Using the theory of planned behaviour to explain hand hygiene among nurses in Hong Kong during COVID-19

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S U M M A R Y

Background: The emergence of the COVID-19 pandemic has emphasized the importance of human behaviour in controlling the spread of disease. Hand hygiene is one of the most cost-effective ways to reduce the transmission of infections.
Aim: The aim of the present study was to use the theory of planned behaviour to examine hand hygiene beliefs and behaviours among hospital nurses in Hong Kong during the outbreak of COVID-19.
Methods: A cross-sectional study was conducted recruiting a sample of nurses working in public hospitals across Hong Kong to complete an online questionnaire examining attitudes, subjective norms, and perceived behavioural control towards hand hygiene behaviour; hand hygiene beliefs and hand hygiene knowledge were also examined.
Results: A total of 122 nurses (73% female) participated in the study. Self-reported hand hygiene performance was 81.93% in the present sample and nearly two-thirds had engaged in post-registration infection control training. Findings revealed that subjective norms and perceived behavioural control were significantly and positively associated with hand hygiene behaviour through intentions. However, attitude had no effect on hand hygiene intention and behaviour in the present study.
Conclusion: The theory of planned behaviour provides a useful and effective framework in explaining the hand hygiene behaviour of nurses working in Hong Kong public hospitals during the COVID-19 outbreak. Continued commitment to improve hand hygiene practices is essential in the continued battle against the transmission of infectious diseases.

Introduction

In March 2020, COVID-19 was declared a global pandemic by the World Health Organization [1]. Now, more than 18 months since the pandemic was declared, and with more than 5 million deaths worldwide [2], countries around the world are still struggling with the burden that the pandemic has brought.

Hong Kong has been lauded as a success story in terms of its control over the pandemic with high levels of behavioural compliance in relation to mask-wearing and social distancing [3]. Hong Kong was seriously affected by the severe acute respiratory syndrome (SARS) epidemic that emerged in 2003 [4], and as such it could be argued that the people of Hong Kong were better prepared for COVID-19 due to their prior experience of a large-scale infectious disease outbreak, such as SARS. Hand hygiene is one of the most cost-effective ways of reducing infection transmission. However, studies have demonstrated that adherence to hand hygiene guidelines is inadequate [5]. The aim of the present study was to use the theory of planned

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behaviour (TPB) to examine hand hygiene behaviour among nurses in public hospitals in Hong Kong during the outbreak of COVID-19.

Behaviours of the general public are of vital importance in the management of the outbreak; in particular, in the early stages of the outbreak, when no vaccination or treatment was available, non-pharmaceutical interventions were the only options to attempt to contain the outbreak. The efficacy of non-pharmaceutical interventions are at the mercy of an individual's degree of engagement and compliance in protective behaviours, such as facemask wearing and regular practice of hand hygiene, and in relation to this, an individual's willingness to engage in protective behaviours voluntarily may be dependent on the individual's perceived risk of COVID-19 [6]. In this sense, Hong Kong's prior experience of dealing with the SARS outbreak in 2003 could have informed people's risk perception.

The regular practice of hand hygiene is an easy but critical step in breaking down the chain of infection and preventing transmission of infection, which has been become more important since the emergence of the COVID-19 pandemic. Prior to the emergence of the global pandemic, the World Health Organization estimated the global average hand hygiene compliance rate at just under 39% [7]. Compare this to hand hygiene compliance rates in Hong Kong for healthcare workers in clinical settings, where hand hygiene compliance rates have been enhanced over the last half decade from 86% in 2006 to nearly 90% in 2020 [8].

The TPB [9] is a widely applied behavioural model that has been used in numerous studies to predict health behaviour. The TPB has also been applied specifically to examine hand hygiene in different clinical contexts around the world [10,11]. According to the TPB, the best determinant of behaviour is an individual's intention, which in turn is influenced by three components: attitude, subjective norms and perceived behavioural control. Attitude refers to one's evaluations (positive or negative) of the behaviour (e.g., performing hand hygiene is good); subjective norms refers to perceptions of approval or disapproval from significant others of you performing the behaviour (e.g., significant others would want me to engage in hand hygiene behaviour); and perceived behavioural control, individual beliefs about the ease or difficulty with which the behaviour can be performed (e.g., it would be easy for me to perform hand hygiene). According to Ajzen and Fishbein [12], the most impactful predictor of behaviour is an individual's intention to perform the behaviour itself. Intention thus reflects an individual's motivation to perform the behaviour. The importance of attitudes, norms and control in the prediction of intention varies across behaviours and also situations [9], and as such the influence of perceived behavioural control on intentions could be weaker in those contexts where attitudes or subjective norms are strong predictors of behaviour [13].

