



Social Isolation, Loneliness, and Mobile Phone Dependence among Adolescents During the COVID-19 Pandemic: Roles of Parent–Child Communication Patterns

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Abstract

During the COVID-19 pandemic, mobile phone dependence (MPD) became a common addictive behavior among adolescents because of social isolation. To understand the underlying mechanisms of the impact of social isolation on MPD, this study examined the mediating role of loneliness and the moderating role of parent–child communication patterns on social isolation and MPD. Six hundred and eighty-three adolescents from a middle school in Huang’gang city, China, were recruited to complete a self-report questionnaire. Data analysis comprised latent profile analysis and structural equation modelling. The results showed that social isolation had a significant and positive indirect effect on MPD via loneliness. In addition, three types of parent–child communication patterns were observed: complex, adaptive, and maladaptive. For adolescents with complex parent–child communication, the indirect relation of social isolation to MPD via loneliness is weaker than that of adolescents with maladaptive parent–child communication. These findings suggested that the indirect effect of social isolation on MPD via loneliness was moderated by parent-child communication patterns. Psychological intervention for MPD should emphasize relieving adolescents’ loneliness and improving the quality of their communication with parents during the COVID-19 pandemic.

Keywords Social isolation · Loneliness · MPD · Parent–child communication

COVID-19 is an extremely contagious disease with high infectivity and fast transmission, which poses a high risk to all age groups, and has led to widespread public health damage (Dong et al., 2020). To reduce the chances of being infected during the COVID-19 pandemic, the public were asked to stay indoors in quarantine at home for extended periods. Thus, more than 220 million children and adolescents were confined to their homes and

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informed that the spring semester would be postponed (Wang et al., 2020). However, to allow children and adolescents to continue studying normally, as they did pre-pandemic, they were asked to use mobile phones or computers to carry out the required online schoolwork, which is considered an effective way to learn. Undoubtedly, as there was a lack of monitoring and evaluation of students who are participating in online courses and/or to the inexperienced and inefficient administration of these courses (Duan et al., 2020), it has facilitated students to show mobile phone dependence (MPD), which refers to overuse of and excessive craving for mobile phone so that individuals are unable to regulate and withdraw (Fu et al., 2020; Zhang et al., 2020). For example, 33.37% of the adolescents in Dong et al.'s (2020) study were identified as a problematic smartphone user during the COVID-19 pandemic. Importantly, overuse of mobile phones or MPD may lead to mental or behavioral problems, including poor academic performance, decreased real-life social interaction, neglect of one's personal life, relationship disorders, and mood dysfunction (Duan et al., 2020; Soni et al., 2017). Thus, we argue that adolescents' MPD should be a target of psychological intervention during widespread health crises like the COVID-19 pandemic.

An important prerequisite to determining which interventions might be most effective for MPD was to clarify the risk factors for MPD during the COVID-19 pandemic and to understand their underlying mechanisms. While researchers have found that many factors influence MPD (Busch & McCarthy, 2021), social isolation seems to have been a particularly strong factor during the COVID-19 pandemic. It is an objective state measured via indicators such as living alone, having few or infrequent social contacts and low levels of social activity (Dahlberg, 2021), and underling one end of a spectrum encompassing social network size and social contact frequency (Petersen et al., 2016). Stay-at-home and quarantine orders would lead to induced (Kawabe et al., 2020) and enforced social isolation (Fancourt et al., 2021) on an unprecedented scale. Theoretically, people seek relief way through easily accessible means—their smartphones and internet devices—and over-reliance on such coping mechanisms (Elhai et al., 2020). Given this assumption, individuals can turn to the Internet (Chen & Schulz, 2016; Siste et al., 2020) via their mobile phone or computer to avoid isolation and to meet their social interaction needs in real context, which may increase their risk of MPD. Thus, social isolation may be a risk factor for problematic Internet and smartphone use during widespread forced quarantines such as those imposed during the COVID-19 pandemic (Alheneidi et al., 2021; King et al., 2020).

