2012.07.003>.
- Schmidt, S. J., Mueller, D. R., & Roder, V. (2011). Social cognition as a mediator variable between neurocognition and functional outcome in schizophrenia: Empirical review and new results by structural equation modeling. *Schizophrenia Bulletin*, 37(suppl_2), S41–S54. <https://doi.org/10.1093/schbul/sbr079>.
- Schraml, K., Perski, A., Grossi, G., & Simonsson-Sarnecki, M. (2011). Stress symptoms among adolescents: The role of subjective psychosocial conditions, lifestyle, and self-esteem. *Journal of Adolescence*, 34(5), 987–996. <https://doi.org/10.1016/j.adolescence.2010.11.010>.
- Smith, B. W., & Freedy, J. R. (2000). Psychosocial resource loss as a mediator of the effects of flood exposure on psychological distress and physical symptoms. *Journal of Traumatic Stress*, 13(2), 349–357. <https://doi.org/10.1023/A:1007745920466>.
- Tang, K., Chan, C. S., Ng, J., & Yip, C.-H. (2016). Action type-based factorial structure of Brief COPE among Hong Kong Chinese. *Journal of Psychopathology and Behavioral Assessment*, 38(4), 631–644. <https://doi.org/10.1007/s10862-016-9551-0>.
- Tang, W., Hu, T., Yang, L., & Xu, J. (2020). The role of alexithymia in the mental health problems of home-quarantined university students during the COVID-19 pandemic in China. *Personality and Individual Differences*, 165, 110131. <https://doi.org/10.1016/j.paid.2020.110131>.
- Tang, J., Yu, Y., Du, Y., Ma, Y., Zhang, D., & Wang, J. (2014). Prevalence of internet addiction and its association with stressful life events and psychological symptoms among adolescent internet users. *Addictive Behaviors*, 39(3), 744–747. <https://doi.org/10.1016/j.addbeh.2013.12.010>.
- Teng, Z., Pontes, H. M., Nie, Q., Griffiths, M. D., & Guo, C. (2021). Depression and anxiety symptoms associated with internet gaming disorder before and during the COVID-19 pandemic: A longitudinal study. *Journal of Behavioral Addictions JBA*, 10(1), 169–180. <https://doi.org/10.1556/2006.2021.00016>.
- Theurel, A., & Gentaz, E. (2018). The regulation of emotions in adolescents: Age differences and emotion-specific patterns. *PloS One*, 13. <https://doi.org/10.1371/journal.pone.0195501>.
- Thomas, E. Y., Anurudran, A., Robb, K., & Burke, T. F. (2020). Spotlight on child abuse and neglect response in the time of COVID-19. *The Lancet Public Health*, 5(7), e371. [https://doi.org/10.1016/S2468-2667\(20\)30143-2](https://doi.org/10.1016/S2468-2667(20)30143-2).
- UNESCO. (2020). UNESCO rallies international organizations, civil society and private sector partners in a broad coalition to ensure #learningneverstops. Retrieved from <https://en.unesco.org/news/unesco-rallies-international-organizations-civil-society-and-private-sector-partners-broad>.
- Wang, C., Chan, C. L. W., Mak, K.-K., Ho, S.-Y., Wong, P. W. C., & Ho, R. T. H. (2014). Prevalence and correlates of video and internet gaming addiction among Hong Kong adolescents: A pilot study. *The Scientific World Journal*, 2014, 874648. <https://doi.org/10.1155/2014/874648>.
- Wang, C., Ho, R. T., Chan, C. L., & Tse, S. (2015). Exploring personality characteristics of Chinese adolescents with internet-related addictive behaviors: Trait differences for gaming addiction and social networking addiction. *Addictive Behaviors*, 42, 32–35. <https://doi.org/10.1016/j.addbeh.2014.10.039>.
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., McIntyre, R. S., . . . Ho, C. (2020). A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain, Behavior, and Immunity*, 87, 40–48. <https://doi.org/10.1016/j.bbi.2020.04.028>.
