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The association of problematic smartphone use with family well-being mediated by family communication in Chinese adults: A population-based study

NINGYUAN GUO[1], MAN PING WANG[1]*, TZU TSUN LUK[1], SAI YIN HO[2], DANIEL YEE TAK FONG[1], SOPHIA SIU-CHEE CHAN[1] and TAI HING LAM[2]

[1]School of Nursing, University of Hong Kong, Hong Kong, China
[2]School of Public Health, University of Hong Kong, Hong Kong, China

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Background and aims: Few studies have investigated the effects of problematic smartphone use (PSU) in the family context. We studied the association of PSU as a predictor with family well-being and the potential mediating role of family communication in Hong Kong Chinese adults. *Methods:* We analyzed data of 5,063 randomly selected adults [mean age (*SD*) = 48.1 (18.2) years; 45.0% men] from a dual landline and mobile telephone survey in 2017. PSU was assessed by the Smartphone Addiction Scale-Short Version with higher scores indicating higher levels. Family well-being was assessed by three questions on perceived family health, harmony, and happiness (3Hs) with higher scores indicating greater well-being. Perceived sufficiency and quality of family communication were rated. Multivariable regression analyses examined (a) associations of PSU with family 3Hs and well-being and (b) mediating role of family communication, adjusting for sociodemographic variables. *Results:* PSU was negatively associated with perceived family health (adjusted $\beta = -0.008$, 95% CI = −0.016, −0.0004), harmony (adjusted $\beta = -0.009$, 95% CI = −0.017, −0.002), happiness (adjusted $\beta = -0.015$, 95% CI = −0.022, −0.007), and well-being (adjusted $\beta = -0.011$, 95% CI = −0.018, −0.004). Perceived family communication sufficiency (adjusted $\beta = -0.007$, 95% CI = −0.010, −0.005) and quality (adjusted $\beta = -0.009$, 95% CI = −0.014, −0.005) mediated the association of PSU with family well-being, with 75% and 94% of total effects having mediated, respectively. *Discussion and conclusions:* PSU was negatively associated with family well-being, which was partially mediated by family communication. Such findings provide insights for health programs to prevent PSU and improve family well-being.

Keywords: problematic smartphone use, family well-being, family communication, population-based study

INTRODUCTION

Evolving information and communication technologies (ICTs) have transformed family interactions by overcoming time and distance barriers. Greater perceived well-being was observed among families who used smartphone for communication (Wang et al., 2015) and video calls for information sharing (Shen, Wang, et al., 2017). However, concerns are growing about the inappropriate use of ICTs (World Health Organization [WHO], 2015). Young people with Internet addiction reported lower levels of family satisfaction, organization, cohesion, and adaption (Li, Garland, & Howard, 2014). Mobile devices distracted parents from responsiveness and sensitivity toward children during family interactions (Kildare & Middlemiss, 2017). Smartphone use in non-working hours could lead to poor work-family balance and induce family conflicts (Derks, van Duin, Tims, & Bakker, 2015). Problematic smartphone use (PSU) is defined as an impaired ability to control the extent of smartphone use and might demonstrate addiction-like symptoms, such as overuse, withdrawal, tolerance, cyberspace-oriented relationships, and daily-life disturbances (Kwon, Kim, Cho, & Yang, 2013). PSU has been associated with fatigue, eye strain, sleep disturbances, and symptoms of anxiety and depression (Elhai, Dvorak, Levine, & Hall, 2017; Xie, Dong, & Wang, 2018). Associations were also observed between PSU and higher severity of family relationship problems in young people using convenience samples of university students (Chui, 2015; Hawi & Samaha, 2017). The generalizability of these associations remains unclear in older adults, although evidence has suggested the increasing prevalence of PSU among people of a wider age range (De-Sola, Talledo, Fonseca, & Rubio, 2017; Lopez-Fernandez, 2017; Luk et al., 2018; Nahas, Hlais, Saberian, & Antoun, 2018). Population-based studies are warranted to investigate the potential effects of PSU in the family context.

