SAÚDE COLETIVA / PUBLIC HEALTH

The impact of personality traits on residents' attitude towards COVID-19 vaccine: findings from a Chinese cross-sectional study

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ABSTRACT. The objective of this study is to explore the impact of personality traits on the attitude of Chinese population towards COVID-19 vaccine. In this study, the Chinese Big Five Personality Scale and the self-designed COVID-19 Vaccine Attitude Scale were used to investigate the population in Shanxi Province, China. Through quantitative analysis of the valid data from 492 participants, this study found that there were demographic differences among Shanxi residents in personality traits and attitude towards COVID-19 vaccine (ATCV). In the correlation analysis between the Five-factor model of personality traits and ATCV, three items of ATCV were positively correlated with conscientiousness, agreeableness, openness and extroversion, and one item of ATCV (effectiveness of COVID-19 vaccine) was weakly negatively correlated with neuroticism. In the canonical correlation analysis, conscientiousness played a major role in personality traits, and the 'effectiveness' item in ATCV played a major role. Different personality traits and demographic factors are recommended to be integrated into the category of comprehensive consideration in the process of COVID-19 vaccine promotion and health education, and the relevant theoretical results of health communication can be combined to achieve better effects.

Keywords: COVID-19 vaccine; five-factor model of personality; ATCV; correlation; health communication.

Introduction

The continuous spread of COVID-19 has profoundly affected people's production and life. There have been more than 560 million confirmed coronavirus cases and 63 million deaths worldwide, according to the World Health Organization's official website (Word Health Organization [WHO], 2019). COVID-19 vaccination is considered an effective way to control the spread of the epidemic (Christie et al., 2021). Although the total coverage rate of COVID-19 vaccine in 31 provinces (autonomous regions, municipalities) and Xinjiang Production and Construction Corps in China has reached 89.7% (Chen, 2020), the epidemic prevention and control is still severe due to the mutation of the virus, especially the emergence of Omicron variant, and the vaccine research and development of variant strain is still advancing. Whether and when to vaccinate with the Omicron variant is under international and domestic research. According to the research of Čukić and Weiss (2014), personality traits are closely related to disease-related behaviors, and will directly or indirectly affect the population physical and mental health. In addition, according to Li and Chen (2021), individual beliefs and attitudes may lead to changes in individual behaviors. From this perspective, individual personality traits and attitude towards COVID-19 vaccine (ATCV) may affect individual vaccination behavior.

The objective of this study is to explore the impact of personality traits on the attitude of Chinese citizens towards COVID-19 vaccine. It will test the demographic differences among Shanxi residents in personality traits and ATCV, analyze the correlation between big-five personality and ATCV, and propose improvement strategies from the perspective of health communication, so as to provide reference for better health education and research on COVID-19 vaccine and other vaccines in similar fields.

Background

The Big Five Personality and Health

The Big Five Personality Theory is an important personality theory, which is more popular with contemporary personality psychologists. John and Srivastava (1999) summarized the Big Five personality to

clarify the basic personality traits, including agreeableness, conscientiousness, openness, extroversion and neuroticism. These five dimensions can comprehensively reflect the personality traits of a person, which was a major reason why the Big Five personality was chosen. Since then, the Big Five personality has been widely used in physiology, management psychology and other fields. The studies found that residents with different demographic characteristics in different groups showed differences in the Big Five personality traits. At the same time, there is a close relationship between the Big Five personality and many attitudes and physiological activities (Rochefort, Hoerger, Turiano, & Duberstein, 2019). In recent years, the study of the Big Five personality and different health issues has obtained certain achievements. Many studies have found that the Big Five personality with demographic factors jointly influence people's cognition, attitude and behavior to health issues. A study of smoking shows that among unmarried, core family, women, agreeableness, neuroticism and openness of personality traits are protective factors of adult cigarette smoking (Min, Wu, & Sun, 2022). Tuberculosis patients with different personality traits will adopt different coping styles for the disease. People with high scores of neuroticism tend to cope negatively, while those with high levels of conscientiousness and agreeableness tend to choose positive coping styles (Mabuchi et al., 2005). Patients with type 2 diabetes mellitus of different genders, ages, education levels and income levels, are different in different dimensions of type 5 personality, and the self-management attitude of type 2 diabetes mellitus patients is correlated with the five personality characteristics, among which neuroticism plays a particularly significant role (Li, Gao, Chen, & Sun, 2020). However, the current research on the relationship between the Big Five personality traits and health issues has focused on chronic behavioral diseases, and there has been no research on the relationship between the Big Five personality traits and ATCV.

