

Practices, Knowledge, and Attitudes of Chinese University Students Toward Traditional Chinese Herbal Medicine for the Control of COVID-19

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Background: The application of traditional Chinese herbal medicine has been officially recommended and strongly promoted in China as an important complement to conventional prevention and treatment for COVID-19. Capturing the practices, knowledge and attitudes of young adult population toward using Chinese herbs for COVID-19 is important for understanding the future of Chinese herbal medicine over the coming decades.

Methods: This cross-sectional questionnaire-based study was conducted from May to June, 2022, among 313 student volunteers in Wuhan University of Science and Technology, a provincial comprehensive university in China.

Results: Results showed that only 18% of students had used Chinese herbs to prevent COVID-19. The main information sources were social media, the students' family members, relatives, friends, etc. as well as the healthcare professionals. However, most students only sometimes paid close attention to related reports and news articles in social media. Clear pharmacological and toxicological properties of herbs were considered by 43% students as the most important factor to promote their own application of Chinese herbs to fight COVID-19. The mean knowledge score was 1.64 out of 5. Students' overall attitudes toward application of Chinese herbal medicine to fight COVID-19 were very positive.

Conclusion: These data suggests most university young adults had a positive attitude but lack of practices and knowledge towards traditional Chinese herbal medicine for COVID-19 control.

Keywords: Chinese herbs, young adults, pandemic, questionnaire

Introduction

In December 2019, the first cases of coronavirus disease 2019 (COVID-19) were found in Wuhan, China, then this epidemic disease spread rapidly across the country and the world.¹ Until now, the morbidity and mortality of COVID-19 provably caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) have been increasing among almost all populations. Especially, the number of COVID-19 cases is increasing rapidly worldwide among young adults, a healthier population group generally believed to be “invincible” to infectious disorders.^{2,3} Recent evidence suggested that, during the COVID-19 second wave caused by highly virulent SARS-CoV-2 variants, young adults were more severely burdened than other age tiers, and the profile of deaths considerably changed with a shift to younger COVID-19 victims.³ Most of the COVID-19 infected individuals are either asymptomatic carriers or accompanied with a mild influenza-like disorder.^{4,5} So far, several vaccines have been used to prevent new coronavirus infection, but there are still no specific antiviral prevention and treatment strategies with the confirmed truth of efficiency. The current clinical treatments for COVID-19 such as oxygen reception, mechanical ventilation, application of antibiotics and oseltamivir are mainly symptomatic.^{1,6} Under such circumstances, the Chinese herbs have been highly valued for the COVID-19 control

based on rich experiences of the Traditional Chinese Medicine (TCM) in applying herbs to combat epidemic diseases over the past thousands of years.^{7–15}

As one of the most popular and mainstream forms of complementary and integrative medicine worldwide, TCM based on a unique holistic theory has been practiced for more than 2000 years in the Chinese healthcare system, and is gaining more and more attention and popularity around the world.^{7–15} Focusing on enhancing the human body's resistance to disorders and prevention by improving the inter-connections among components within a holistic system, TCM employs diversified therapeutic methods, such as herbal therapy, acupuncture, massage, moxibustion, fumigation, Qigong, and Taiji boxing, to provide a valuable supplement and a significant contribution to modern medicine.¹⁶ Although the academic researches in modern Western medicine are ongoing, there is still no effective treatment for quite a few complex and intractable health problems. Despite the fact that the action mechanism of many TCM treatments is still unclear, as a practical medicine built on experience, TCM according to a theoretical system different from that of Western medicine has been proved to show clinical advantages in various disorders based on individualized treatment and syndrome differentiation.¹⁶ For example, in the treatment of patients infected with SARS-CoV erupted in 2002–2003, systemic corticosteroid therapy acted as the mainstay of Western medicine treatment for SARS-CoV, however, its beneficial effect in patients cannot be readily determined but its adverse effects are serious.^{17,18} Application of TCM has been demonstrated to effectively shorten the hospitalization time, decrease steroid-related side effects, and improve symptoms, thus greatly contribute to the relatively low mortality of SARS patients in China.^{10,19} Even when applied as the only measure to treat many SARS patients, TCM had been reported to yield satisfactory clinical results.¹⁹