Family well-being has been conceptualized as "family life satisfaction," "sense of well-being," and "family functioning" (Pinquart & Sörensen, 2000). Our two

* Corresponding author: Man Ping Wang; School of Nursing, The University of Hong Kong, 21 Sassoon Road, Hong Kong, China; Phone: +852 3917 6636; Fax: +852 2872 6079; E-mail: mpwang@hku.hk

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qualitative studies among community leaders and lay individuals have identified family health, harmony, and happiness (3Hs) as three interrelated dimensions of family well-being in Chinese culture (Chan et al., 2011; Lam et al., 2012). Family harmony through good interpersonal communication is a prerequisite for family health and happiness as a cohesive unit, reflecting communication as the core component of family 3Hs (Lam et al., 2012). One explanation might be that family communication facilitates the development of emotional connections within families and enables family members to express and share attitudes, values, and beliefs and to be flexible in changing family's leadership, roles, and rules (Epstein, Bishop, & Levin, 1978; Olson, 2000). Our community-based interventions provided experimental evidence that family well-being could be promoted through perceived sufficient time and high quality of family communication (Ho et al., 2018; Shen, Wan, et al., 2017).

Some evidence has suggested the adverse effects of PSU on communication sufficiency and quality among family members. In a qualitative study, respondents agreed that PSU in particular symptoms of overuse and cyberspace-oriented relationships might hamper family talks and breed loneliness of family members, which may create possible family conflicts (Romero-Ruiz et al., 2017). Another time-diary analysis showed that smartphone use could challenge time both copresent and on family activities in children with parents (Mullan & Chatzitheochari, 2019), and shared family time allows sufficient family communication (Ho et al., 2018). The findings were supported by the social activity displacement hypothesis proposing that physical interactions might be decreased or displaced by prolonged phone use, given the underlying reality that individuals have a limited amount of time (Kraut et al., 1998). PSU was associated with a behavior of snubbing someone in social settings using smartphones instead of paying attention (Chotpitayasunondh & Douglas, 2016). To disconnect with family members in face-to-face interactions might interfere with verbal conversations and prevent nonverbal behaviors, such as body language and eye contacts, which results in a family communication of less quality (Nazir & Piskin, 2016).

Hong Kong, the most westernized and developed city of China, is one of the most connected places worldwide and provides an appropriate platform to understand the potential effects of PSU in the family context. Smartphone use is widespread among people of all ages, with an average penetration rate of 88.6% in 2017 (Census and Statistics Department, 2018). Nearly all Internet users (98.1%) used smartphones for online connection, and the average daily online time was up to 4.6 hr (Census and Statistics Department, 2018). We took advantage of a large and representative sample of the general Chinese population to examine the associations among PSU, family communication, and family well-being. We hypothesized that (a) PSU was negatively associated with family well-being; (b) perceived sufficiency and quality of family communication mediated the association of PSU with family well-being.

METHODS

Design and participants

The Hong Kong Family and Health Information Trends Survey (FHInTS) is a periodic territory-wide telephone survey on the general public's behaviors and views regarding information use, individual health, and family well-being, under the project "FAMILY: A Jockey Club Initiative for a Harmonious Society." The target population was Cantonese-speaking Hong Kong residents more than 18 years. Five waves of FHInTS have been conducted since 2009, and details of the study design were reported elsewhere (Luk et al., 2018; Shen, Wang, et al., 2017; Wang et al., 2015). This study is part of the fifth wave of FHInTS, conducted from February to August 2017. We used a dual-frame (landline and mobile) telephone sampling method. Telephone numbers were randomly generated using known prefixes assigned to telecommunication service providers under the Numbering Plan provided by the Government Office of the Communications Authority. Invalid numbers were eliminated according to the computer and manual dialing records. Telephone numbers of respondents from previous waves were also filtered. For the landline telephone survey, once a household was successfully reached, an eligible family member whose coming birthday was the closest to the interview day was invited for the survey. No second-level sampling was in place for the mobile phone survey. Respondents' participation is completely voluntary with no incentive. All telephone interviews were conducted by trained interviewers of Public Opinion Programme (POP) at the University of Hong Kong, a reputable local survey agency. A total of 5,063 respondents (landline: $n = 4,054$; mobile: $n = 1,009$) were successfully interviewed based on 7,347 cases (landline: $n = 5,773$; mobile: $n = 1,574$), yielding a response rate of 68.9%.