Cognition and attitude towards COVID-19 vaccine

Since the COVID-19 pandemic, the research on COVID-19 vaccine has become an intense topic, among which the research on the cognition and attitude of COVID-19 vaccine mainly includes the vaccination attitude, vaccination intention, vaccination hesitation and their influencing factors. A study found high acceptance and low rejection rates of COVID-19 vaccines. The concern about the side effects of COVID-19 vaccine and the belief that other people's vaccination will not help to control the epidemic are the important influencing factors of COVID-19 vaccination attitude (Wu et al., 2021). In terms of vaccination willingness, residents have a strong willingness to vaccinate against COVID-19, but their enthusiasm immediately after the vaccine is on the market is low. It is suggested to strengthen the publicity and education of COVID-19 vaccine-related knowledge (Wang, Li, Huang, Yang, & Lv, 2021). Vaccine hesitancy is widespread among different populations in different countries (Coustasse, Kimble, & Maxik, 2021; Sherman et al., 2021). The factors affecting the hesitation of vaccination mainly include: the perception of vaccine safety and effectiveness (Pogue et al., 2020), the accuracy of vaccine information provided by the media (Lin, et al., 2020), socioeconomic status and education level (Sun, Lin, & Operario, 2021).

Health communication research

Health communication is an important discipline branch in the field of communication. In the 1970s, the 'Stanford Heart Disease Prevention Program', a cooperation between American medical experts and communication scholars, was regarded as the beginning of modern health communication research. Over the past decades, scholars in journalism and communication and public health have combined communication theory with medical knowledge, and achieved relatively fruitful research results. From the perspective of health communication, scholars pay attention to the spread of AIDS knowledge and behavior change, the prevention and intervention of diabetes, the improvement of health literacy, tobacco control and other issues (Sun & Chen, 2018). It can be said that the theoretical achievements of communication provide a richer disciplinary perspective and solutions for the study of health issues.

Summary

In academic circles, the Big Five personality and health, cognition and attitude towards COVID-19 vaccine, and health communication have been studied by many scholars, while no scholars have chosen to study the relationship between the Big Five personality traits and ATCV. By exploring the impact of personality traits on Chinese residents' ATCV, this study could fill the gap in research. In order to study smoothly this question, two research problems were proposed.

RQ1: Are there significant demographic differences in the Big Five personality traits and ATCV among residents? If yes, how are these differences represented?

RQ2: Is there a correlation between residents' big five personality traits and ATCV? If yes, what is the correlation?

Accordingly, two research hypotheses were proposed.

H1: There are significant demographic differences among residents on Big Five personality traits and ATCV.

H2: There are significant positive correlation between Big Five personality traits and ATCV on the residents.

Material and methods

Participants

This study took the population of Shanxi Province, China as the research object, involving all the 11 prefecture-level cities under its jurisdiction. The reason for choosing these participants was that the researcher was born and lived in Shanxi Province for a long time and had a certain understanding of the Big Five personality traits and ATCV of the residents of this province. Thus, it was easier for the researcher to approach the participants. For ethical reason, all the participants were required to have no cognitive impairment and fill in the informed consent form. A total of 492 respondents were enrolled in this study. The questionnaire was collected over a one-month period from June 23 to July 23, 2022.