Another risk factor for MPD may be loneliness. Different from the objective nature of social isolation, loneliness is a subjective negative feeling resulting from a perceived discrepancy between individuals' desired and achieved social connectedness (Perlman & Peplau, 1981). It has been considered a common psychological reaction during the COVID-19 pandemic (Loades et al., 2020) owing to the implementation of social distancing, lockdown, and quarantine measures (Bu et al., 2020; Dahlberg, 2021; Li & Wang, 2020). Davis's (2001) cognitive-behavioral model of problematic Internet use provides a possible explanation: individuals who suffer from loneliness are more likely to have distorted cognitions about the self and the world and to develop a strong aversion to and become less satisfied with the physical world (Zhen et al., 2019). In such cases, they may rely on mobile phones to access the world virtually, which may temporarily relieve their loneliness (Kim, 2017); however, this approach may also increase their risk of MPD (Zhen et al., 2019). Indeed, loneliness has been associated with increased MPD (Darcin et al., 2016; Öztunç, 2013).

While a series of quarantine measures may lead to both social isolation and loneliness, thereby causing MPD, social isolation and loneliness are distinct constructs. Moreover, social isolation shows a certain relation to loneliness (Petersen et al., 2016),

whereby social isolation limits an individual's ability to interact with or in their available social networks, which, in turn, can lead to loneliness (Savikko et al., 2005). Indeed, social isolation is positively correlated with loneliness (Cacioppo et al., 2010). Thus, we proposed that social isolation might have an indirect effect on MPD via loneliness.

As Tang et al. (2021) note, adolescents' parents typically have interacted the most with them during recent home quarantines, and thus, maintaining positive communication with their parents may serve as a protective factor for adolescents' mental health when confronted with social isolation. Furthermore, the effect of social isolation on loneliness and MPD may vary with individual differences in parent–child communication patterns; that is, the role of parent–child communication in adolescents' development is mainly a function of its patterns (Fang et al., 2004; Fitzpatrick & Ritchie, 1993). Barnes and Olson's (1985) circumplex model suggests that parent–child communication can be viewed as a continuum from open to problematic communication. In this model, open parent–child communication is characterized by the positive disclosure of information between parent and child (Barnes & Olson, 1985; Metcalfe et al., 2008; Zhou et al., 2020); furthermore, parents are responsive to and affectively involved with their adolescents, who then perceive more positive parental attitudes and behaviors (Fang & Fang, 2003). Thus, open parent–child communication may help adolescents in home quarantine or social isolation during the pandemic perceive more support and meet their relationship needs, thus relieving their sense of loneliness and reducing their use of mobile phones for engaging in interpersonal interactions. In contrast, problematic communication is characterized by restrained and cautious communication between parents and their children, even to the extent of avoidance in some cases (Fang & Fang, 2003). Such communication patterns would clearly fall short of meeting adolescents' relationship needs in socially isolated situations such as those experienced during the COVID-19 pandemic. Thus, socially isolated adolescents are more likely to be lonely and thus use their mobile phones to satisfy their relationship needs, which in turn increases their risk for MPD.

While open or problematic parent–child communication may exert distinct effects on adolescents' mental and behavioral health, few families show absolute open or problematic parent–child communication in real contexts, and separating one from the other to examine the role of parent–child communication was deemed unrealistic. In fact, each individual may simultaneously experience the two types of parent–child communication in his or her family life, and open and problematic communication will show different combination patterns in different families. Therefore, clarifying the combination patterns can promote a more comprehensive understanding of the heterogeneous characteristics of parent–child communication among adolescent population. Furthermore, because of the widespread implementation of social distancing, lockdowns, and quarantine measures, parent–child communication, social isolation, and loneliness are popular issues that people have been discussing since the COVID-19 pandemic began (Fancourt et al., 2021; Loades et al., 2020; Tang et al., 2021); however, whether these variables have a combined effect on MPD remains unclear. To fill these gaps, this study would examine the moderating role of parent–child communication patterns in the indirect-effect model of the influence of social isolation on MPD via loneliness. Drawing on previous theories and studies, we proposed that different combination patterns of open and problematic parent–child communication would exist in adolescents during the pandemic, and such patterns would moderate the relations between social isolation and MPD via loneliness as a mediator (see Fig. 1).

