Exploring What Effects on Vaccination for Covid-19: Converging Health Locus of Control and Health Belief Model

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코로나 19 백신 접종영향 요인의 탐색: 건강통제소재와 건강신념모형의 융합

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Abstract Since the outbreak of Covid-19, many countries have tried to defense Covid-19 to protect their people and as an influential and reliable policy as of now, they have recommended vaccinating. Thus, this research explored what influences the intention to vaccinate against Covid-19 with three health locus of control from multi-dimension health locus of control (MHLC) and perceived susceptibility and severity from health belief model (HBM) through PLS path modeling. Consequently, chance locus of control (CHLC) influence indirectly intention to vaccinate against Covid-19 mediating with susceptibility perception. It implies that the more fatalistic people attitude toward Covid-19, the more susceptible they perceived to the disease, and then, the stronger intention to vaccinate they would have. Thus, the health promotion authorities should motivate to activate people's susceptibility perception toward the disease through utilizing a variety of policies and consider that the fatalistic tendency toward the disease of people could play an antecedent role in the process.

Key Words : Covid-19, Health locus of control, Health belief model, Vaccine, PLS path modeling

요 약 코로나 19가 발생한 이래 각국은 국민들을 코로나19로부터 보호하기 위해서 다양한 정책을 펴고 있고, 가장 유력한 방안으로 백신접종을 권장하고 있다. 이에 본 연구는 대학생들의 대상으로 백신접종에 어떤 요인들이 영향을 미치는지를 규명하기 위해 다차원건강통제소재의 3가지 건강통제소재와 건강신념모형의 지각된 취약성과 심각성을 융합하여 백신접종 의도를 탐색하였다. PLS경로모형 분석을 실시한 결과 최종적으로 우연 건강통제소재 (CHLC)가 취약성 지각을 매개하여 백신접종의도에 영향을 미치고 있었다. 이는 코로나 19에 대해 운명론적 태도가 클수록 코로나 19에 대해 더 취약하다고 인식하고 백신을 접종하려는 의도가 더 커진다는 것을 의미한다. 따라서 예방접종율을 높이기 위해서는 보건당국은 다양한 방안을 활용하여 국민들의 질병에 대한 감수성 인식을 활성화 하도록 동기를 부여할 필요가 있다. 이 과정에서 사람들의 숙명론적 경향이 선행변인 역할을 할 수 있음도 고려해야 한다.

주제어 : 코로나 19, 건강통제소재, 건강신념모형, 백신, PLS 경로 모형

1. Introduction

Since the outbreak of Covid-19 in the last quarter of 2019, the world has faced the pandemic and is suffering from the disease. To prevent or reduce the risk of the disease, many governments have recommended some public hygienic behaviors like washing hands, coughing on one's own sleeve, and wearing a quarantine mask. In addition, some governments encouraged pharmaceutical companies to produce vaccines and therapeutic medicine.

As of February 2021, Pfizer, Modena, AstraZeneca, and so on produced the vaccines, which were approved or are being approved in some countries. Some countries, such as America, England, and French, have started to vaccinate their people. The Korean government announced having contracts with some companies to purchase the Covid-19 vaccine.

In the context of vaccination, governmental health officers and medical practitioners would pay attention to how many people get the vaccination and how fast. People also could pay attention to when they get vaccinated and how much costs. These issues have something to do with hesitancy to accept vaccines or denial. A few people could resist the vaccination for some reasons and then collective social immunity would be lagged. People and professionals seriously worry about that.

Korea has got a reputation for a comparatively successful defense against Covid-19. However, recently in Korea, some conflict was rising surrounding the contract of the vaccine among the political forces. Some criticized the government to fail to retain the vaccine. People on the pro-governmental side say the country could control the disease, the safety of the vaccine would be fully verified and then the vaccine could be imported for vaccinating. More important than the conflict is securing the vaccine, vaccinating the largest possible number of people, and then cultivating collective social immunity as soon as possible. A key point for rapid immunization would be to decrease people's antipathy toward vaccination.