Instruments

In this study, the Chinese Big Five Personality Inventory brief version (CBF-PI-B) developed by Wang, Dai and Yao (2011) was used to measure the individuals' personality traits, and the self-designed questionnaire was used to measure their ATCV. The questionnaire also collected their general demographic characteristics, involving their gender, age, area, education level and marital status.

CBF-PI-B

The CBF-PI-B consisted of five subscales, namely neuroticism (N), conscientiousness (C), agreeableness (A), openness (O) and extroversion (E). The questionnaire involved a total of 40 questions, and each subscale was measured by eight questions. For example, neuroticism was measured by Q1 (I often feel afraid.), Q6 (Sometimes I feel that I am worthless.), Q11 (I often associate myself with a careless remark from others.), Q16 (When facing pressure, I feel like I'm going to collapse.), Q21 (I often worry about something unimportant.), Q26 (I often feel insecure.), Q31 (I often worry about what bad things will happen.) and Q36 (I seldom feel blue or depressed.). Through questions, this study could investigate comprehensively the personality traits of those Chinese residents. In addition, these questions were scored on a 6-level Likert scale, as 1 indicating complete disagreement and 6 indicating complete agreement. The questionnaire contained reverse scoring items, which were item 5, 8, 13, 15, 18, 32 and 36, respectively. Scoring methods were as follows: Reverse scoring of items were done in reverse, and scoring of each dimension was obtained by adding the score of each dimension. The higher the score of each subscale, the more obvious the characteristics of the subscale were.

Self-Designed Questionnaire

The self-designed questionnaire was intended to investigate Chinese residents' ATCV, involving three items such as safety, effectiveness and positive recommendation of COVID-19 vaccines. That is, 'I think COVID-19 vaccines are safe.' 'I think COVID-19 vaccines are effective.' 'I would advise my relatives and friends to get vaccinated against COVID-19.' These questions in the survey were also scored on a 6-level Likert scale, with 1 indicating complete disagreement and 6 indicating complete agreement.

Reliability and Validity Scale Tests

Subsequently, the reliability and validity of the self-designed scale were evaluated. Items with high residual value (> 0.5) and low standardized factor loadings (< 0.5) needed to be deleted (Kline, 2010). Therefore, two items were deleted from the scale. The remaining questions included attitude towards COVID-19 vaccine safety (ACVT1), effectiveness (ACVT2), and positive recommendation (ACVT3).

Table 1 shows the results of reliability and validity test of the self-designed questionnaire. The factor loading coefficients of the measured indicators were 0.931, 0.853 and 0.781 respectively, which means the measured indicator variables could effectively reflect the measured attitude towards COVID-19 vaccine. Cronbach's α was 0.890, which is higher than the recommended value of 0.7. This indicates that the reliability of the survey was good (Tavakol & Dennick, 2011). The combined reliability (CR) value was 0.892, which implies that the measurement questions of latent variables had internal consistency. The AVE value was 0.735, which was greater than 0.5, indicating good convergent validity. Therefore, the self-designed questionnaire had good reliability and validity.

Table 1. Reliability and validity test.

Dimension	Item	Unstd.	S.E.	Z	P	Std.	Cronbach'α	CR	AVE
ATCV	ATCV1	1.000				0.931	0.890	0.892	0.735
	ATCV2	0.870	0.036	23.879	***	0.853			
	ATCV3	0.838	0.039	21.259	***	0.781			

Quality control

The on-site one-to-one survey was conducted by previously trained investigators in the past two months, and the questionnaires were filled out by the investigators. Compared with the questionnaire filled by the participants themselves, the questionnaire filled by the investigators could help them better communicate with the participants and ensure the quality of the survey. In addition, this study established database through Excel, and parallel double entry.

Data analysis

SPSS26.0 was used for statistical analysis. Categorical data was expressed as constituent ratio, continuous variables were expressed as mean ± standard deviation, and comparisons between groups were performed using Mann-Whitney U test, Kruskal-Wallis H test, t-test or analysis of variance. Spearman correlation analysis was used to analyze the correlation between demographic factors, personality traits and ATCV, and canonical correlation was used to explore the relationship and degree of influence between variable groups. Test level α = 0.05.