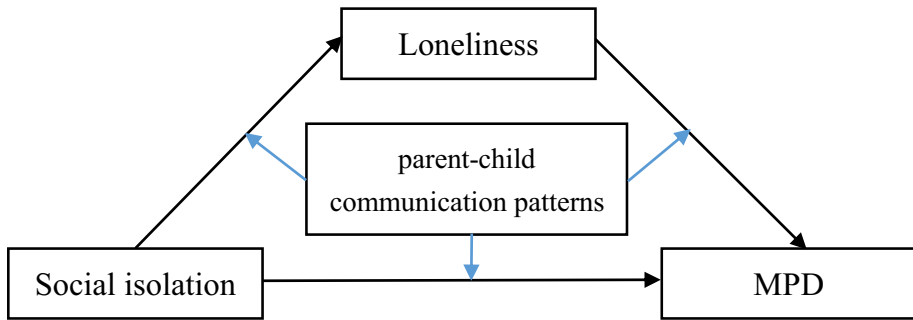


Fig. 1 Hypothesized moderated mediation model

Methods

Participants and Procedures

About half a year after the outbreak of COVID-19 pandemic in China, we recruited adolescents from a middle school in Huang'gang city to participate in this investigation during July 16~23, 2020. As Huang'gang is adjacent to Wuhan, it had been severely threatened by the COVID-19 pandemic, and the confirmed COVID-19 cases in Huang'gang city ranked third among a total of 17 cities and districts in Hubei Province. In addition, there were great differences in the pandemic situation in difference places, so that students in some areas had been returned to schools whereas students in other areas might be in strict home quarantine. Therefore, we adopted convenient sampling method to recruit those participants who resumed classes and were willing to participate in this survey. In total, 683 students from a middle school in Huang'gang city were enrolled in this study. Of them, 341 (49.9%) were male, 301 (44.1%) were female, and 41 (6.0%) did not report sex. The mean age was 16.06 years (standard deviation 0.56 years; range 15–18 years).

This study was approved by the Research Ethics Committee of the Department of Psychological and Behavioral Sciences, Zhejiang University. All students in the selected students attended school on the assessment date, and all agreed to participate in the investigation and complete self-report questionnaires. Before the survey, participants were informed of the research purpose and the voluntary nature of participation. Besides, we declared to them that the obtained data would be strictly confidential and would only be used for scientific research. Written informed consent was obtained from all students and their guardians. Assessments were conducted under the supervision of trained psychology postgraduate students.

Measures

Social Isolation

Zhen et al., (2021, in press) social isolation questionnaire was used to assess adolescents' social isolation during the COVID-19 pandemic. The questionnaire was developed based on the core conception of social isolation, manifested by how often individuals

communicate with important others (e. g., family members, friends) in their social network (Taylor et al., 2016). This questionnaire comprised four items (e.g., the frequency for communicating with friends during the COVID-19 pandemic), each rated on a three-point scale: 0 = “always,” 1 = “sometimes,” and 2 = “never.” A higher summed score indicated greater social isolation.

Loneliness

A state loneliness scale (Gerson & Perlman, 1979) was used to assess adolescents’ loneliness during the COVID-19 pandemic. It comprised 12 items (e.g., lack of friends), each rated on a five-point Likert scale (1 = “completely disagree” to 5 = “completely agree”). In this study, this scale showed good reliability (Cronbach’s $\alpha=0.84$).

MPD

A seven-item scale developed by Seo et al. (2016) was used to assess adolescents’ MPD. Responses on each item were rated on a four-point Likert scale (1 = “strongly no” to 4 = “strongly yes”); a higher aggregated score indicated greater MPD. The scale showed good reliability in previous studies (Fu et al., 2020; Zhen et al., 2020) and in the current study (Cronbach’s $\alpha=0.85$).

Parent–child Communication

The Chinese version of a parent–child communication scale was used to assess parent–child communication (An, 2004). This scale comprised 20 items, divided into two dimensions: openness and problems in parent–child communication. Items were rated on a five-point Likert scale (1 = “completely disagree” to 5 = “completely agree”). This scale has previously shown good reliability and validity with adolescents (Zhou et al., 2020) and also showed good reliability in the present study for both open parent–child communication (Cronbach’s $\alpha=0.91$) and problematic parent–child communication (Cronbach’s $\alpha=0.79$).