In the aforementioned context, the present research aims to identify how to decrease the hesitancy and the antipathy toward vaccination. We try to find out the way to reduce vaccination hesitancy and antipathy with this research that identify the structural relationship among the attitude toward Covid-19, health locus to control, and prevention behavior. Concretely, this research explores how the attitude toward Covid-19, named perceived susceptibility and perceived severity from Health Belief Model (HBM), and perception of health locus of control, classified into internal (IHLC), chance (CHLC), and powerful other locus of control (PHLC), effect on intent to vaccinate against Covid-19. The analysis is expected to provide the implication of how to reduce hesitancy and antipathy. Through the analysis, we would suggest significant implications which factors encourage people to get vaccinated to reach collective social immunity.

2. Theoretical Background and Research Hypotheses

2.1 A Briefing of Korea's Recent Outbreak of Viral Infectious Diseases from Overseas

With increasing international exchange and overseas tours, the possibility of an influx of viral infection diseases from foreign countries is rising [1]. In 2009, the swine flu, or H1N1 influenza, threatened the whole world and caused global fear. As the Korean government announced daily the number of the confirmed cases and deaths and the press reported it intensively, people were scared fear for months.

The number of deaths for one year since August 15, 2009, the first death confirmed from the flue, was 263. For six months from August 1 to December 31, 2009, the confirmed cases of 740,835 were officially reported, and an average of 5,000 confirmed cases and 5 deaths per day occurred [2].

In 2015, MERS (Middle East respiratory syndrome coronavirus) epidemic had a huge impact on Korean society, economy, and culture and was memorized never to forget for Korean people [3-8]. During four months in Korea, the prevalence of MERS resulted in 186 patients, 36 deaths, and over 16,000 isolated people and due to many evaders of social life, serious economic losses were caused [3,9,10]. Failing the first maneuver for preventing epidemic and not controlling the diffusion of uncertainty, the government lost the trust of the people. In addition, because of the failure of governmental surveillance, the media was criticized [3,11-13]. In 2015, the influx of MERS had a considerable impact as a national crisis disease on Korean society. In terms of the possibility for the influx of an overseas epidemic, it served as a momentum sounding the alarm again and preparing a lot of policies to manage diseases. The media also strengthened the news guideline of the national epidemic not to make mistakes as in the past. People, through experiencing a national crisis from the outbreak, learned to cope with the influx of the epidemic overseas and got so-called literacy against an epidemic [3]. Due to the experience, in 2018 re-influx of MERS finished in a short term and did not continue as a media issue.

These experiences of the influx of the overseas outbreak had made the Korean government and the people dealing intelligently and orderly with an epidemic. Since the Covid-19 pandemic, Korea has responded to Covid-19 better than other countries.

2.2 Health Locus of Control: Multi-Dimensional Health Locus of Control

Locus of control was derived from Rotter's social learning theory and has received a significant amount of attention in behavioral research. Locus of control, applied in the context of health-related behavior, has shown some promise in predicting and explaining specific health-related behaviors [14]. Locus of control is defined as a psychological concept that refers to how strongly people believe they have control over the situations and experiences that affect their lives [15]. In the health promotion field, health locus of control refers to individuals' perceptions of what controls their health [16,17].

To measure health locus of control, Wallston et al. [18] developed the Multidimensional Health Locus of Control (MHLC) questionnaire which is one of the most widely used instruments in health psychological study [17]. The MHLC scales derive from the expectancy construct in Rotter's social learning theory [19] and are modeled after Levenson's I, P, and C scales that conceptualized external locus of control as either due to chance or the influence of powerful other people [20,21]. Internal locus of control (IHLC) represents the internal part of perceived control and refers to the individual's tendency to believe that health outcomes are principally due to the individual's behavior and within their control. Whereas powerful others locus of control (PHLC) and chance locus of control (CHLC) mean the external parts of perceived control and they refer to the individual's tendency to believe that health outcomes are principally due to either other people or chance factors [17].

The MHLC is widely used in health-related research [17]. First, it is used to predict or

explain several health behaviors for several health conditions. For example, patients with higher external locus of control are more likely to be passive [22]. On the other hand, patients with higher IHLC are more likely to return earlier to work, adhere to health-promoting lifestyle changes and illness-preventing behaviors, and have higher survival rates [23,24]. Higher PHLC is associated with trust in health professionals while higher CHLC with mistrust [25]. Second, the MHLC is used to assess the level of perceived control of patients with chronic disease [26,27].

