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The immediate and subsequent effects of public health interventions for COVID-19 on the leisure and recreation industry

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ABSTRACT

Public health interventions to combat COVID-19 can be viewed as an exogenous shock to the economy, especially for industries—such as leisure, recreation, and tourism—that rely heavily on human mobility. This study investigates whether and how exactly the economic impact of government public health policies varies over time. Focusing on the leisure and recreation industry, we use data for 131 countries/regions from February to May 2020 and employ generalized difference-in-differences models to investigate the short- and longer-term effects of public health policies. We find that stricter policies lead, on average, to an immediate 9.2 percentage-point drop in leisure and recreation participation. Even so, that industry recovers in about seven weeks after a COVID-19 outbreak in countries/regions that undertake active interventions. After thirteen weeks, leisure and recreation involvement recovers to 70% of pre-pandemic levels in a place that actively intervened but stagnates at about 40% in one that did not.

1. Introduction

The spread of the novel coronavirus disease 2019 (COVID-19) has become a global pandemic—afflicting more than 200 countries in a matter of months since the first confirmed case was reported in Wuhan, China, in mid-December 2019. According to the World Health Organization (WHO), this pandemic had resulted in some 180 million confirmed cases and more than 3 million deaths globally by the end of June 2021 (WHO, 2021). The pandemic has also triggered a massive spike in uncertainty, sparking fears of an economic crisis and recession (Nicola et al., 2020). According to World Bank’s Global Economic Prospects Report (2021), the global economy is estimated to have shrunk 4.3% in 2020. While almost all sectors have been affected, the tourism and leisure industry lies among the hardest-hit and most damaged global industries (Abbas et al., 2021). A report of the pandemic impacts on tourism launched by World Tourism Organization indicates that export revenues from tourism could fall by $910 billion to $1.2 trillion in 2020, which will have a wider impact and could reduce global GDP by 1.5%–2.8% (UNWTO, 2020).

To minimize the spread of this virus, governments all around the world have implemented a wide range of public health measures: travel restrictions, domestic lockdowns, public testing, and bans on mass gatherings. Mobility and travel restrictions can effectively mitigate the pandemic (Chinazzi et al., 2020), but such measures can have adverse effects on the economy (Bonaccorsi et al., 2020) and especially on the leisure, recreation, and tourism industry—given its reliance on human mobility (Bakar & Rosbi, 2020; Yang, Zhang, & Chen, 2020). Fig. 1 plots changes in visits to leisure and recreation locales in nine countries from different continents during the 3–4 months following the first domestic COVID-19 case (Google, 2020). It is clear that the leisure and recreation industry has been severely affected worldwide during the pandemic, and a severe decline in the leisure and recreation industry has occurred in each country following adoption of public health measures.

Although there is a consensus on the importance of credible measures from government to generate market confidence and reduce the risk from this virus for the tourism industry (Assaf & Scuderi, 2020), little is known on the actual effect of the policies adopted (Weible et al., 2020). The combination of the decline in Fig. 1 and an impending economic recession suggests that, although the government plays an essential role in crises and crisis management, its actions might sometimes not be economically beneficial (Hur, 2019; Rosenthal & Kouzmin, 1997). Thus we are led to ask: When there is a serious global health

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emergency like COVID-19, is it possible to maintain public health and economic growth at the same time? In other words: Are public health interventions an obstacle to economic performance?

It is critical to generate systematic evidence that would support effective policy decisions under the grim situation arising from pandemic of COVID-19—and in similar, future global emergencies. Hence we must carefully evaluate the economic impact of public health measures during this pandemic. Our study offers such an assessment, from a global perspective, for the leisure and recreation industry. We collected data on leisure and recreation activities and public health policies for more than 130 countries/regions and examined how participation in leisure and recreation activities has responded to government policies; for that purpose, we use a generalized difference-in-differences (DID) framework with dynamic treatment effects. That framework allows us to investigate the impact of public health interventions over time and, more specifically, the difference between immediate and subsequent effects. To the best of our knowledge, this paper is the first to estimate the full impact of public health interventions for COVID-19 at different time intervals.