Measurements

Smartphone ownership referred to an affirmative response to "Please indicate if you have a smartphone (e.g., iPhone, Android, Blackberry, and Windows phone)." PSU was assessed by the 10-item Smartphone Addiction Scale – Short Version (SAS-SV), which examines five addiction-like symptoms including overuse, withdrawal, tolerance, cyberspace-oriented relationships, and daily-life disturbances (Kwon et al., 2013). Each item scores on a 6-point Likert scale (1 = strongly disagree, 6 = strongly agree), with a higher total score (range: 10–60) indicating a higher level of PSU (Kwon et al., 2013). The Chinese version of SAS-SV was found reliable and valid (Luk et al., 2018). Cronbach's α was .842 in the present sample.

The definition of family (family members who are related through biological, marital, cohabitation, and/or emotional bonding) was explained to the respondents prior questions on perceived family well-being and communication. Family well-being was assessed by three separate questions on perceived family health, harmony, and happiness (family 3Hs, range: 0–10), with a higher score indicating a higher level of family 3Hs, respectively. The mean score of family

3Hs was calculated, with a higher score indicating greater overall well-being. The single item of perceived family happiness scale was validated in Hong Kong Chinese adults (Shen et al., 2018). Two-week test-retest reliability of family 3Hs was of 0.81 (Wang et al., 2016). Cronbach's α was .887 in the present sample. Family 3Hs was positively correlated with scores of Subjective Happiness Scale (SHS; Lyubomirsky & Lepper, 1999), Short Warwick–Edinburgh Mental Well-being Scale (SWEMWBS; Stewart-Brown et al., 2009), Family APGAR Scale (Adaption, Partnership, Growth, Affection, and Resolve) (Smilkstein, 1978), and Family Communication Scale (FCS) [Olson, 2011; Pearson's correlation coefficients (r) range: .35–.59; all $p < .001$].

Respondents reported whether they had sufficient communication with family members on a 5-point scale (1 = very insufficient, 5 = very sufficient) and perceived communication quality between family members on an 11-point scale (0 = very poor, 10 = very good). Both perceived family communication sufficiency and quality were positively correlated with scores of SHS, SWEMWBS, Family APGAR, and FCS (sufficiency: r range .25–.40, all $p < .001$; quality: r range .37–.60, all $p < .001$; Lyubomirsky & Lepper, 1999; Olson, 2011; Smilkstein, 1978; Stewart-Brown et al., 2009).

Sociodemographic variables included sex, age, marital status (unmarried, cohabitated/married, or divorced/separated/widowed), employment status (unemployed, in-paid employed, retired, housekeeper, or full-time student), educational attainment (primary or below, secondary, or tertiary), and monthly household income (HK $ ≤19999, ≥20000, or unstable) (US $1 = HK $7.8).

Statistical analyses

Chi-squared tests were used to compare sociodemographic characteristics and smartphone ownership between the landline and mobile phone samples. To increase the representativeness of the combined sample, all data were weighted by sex, age, and educational attainment distribution of the Hong Kong general population using the random iterative method (Izrael, Hoaglin, & Battaglia, 2004). Associations of PSU with family 3Hs and overall well-being were examined by bivariate and multivariable linear regression analyses adjusting for sociodemographic variables. A series of multivariable linear regression analyses were conducted to test the potential mediating role of family communication. Mediating effects might indicate if four of these steps are met (Baron & Kenny, 1986): (a) significant associations of independent variable (i.e., PSU level) with potential mediators (i.e., perceived family communication sufficiency and quality), (b) a significant association of independent variable (i.e., PSU level) with dependent variable (i.e., family well-being), (c) significant associations of potential mediators (i.e., perceived family communication sufficiency and quality) with dependent variable (i.e., family well-being), and (d) shrinking associations of independent variable (i.e., PSU level) with dependent variable (i.e., family well-being) upon the addition of potential mediators (i.e., perceived family communication sufficiency and quality) to the regression model. Sobel–Goodman tests decomposed the total effects of PSU on family well-being. Bootstrapping with 1,000 replications was used to examine whether the mediating effects were statistically significant. All analyses were conducted using STATA version/MP 15.1 (StataCorp., TX, USA). The value $p < .05$ was considered statistically significant.