Among various TCM treatment measures, the traditional Chinese herbal medicine formulas has been well-accepted as the essence of TCM that are characterized by fewer side effects, multitarget and significant therapeutic benefits.^{16,20} To control the current COVID-19 pandemic in China, the Chinese government has implemented multiple effective strategies, among which the application of traditional Chinese herbal formulas has been officially recommended in the national Guideline of Diagnosis and Treatment Plan for COVID-19 as an important complement to conventional treatment for different phases of COVID-19, including mild, moderate, severe, even critically ill patients.^{7,9,21–23} The Chinese state media and medical experts also strongly promoted the idea of using traditional Chinese herbal medicine as an integral part of the COVID-19 control plan.²³ Based on TCM theory, three Chinese patent medicines (including Lianhua Qingwen Capsule, Jinhua Qinggan Granules, and Xuebijing Injection) as well as three herbal prescriptions (including Xuanfeibaidu Recipe, Huashi Paidu Recipe, and Qingfei Paidu Decoction) have been identified to prevent the transmission of SARS-CoV-2 and to treat COVID-19.⁸ So far, more and more clinical evidences have suggested the inspiring effectiveness and safety of these prescriptions of Chinese herbs such as Qingfei Paidu Decoction,^{21,22} Lianhua Qingwen Capsule^{24,25} and Huashi Paidu Recipe²⁶ in controlling COVID-19. Moreover, the potential anti-SARS-CoV-2 characteristics of some single Chinese herbs particularly attracted increasing interest of scientists. For example, as an excellent anti-viral and anti-inflammatory herbal candidate, honeysuckle (*Lonicera japonica*) has been shown to effectively improve the clinical symptoms and laboratory indicators of COVID-19 patients, and might act as an inhibitor of SARS-CoV-2 virus entry and replication.^{27–29} There were evidences showing the preventive effect of Chinese herbal decoction as used in time on close contacts of COVID-19 patients to effectively decrease the conversion rate of contacts to confirmed patients.³⁰ Moreover, it has been generally considered that the Chinese herbal medicine showed remarkable achievements in preventing COVID-19 patients at early stage of outbreak against the deterioration into severe or critical stage.^{7–9,11} After the national promotion of Chinese herbal medicine in epidemic control, the mortality rate of COVID-19 has been reported to be notably reduced in many regions of China.⁷ For example, at the beginning of the COVID-19 outbreak in Wuhan without a deep understanding about the nature of this epidemic disease, many patients turned to the Chinese herb therapy in the TCM Hospital, which was later reported with >90% efficacy.³¹

Nevertheless, there is still no certain evidence and firm consensus regarding the beneficial role of Chinese herbs in overcoming the COVID-19 pandemic.^{9,12} Furthermore, perhaps because of the intrinsic differences between TCM and Western Medicine, as well as the unclear pharmacological and toxicological properties of herbs, the lack of sufficient confidence about traditional Chinese herbal medicine has always been one of challenges for the popularization of TCM in modern healthcare.^{32,33} Therefore, the present study assessed the practice, knowledge, and attitudes regarding the

application of Chinese herbs to control COVID-19 among Chinese university students, to understand the confidence of the young adult generation about Chinese herbal medicine and its influencing factors especially under COVID-19 conditions.

Methods

Study Design

This cross-sectional questionnaire-based study was conducted from May to June, 2022, in Wuhan University of Science and Technology, a provincial comprehensive university in China, and was approved by the Ethics Committee of Medical college, Wuhan University of Science and Technology (No.: WUST-22189). At each weekend during the survey period, our research team set a booth in the campus where students in the university could be approached at random and invited to complete an online anonymous questionnaire.

Questionnaire and Participants

The questionnaire consisted of four parts ([Supporting Information S1 Questionnaire used for data collection](#)). The first part consisted of four questions about the respondents' socio-demographic indicators, including gender, age, profession (Q1–3), and an additional question about whether the respondents had ever used Chinese herbs to treat or prevent disorders excluding COVID-19 in recent 5 years (Q4). The second part included elements to investigate the practice of Chinese herb use under COVID-19 conditions. Concretely speaking, the respondents were asked whether they had used Chinese herbs for the prevention of COVID-19 (Q5), the information sources (Q6) and the attention degree (Q7) in application of Chinese herbs for COVID-19 control, as well as the most important factor to promote their own application of Chinese herbs to fight COVID-19 (Q8). The third part of questionnaire was designed to measure the knowledge regarding using Chinese herbs for COVID-19 control. Students were asked five scoring knowledge questions about whether the application of traditional Chinese herbs has been officially recommended in the national Guideline of Diagnosis and Treatment Plan for COVID-19 (Q9), the role of Chinese herbal medicine in the current COVID-19 control plan in China (Q10), the utilization rate and total efficiency rate of Chinese herbs among COVID-19 patients in Hubei province according to official reports (Q11), as well as three Chinese patent medicines (Q12) and three herbal prescriptions (Q13) that have been screened out for the effective COVID-19 control, respectively. A knowledge score of 1 for correctly answered question. The maximum knowledge score was 5, and the minimum was 0. The last part requested responses regarding the attitudes and opinions concerning the application of Chinese herbs to fight COVID-19. The attitude-related questions in this part included five ones (Q14–Q18) answered in a 5-point Likert-scale format that ranged from “strongly disagree” (1) to “strongly agree” (5), and the other four being single-choice questions (Q19–Q22).