2. Literature review

Over the past year, a large body of literature on COVID-19 and the leisure, recreation and tourism industry has emerged, mainly focusing on assessing the impact of the COVID-19 pandemic on this industry (e.g. Gossling et al., 2020; Yang et al., 2020), and discussing its recovery (e.g. Fotiadis et al., 2021; Sigala, 2020; Zhang et al., 2021). As one of the hardest-hit industries, many different sectors of leisure, recreation and tourism industry have been negatively impacted by the pandemic (Dolnicar & Zare, 2020; Gossling et al., 2020; Hall et al., 2020). The COVID-19 crisis is different in many ways from past ones (Kreiner & Ram, 2021). Yang et al. (2020) employed a ‘dynamic stochastic general equilibrium’ (DSGE) model for better understanding the impact of the pandemic on global tourism in this scenario.

Various efforts have made by governments to support the tourism industry, and there exists substantial inter-country heterogeneity in terms of policy responses as countries have been impacted differently by the pandemic, and have different political system and culture, and affect the dynamic evolution of economic activities, including the leisure and recreation industry. Among methods that are commonly employed to investigate the economic impact of policies—such as regression discontinuity designs, DID, propensity score matching (PSM), PSM–DID, and quasi-experimental methods (Crown, 2014; Lee & Lemieux, 2010)—

3. Empirical model and data

3.1. DID model

After a domestic COVID-19 outbreak, there is considerable inter-country heterogeneity in public health interventions; these policies

Fig. 1. Changes in the number of participations in leisure and recreation activities (horizontal axis marks the number of days after each country’s first reported COVID-19 case).
we adopted DID because it can neutralize the selection bias that is naturally characteristic of governments’ public health interventions during the pandemic. The DID approach is an attractive choice for estimating causal effects when using research designs based on controlling for confounding variables or using instrumental variables is deemed unsuitable, and at the same time, pre-treatment information is available (Lechner, 2010). It is therefore one of the most popular tools for applied research in economics to evaluate the effects of public interventions and other treatments of interest on some relevant outcome variables (Abadie, 2005). The method has been widely used in general public policy evaluation (e.g. Card & Krueger, 1994; Yeon et al., 2020) as well as studies on the tourism industry during COVID-19 (e.g. Brodeur et al., 2021; Polemis, 2020). In this paper, we use a generalized DID model in which (a) the treatment is a continuous index that measures the stringency of public health policies in each country and (b) the treatment effect lasts for multiple periods. Our main regression model is as follows:

\[
\Delta \text{Leis}_{t;i} = \alpha + \sum_{k=2}^{11} \beta_k (\text{Week}_{t;i}^k) + \sum_{k=2}^{11} \gamma_k (\text{PubH}_{t;i}^k) + \sum_{k=2}^{11} \delta_k (\text{PubH}_{t;i}^k) \\
+ \sum_{k=2}^{11} \tau_k (\text{Week}_{t;i}^k \times \text{PubH}_{t;i}^k) + \varphi (\text{PubH}_{t;i}) + \text{Cases}_{t-1} + \sum_{d=2}^{7} \sigma_d + \text{Controls},
\]

\[+ \epsilon_{t;i}, \] (1)

here \(\Delta \text{Leis}_{t;i}\) denotes the change in leisure and recreation participation on date \(t\) as compared with the same weekdays from a pre-pandemic benchmark period, the five weeks from 3 January to February 6, 2020, in country/region \(i\). For \(k \geq 1\), \(\text{Week}_{t;i}^k\) is a dummy set to 1 for days in the \(k\)th week after the first reported COVID-19 case in country/region \(i\) (and set to 0 otherwise). The term \(\text{Week}_{t;i}^k\) similarly denotes, for \(k < 0\), week dummies before a COVID-19 outbreak; these indicators are included to test for parallel trends in the pre-treatment periods. The first week following a pandemic outbreak is the benchmark period, so that dummy is dropped from the regression.