MHLC is the concept, developed within a health behavior-related context and frequently used in the field of health research, different from self-efficacy and community involvement frequently cited. Understanding individuals' MHLC, we could predict their behavior in a certain health-related situation and plan to change their behavior in proper directions. MHLC is a variable that measures the difference among people in health-related psychological research [28]. In the MHLC context, individuals' differences in MHLC could cause individuals to react differently toward Covid-19. Therefore, MHLC could validate the aim of the present study that directs to a micro approach based on individual hygiene.

2.3 Health Belief Model (HBM): Perceived Susceptibility and Severity

The Health Belief Model (HBM) was suggested in the early 1950s by social scientists at the U.S. Public Health Service to understand the failure of people to adopt disease prevention strategies or screening tests for the early detection of disease. Since HBM has been introduced, the model has been adopted and modified in various fields of science and has represented health promotion theory. HBM is an explanatory model

frequently used to study preventive health behaviors [28]. HBM suggested some salient concepts, perceived threat, behavioral evaluation, and cue to action, that affect individuals' health-related behavioral change.

Concretely, perceived threat comprises perceived susceptibility and severity. The practical health behavior is measured and predicted with the behavioral evaluation, named perceived barriers and benefits, which is accompanying results toward an expectancy [28]. Cues to action refer to the trigger of health behavior when suitable health beliefs are held. The factor comprised two components, internal cues (i.e., having an accident oneself, feeling pain, etc.) or external cues (i.e., reading a mass-media article about the effects of an unhealthy diet, a close friend discovering she has cancer, etc.) [29]. According to a meta-analysis [30], HBM constructs are frequently proved as significant predictors of health behavior.

Especially, this study pays attention to perceived threat because the side-effects of Covid-19 vaccines are reported through the coverage of presses, and then people get hesitancy and denial to vaccinate. Perceived susceptibility refers to subjective assessment of risk of developing a health problem. The HBM predicts that individuals who perceive that they are susceptible to a particular health problem will engage in behaviors to reduce their risk of developing the health problem. Perceived severity means the negative consequences an individual associates with an event or outcome, such as a diagnosis of cancer. These consequences may relate to an anticipated event that may occur in the future, or to a current state such as a pre-existing health problem [31]. In the context of Covid-19, perceived susceptibility and severity would also validate

and explain the acceptance of vaccinating or hesitancy and denial.

2.4 Research Hypotheses

Because health locus of control (HLC) and HBM affect people's health perception and behavior, MHLC and HBM are theoretical frameworks frequently used in the health education field to understand the relationship between HLC and health beliefs and to conduct desirable health behaviors. The research exploring the correlation between HLC and health beliefs validated significant correlation between perceived threat and HLC, however, there is a rare study analyzing causalities between two components. Joo [28] explored the structural causality between MHLC and perceived threat in the context of particulate matter. The previous study validated the convergence model with MHLC (IHLC, CHLC, and PHLC) and HBM (perceived susceptibility and severity) toward intention to health behavior. Based on Joo [28], we would validate the relationship between the perceived threat and MHLC in the context of Covid-19 vaccinating intention. Accordingly, hypothesis 1 is set as the following.

H1. MHLC in the context of Covid-19 vaccinating will influence the perceived threat.
H1-1. IHLC will influence the perceived susceptibility.
H1-2. IHLC will influence the perceived severity.
H1-3. CHLC will influence the perceived susceptibility.
H1-4. CHLC will influence the perceived severity.
H1-5. PHLC will influence the perceived susceptibility.
H1-6. PHLC will influence the perceived severity.

Hypothesis 2 is based on the part of traditional HBM. The relationship between perceived threat and intention to vaccinating would be validated in the context of Covid-19 vaccinating intention. Accordingly, we set hypothesis 2.

H2. The perceived threat relating to Covid-19 vaccinating will influence the intention to vaccinate.
H2-1. The perceived susceptibility will influence the intention to vaccinate.
H2-2. The perceived severity will influence the intention to vaccinate.

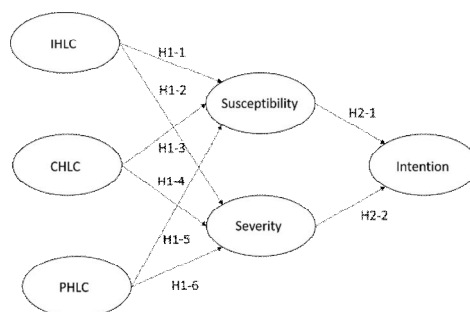The following Fig. 1 illustrates the above hypotheses.