The TPB has been applied in the context of infectious disease outbreaks, with studies examining the utility of the TPB in the prediction of preventive behaviour in relation to SARS, providing support for the TPB [14]. Previous studies have identified a positive relationship between attitudes and hand hygiene behaviour [10,15]. In terms of subjective norms, studies conducted in Europe, Asia and Australia have observed a positive association between subjective norms and hand hygiene behaviour [11,15,16]. Cultural norms have also been identified as important in hand hygiene compliance [17]. Meanwhile, positive associations have been observed in previous studies between perceived behavioural control and hand hygiene behaviour [15,16]. While moderate levels of control were observed in relation to hand hygiene behaviour among nurses in the USA [18], high levels of control in relation to hand hygiene behaviour were observed among healthcare workers in the United Arab Emirates [10]. Some studies have identified lack of access to hand hygiene products as a key barrier to the performance of hand hygiene behaviour among healthcare workers [19]. Lack of knowledge of hand hygiene practices and skin irritations have also been identified as barriers to the practice of hand hygiene among healthcare workers [11,19]. Studies have also identified the importance of senior healthcare workers setting an example by engaging in the practice of hand hygiene [11], whilst other studies have observed lower intention to engage in hand hygiene behaviour during medical emergencies among healthcare workers [18].

The aim of this study was to examine the utility of the TPB in explaining the hand hygiene behaviour of Hong Kong nurses in public hospitals during the outbreak of COVID-19. Although the TPB has been applied to a variety of health behaviours in prior research, the TPB has not been applied specifically to hand hygiene behaviour in a Chinese context, particularly during the outbreak of the recent pandemic, at a time when compliance with cost-effective preventive behavioural measures has gained renewed importance and significance. The present study tested a model including attitude, subjective norms, perceived behavioural control and intention as predictors of hand hygiene behaviour among Hong Kong nurses. Consistent with previous research on the TPB and health behaviour, it was hypothesized that attitudes, subjective norms, and perceived behavioural control would predict intention to engage in hand hygiene behaviour, which in turn would predict hand hygiene behaviour among nurses working in public hospitals in Hong Kong.

Materials and methods

Participants and procedure

An e-mail invitation was sent out via the Association of Hong Kong Nursing Staff to invite nurses working in public hospitals in Hong Kong to participate in the study. As the study took place at the outbreak of COVID-19, an online survey was adopted in order to minimize social contact. Those individuals interested in taking part in the study were referred to a participant information sheet with more comprehensive information about the study before providing informed consent and completing the survey online. Ethical approval was obtained (Ref: A-5790-202012-16) prior to data collection taking place.

Measures

The cross-sectional online survey contained a total of 59 items and consisted of the following domains:

Handwashing assessment: the Handwashing Assessment Inventory (HAI) developed by Ng *et al.* [10] is a 42-item self-report measure examining seven aspects of hand hygiene behaviour through the TPB, namely: behavioural beliefs (14 items, i.e., "I believe that if I regularly decontaminate my hands through hand hygiene in a healthcare setting, my

patients will have fewer infections"), attitudes (eight items, i.e., "Consistently performing hand hygiene to decontaminate my hands is inconvenient"), normative beliefs (seven items, i.e., "Nurses I respect have strongly indicated I should not comply with hand hygiene"), subjective norms (one item, "Most people who are important to me would disapprove of me following the hospital's hand hygiene protocol"), control beliefs (five items, i.e., "I am confident of my knowledge about the hospital's hand hygiene protocol"), perceived behavioural control (two items, i.e., "If I want to, I can find a way to comply with the hospital's hand hygiene protocol"), and intention (five items, i.e., 'I engage in hand hygiene behaviour in every situation in which it is indicated"). Items are measured on a seven-point scale (1 = strongly disagree to 7 = strongly agree), negatively worded items are reverse-scored. Mean scores are calculated for each domain, with higher scores indicative of a more positive motivation to engage in hand hygiene behaviour. Reliability and validity have been established in previous studies [10]. Reliability for the HAI in the current study was reasonable ($\alpha = 0.90$).