- Wang, G., Zhang, Y., Zhao, J., Zhang, J., & Jiang, F. (2020). Mitigate the effects of home confinement on children during the COVID-19 outbreak. *The Lancet*, 395(10228), 945–947. [https://doi.org/10.1016/S0140-6736\(20\)30547-X](https://doi.org/10.1016/S0140-6736(20)30547-X).
- Weissman, D. G., Rodman, A. M., Rosen, M. L., Kasperek, S. W., Mayes, M., Sheridan, M., . . . McLaughlin, K. A. (2021). Contributions of emotion regulation and brain structure and function to adolescent internalizing problems and stress vulnerability during the COVID-19 pandemic: A longitudinal study.

- Wu, A. M. S., Li, J., Lau, J. T. F., Mo, P. K. H., & Lau, M. M. C. (2016). Potential impact of internet addiction and protective psychosocial factors onto depression among Hong Kong Chinese adolescents – direct, mediation and moderation effects. *Comprehensive Psychiatry*, 70, 41–52. <https://doi.org/10.1016/j.comppsy.2016.06.011>.
- Xiong, J., Lipsitz, O., Nasri, F., Lui, L., Gill, H., Phan, L., ... McIntyre, R. S. (2020). Impact of COVID-19 pandemic on mental health in the general population: A systematic review. *Journal of Affective Disorders*, 277, 55–64. <https://doi.org/10.1016/j.jad.2020.08.001>.
- Yang, X., Huang, B., & Wong, K. M. (2021). Prevalence and socio-demographic, anthropometric, and cognitive correlates of internet gaming disorder among children in China. *Children and Youth Services Review*, 122, 105893. <https://doi.org/10.1016/j.chidyouth.2020.105893>.
- Yang, X., Jiang, X., Mo, P., Cai, Y., Ma, L., & Lau, J. (2020). Prevalence and interpersonal correlates of internet gaming disorders among Chinese adolescents. *International Journal of Environmental Research and Public Health*, 17, 579. <https://doi.org/10.3390/ijerph17020579>.
- Yang, X., Lau, J., & Lau, M. (2018). Predictors of remission from probable depression among Hong Kong adolescents – A large-scale longitudinal study. *Journal of Affective Disorders*, 229, 491–497. <https://doi.org/10.1016/j.jad.2017.12.080>.
- Ye, B., Wu, D., Im, H., Liu, M., Wang, X., & Yang, Q. (2020). Stressors of COVID-19 and stress consequences: The mediating role of rumination and the moderating role of psychological support. *Children and Youth Services Review*, 118, 105466. <https://doi.org/10.1016/j.chidyouth.2020.105466>.
- Ye, Z., Yang, X., Zeng, C., Wang, Y., Shen, Z., Li, X., & Lin, D. (2020). Resilience, social support, and coping as mediators between COVID-19-related stressful experiences and acute stress disorder among college students in China. *Applied Psychology: Health and Well-Being*, 12(4), 1074–1094. <https://doi.org/10.1111/aphw.12211>.
- Zhou, J., Yuan, X., Qi, H., Liu, R., Li, Y., Huang, H., ... Wang, G. (2020). Prevalence of depression and its correlative factors among female adolescents in China during the coronavirus disease 2019 outbreak. *Globalization and Health*, 16(1), 69. <https://doi.org/10.1186/s12992-020-00601-3>.
- Zhou, S., Zhang, L.-G., Wang, L.-L., Guo, Z.-C., Wang, J.-Q., Chen, J.-C., & Chen, J.-X. (2020). Prevalence and socio-demographic correlates of psychological health problems in Chinese adolescents during the outbreak of COVID-19. *European Child & Adolescent Psychiatry*, 29(6), 749–758. <https://doi.org/10.1007/s00787-020-01541-4>.
- Zhu, J. (2014). Study of the relationship among middle school students' academic pressure, academic motivation, academic self-confidence and academic achievement. Wuhan: Central China Normal University.
- Zhu, X., Auerbach, R. P., Yao, S., Abela, J. R., Xiao, J., & Tong, X. (2008). Psychometric properties of the cognitive emotion regulation questionnaire: Chinese version. *Cognition & Emotion*, 22(2), 288–307. <https://doi.org/10.1080/02699930701369035>.