Results

Analysis of the five-factor model of personality traits, ATCV and demographic variables

Among 492 valid respondents, the majority of respondents were females, aged between 18 and 35, had a Bachelor's, Master's degree or PHD, and married (see Table 2).

The results of the difference tests showed that there were differences in agreeableness, openness and extroversion among respondents of different genders. Relatively, males had higher scores on openness and extroversion, while females scored higher on agreeableness.

In the comparison of personality traits of respondents in different age groups, it was found that the scores of their neuroticism and conscientiousness in the age group of 56 to 65 were significantly higher than those in other age groups. The respondents aged 46-55 had the highest score in the personality trait of agreeableness.

In addition, there were differences in neuroticism, conscientiousness and ATCV among respondents with different education levels. In terms of neuroticism, respondents with higher education level had lower scores in this dimension. Those with a high school education scored highest in conscientiousness. Those with a junior high school education or below had the highest score, while those with a Master's degree or above had the lowest score on ATCV.

Moreover, there were also some differences in the scores of neuroticism, conscientiousness and ATCV among respondents with different marital status. In comparison, people who were divorced or widowed scored higher on neuroticism and conscientiousness personality traits, and had a more positive ATCV.

Furthermore, the study found that there were no statistically significant differences in the five dimensions of personality traits and ATCV among residents of different places of residence (rural or urban).

Table 2. Difference tests of CBF-PI-B and ATCV in demographic factors.

DVs	Items	n (%)	N	C	A	O	E	ATCV
Gender	Total	492(100)	26.92 ± 8.24	35.57 ± 6.35	36.68 ± 5.81	33.36 ± 7.01	29.05 ± 7.34	16.17 ± 2.43
	Male	191(38.8)	26.51 ± 8.13	36.08 ± 5.8	35.92 ± 6.09	34.83 ± 7.12	30.07 ± 7.17	16.27 ± 2.28
	Female	301(61.2)	27.19 ± 8.3	35.24 ± 6.67	37.17 ± 5.58	32.43 ± 6.79	28.41 ± 7.39	16.11 ± 2.52
	t/Hc		-0.89	-0.90	-2.35	-3.54	-2.55	-0.41
	P		0.37	0.37	0.02	0.00	0.01	0.68
Age	<18	7（1.4）	30.71 ± 4.19	33.29 ± 8.36	32.57 ± 4.65	36.71 ± 9.79	30.14 ± 10.56	16.57 ± 1.81
	18-25	130（26.4）	27.81 ± 7.81	34.68 ± 5.86	35.85 ± 5.31	34.22 ± 6.56	29.74 ± 7.12	16 ± 2.3
	26-35	211（42.9）	26.25 ± 7.48	35.3 ± 6.06	36.45 ± 6.06	33.43 ± 6.58	28.57 ± 6.9	16.02 ± 2.42
	36-45	64（13）	25.89 ± 8.07	35.8 ± 7.91	37.36 ± 5.59	31.88 ± 6.7	28.88 ± 6.93	16.22 ± 3.12
	46-55	48（9.8）	24.4 ± 8.78	36.75 ± 6.36	39.04 ± 5.69	31.96 ± 8.8	30.19 ± 8.87	16.37 ± 2.14
	56-65	27（5.5）	33.44 ± 12.03	39.78 ± 4.79	37.93 ± 5.94	33.67 ± 8.27	28.07 ± 8.62	17.11 ± 1.95
	⩾66	5（1）	29.2 ± 7.92	35.8 ± 5.26	35.8 ± 5.81	34.2 ± 8.17	26.8 ± 9.18	17 ± 1.41
	Hc		21.32	20.60	16.27	6.55	3.15	11.89
	P		0.00	0.00	0.01	0.36	0.79	0.06
Area	Urban	405（82.3）	26.7 ± 8.39	35.55 ± 6.47	36.87 ± 5.83	33.32 ± 6.93	29.09 ± 7.41	16.15 ± 2.46
	Rural	87（17.7）	27.97 ± 7.45	35.64 ± 5.83	35.79 ± 5.66	33.55 ± 7.42	28.89 ± 7.06	16.25 ± 2.31
	t/Hc		-1.303	-0.355	-1.795	-0.062	-0.604	-0.184
	P		0.193	0.723	0.073	0.95	0.546	0.854
Education level	Middle school	24(4.9)	29.46 ± 8.49	36.29 ± 7.7	35.42 ± 5.63	34.79 ± 9.8	28.71 ± 9.01	17.08 ± 1.44
	High school	21(4.3)	27.86 ± 8.58	38.43 ± 5.94	37.43 ± 6.12	35.67 ± 8.52	31.14 ± 7.12	15.76 ± 3.35
	Junior college	78(15.9)	27.51 ± 8.68	36.13 ± 6.57	37.24 ± 6.2	33.85 ± 6.58	28.94 ± 7.32	16.62 ± 2.41
	Bachelor	274(55.7)	27.42 ± 7.9	34.77 ± 6.31	36.31 ± 5.62	32.89 ± 6.81	28.95 ± 7.12	16.18 ± 2.31
	Master or PhD	95(19.3)	24.17 ± 8.21	36.57 ± 5.73	37.46 ± 5.96	33.44 ± 6.71	29.07 ± 7.64	15.65 ± 2.66
	F/Hc		3.72	10.08	3.65	3.36	2.91	12.18
	P		0.005	0.04	0.46	0.50	0.57	0.02
Marital status	Unmarried	187(38.0)	27.86 ± 7.52	34.67 ± 6.18	35.55 ± 5.55	34.26 ± 6.98	29.02 ± 7.22	16.14 ± 2.25
	Married	283(57.7)	25.81 ± 8.18	36.1 ± 6.39	37.37 ± 5.88	32.85 ± 6.86	29.26 ± 7.27	16.11 ± 2.59
	Divorced/ Widowed	21(4.3)	33.67 ± 10.89	36.29 ± 6.88	37.43 ± 5.79	32.38 ± 8.68	26.57 ± 9.1	17.24 ± 1.38
	F/Hc		13.77	13.54	4.17	5.31	3.03	12.91
	P		0.02	0.02	0.53	0.38	0.70	0.02