Hand hygiene behaviour: one item was adopted from a recent study [10] to assess self-reported hand hygiene behaviour. Participants were required to self-report "In what percentage of situations requiring hand hygiene do you perform the behaviour?" with a response from 0 to 100%.

Hand hygiene knowledge was examined using the Hand Hygiene Knowledge Questionnaire for Health-Care Workers (HHKQ) [20]. The HHKQ is an eight-item measure developed by the World Health Organization specifically examining the hand hygiene knowledge of healthcare workers. Items include: "What is the minimal time needed for alcohol-based hand rub to kill most germs on your hands?" Reliability and validity for the HHKQ has been established in previous studies. Scores of 75% are considered good, scores between 50% and 74% are considered moderate, and scores lower than 50% are interpreted as poor [21]. Reliability for the HHKQ in the current study was reasonable ($\alpha = 0.74$).

The final section of the measure comprised eight sociodemographic items, including: age, gender, educational attainment, nursing discipline and ranking, work experience and training.

Analysis

Data were analysed using IBM SPSS 26. Preliminary analysis was initially conducted to examine the relationship between all study variables using correlation analysis, with means, standard deviations and ranges calculated for all key variables. Inferential statistical analysis was used to test the hypotheses before path analysis and linear regression analysis were used to examine effect and variance. Regression analysis was used to check assumptions for path analysis. Assumptions of linear relationship, normal distribution, variance, and independent observation were checked; hand hygiene behaviour was the outcome considered. All data were screened for multi-collinearity with no issues identified. Statistical assumptions for regression were tested using the normality test, which demonstrated that the data was normally distributed. A *P*-value of ≤ 0.05 was considered significant. The data that support the findings of this study are available from the corresponding author upon reasonable request.

Results

A total of 122 respondents were recruited to the study during January to March 2021. The majority of participants were female (73%), and registered nurses (75%), half the sample were aged 21–30 years. In terms of infection training, nearly two-thirds (61%) of participants reported engaging in post-registration or post-enrolment infection control training (see Table I).

Preliminary analysis was conducted to examine the relationship among all key variables. Descriptive statistics, including correlations, means, standard deviations and reliability, can be found in Table II. Significant relationships were observed between all key variables with a few exceptions: no significant association was observed between behavioural and normative beliefs, between normative beliefs and hand hygiene behaviour, between normative beliefs and control beliefs, and also between subjective norms and hand hygiene behaviour, otherwise strong relationships of significance were observed between all other key variables in the present sample (see Table II). In terms of hand hygiene knowledge, the majority of the sample had moderate knowledge of hand hygiene, demonstrating that the current sample of Hong Kong nurses understand the fundamentals of hand hygiene. Mean self-reported actual hand hygiene performance of the current sample was 81.93% (standard deviation = 10.90).

Simple linear regression indicated that behavioural beliefs explained a significant amount of variance in attitudes toward hand hygiene, $F(1,120) = 52.00$, $P<0.001$, $R^2 = 0.30$. Analysis indicated that control beliefs explained a significant amount of variance in perceived behavioural control, $F(1, 120) = 138.10$, $P<0.001$, $R^2 = 0.54$. Path analysis was performed based on the TPB model (see Figure 1). Results indicated that the model fit the data, $\chi^2 = 4.21$, degrees of freedom = 2, $P = 0.12$, comparative fit index (CFI) = 0.98, root mean square error of

Table I
Sociodemographic participant profile

		N	%
Gender	Male	33	27%
	Female	89	73%
Age, years	21–30	61	50%
	31–40	18	15%
	41–50	24	20%
	>50	19	15%
Discipline	General	109	89%
	Psychiatric	13	11%
Rank	Enrolled Nurse	3	2%
	Registered Nurse	91	75%
	Advanced Practice Nurse/ Nursing Officer	19	15%
	Ward Manager or above	9	8%
Work experience, years	0–2	44	36%
	3	7	6%
	4–10	23	19%
	>10	48	39%
Hand hygiene knowledge	Poor	0	0%
	Moderate	85	70%
	Good	37	30%
Infection control training	Yes	75	61%
	No	47	39%