The term \(\text{PubH}_{t;i}\) is an index that measures governments’ public health interventions; it reflects an average of ten sub-indices. The interaction terms between policy and different week dummies are intended to capture the presumably heterogeneous effect of public health interventions during different time intervals. We incorporate a constant term \((\alpha)\), and \(\beta, \gamma, \varphi\) are all regression coefficients; \(\epsilon_{t;i}\) is the random term. Cumulative confirmed COVID-19 cases prior to date \(t - 1\) (\(\text{Cases}_{t-1}\)) are also included in the regressions along with six day-of-week indicators \((\sigma_d)\), excluding Monday. Control variables \((\text{Controls})\) contain various factors related to leisure and recreation involvement during the pandemic, including per-capita GDP (Houston & Wilson, 2002; Sumner et al., 2020; Thompson & Tinsley, 1978), average monthly temperature (Qi et al., 2020; Richardson & Loomis, 2005), the share of the population aged 65 and over (Abdulamir & Hafidh, 2020; Krugler et al., 2005), and the urbanization rate (Desmet & Wacziarg, 2021; Hauser, 1962).

To examine whether the empirical results are robust to model choices, we use a combination of a linear and a quadratic term for the date in order to capture both the change in leisure and recreational involvement and the dynamic effect of governmental public health interventions. This second regression model is written as

\[
\Delta \text{Leis}_{t;i} = \tilde{\alpha} + \tilde{\beta}_1 (\text{Date}_{t;i}) + \tilde{\beta}_2 (\text{Date}_{t;i}^2) + \tilde{\gamma}_1 (\text{PubH}_{t;i} \times \text{Date}_{t;i}) + \tilde{\gamma}_2 (\text{PubH}_{t;i} \\
\times \text{Date}_{t;i}^2) + \tilde{\varphi} (\text{PubH}_{t;i}) + \text{Cases}_{t-1} + \sum_{d=2}^{7} \sigma_d + \text{Controls}, + \epsilon_{t;i},
\]

where \(\text{Date}_{t;i}\) represents the number of days after the first reported case in country/region \(i\) and where the other variables are defined as before. The term \(\tilde{\alpha}\) is a constant term, and \(\tilde{\beta}, \tilde{\gamma}, \tilde{\varphi}\) are all regression coefficients. We again include interaction terms—between our policy index and the linear and quadratic date terms—to assess the effects of public policy intervention on the trend of participating in leisure and recreation activities.

### 3.2. Data sources

The data on trends in mobility—visits to recreation and retail destinations such as cafés, shopping centers, theme parks, museums, libraries, and movie theaters—are from Google’s (2020) mobility trend database. Retailing places like shopping malls typically share a building with leisure places like movie theaters. Besides, the dataset covers partially both domestic and international tourism activities as leisure and recreation places defined in the google mobility data data substantially with tourist spots; e.g. theme parks and museums included in the measurement are typically also tourist destinations. The period covered is from 16 February to May 26, 2020. The metric is the percentage change of leisure and recreation participation in the sample period compared to that in a pre-pandemic period, from 3 January to February 6, 2020, within the same country, which facilitates inter-country comparisons. The Google mobility trend database includes relatively complete and comparable data that are available for a large number of countries and regions. We therefore use these data to represent the change in leisure and recreation activities. Statistics on per-capita GDP, urbanization rate, and the percentage of population aged 65+ are from the World Bank Open Data website (https://data.worldbank.org), and the average monthly temperature for each country/region is obtained from Climate Data Online (NOAA, 2020).

Total confirmed COVID-19 cases from December 31, 2019 to 1 June 2020—as well as governments’ responses to COVID-19—are included in the Response2covid19 data set assembled by Porcher (2020), which is widely used for assessing governmental reactions to COVID-19 (e.g., Nagpal et al., 2020; Uddin, Imam, Moni, & Thow, 2020). This dataset classifies public health interventions into ten categories: bans on mass gatherings (our Mass variable), bans on sports and recreation events (Sport), restaurant and bar closures (Rest), domestic lockdowns (Domestic), travel restrictions (Travel), declarations of states of emergency (State), public testing (Testing), enhanced surveillance (Surveillance), school closures (School), and postponement of elections (Elect). For a given date, each policy variable for a country takes the value 1 if the country has strictly implemented that policy at the national level, the value 0.5 if the implementation is partial or localized, or the value 0 if the focal policy is not implemented. It should be pointed out that the dataset does not integrate whether the measures are correctly implemented, and the level of the indices should not be interpreted as proxies for good or bad governance (Porchor, 2020).