Ethics

The Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster approved this study. All respondents provided verbal informed consent. Telephone interviews were tape-recorded for quality checking with respondents' consent. Records were then erased 6 months after completing the survey.

RESULTS

Compared with the landline sample ($n = 4{,}054$; 80.1%), the mobile sample ($n = 1{,}009$; 19.9%) included more male, young, highly educated, unmarried, employed, and high-income respondents (all $p < .001$; Table 1). Of the combined sample ($N = 5{,}063$), 45.0% were males, and the mean age [standard deviation (SD), range] was 48.1 years (18.2, 18–96). Most respondents (76.3%) held secondary or greater education. Most of them owned a smartphone (81.6%, 95% CI: 80.3%, 82.9%). The mean SAS-SV score (SD) was of 29.1 (10.2) after excluding missing data on any item of the SAS-SV ($n = 44$; Table 2).

The multivariable regression analyses showed that PSU level was associated with lower levels of perceived family health (adjusted β = −0.008, 95% CI = −0.016, −0.0004), harmony (adjusted β = −0.009, 95% CI = −0.017, −0.002), happiness (adjusted β = −0.015, 95% CI = −0.022, −0.007), and overall well-being (adjusted β = −0.011, 95% CI = −0.018, −0.004), after adjusting for sociodemographic variables (Table 3).

Perceived sufficiency and quality of family communication mediated the association of PSU level with family well-being by meeting the four steps (Table 4): (a) PSU level was negatively associated with perceived family communication sufficiency (adjusted β = −0.016, 95% CI = −0.020, −0.011) and quality (adjusted β = −0.016, 95% CI = −0.024, −0.008), (b) PSU level was negatively associated with family well-being (adjusted β = −0.011, 95% CI = −0.018, −0.004), (c) perceived family communication sufficiency (adjusted β = 0.489, 95% CI = 0.436, 0.542) and quality (adjusted β = 0.591, 95% CI = 0.558, 0.625) were positively associated with family well-being, and (d) the magnitude of associations between PSU level and family well-being decreased upon the addition of perceived family communication sufficiency (adjusted β = −0.003, 95% CI = −0.010, 0.003) and quality (adjusted β = −0.001, 95% CI = −0.007, 0.004) to corresponding regression models (both $p > .05$).

Sobel-Goodman tests and bootstrapping with 1,000 replications showed that perceived family communication sufficiency (adjusted β = −0.007, 95% CI: −0.010, −0.005) and quality (adjusted β = −0.009, 95% CI: −0.014, −0.005)

Table 1. Sociodemographic characteristics and smartphone ownership by sampling frame ($N = 5,063$)