Data Analysis Procedures

This study had two aims: assessing the latent combination patterns of open and problematic communication and examining the moderating role of such patterns in the relations among social isolation, loneliness, and MPD. In view of the first aim, we used Mplus 7.0 to conduct latent profile analysis based on adolescents’ open and problematic parent–child communication. To determine the optimal number of latent classes, 1- to 5-class solutions were evaluated and compared on the basis of fit statistics, interpretability, and theoretical considerations. A good model fit was indicated by lower Bayesian information criterion, adjusted Bayesian information criterion, and Akaike information criterion, higher entropy, a significant Lo–Mendell–Rubin likelihood ratio test (LMR-LRT), and a significant adjusted LMR-LRT (ALMR-LRT). After determining the optimal class, the most likely class membership variables were then exported in the set of parent–child communication patterns data to SPSS21.0, and the following analysis was conducted.

In view of the second aim, several analysis procedures were performed. First, we built a direct-effect model, with social isolation predicting MPD. Second, we built an

indirect-effect model in Mplus 7.0, with loneliness mediating the relationship between social isolation and MPD. To evaluate model fits, we used chi-square values, the comparative fit index (CFI), the Tucker-Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean residual (SRMR). The cutoffs for accepting a model were equal to or greater than 0.90 for CFI and TLI and equal to or less than 0.08 for the RMSEA and SRMR. Next, a multiple-group comparison model in Amos 20.0 was built to examine the moderating role of parent–child communication patterns on the indirect-effect model. Based on our hypothesis that parent–child communication patterns could play a moderating role in the direct effect of social isolation on loneliness and MPD, we then constrained the predictive paths from social isolation to loneliness and MPD in distinct parent–child communication patterns model to be equal. Next, following the suggestions of Farrell (1994), we compared the measurement parameters between the two groups, as there were no structural parameters. The difference in the CFI between the unconstrained and constrained models was more than 0.01 which informs a significant difference of two models (Cheung & Rensvold, 2002), suggesting a significant moderating effect.

Results

Descriptive Statistics and Correlation Analysis

Table 1 presents the descriptive statistics and correlations among the main variables. We observed a significant and positive correlation between social isolation, loneliness, MPD, and problematic parent–child communication. Open parent–child communication was significantly and negatively related to the other variables.

Assessment of Parent–Child Communication Patterns

Table 2 shows the latent class solution for both open and problematic parent–child communications among participating adolescents. We found that the value of entropy exceeded 0.70 for the 3- to 6-class solutions, suggesting that the 3- to 6-class solutions had better between-group distinctions than other solutions. Moreover, the findings indicated that the LMR-LRT and ALMR-LRT values were significant for the 2-, 3-, and 5-class solutions but not for the other solutions. The prevailing standard is that when the LMR-LRT and

Table 1 Descriptive statistics and correlation analysis among main variables

Variables	M (SD)	1	2	3	4
1. Social isolation	3.97 (1.48)	1.00			
2. Loneliness	31.47 (7.81)	0.38***	1.00		
3. MPD	17.94 (4.69)	0.12**	0.28***	1.00	
4. Open communication	18.35 (8.68)	−0.40***	−0.44***	−0.14***	1.00
5. Problematic communication	20.14 (7.24)	0.32***	0.42***	0.30***	−0.56***

Open communication = open parent–child communication; Problematic communication = problematic parent–child communication

*** $p < 0.001$, ** $p < 0.01$

Table 2 Goodness of fit indices for distinct solutions

Class	AIC	BIC	<i>adj</i> BIC	Entropy	LMR-LRT	ALMR-LRT
1-Class	9274.701	9292.789	9280.089	–	–	–
2-Classes	9127.950	9159.604	9137.379	0.612	152.751**	145.324**
3-Classes	9015.146	9060.367	9028.615	0.736	118.804***	113.027***
4-Classes	8999.893	9058.680	9017.404	0.791	21.253	20.219
5-Classes	8980.268	9052.622	9001.820	0.771	25.625**	24.379**
6-Classes	8976.306	9062.226	9001.899	0.775	9.962	9.477

*** $p < 0.001$, ** $p < 0.01$. The 3-Classes in bold font indicates the optimal solution.

ALMR-LRT values are significant in many classes of solutions, the solution with the largest number of classes should be accepted (Rosellini, Coffey, Tracy, & Galea, 2014). In light of these criteria, 3- and 5-class were considered in this study. However, we found that one of the classes in the 5-class solution only had eight participants (1.2%), suggesting that the 5-class solution was unstable and should thus be excluded as an optimal solution. We then selected the 3-class solution as optimal for this study.