Table II
Descriptive statistics (correlations, means, standard deviations and alpha coefficients) for all study variables

|	1	2	3	4	5	6	7	8	9	Mean	SD	α
1. Behavioural beliefs	1									4.97	0.73	0.80
2. Attitudes	0.55***	1								5.09	0.98	0.85
3. Normative beliefs	0.04	-0.28**	1							2.44	1.56	0.98
4. Subjective norms	0.23**	0.41***	-0.39***	1						5.61	1.42	—
5. Control beliefs	0.62***	0.57***	0.002	0.21*	1					5.05	1.05	0.83
6. Perceived behavioural control	0.49***	0.45***	-0.05	0.19*	0.73***	1				5.20	1.14	0.73
7. Hand hygiene intention	0.46***	0.43***	-0.16	0.43***	0.61***	0.55***	1			5.45	0.91	0.79
8. Hand hygiene behaviour	0.32***	0.32***	-0.04	0.07	0.50***	0.43***	0.38***	1		81.93	10.90	—
9. Hand hygiene knowledge	0.36***	0.07	0.43***	0.07	0.20*	0.22*	0.15	-0.04	1	17.39	10.9	0.74

SD, standard deviation.
*$P \leq 0.05$.
**$P \leq 0.01$.
***$P \leq 0.001$.

approximation (RMSEA) = 0.096. Attitudes, subjective norms, and perceived behavioural control accounted for 41.5% of the variance in intention to perform hand hygiene behaviour, meanwhile perceived behavioural control and intention accounted for 21% of the variance in hand hygiene behaviour. Lai and Green [22] describe RMSEA between 0.05 and 0.10 as representing an acceptable fit. Thus, analysis indicates that the model fit the data. As can be seen in Figure 1, subjective norms and perceived behavioural control were significant predictors of intentions, which in turn significantly predicted hand hygiene behaviour. The path analysis revealed that perceived behavioural control was the strongest predictor of intentions. However, attitude was not predictive of intentions or behaviour in the present study. No significant indirect effect was observed between attitude and behaviour, and no direct effect on intention. A significant indirect effect of subjective norms on hand hygiene behaviour was observed, and a significant direct effect on intention was also observed.

A significant direct effect of perceived behavioural control on hand hygiene behaviour was observed, and a significant direct effect of perceived behavioural control through intention on hand hygiene behaviour was also observed, in addition to a significant direct effect of perceived behavioural control on intention. Overall, the significant total effect on hand hygiene behaviour was $\beta = 0.40$, $P = 0.001$, 95% confidence interval (0.22, 0.55). Finally, a significant direct effect of intention on behaviour was found. Meaning that the only element of the TPB that did not have a significant effect on hand hygiene behaviour in the model was attitude (Figure 1).

Discussion

The emergence of the COVID-19 pandemic has emphasized the importance of human behaviour in controlling the spread of disease [23,24]. In the absence of a vaccination in the emergence of the COVID-19 pandemic, non-pharmaceutical
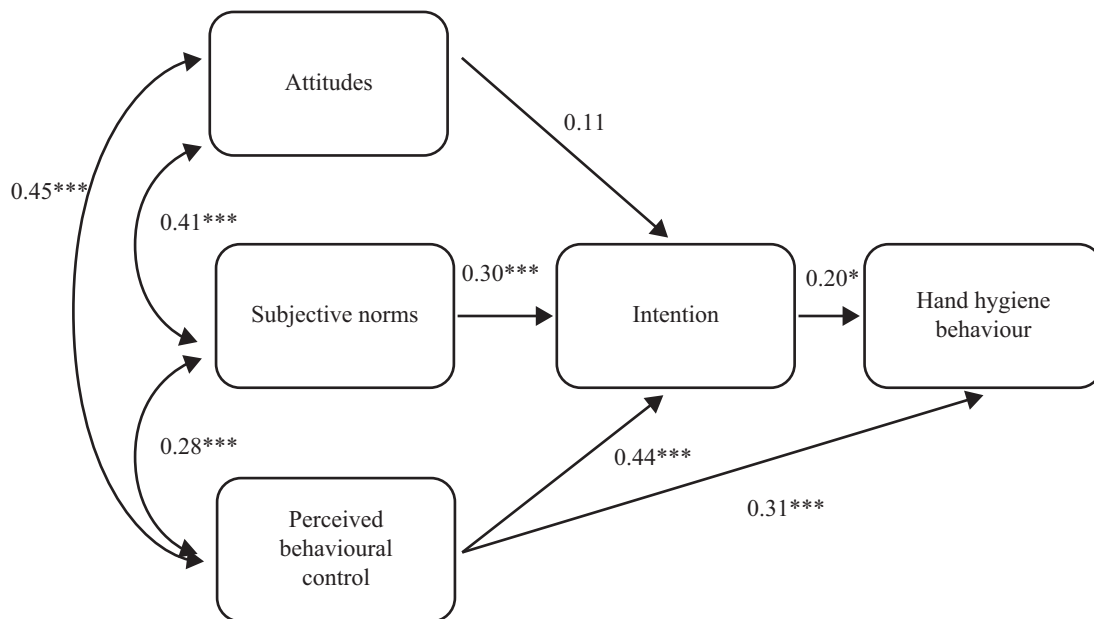
*$P \leq 0.05$; **$P \leq 0.01$; ***$P \leq 0.001$