	Sample frame			Blended ($N = 5,063$)	
	Landline ($n = 4,054$)	Mobile ($n = 1,009$)	p	Unweighted	Weighted[a]
Male	1,535 (37.9)	506 (50.2)	<.001	2,041 (40.3)	2,280 (45.0)
Age (years)			<.001		
18–24	417 (10.3)	122 (12.1)		539 (10.7)	462 (9.1)
25–44	573 (14.1)	396 (39.3)		969 (19.1)	1,793 (35.4)
45–64	1,437 (35.5)	357 (35.4)		1,794 (35.4)	1,871 (37.0)
≥65	1,627 (40.1)	134 (13.3)		1,761 (34.8)	937 (18.5)
Marital status			<.001		
Unmarried	852 (21.0)	328 (32.5)		1,180 (23.3)	1,431 (28.3)
Cohabitated/married	2,577 (63.6)	599 (59.4)		3,176 (62.7)	3,099 (61.2)
Divorced/separated/widowed	625 (15.4)	82 (8.1)		707 (14.0)	533 (10.5)
Employment status			<.001		
Unemployed	128 (3.2)	32 (3.2)		160 (3.2)	258 (5.1)
In-paid employed	1,279 (31.6)	656 (65.0)		1,935 (38.2)	2,516 (49.7)
Retired	1,632 (40.3)	151 (15.0)		1,783 (35.2)	1,116 (22.0)
Housekeeper	732 (18.1)	105 (10.4)		837 (16.5)	868 (17.1)
Full-time student	283 (7.0)	65 (6.4)		348 (6.9)	305 (6.0)
Educational attainment			<.001		
Primary or below	959 (23.7)	98 (9.7)		1,057 (20.9)	1,198 (23.7)
Secondary	1,730 (42.7)	394 (39.1)		2,124 (42.0)	2,435 (48.1)
Tertiary	1,365 (33.7)	517 (51.2)		1,882 (37.2)	1,430 (28.3)
Monthly household income (HK $)[b]			<.001		
≤19,999	1,671 (41.2)	236 (23.4)		1,907 (37.7)	1,765 (34.9)
≥20,000	2,258 (55.7)	754 (74.7)		3,012 (59.5)	3,174 (62.7)
Unsteady	125 (3.1)	19 (1.9)		144 (2.8)	124 (2.5)
Smartphone ownership	2,928 (72.2)	943 (93.5)	<.001	3,871 (76.5)	4,132 (81.6)

Note. [a]Weighted by sex, age, and educational attainment distribution of the Hong Kong general population. [b]US $1 = HK $7.8.

Table 2. Descriptive characteristics of SAS-SV score, family 3Hs, and family communication

			Mean (*SD*)	
	Range	Sample size	Unweighted	Weighted[a]
SAS-SV score	10–60	4,088	28.6 (10.1)	29.1 (10.2)
Family health	0–10	5,024	7.3 (1.8)	7.2 (1.8)
Family harmony	0–10	5,029	7.6 (1.8)	7.5 (1.8)
Family happiness	0–10	5,024	7.5 (1.8)	7.3 (1.8)
Family well-being	0–10	5,015	7.4 (1.7)	7.3 (1.6)
Perceived family communication sufficiency	1–5	5,019	3.4 (1.1)	3.4 (1.1)
Perceived family communication quality	0–10	5,019	6.9 (1.9)	6.8 (1.9)

Note. SAS-SV: Smartphone Addiction Scale – Short Version; 3Hs: health, harmony, and happiness; *SD*: standard deviation.
[a]Weighted by sex, age, and educational attainment distribution of the Hong Kong general population.

Table 3. Associations of SAS-SV score with family 3Hs and overall well-being[a]

		Association			
	Sample size	Crude β [95% CI]	p	Adjusted β [95% CI][b]	p
Family health (range: 0–10)	4,072	−0.008 [−0.016, 0.0004]	.064	−0.008 [−0.016, −0.0004]	.039
Family harmony (range: 0–10)	4,072	−0.009 [−0.017, −0.001]	.031	−0.009 [−0.017, −0.002]	.016
Family happiness (range: 0–10)	4,071	−0.013 [−0.021, −0.005]	.001	−0.015 [−0.022, −0.007]	<.001
Family well-being (range: 0–10)	4,065	−0.010 [−0.017, −0.003]	.007	−0.011 [−0.018, −0.004]	.002

Note. SAS-SV: Smartphone Addiction Scale-Short Version, range: 10–60; CI: confidence interval.
[a]Weighted by sex, age, and educational attainment distribution of the Hong Kong general population. [b]Adjusted for sex, age, educational attainment, marital status, employment status, and monthly household income.