Table 3 shows the unstandardized scores for open and problematic parent–child communication in three types of patterns, as well as the results of the analyses of variance and post hoc pairwise comparisons. We found that between-class differences in open and problematic parent–child communications were significant. As Table 3 shows, for the first group, the level of open parent–child communication was slightly higher than that of its population mean (18.35), while problematic parent–child communication was slightly less than that of the population mean (20.14). This suggested that these adolescents had both medium-levels of open and problematic parent–child communication and thus we referred to this group as the *complex communication group* ($n = 467$, 68.7%). The second group, which we named the *adaptive communication group* ($n = 78$, 11.5%), had high levels of open parent–child communication and low levels of problematic parent–child communication. The third group, called the *maladaptive communication group* ($n = 135$, 19.9%), had high levels of problematic parent–child communication and low levels of open parent–child communication.

Examination of the Moderated Mediating Model

A direct-effect model in which social isolation predicted MPD fits the data completely, $\chi^2(0) = 0.00$, CFI = 1.00, IFI = 1.00, RMSEA (90% CI) = 0.00 (0.00–0.00). Social isolation was significantly positively related to MPD ($\beta = 0.12$, $p < 0.01$). Next, we put the loneliness variable between social isolation and MPD and built the indirect-effect model (Fig. 2). This model fits the data completely, $\chi^2(0) = 0.00$, CFI = 1.00, IFI = 1.00, RMSEA (90% CI) = 0.00 (0.00–0.00). Using path analysis, we found that the direct path from social isolation to MPD was non-significant, but social isolation had an indirect positive effect on MPD via loneliness. These results suggested that loneliness played a partial mediating role between social isolation and MPD.

Next, based on the mediation effect model in Fig. 2, multiple group analysis was conducted to assess whether the mediating effect of loneliness between social isolation and MPD differed between the complex ($n = 467$), adaptive ($n = 78$), and maladaptive ($n = 135$)

Table 3 Class means for the 3-class solution

	Complex communication M (SD)	Adaptive communication M (SD)	Maladaptive communication M (SD)	<i>F</i>	η_p^2	Com- parisons ($p < 0.05$)
Open-communication	19.07 (5.25)	33.08 (4.92)	7.43 (4.42)	632.65 ^{***}	0.66	3 < 1 < 2
Problematic-communication	19.30 (5.03)	9.78 (4.94)	28.82 (4.73)	372.92 ^{***}	0.54	2 < 1 < 3