Fig. 1. Hypothetical Model

3. Method

3.1 Sample

This study chose participants, based on a convenience sampling. The participants were 116 Korean collegians rolling in undergraduate and graduate programs, whose demographic profiles are presented in Table 1.

As shown in Table 1, 55.2% of respondents were female with 44.8% male. As for grade composition, 33.6% of respondents were graduate student; 26.7% were freshman; 18.1% were sophomore; 14.7% were senior; 6.9% were

junior. In terms of major, 33.6% of respondents majored in engineering; 19.8% majored in health care; 15.5% majored in liberal art; 11.2% majored in social science; 11.2% majored in art, physical education, and others; 8.6% majored in natural science. As for residence, 45.7% of respondents resided in Seoul; 33.6 resided in Gyeonggi-do and Incheon; 20.7% resided in out of Seoul metropolitans. The average age of respondents was 23.4 (S.D=3.30).

Table 1. Demographic profile

Demographic		N	%
Gender	male	52	44.8
	female	64	55.2
Grade	freshman	31	26.7
	sophomore	21	18.1
	junior	8	6.9
	senior	17	14.7
	graduate student	39	33.6
Major	engineering	39	33.6
	social science	13	11.2
	health care	23	19.8
	liberal art	18	15.5
	natural science	10	8.6
	arts, physical education, & others	13	11.2
Residence	Seoul	53	45.7
	Gyeonggi-do & Incheon	39	33.6
	others	24	20.7

3.2 Survey Administration

To test the hypotheses, we employed a self-reported survey of Korean collegians. We employed online snowball sampling of convenience samplings. Concretely, we posted the link of the questionnaire of Google Form on the researchers' Facebook page and asked the followers to fill out and then recommend reposting the questionnaire for recruiting their followers on their page.

The questionnaire was uploaded on Google Form for 10 days from December 30, 2020, to January 8, 2021. At that time, there was some controversy over securing Covid-19 vaccines in Korea and some international news reporting the side effects of the vaccines, which made people worried to vaccinate against Covid-19. Accordingly, the context would be appropriate to the present research purpose which investigates what affects vaccinating.

3.3 Measurement

This research validates the relationship among three dimensions from MHLC, two salient components from HBM, and intention to vaccinate toward Covid-19. The research instruments consist of a 3-part questionnaire that was modified from a variety of sources to gather information regarding demographics, MHLC (IHLC, CHLC, and PHLC), and HBM (susceptibility, severity, and intention to vaccinate toward Covid-19). We employ five-point Likert scales, anchored with strongly disagree to strongly agree for measuring the above constructs.

Table 2. The Scale of Measurement

IHLC
- I get sick from Covid-19, it is my own behavior that determines how soon I got well again.
- The main thing which affects my health relevant to Covid-19 is what I do.

CHLC
- No matter what I do, I am likely to get sick from Covid-19.
- My good health relevant to Covid-19 is largely a matter of good fortune.

PHLC
- Health professionals control my health relevant to Covid-19.
- Regarding my health relevant to Covid-19, I can only do what health professionals tell me to do.

Perceived Susceptibility (SUSCPT)
- I think I am in danger of getting sick from Covid-19
- I think I have no other choice but to get sick from Covid-19
- I think I am at a high chance of getting sick from Covid-19

Perceived Severity (SVRT)
- I think Covid-19 is a serious hazardous disease
- I think Covid-19 is lethal
- I think Covid-19 is a serious threat

Intention to vaccinate (INT)
- I intend to vaccinate to reduce health risks during the Covid-19 pandemic.
- I intend to vaccinate even though any side effects are reported.
- I intend to vaccinate even though others resist vaccinating.

The items of MHLC were modified from Joo [28], which originated from Wallston et. al[18]. IHLC, CHLC, and PHLC consisted of two items, respectively.

Two salient components of HBM, perceived susceptibility and severity, are modified from Joo[32]. Susceptibility and severity are measured respectively with three items.

Items of intention to vaccinate are devised with considering the context of the Covid-19 pandemic and applying previous researches [28,33]. Intention to vaccinate consists of three items. Concrete items are specified in Table 2.

4. Findings

4.1 Reliability and Validity of Measurement

To validate reliability and validity of measurement scales, we executed to click PLS Algorithm on Calculate menu of SmartPLS 3 package to compute Cronbach's Alpha(α) and composite reliability.