Table 4. Testing for mediating effect of perceived sufficiency and quality of family communication[a]

	Predictor	Outcome	Association			
			Crude β [95% CI]	*p*	Adjusted β [95% CI][b]	*p*
Step 1	SAS-SV score (range: 10–60)	Perceived family communication sufficiency (range: 1–5)	−0.016 [−0.021, −0.011]	<.001	−0.016 [−0.020, −0.011]	<.001
	SAS-SV score	Perceived family communication quality (range: 0–10)	−0.016 [−0.024, −0.008]	<.001	−0.016 [−0.024, −0.008]	<.001
Step 2	SAS-SV score	Family well-being (range: 0–10)	−0.010 [−0.017, −0.003]	.007	−0.011 [−0.018, −0.004]	.002
Step 3	Perceived family communication sufficiency	Family well-being	0.504 [0.450, 0.558]	<.001	0.489 [0.436, 0.542]	<.001
	Perceived family communication quality	Family well-being	0.606 [0.571, 0.641]	<.001	0.591 [0.558, 0.625]	<.001
Step 4	SAS-SV score + perceived family communication sufficiency	Family well-being	−0.002 [−0.009, 0.005]	.527	−0.003 [−0.010, 0.003]	.312
	SAS-SV score + perceived family communication quality	Family well-being	−0.001 [−0.006, 0.005]	.808	−0.001 [−0.007, 0.004]	.589

Note. SAS-SV: Smartphone Addiction Scale – Short Version; CI: confidence interval.
[a]Weighted by sex, age, and educational attainment distribution of the Hong Kong general population. [b]Adjusted for sex, age, educational attainment, marital status, employment status, and monthly household income.

mediated the effects of PSU level on family well-being (both $p < .05$). The proportions of total effects mediated through perceived family communication sufficiency and quality were 75% and 94%, respectively (Table 5).

DISCUSSION

Increasing evidence has shown the adverse effects of inappropriate use of ICTs on the family, but population-based studies of PSU in the family context remain scarce. We aimed to address the generalizability issue by taking advantage of a large and representative sample of the general Chinese population. This study extended previous findings by providing new evidence that PSU was associated with lower levels of perceived family health, harmony, happiness, and overall well-being. Perceived sufficiency and quality of family communication partially mediated the association of PSU with family well-being.

We observed that the mobile sample included more young, highly educated, unmarried, employed, and high-income respondents, which was consistent with the findings of another study comparing two sampling frames in Hong Kong (Chiu & Jiang, 2017). The traditional random-digit-dialing landline survey may raise the undercoverage issue as the method cannot reach the increasing mobile-phone-only population (Chiu & Jiang, 2017; Keeter, Kennedy, Clark, Tompson, & Mokrzycki, 2007), which can be partially supported by our findings of more smartphone owners in the mobile sample than the landline sample (93.5% vs. 76.5%; $p < .001$). Future studies on ICTs may caution the choice of sampling frame guided by the target population.

We observed PSU was associated with lower levels of family 3Hs and overall well-being, which added new evidence to earlier studies of Internet addiction reporting consistent negative associations with family satisfaction, organization, cohesion, and adaption in young people (Li et al., 2014). Our findings aligned with another cross-sectional study in Hong Kong showing that PSU was associated with higher severity of family relationship problems using convenience samples of university students (Chui, 2015). The directionality of these associations remains unclear. PSU has been associated with depression symptoms and increased loneliness (Elhai et al., 2017; Enez Darcin et al., 2016; Romero-Ruiz et al., 2017), which might produce an estrangement of family members (Turkle, 2017). On the contrary, people with lower levels of family well-being might refer to PSU as a emotion compensator to regulate or alleviate negative emotions, given that the device is constantly accessible and may be the first and most obvious object or process to deflect the negative context, proposed by the Compensatory Internet Use Theory (Kardefelt-Winther, 2014). The predicting role of impaired family well-being was evident in a prospective cohort study on Internet addiction among young adolescents (Ko, Yen, Yen, Lin, & Yang, 2007). However, PSU could be a maladaptive coping strategy (Elhai, Levine, & Hall, 2019), and this inability to turn to family members for problem-solving and support might, in turn, harm family well-being. This bidirectional association between family conflicts and Internet addiction was supported in another prospective cohort study (Ko et al., 2015).