Therefore, this study proved that H1 is partly true. That is, there were statistically significant differences among residents on Big Five personality traits in gender, age, education level and marital status. Meanwhile, there were also statistically significant differences among residents on ATCV in education level and marital status. However, there were no statistically significant differences among residents on Big Five personality traits and ATCV in the area.

Linear correlation analysis between personality traits and ATCV

Spearman correlation analysis was used to analyze the correlation between the Five-factor model of personality traits and ATCV of Chinese residents. It was found that among these five personality traits, there was a negative correlation between the neuroticism dimension and Chinese residents' ATCV. Neuroticism's negative correlation with safety and positive recommendation of COVID-19 vaccines was not significant, while its negative correlation with effectiveness of COVID-19 vaccines was significant. On the contrary, the other four personality traits (i.e., conscientiousness, agreeableness, openness, extroversion) showed different degrees of significantly positive correlation with three items of ATCV (see Table 3). Therefore, H2 was proved partly true.

Table 3. Linear correlation analysis between personality traits and ATCV.

Items	N[1]	C[2]	A[3]	O[4]	E[5]
1. I think COVID-19 vaccines are safe.	-0.039	0.290**	0.223**	0.161**	0.115*
2. I think COVID-19 vaccines are effective.	-.096*	0.313**	0.250**	0.156**	0.092*
3. I would advise my relatives and friends to get vaccinated against COVID-19.	-0.084	0.309**	0.266**	0.164**	0.122**

[1]Neuroticism, [2]Conscientiousness, [3]Agreeableness, [4]Openness, [5]Extroversion. **Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