Table 1 summarizes the proportion of countries/regions that adopt each of the ten interventions at different times after observing the first domestic case. By 30 days after the initial outbreak, 79.2% of the 131
countries/regions in our sample have implemented travel restrictions and 68.8% (resp., 62.4%) have implemented bans on mass gatherings (resp., domestic lockdowns). A majority of countries/regions have also closed schools and restaurants, prohibited sports events, and postponed elections. Declaring a state of emergency, large-scale testing, and sur—veillance are used relatively less often across countries. The \( \text{PubH}_i \) index we use in regressions, which is the average of these ten public health measures, is 0.37 at the 30-day mark following the first confirmed case in country/region \( i \). That is, a typical country has implemented 3.7 out of 10 public health measures within the first month of its first reported COVID-19 case.

4. Results

4.1. Change in leisure and recreation involvement following public health interventions

Public health policies have immediate negative consequences for the leisure and recreation industry. Table 2 shows the changes in leisure and recreation activities around the dates when three selected measures are put into place. Compared with the pre-pandemic benchmark, participation in leisure and recreation activities declined on average by 37.2 percentage points (p.p.) one day after domestic lockdowns were implemented—that is, by a much greater amount than the 23.6-p.p. decrease one day before policy implementation. This average decline becomes even more pronounced, at 57.1%, one month after the announcement of domestic lockdowns. This result is consistent with the previous finding that global tourism has slowed down significantly as a result of travel restrictions and lockdowns (Gosling et al., 2020). After 60 days, however, the leisure and recreation industry show signs of recovery: the relative changes average –43.0%, or nearly 14 p. p. Higher than those 30 days after policy implementation. These raw comparisons document the existence of a decline-then-recovery pattern in leisure and recreation activities following implementation of domestic lockdowns. A similar trend is observed for travel restrictions and bans on mass gatherings. Next, we verify these dynamic changes in a formal regression setting.

4.2. Impact of public health interventions on participation in leisure and recreation activities

Table 3 reports the coefficients, from our baseline regression model, which are related to the effects of public health policies on participation in leisure and recreation activities. In model (1), \( \gamma_1 \) (resp., \( \gamma_2 \)) is the coefficient for the interaction term between the policy index and the dummy variable for one week (resp., two weeks) before a COVID-19 outbreak. Both of these coefficients are statistically insignificant.

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suggesting that there are no pre-treatment differences in the trend of leisure and recreation activities for countries that would have intervened differently in response to the pandemic’s outbreak.

Recall that our dummy for the first week is used as the benchmark and so is omitted from these regressions. The coefficients $\beta_2, \ldots, \beta_{13}$ are for the dummies for weeks following the coronavirus outbreak. Most values of $\beta$ are negative and become more so over time. The impact of public health interventions is captured by the values of $\phi$ and $\gamma$. The $\gamma_2, \ldots, \gamma_6$ are negative, $\gamma_7$ is insignificant, and $\gamma_8, \ldots, \gamma_{13}$ are positive, which suggests that the effects of public health policies on the leisure and recreation industry are heterogeneous over different time intervals. To illustrate this impact—and the difference between short and longer terms—in Fig. 2 we use the estimated coefficients given in Table 3 to plot the change of leisure and recreation involvement in two types of countries/regions: in the first type, there is no public health intervention (i.e., $PubH_i$ index = 0); in the second, public health policies are implemented to the average extent (i.e., $PubH_i$ index = 0.37).

As compared with a destination that undertakes no policy responses, those in which public health measures are actively implemented see an immediate 9.2 p.p. drop in leisure and recreation activities during the first week. After a month, the relative decline in the leisure and recreation industry is 21.4 p.p. In the case with no response but a far greater 44.3 p.p. In the case of interventions. During the second month, leisure and recreation activities continue to decline in the former case yet gradually stabilize in the latter. By the eighth week, the leisure and recreation industry in countries with public health interventions performs slightly better than in those without any such policy. From the eighth to the thirteenth week, the participation in leisure and recreation activities remains relatively stable in the no-policy case but begins a recovery in countries that have actively intervened. In the thirteenth week, leisure and recreation involvement returns to 70% of its pre-pandemic level in a country/region that actively intervened but is stuck at 40% in one that did not. While the negative short-run effect confirms results in the literature, the positive longer-term effects of public health interventions might be due to the following reasons. It is well documented that active public health interventions are a useful tool in mitigating and controlling the pandemic (e.g. Chinazzi et al., 2020), which brings less panic concerning the pandemic and, therefore, more certainty about the financial stability, corporate liquidity and solvency (IMF, 2020). Besides, strong government public health policies and quick policy responses could help travel and leisure companies and consumers to cope with a pandemic (Raczmarek et al., 2021). In particular, they learn how to conduct business in a relatively safe way—e.g. sitting 1 m apart in restaurants or bars (Sigala, 2020). Together, these contribute to a faster recovery of the tourism industry over the medium run.