*** $p < 0.001$

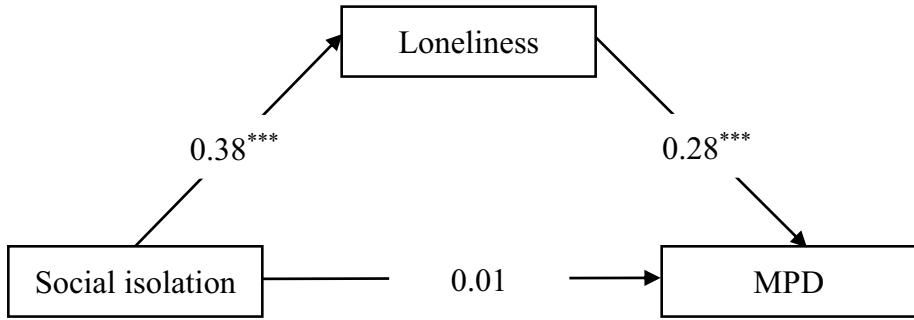


Fig. 2 Mediation effect model. *** $p < 0.001$

communication groups. Following the suggestions of Farrell (1994), we compared the measurement parameters between these three groups, as there were no structural parameters. In terms of measurement parameters, all the paths were constrained to be equal. The results showed that the measurement model had good fit indices: $\chi^2(6) = 10.29$, CFI=0.95, IFI=0.95, RMSEA (90% CI)=0.03 (0.00–0.07). A significant difference was found between the constrained model and the non-constrained model: Δ CFI=0.051 and Δ IFI=0.049. The results indicated that the mediation model was moderated by parent–child communication patterns. The critical ratios for the differences between parameters (Table 4) indicated that the predictive path from social isolation to loneliness differed between complex communication and maladaptive communication: the positive relation between social isolation and loneliness in the maladaptive communication group ($\beta = 0.37$, $p < 0.05$) was stronger than that in the complex communication group ($\beta = 0.22$, $p < 0.05$). All the other predictive paths had non-significant differences between the two or three communication patterns.

Discussion

During the COVID-19 pandemic, the implementation of home quarantines and social distancing measures has highlighted the need to investigate and facilitate the assessment of the underlying mechanisms of MPD from the perspective of social isolation, loneliness, and parent–child communication, which have been separately discussed by researchers as common issues since the beginning of the pandemic (Fancourt et al., 2021; Faustino et al., 2021; Loades et al., 2020; Tang et al., 2021). This is the first attempt to clarify the

Table 4 Critical ratios for differences between parameters in multiple-group analysis

Predictive paths	Complex vs maladaptive communication	Adaptive vs maladaptive communication	Complex vs adaptive communication
Social isolation → MPD	CR = -0.20, $p > 0.05$	CR = -1.00, $p > 0.05$	CR = 1.10, $p > 0.05$
Social isolation → Loneliness	CR = 2.22, $p < 0.05$	CR = 0.27, $p > 0.05$	CR = 1.49, $p > 0.05$
Loneliness → MPD	CR = -0.50, $p > 0.05$	CR = -1.22, $p > 0.05$	CR = 0.97, $p > 0.05$

combination patterns of open-communication and problematic-communication in an adolescent sample during the COVID-19 pandemic. More importantly, this research firstly revealed the interactive influencing mechanism among such patterns, social isolation, loneliness, and adolescents' MPD.

In specific, we found that social isolation had a direct positive relation with MPD, which is consistent with previous findings (Al-Kandari & Al-Sejari, 2020). In fact, social isolation is considered a social alienation dimension (Al-Kandari & Al-Qashan, 2001), wherein individuals have difficulty in developing friendships in real life (Al-Kandari & Al-Sejari, 2020). They may then resort to mobile phone for online communication and social interaction, as suggested by the social compensation hypothesis (McKenna et al., 2002). Previous research found that using smartphone apps of communication and social networking did reduce individuals' social isolation and improve their personal lives (Cho, 2015). Hence, social isolation directly impelled adolescents during the pandemic to a high possibility of MPD.

Furthermore, the research found that adolescents' subjective lonely state completely mediated the relation between objective social isolation and their MPD. This suggested that the ultimate cause for these adolescents to depend on mobile phones lied in their internal loneliness. Social isolation in the pandemic may initially separate adolescents in objective situations and limited their interpersonal interaction (Lewis, 2020). However, this made it difficult to satisfy their basic psychological needs of relatedness and sense of belongingness, which increased the discrepancy between desired and achieved social connectedness (Perlman & Peplau, 1981), eliciting adolescents' loneliness (Mellor et al., 2008). Especially in the context of the stressful COVID-19 event, the daily social network of these adolescents was suddenly cut off, and their perceived loneliness boosted in a short time, so they are more likely to make up for the sharp deletion of interpersonal intimacy and social support in real life through various mobile network means (Caplan, 2007; Ceyhan & Ceyhan, 2008; McKenna et al., 2002). As a result, the lonely feelings generated from social isolation urged adolescents to experience increased MPD.