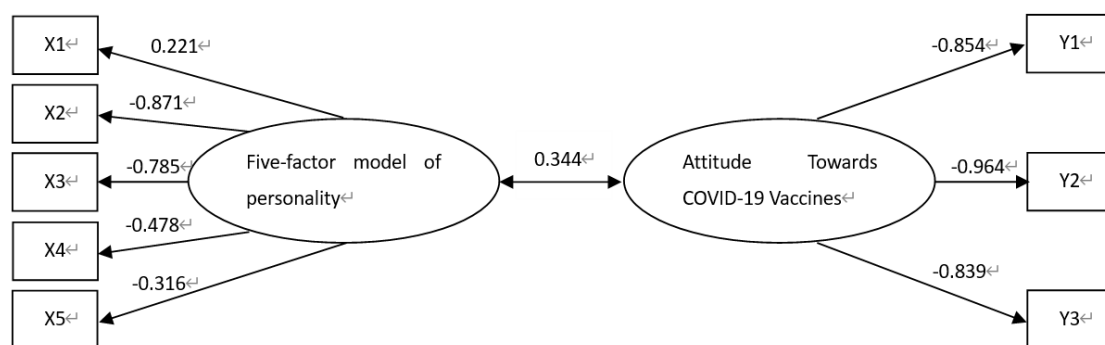## Canonical correlation analysis between personality traits and ATCV

This study considered the Five-factor model of personality traits as the independent variable X (X1-X5 were neuroticism, conscientiousness, agreeableness, openness, and extroversion and ATCV as the dependent

variable Y (Y1-Y3 corresponded to safety attitude, effectiveness attitude, and positive recommendation attitude. The canonical correlation analysis showed that the first correlation coefficient was 0.344 (p = 0.000). The first canonical variable Y = -0.61Y1-0.695Y2-0.331Y3 between the Five-factor model of personality group (X) and ATCV group (Y), in which the absolute value of Y2 was the largest. Y = -0.040X1-0.622X2-0.535X3-0.143X4-0.068X5, in which the absolute value of Y2 coefficient was larger (see Table 4).

Table 4. The canonical correlation coefficient and significance test.

Items	Canonical Correlations	Wilk's	x^2	P
1	0.344	0.864	70.868	0.000
2	0.124	0.980	9.570	0.283
3	0.067	0.996	2.161	0.540

In addition, Figure 1 showed that the canonical variable of ATCV was mainly played by Y2 'I think COVID-19 vaccine is effective', and conscientiousness (X2) plays a major role in personality traits.

Figure 1. Canonical correlation between five-factor model of personality and ATCV.

Discussion

Based on the results, this study could further discuss the results by combining with relevant theories, which helped to put forward improvement strategies from the perspective of health communication.

Differences of personality traits in demographic variables

The results show that among five personality traits, neuroticism had statistically significant differences among Shanxi residents in three demographic variables (i.e., age, educational level and marital status). Relatively, the younger and the elderly, the less educated and the divorced/widowed were more likely to be affected by negative emotions. Neuroticism is associated with vulnerability, anxiety and depression, and impulsivity and anger. Laferton, Fischer, Ebert, Stenzel and Zimmermann (2020) found that the younger and less educated people generally have a higher neuroticism. They are more likely to experience negative emotions (such as anxiety, anger, guilt, depression, etc.).

Like neuroticism, conscientiousness had statistically significant differences among Shanxi residents in age, educational level and marital status. In comparison, the middle-aged, better-educated and married people tend to be more conscientious. The results have been proved by some scholars. For example, Chopik (2016) considered that the middle-aged usually have a strong sense of conscientiousness. They actively take responsibility in their work and life, without passing the buck. Fan, Chatterjee and Kim (2022) pointed out that married people have a strong sense of family and social responsibility. They need to take the responsibility of defending marriage, protecting children, caring for parents and repaying the society.

Agreeableness had statistically significant differences among Shanxi residents in gender and age. In contrast, the middle-aged people and women are more agreeable than men, younger and older people. The results were in line with the view of Biron, Reuver and Toker (2016). The middle-aged people and women may show more emphasis on interpersonal harmony with others in work and life. They are modest, compassionate and easily trusted by others.