Table 5. Adjusted[a] indirect, direct, and total effect of SAS-SV score on family well-being mediated by perceived sufficiency and quality of family communication[b]

	Family communication sufficiency		Family communication quality	
Effect	β	95% CI[c]	β	95% CI[c]
Indirect effect	**−0.007**	**[−0.010, −0.005]**	**−0.009**	**[−0.014, −0.005]**
Direct effect	−0.002	[−0.009, 0.005]	−0.001	[−0.006, 0.005]
Total effect	**−0.010**	**[−0.016, −0.003]**	**−0.010**	**[−0.016, −0.003]**
Proportion of total effect mediated	0.750		0.940	

Note. $p < .05$ are marked in bold. SAS-SV: Smartphone Addiction Scale – Short Version; CI: confidence interval.
[a]Adjusted for sex, age, educational attainment, marital status, employment status, and monthly household income. [b]Weighted by sex, age, and educational attainment distribution of the Hong Kong general population. [c]Bootstrapping with 1,000 replications for bias-corrected 95% CI was used.

Our findings of mediating effects of communication sufficiency and quality reflected the contributing role of family communication to family well-being in Olson's Circumplex Model of Family Systems (Olson, 2000), McMaster Model of Family Functioning (Epstein et al., 1978), and our community-based intervention studies (Ho et al., 2018; Shen, Wan, et al., 2017). The negative association between PSU and family communication was consistent with previous findings that Internet addiction was associated with lower levels of quantity and quality of parent–adolescent communication (Lei & Wu, 2007; Liu, Lin, Zhou, & Zhang, 2019). People with PSU tended to sacrifice communication time with family members because of the tolerance and overuse symptoms to increase frequency and duration of smartphone use to obtain satisfaction (Kwon et al., 2013; Lepp, Li, & Barkley, 2016), which was supported by the social activity displacement hypothesis proposing that family activities could be decreased or displaced by using digital media (Kraut et al., 1998). PSU was associated with a fear of missing out (Elhai et al., 2018), and the obsession of checking devices can produce intended or unintended distractions during the process of face-to-face interactions (Dienlin, Masur, & Trepte, 2017). Findings of experimental studies suggested that the mere presence of mobile phones might inhibit the development of closeness in a conversation of high quality (Brown, Manago, & Trimble, 2016; Przybylski & Weinstein, 2013).

One of the study's limitations is that the temporal sequence between PSU and family well-being cannot be determined using the cross-sectional data. Residual confounding by unmeasured or unknown confounders might exist, while we adjusted sociodemographic variables in regression and mediation analyses. All data were self-reported. Although this approach is the most feasible and common in literature, the results might be influenced by the recall bias and social desirability bias. Objective record of smartphone usage can be included if possible in future research. We assessed family factors including family well-being and communication by asking questions that were developed in Chinese culture. Generalizability is uncertain in other cultural settings. However, we observed positive correlations of family well-being and family communication with scales developed in the West such as SHS, SWEMWBS, Family APGAR, and FCS (Lyubomirsky & Lepper, 1999; Olson, 2011; Smilkstein, 1978; Stewart-Brown et al., 2009). Studies crossing cultural settings are warranted to provide strong evidence of the effects of PSU in the family context. Future studies may also benefit from using standardized and validated measurements of family factors.

CONCLUSIONS

Our population-based study provided one of the first evidence that PSU was associated with lower levels of perceived family health, harmony, happiness, and overall well-being, through the partial mediating effects of perceived sufficiency and quality of family communication. The findings have implications for the large number of smartphone users that effects of PSU can expand in the family context. Family communication played a crucial role in the relation between PSU and family well-being. Such knowledge could aid health programs in preventing PSU and improving family well-being.

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Authors' contribution: MPW, SYH, SS-cC, and THL conceived the study. NG analyzed the data and wrote the first draft of the manuscript. NG, MPW, and TTL interpreted the data. All authors critically revised and approved the final version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

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