Each of the three distinct parent-child communication patterns that derived from the latent profile analysis—complex, adaptive, and maladaptive—contained both open and problematic communication components, suggesting that parent-child communication during the COVID-19 pandemic was likely neither absolutely open nor absolutely problematic, and was heterogeneous among adolescents. Interestingly, the complex communication group had the largest population ($n=467$, 68.7%), followed by the maladaptive communication group ($n=135$, 19.9%) and finally adaptive communication group ($n=78$, 11.5%). The complex group is characterized by equivalent medium levels of open and problematic parent-child communication. On the one hand, the measures of home quarantine made family members to stay together every day, which had created opportunities for parents and children to confide in each other and showed an open communication style. But on the other hand, quarantine at home aroused the conflicts between parents and children when academic supervision, housework sharing, and other household chores were not well handled (Chen et al., 2021). For example, a survey on 12,711 parents showed that compared with last year, 31.4% of them reported an increase in the frequency of parent-child conflicts during the COVID-19 pandemic in China (Chen et al., 2021). Such conflicts may trigger problematic parent-child communication style. Hence, the major adolescents displayed the coexisting pattern of open and problematic communication during the pandemic.

More importantly, parent-child communication patterns moderated the path from social isolation to loneliness. In specific, the positive relation between social isolation and loneliness in the maladaptive communication group was stronger than that in the

complex communication group. Adolescents with the maladaptive communication pattern avoided discussing or communicating with their parents; thus, these socially isolated ones could not meet their relatedness needs and were likely to involve in negative cognition, and finally they perceived a deep sense of loneliness. Differently, adolescents with the complex communication pattern had a medium level of open communication with their parents, in which children to a certain degree felt supported by parents and perceived positive parental attitudes (Fang & Fang, 2003), so their loneliness brought by social isolation was weaker. What is unexpected, there was no significant difference in the relation of social isolation to loneliness between the maladaptive and the adaptive communication group. Although adaptive communication pattern had a high level of open communication, with which parents and children had more disclosure and support for each other, sharing worries and concerns may also cause family members to experience symptoms of psychological distress (Teyber, 1983). This may be due to the contagious effect of emotions (Hatfield et al., 1993), which endows adolescents to perceive their parents' negative emotions under the pandemic and then show similar emotions. Hence, isolated adolescents with adaptive communication pattern did not perceive reduced loneliness. Such finding suggested that an appropriate level of communication between parents and children was optimal when encountering in stressful events such as the COVID-19 pandemic.

Several limitations in this study should be noted. First, this is a cross-sectional research design, so all the causal language is on the basis of theoretical assumptions and no causal conclusions can be drawn. Second, interpersonal interactions are important for adolescents, but we only took parent–child communication into account and neglected other types of interpersonal communication (e.g., with peers). Third, as measures of quarantine and social distancing are different in distinct developmental phases of the pandemic, adolescents' experiences of social isolation and loneliness may vary in different phases and different pandemic severity (Murayama et al., 2021). Therefore, these factors need to be considered when interpreting the results of this study. Finally, this study only included some adolescents from one city in Hubei Province, China; the selective-bias sampling reminds that any generalizations of the findings to population of other age groups in other areas should be made with caution.

Notwithstanding these limitations, this is the first study to examine the combined role of social isolation, loneliness, and parent–child communication in MPD during the COVID-19 pandemic. The positive effects of social isolation on MPD via only loneliness reflect that MPD's core factor was the subjective psychological state elicited by objective isolation, home quarantine, and social distancing. Moreover, while parent–child communication patterns moderated the indirect effect of social isolation on MPD via loneliness, those patterns did not change the predictive valence of social isolation's influence on MPD via loneliness. This finding indicates that when adolescents are socially isolated, they may nevertheless be lonely and thus at risk for MPD, irrespective of the type of communication pattern they have with their parents. From a clinical perspective, psychological intervention for MPD should be emphasized to relieve adolescents' psychological problems, particularly loneliness during forced isolation such as that experienced during the COVID-19 pandemic. Additionally, once the pandemic has diminished, an effective strategy to relieve adolescents' MPD may be to increase adolescents' social communication, in addition to parents.

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Declarations

Ethical Approval This study was approved by the Research Ethics Committee of the Department of Psychological and Behavioral Sciences, Zhejiang University. Informed consent was obtained from each participant included in our investigation.

Conflict of Interest The authors declare no competing interests.

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