Figure 1. Path analysis of hand hygiene under the theory of planned behaviour.

preventive measures such as mask wearing, handwashing and the practice of social distancing measures are important and cost-effective means to contain the outbreak. The present study examined the utility of the TPB in explaining hand hygiene behaviour among nurses working in public hospitals in Hong Kong during the emergence of COVID-19. Findings from the present study revealed that the TPB was effective in predicting hand hygiene behaviour of nurses in public hospitals in Hong Kong. According to path analysis, attitudes was the only domain of the TPB not significantly predictive of hand hygiene behaviour among nurses in public hospitals in Hong Kong during the emergence of COVID-19; all other variables were positively and significantly predictive of hand hygiene behaviour. Path analysis of the original TPB model indicated that subjective norms and perceived behavioural control both had significant and positive effects on hand hygiene intention and behaviour. However, hand hygiene attitudes did not predict intention to engage in hand hygiene behaviour in the current sample of Hong Kong nurses.

These findings echo previous studies conducted in Europe, Korea and the United Arab Emirates [10,15,16], in that although nurses in the current sample held favourable attitudes towards hand hygiene, this did not predict hand hygiene behaviour. One explanation could be that for nurses in Hong Kong, who have been practising very strict hand hygiene measures in hospitals since the SARS outbreak in 2003, and have experienced multiple disease outbreaks since that time, including H1N1 in 2009 [4], attitudes may be less relevant in the prediction of hand hygiene behaviour, which is considered absolutely essential practice for nurses working in public hospitals in Hong Kong. Recent research conducted in Italy among the lay population during the outbreak of COVID-19 [25] found attitudes to be predictive of intention and hand hygiene behaviour, thus it could be that attitudes are a weaker component of hand hygiene behaviour in an isolated population of healthcare workers, where hand hygiene practice is deemed essential in the workplace, but are a meaningful component of hand hygiene behaviour in lay populations not employed within healthcare settings. Another study comparing health behaviours of French and Belgian residents during the COVID-19 pandemic found that more favourable attitudes were related to higher adherence to handwashing in both French and Belgian samples [26]. Meanwhile, a recent Italian study conducted during COVID concluded that the training of healthcare professional is a key factor in preventing and containing the spread of COVID in hospitals [27]. However, the present findings did not completely align with these findings. In the present sample, hand hygiene knowledge was moderate and a significant proportion of nurses (39%) had no infection control training; in addition to this more than one-third of the sample had relatively little work experience, and yet participants in the present sample practised strict hand hygiene behaviour regardless. Thus, emphasizing that attitudes may be less relevant where hand hygiene behaviour is deemed essential, particularly in an environment such as Hong Kong, which has had strict hand hygiene measures in place in hospitals since the emergence of SARS in 2003.

Previous studies have identified concern with skin irritations, and hands becoming dry and cracked, etc., as a barrier to engagement in hand hygiene behaviour [11,18], these concerns were not observed in the present sample. Previous studies have also observed that emergency and busy situations may be a barrier to effective hand hygiene behaviour among healthcare

workers [11,18]. However, these concerns were not observed in the present sample. Ajzen [9] noted that perceived behavioural control encompasses the difficulties of performing a behaviour influenced by previous experience and current information to act. Prior experience may help to explain the unique situation in Hong Kong. In less than two decades, Hong Kong has experienced numerous infectious disease incidents, including the SARS outbreak in 2003, and the H1N1 swine flu outbreak in 2009 [4]. Previous and current experiences of such incidents may improve the perceived behavioural control of individuals to engage in hand hygiene behaviour in such situations.