To address problems that could arise from missing variables—which might affect public health intervention and leisure and recreation activities—but are not among our controls—we added country/region fixed effects to the baseline regression and accordingly dropped all variables that do not change over time. The results are similar, both qualitatively and quantitatively, to those reported in Table 3.⁹

4.3. Robustness check for the impact of public health interventions on participation in leisure and recreation activities

Regression model (2) amounts to a robustness check in which we use a combination of a linear and quadratic date terms—rather than week dummies—to capture the decline-then-recovery pattern of participation in leisure and recreation activities. The results are presented in Table 4. In column [1], the coefficient for $Date_{t-1}$ is negative and that for its squared term is positive, confirming the observed decline-then-recovery pattern. Public health measures are added as independent variables in column [2]; and in column [3] we control for country fixed effects. The impact of policies on the trend of leisure and recreation activities is captured by the coefficients for the policy index $PubH_i$ and for the two interaction terms between the policy index and first & second order term of date.

This table shows that the coefficient for $PubH_i \times Date_{t-1}$ is significantly negative while that for $PubH_i \times Date_{t-2}$ is significantly positive. Using these values yields the following estimate: with average public health intervention, it takes 50 days for leisure and recreation activities to recover; this duration is practically identical to the baseline results (7 weeks = 49 days) reported in Table 3.

5. Conclusion and discussion

This paper presents an empirical analysis of how public health interventions for COVID-19 affect leisure and recreation activities. Employing a DID modelling framework, we collect data for more than 130 countries/regions, and find that the longer-term effects of public

![Diagram](image-url)

**Fig. 2.** Public health policies and change in leisure and recreation participation.

| Date\_t | $-1.31^{***}$ | $-1.47^{***}$ | $-1.60^{***}$ |
|---------|---------------|---------------|---------------|
|        | (0.02)        | (0.07)        | (0.06)        |
| Date\_t | $0.01^{***}$  | $0.007^{***}$ | $0.007^{***}$ |
|         | (0.000)       | (0.001)       | (0.001)       |
| PubH\_i | $-70.47^{***}$ | (4.83)        | |
| PubH\_i $\times$ Date\_t | $-0.95^{***}$ | $-0.62^{***}$ | |
|         | (0.22)        | (0.14)        | |
| PubH\_i $\times$ Date\_t | $0.033^{***}$ | $0.031^{***}$ | |
|         | (0.002)       | (0.002)       | |
| Cases   | Yes           | Yes           | Yes           |
| Controls | No            | Yes           | No            |
| Country FE | No          | No            | Yes           |
| Day-of-week FE | Yes        | Yes           | Yes           |
| $R^2$   | 0.13          | 0.33          | 0.43          |
| Observations | 9859       | 7969          | 9384          |

Notes: The dependent variable is $\Delta Leisure$, change in leisure and recreation activities. FE = fixed effects.

⁹ In particular, $\gamma_2, \ldots, \gamma_6$ are negative, $\gamma_7$ is insignificant, and $\gamma_8, \ldots, \gamma_{13}$ become positive and increase over time.
health policies differ substantially from their immediate impact. In particular, stringent public health interventions have an immediate negative effect on participation in leisure and recreation activities, which declines 9.2 additional percentage points upon policy implementation and remains still at a lower level after six weeks; those interventions, however, help the leisure and recreation industry to surpass its recovery—when compared with the case of no interventions—in about seventh weeks after a COVID-19 outbreak. After thirteen weeks, leisure and recreation activities are already at 70% of their pre-pandemic level in countries/regions that intervened actively; however, they stagnate at about 40% in those that did not.