Moreover, openness and extroversion had statistically significant differences among Shanxi residents in gender. Relatively, men were more open and extroversive than women. Kurpisz et al. (2016) also pointed out that men are more receptive to new things, with more optimistic emotions and a richer imagination.

Exploring the differences in personality traits of residents with different demographic characteristics can help to quickly identify people who are easy to accept in the process of vaccine promotion, so as to facilitate the popularization of vaccine. According to the diffusion of innovation theory, as the spread of the new content in the audience of the diffusion and adoption is not uniform, the process of people to accept and adopt new things present a s-shaped curve (see Figure 2). That is to say, the innovation diffusion at first in a low level, over a period of time after rapid diffusion, and slows down again and enters a stable phase when approaching the peak (Zhang, 2009). Adopters can be divided into innovators, early adopters, early majority, late majority, and laggards according to the order of adoption.
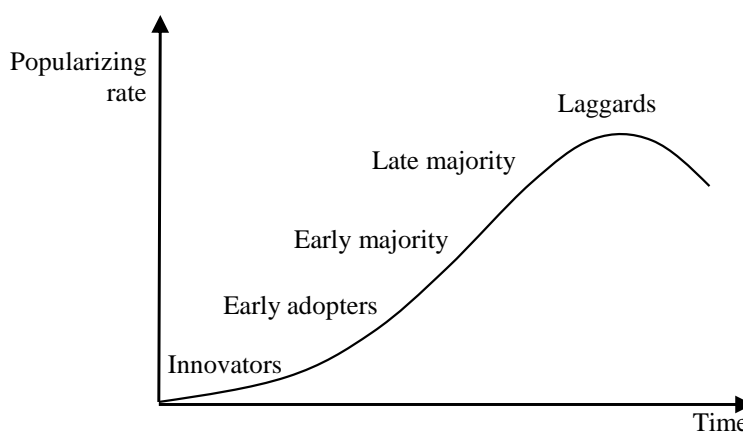

Figure 2. S-shaped curve of innovation diffusion.
Fonte: Zhang (2009).

Thus, the rapid identification of potential innovators and early adopters at the beginning of the diffusion process of an innovation can help shorten the time for the innovation to be accepted by the public. According to fear-driven theory, fear can lead to behavior change (Zhang, 2009). According to this study, in the context of the COVID-19 pandemic, young people were more likely to acutely feel stress and fear, which will lead to behavioral changes. Male group had higher scores of openness and extroversion dimension, more optimistic mood and easier to adopt new things. Therefore, the young and male groups of Shanxi residents were more likely to be pioneers in the spread of COVID-19 vaccines as innovations. The middle-aged people and females were more agreeable. They paid more attention to the harmony of their relationships with others and were more likely to be influenced by pioneers to take action and become early adopters. Therefore, in the health education and behavioral intervention on COVID-19 vaccination, groups with the above demographic characteristics deserve priority attention.

Differences of ATVC in demographic variables

Regarding the ATCV, there were statistically significant differences among Shanxi residents with different educational levels. Relatively, residents with lower education levels had more positive ATCV than higher-educated residents. The persuasion theory from the perspective of health communication can provide a reference for improving this situation. Persuasion theory holds that the formation of mass communication effect is restricted by various conditions such as persuasion strategy and audience attributes. Among them, the relevant research on persuasion strategy found that for the people with low education level, the effect of 'one-side prompt' was better, and for the people with high education level, the effect of 'two-sides prompt' was better (Guo, 1999). The so-called 'one-side prompt' refers to the object of persuasion only to prompt the judgment material of their own advantage, while the so-called 'two-sides prompt' refers to the point of view or material of the opposite party in a certain way while prompting the powerful material. Therefore, in the health education and behavioral intervention on COVID-19 vaccination, the "two-sided prompt" can be carried out in an appropriate way for people with higher education level to achieve better communication effect.