The literature has identified subjective norms as the weakest component of the TPB when compared with the relationship between other elements of the model [28]. However, in the present study, attitude was observed to be the weakest component in explaining the hand hygiene behaviour of Hong Kong nurses, meanwhile subjective norm was a strong component of the model, with perceived behavioural control the strongest predictor of hand hygiene behaviour in the present sample. One consideration could be the collectivistic nature of Hong Kong and Chinese culture, in which the consideration of significant others may be more impactful in Hong Kong compared with more individualistic societies. These findings echo other recent studies where a strong association was observed between handwashing and subjective norms in Italy during the emergence of the COVID-19 outbreak [25].

As mentioned above, a significant direct link between perceived behavioural control and hand hygiene behaviour was observed in the analysis. A recent study examining protective behaviour during the emergence of COVID-19 in Italy failed to find a significant direct relationship between perceived behavioural control and protective behaviour, including hand hygiene behaviour [25]. This was explained as being due to people inaccurately judging or overestimating the degree of control they have over a behaviour [29]. However, in the current study, this could perhaps be explained by the fact that hand hygiene behaviour is relatively easy to perform comparatively, and as such, participants felt a greater degree of control over their ability to engage in such behaviour. Hand hygiene equipment is easily accessible and available, with a sink for handwashing available in each ward, and each patient bedside contains hand hygiene equipment also in Hong Kong public hospitals. As such, it could be interpreted that equipment availability is a facilitating factor for Hong Kong nurses in that the Hong Kong hospital policy of offering a proliferation of hand hygiene equipment and facilities promotes hand hygiene behaviour. This is in line with previous studies that have identified the availability of equipment as a facilitating factor to preventive behaviour [11]. Since the emergence of SARS in 2003, the Hospital Authority has provided much more comprehensive education and guidelines on the practice of infection control in clinical settings with an emphasis on hand hygiene behaviour [30], and as such has been creating a hand hygiene culture within clinical settings by consistently and continuously encouraging infection control behaviour, regardless of whether a pandemic exists or not. This is reflected in Hong Kong having one of the highest hand hygiene compliance rates prior to the emergence of the COVID-19 pandemic [8].

The present findings provide support for the utility of the TPB in explaining hand hygiene behaviour of nurses in public hospitals in Hong Kong. Findings show that all components of the original TPB model with the exception of attitudes were

significant predictors of hand hygiene intention and behaviour in the present study. The current findings lend support for claims that the relative importance of TPB constructs varies across behaviour [25]. Recent studies have shown that the hand hygiene behaviour compliance of healthcare workers improved during the early stages of the pandemic [31]. The present study was also conducted during the early stages of the pandemic. As such, it would be interesting to examine whether compliance behaviour remains as high as we enter the second year since the emergence of the pandemic. However, the present study is not without its limitations which must be acknowledged. The sample size was relatively small and the study was cross-sectional, meaning that any long-term changes in hand hygiene behaviour through the evolution of the COVID-19 pandemic remains unknown. The reliance on a convenience sample may have resulted in positive bias in the sample in terms of hand hygiene behaviour, which must be acknowledged. The sample consisted of a predominantly female sample of nurses, although this is reflective of the nursing workforce in Hong Kong, which consists predominantly of women, with just over 10% of nurses being male [32]. The present study makes a meaningful contribution to the literature with findings demonstrating the utility of the TPB in explaining the hand hygiene behaviour of nurses in Hong Kong public hospitals during the emergence of the COVID-19 pandemic. Future studies could consider expanding the scope of the model. Findings in a Hong Kong context suggested that other variables may have played a role in the relationship between attitudes and intention. Thus, it may make sense for future studies to examine the role of other variables, e.g., risk perception. However, recent studies have shown risk perception to be weakly related to preventive behaviours in the context of COVID-19 in the European context [25]. In Hong Kong, with prior experience of infectious disease outbreaks within the last two decades, risk perception may show a stronger association with preventive behaviour in such a context. Greater awareness of those factors leading to effective preventive behaviour remains of great significance almost two years after the emergence of COVID-19, with vaccinations now in full swing, but still no end to restrictions and COVID-19 rates around the globe; understanding more about preventive behaviour, which is relatively easy and cost-effective to engage in and implement remains of the utmost importance in the face of the ongoing battle against COVID-19.

Conflict of interest statement

Funding sources

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