Our study provides empirical support for the views held by some public health experts during the coronavirus pandemic. As Dr. Anthony Fauci—director of the US National Institute of Allergy and Infectious Disease—stated: “We should be looking at public health measures as a vehicle, or a gateway, to opening the country, not as the obstacle in the way” (Johnson, 2020). In light of the demonstrated sharply differing effects of government public health interventions over different time intervals, leaders worldwide should remain cognizant, when designing public health interventions (and determining how long they should last), of the trade-off between short-term economic losses and longer-term benefits. Besides, the containment and closure policies typically bear substantial social and economic costs, governments should also carefully balance the undertaken actions’ costs and benefits (Kaczmarek et al., 2021).

It is also important to note that, although public health interventions play a leading role in the recovery of the leisure, recreation and tourism industry, that recovery was not full in the sample period we studied. A practical implication of this finding is that more comprehensive measures, e.g. a combination of public health interventions and economic stimulus, should be adopted in this special period. For example, as argued by Yang et al. (2020), such a comprehensive approach should include simultaneous subsidies designed to encourage the consumption of tourism, hospitality, and leisure as well as subsidies to the health sector to facilitate post-pandemic recovery. The world has experienced a number of major epidemics/pandemics in the last 40 years, yet none had similar implications for the global economy as the COVID-19 pandemic (Gosling et al., 2020). Therefore, whether government responses to previous pandemic, like economic policies, are still effective under strict public health interventions should be examined in the context of COVID-19. Furthermore, leisure, recreation and tourism are closely connected to other parts of the economy through input-output linkages, and the recovery of the sector depends critically on other sections of the economy given the high interdependence. Therefore, policy coordination across industries is of particular importance for successful recovery of the leisure, recreation and tourism industry.

From a long run perspective, the pandemic and the induced public health interventions should be considered as a transformative opportunity for the tourism industry—it should not only recover but also reimagine and reform the next normal and economic order (McKinsey & Company, 2020; Sigala, 2020). COVID-19 presents a once in a generation opportunity for such a transformation (Brouder, 2020). During the COVID-19, new health protocols have been applied for safe recreation and travel, which restores confidence and stimulates demand with new COVID-19, new health protocols have been applied for safe recreation which declines 9.2 additional percentage points upon policy implementation policies adopted immediately after a COVID-19 outbreak and remain still at a lower level after six weeks; those interventions, however, help the leisure and recreation industry to surpass its recovery—when compared with the case of no interventions—in about seventh weeks after a COVID-19 outbreak. After thirteen weeks, leisure and recreation activities are already at 70% of their pre-pandemic level in countries/regions that intervened actively; however, they stagnate at about 40% in those that did not.

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In any pandemic, intervening at the initial stage is crucial for affecting how it evolves. We remark that policies tend to converge as governments gradually learn which of them are most effective. From the standpoint of identification, variation in government interventions during the pandemic’s initial stage is much greater than at later stages (as can be seen from Table 1). Hence we studied the impact of government policies adopted immediately after a COVID-19 outbreak and focused on the four-month period from February to May 2020. Thus, one limitation of our research is its relatively short-term assessment. Investigation for a longer period of time—with attention given to second or even third waves of outbreaks, as occurred in many parts of the world—would therefore be a valuable extension of this study. Moreover, changes in leisure and recreation intervention cannot be fully captured by the numbers of visitors to retail and recreation establishments; the current non-availability of sufficient data precludes the quantification of this bias, which is therefore a promising avenue for future research.

Impact statement

Pandemic has been one of critical research topics in social science, and it is currently a hot issue in the midst of the coronavirus pandemic. Given the health and economic tradeoffs for public interventions in the COVID-19 pandemic, we investigate the economic impact of public health interventions on leisure and entertainment industry at different time intervals. A noteworthy contribution comes from difference between immediate and subsequent effects of public health interventions on leisure and recreation industry. We found that public health policies have a large positive effect on this industry in its later recovery phase, though it imposes a negative impact in the early declining phase, highlighting the essential role of public health actions on both epidemic control and economic recovery under serious global health issues. This finding provides a new look at the economic impact of public health measures and significant implications for leisure and recreation operators and policymakers in crisis management.

Credit author statement

Yan Fang: Conceptualization, Writing - Original Draft. Lijun Zhu: Methodology, Data Curation, Supervision. Yiyi Jiang: Writing - Review & Editing. Bihu Wu: Writing - Review & Editing.

Declaration of competing interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, or publication of this article.

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