In addition, this study also found that divorced/widowed individuals had a more positive ATCV, which was associated with conscientiousness and agreeableness that played an important role in canonical correlation analysis, given that the divorced/widowed individuals in this study were older, and COVID-19 is more harmful

to the elderly. According to Li and Chen (2021), an individual's perception of the severity of illness will affect the likelihood of adopting healthy behaviors. That is, older divorced/widowed individuals may have a more positive ATCV due to a greater fear of contracting COVID-19.

The impact of personality traits on ATCV

This study found that personality traits were correlated with ATCV to a certain extent. The conscientiousness, agreeableness, openness and extroversion were positively correlated with Shanxi residents' attitude towards the safety, effectiveness and positive recommendation of COVID-19 vaccines. However, there was no statistically significant correlation between neuroticism and Shanxi residents' attitude towards COVID-19 vaccine safety and positive recommendation, and a very weak negative correlation with their attitude towards the effectiveness of COVID-19 vaccines. This is the innovation of this study and fills the gap in research.

Canonical correlation analysis between personality traits and ATCV showed that conscientiousness played a major role in personality traits, and the effectiveness of COVID-19 vaccines played a major role in ATCV. Shanxi residents with strong conscientiousness may carefully consider the pros and cons of COVID-19 vaccination. This is in line with the Knowledge-Attitude-Practice Model (KAP Model). The KAP Model illustrates the association of knowledge, attitude, and practice in promoting individual health behavior changes (Zhang, 2009). According to this model, the effectiveness of information and the salience of expected effects are the promoting factors for people to increase knowledge, strengthen beliefs and then change actions. Therefore, in the process of vaccine promotion and related health education, further highlighting the effectiveness of vaccine and reducing individuals' perception of "behavioral costs/behavioral benefits" will help to promote behavior change on the individuals.

Implications and limitations

Most of the published studies combine the Five-factor model of personality traits with chronic behavioral diseases or study the willingness of different groups to receive COVID-19 vaccines. There is a lack of surveys on personality traits of residents in a certain region and studies on the relationship between personality traits and ATCV. This study explored the relationship between demographic factors, personality traits and ATCV among Shanxi residents, so as to provide reference and help for vaccine promotion and health education in similar fields in the future.

This study has both theoretical and practical significance. The study confirmed a correlation between the Five-factor model of personality traits and ATCV. The more conscientiousness, agreeableness, openness and extroversion, the more positive ATCV Shanxi residents presented. In addition, combined with the relevant theories of health communication, this study discussed that: (1) In the early stage of vaccine promotion, the promotion and publicity should be focused on young people and men; (2) In the middle stage, the middle-aged group and the female group should be emphasized; (3) In the process of vaccine promotion, the publicity of vaccine effectiveness should be strengthened, which is more conducive to improving people's attitude towards vaccines; (4) The 'two-sides prompt' strategy should be used appropriately in vaccine promotion and health education.

This study also has the following limitations. It was a cross-sectional study, and the samples were all permanent residents in Shanxi Province, China. Therefore, the results were only about the relationship between the five-factor model of personality traits and ATCV among current permanent residents in Shanxi Province. Due to the differences in demographic characteristics, economic development levels and other aspects among provinces, Chinese residents may have great differences in personality traits and ATCV. Thus, the results may not be applicable to the real situation throughout China. All the same, the proportion of sample composition was not very reasonable. Limited by objective conditions, the proportion of females, aged 26-35 and with a Bachelor's degree was relatively higher in the samples of this study. This may have a certain impact on the research results.

Conclusion

Under the background of COVID-19 pandemic, the Five-factor model of personality traits of Shanxi residents with different demographic factors showed their own characteristics, and the personality traits showed a certain correlation with ATCV. On the one hand, Shanxi residents with different gender, age,

education level and marital status had differences in the five personality traits, and residents with different education levels and marital status had significant differences in their ATCV. On the other hand, four of the five personality traits were positively correlated with the ATCV, and conscientiousness and effectiveness of COVID-19 vaccines had the most significant effects.

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