Table 3. PLS quality criteria overview

	Cronbach's Alpha	Composite Reliability	AVE	R Square
IHLC	0.796	0.860	0.759	
CHLC	0.833	0.923	0.857	
PHLC	0.714	0.868	0.768	
SUSCPT	0.674	0.819	0.610	0.110
SVRT	0.944	0.964	0.898	0.069
INT	0.868	0.920	0.793	0.062

Table 3 shows some statistics to verify the quality of the measurement. The Cronbach's Alpha of constructs are more than 0.6, the minimum criterion, which indicates the reliable value. Every composite reliability is greater than the minimum criterion, 0.7. Thus, the reliability of measurement scales is appropriate for testing hypotheses.

To test construct validity of the measurement model, the present research employs convergent and discriminant validity [36,40]. This research validates the convergent validity to use average

variance extracted (AVE), which is greater than 0.50 is valid convergent validity [36,41]. In Table 3, AVE in all constructs is greater than 0.5 that is, the present research achieves over the threshold of the criterion.

To examine discriminant validity, we compare the inter-correlations within the latent construct with the root square of AVE of latent constructs. If the square root of AVE of each construct is greater than its correlations with the other latent constructs, the discriminant validity is significant [36]. As shown Table 4, every square root of AVE is appropriate to the criterion respectively.

Table 4. Latent construct correlations

	IHLC	CHLC	PHLC	SUSCPT	SVRT	INT
IHLC	0.871					
CHLC	−0.110	0.925				
PHLC	0.124	0.240	0.876			
SUSCPT	0.003	0.328	0.063	0.781		
SVRT	0.181	−0.019	0.205	−0.002	0.948	
INT	0.219	0.032	0.107	0.228	0.102	0.891

Note: Statistics on the diagonal show the square root of AVE

4.2 Test of Structural Model

We executed to click Bootstrapping on Calculate menu of SmartPLS 3 to compute path coefficients, t statistics, and p values, and then validate hypotheses. The findings of the hypothesis test and path coefficients of the research model appear in Table 5. The model validity is appraised to consider both factors[36,40], the structural paths in Table 5 and R square value in Table 3, and is satisfactory.

Consequently, we identified three valid hypothetical paths. Concretely, both path IHLC-perceived susceptibility (SUSCPT) (H1-1) and IHLC-perceived severity (SVRT) (H1-2) are not significant. Of CHLC-SUSCPT path(H1-3) and CHLC-SVRT path (H1-4), CHLC predicts SUSCPT (β=0.338, t=3.410, p<0.001, two-tailed test), but CHLC-SVRT path is not significant.

PHLC-SUSCPT path(H1-5) is not valid, but PHLC-SVRT path (H1-6) is significant(β=0.199, t=2.196, p<0.05, two-tailed test). Finally, of salient two paths from traditional HBM, SUSCPT (H2-1) predicts intention to vaccinate (INT) (β=0.228, t=2.407, p<0.05, two-tailed test), but SVRT-INT path (H2-2) is not significant.

The proposed model is explained 6.2% and has less coefficient of determination(R^2=0.062) than middle (13%) and greater than small(2%) on Cohen's threshold[41]. According to Cohen, the middle R square in social science refers to an acceptable effect. The R square is some less but acceptable because the research is an exploratory study.

Table 5. Hypothesis testing results

	Hypothesis	β	t	p	Result
H1-1	IHLC → SUSCPT	0.043	0.362	0.717	reject
H1-2	IHLC → SVRT	0.151	0.993	0.321	reject
H1-3	CHLC → USCPT	0.338	3.410	0.001	support
H1-4	CHLC → SVRT	−0.050	0.484	0.629	reject
H1-5	PHLC → USCPT	−0.023	0.174	0.862	reject
H1-6	PHLC → SVRT	0.199	2.196	0.029	support
H2-1	SUSCPT → INT	0.228	2.407	0.016	support
H2-1	SVRT → INT	0.102	0.838	0.402	reject

In short, CHLC predicts INT with mediating SUSCPT. This finding means people who feel that getting Covid-19 would depend on their fortune react more susceptible toward Covid-19, and then the susceptibility would lead them to vaccinate. Another significant finding is PHLC predicts SVRT. With the influx of Covid-19 in Korea, the governmental public health officers and professionals for the medical area actively appeared to report and brief the situation relating to Covid-19 in the press. This could cause the people to perceive severe to Covid-19. The public open policy to Covid-19 and coverage with the press arouse people's attention on Covid-19 and would be efficient to make people act preventive behaviors like wearing a hygienic mask, washing hands, and so on.

4. Conclusion and Discussion

Since the last quarter of 2019, the whole world has been in fear of Covid-19. Countries respectively have tried to defense Covid-19 to protect their people. Some countries rapidly and proactively set the system of quarantine, encourage to develop vaccines and remedies against Covid-19, and ask their people to prevent the disease with some quarantine behavior like wearing masks, coughing on one's sleeves, vaccinating, and so on. Many governments think a prescription coping with Covid-19 would be to vaccinate their people. The government officers and professionals relevant to public health promotion agreed to an opinion to speed up vaccinating to reach collective social immunity. However, due to side-effects of vaccines reported through the source like media and some people's antipathy against the vaccine, there is hesitancy and refusal to vaccinate. In the above context, this research explored relationships among constructs of MHLC and HBM to identify what stimulates vaccinating against Covid-19. Especially, in Korea, the first priority of vaccinating was elders living in elderly nursing facilities and health care workers, and then 70s, 60s, and so on with a few exceptions. The 20s and under are not planned to vaccinate until yet. AS of the present, the 20s would be the last sequence for vaccinating. They perceive themselves as healthy relatively and active. The 20s have no choice but to be careful not to get Covid-19 on their own. They would have the potential to spread Covid-19. Considering these contexts, we judged collegians as the subject for

the research would be appropriate.

This study, which questions what promotes or hinders vaccinating people against Covid-19, seeks to better understand the phenomena by relying on an integrated model of MHLC and HBM. This study aims to explore a model that could explain and predict which factors influence people's intention to vaccinate. As well known, two models, MHLC and HBM, are widely used and are certificate as models having explaining power in health promotion fields. Through employing PLS path modeling toward the integral model, we aim to identify the influential factors on acceptance or hesitancy of vaccinating systematically.

We proposed and validated hypotheses explaining the intention to vaccinate against Covid-19, which three dimensions of MHLC would influence two components of HBM and then finally would influence intention to vaccinate. We found that CHLC influenced SUSCPT(β=0.338, t=3.41, p<001, two-tailed test) and PHLC influenced SVRT(β=0.199, t=2.196, p<0.05, two-tailed test). People who would think to get sick from Covid-19 mainly due to fortune tend to perceive that they are at high risk to get sick from the disease. Because of the difficult situation for getting vaccines and remedy of the epidemic, these fatalists used to think they are very susceptible to the disease. Whereas people who mainly used to depend on professionals relevant to Covid-19 tend to perceive the disease as seriously hazardous and lethal. They listen to the opinions of the powerful others like government officers and professionals relevant to Covid-19 and then feel Covid-19 very serious. Moreover, SUSCPT Influenced INT(β=0.228, t=2.407. p<0.05, two-tailed test). This finding implies the more susceptible people perceive to Covid-19, the more active they would vaccinate.

Consequently, CHLC influence indirectly INT mediating with SUCSPT. This finding means that vaccination against Covid-19 would be predicted by susceptibility perception to the disease which is influenced by a fatalistic tendency. Namely, the more fatalistic people attitude toward Covid-19, the more susceptible they perceived to the disease, and then, the stronger intention to vaccinate they would have. Accordingly, for vaccinating actively and speeding up, first of all, the authorities for public health promotion should motivate to activate people's susceptibility perception toward the disease through utilizing a variety of policies. Furthermore, the authorities should consider that the fatalistic tendency toward the disease of people could play an antecedent role in the process.

Although this study provides significant implications for vaccinating against Covid-19 in Korea, a few limitations are inherent. The survey was administered conveniently through online snowball sampling and a small-size sample of collegians, so that the issue of representativeness would appear. The following study needs to include participants from more diverse regions, jobs, and levels of education and employ a bigger size sample. Moreover, we modified to employ the parsimonious MHLC scale from the previous study[28], which would not be sufficient to measure health locus of control to Covid-19. The following research should employ measuring scales modified from the original MHLC scales[18] to measure more defined and elaborated. Finally, we found the path CHLC-SUSCPT-INT was validated in the Covid-19 context. In practical view, the following research should start to analyze intensively focusing on the context because people perceived not to control the disease by themselves and for their health to depend on chance or fate.

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