The questionnaire was appraised by two public health researchers regarding its content clarity, validity, relevance and conciseness of the questionnaire items, and then was pretested among 20 students who did not participate in the final survey. The Cronbach's α value or the Kaiser–Meyer–Olkin measure was obtained higher than 0.700. After obtaining written informed consent, an online questionnaire was face-to-face administered to students by the research team members to encourage students to participate in this survey. The respondents were informed about the aim of this survey as an explanatory letter at the beginning of questionnaire, and required to complete the questionnaire within 20 min.

The included study population was the enrolled university students who voluntarily participated in the survey and fully completed the questionnaire within the required time period. All collected questionnaires were checked by the survey team members to ensure the data quality. Questionnaires that were incomplete or were not completed within 20 min based on the on-line recording were excluded from this study.

Statistical Analysis

The collected survey data were entered into SPSS 25.0 (SPSS Inc., Chicago, IL, USA) for analysis. Results were shown as numbers (percentages) for categorical variables and mean \pm standard deviation (SD) for quantitative variables. Quantitative variables were analyzed by multiple comparisons using one-way analysis of variance (ANOVA) with post

hoc Tukey's honestly significant difference (HSD) analysis. The categorical data were statistically analyzed using Chi-square test. $p < 0.05$ or $p < 0.01$ were deemed statistically significant.

Results

Descriptive Statistics

By the end of the survey period, a total of 313 valid questionnaires were obtained. Student respondents' characteristics are reported in Table 1. The age range of the responding university students was between 17 and 24 years, with an average age of 19.81 ± 1.45 years. The gender and profession distributions of respondents were approximately balanced. Of the 313 respondents, nearly half (46%) stated that they had ever used Chinese herbs to treat or prevent disorders excluding COVID-19 in recent 5 years.

Practices of Chinese Herb Use Under COVID-19 Conditions

Among the 313 subjects studied, only 48 (18%) had used Chinese herbs for the prevention of COVID-19. As shown in Table 1, there were no significant statistical differences in the socio-demographic features including age and profession. However, the chi-square test showed that more males had experience of using Chinese herbs for COVID-19 prevention than female ($p < 0.05$); and compared to respondents without experience in Chinese herb use, those who reported having used Chinese herbs to treat or prevent other disorders were more likely to also use herbs to prevent COVID-19 ($p < 0.01$).

Other aspects of Chinese herb use practice under COVID-19 conditions among university students are presented in Figure 1. As for the information sources about Chinese herbs for COVID-19 control, the first resource to obtain the related information among students was social media (internet or TV, etc.); the second was the students' family members, relatives, friends, etc. as well as the healthcare professionals (Figure 1A). When the student participants were asked the question "Since the outbreak of COVID-19, have you paid close attention to official reports and news articles in social media related to the use of Chinese herbal medicine in COVID-19 control?", the majority of participants (76%) chose the answer choice of

Table 1 Demographic Information, Application Practice of Chinese Herbs for COVID-19 and Knowledge Scores Among University Students Participating in the Study (n = 313)

Participant Attribute	Number (%)	Experience of Using Chinese Herbs for the Prevention of COVID-19, n (%)	Interrelation of Application Practice of Chinese Herbs for COVID-19 with Demographic Characteristics (p value)	Knowledge Score (Mean \pm SD)	Interrelation of Knowledge Score with Demographic Characteristics (p value)
Gender					
• Male	138(44)	28(9)	0.021 ^a	1.59 \pm 1.02	0.499 ^b
• Female	175(56)	19(6)		1.67 \pm 0.92	
Age					
• < 20 years	128(41)	16(5)	0.305 ^a	1.70 \pm 0.98	0.365 ^b
• \geq 20 years	185(59)	31(10)		1.59 \pm 0.95	
Profession					
• Healthcare professional	164(52)	21(7)	0.251 ^a	1.70 \pm 0.96	0.307 ^b
• Non-medical professional	149(48)	26(8)		1.58 \pm 0.97	
Have you used Chinese herbs to treat or prevent disorders excluding COVID-19 in recent 5 years?					
• Yes	145(46)	33(11)	<0.001 ^a	1.81 \pm 0.96	0.002 ^b
• No	168(54)	14(4)		1.48 \pm 0.95	

Notes: ^aChi-square test; ^bOne-way ANOVA with post hoc Tukey's HSD.

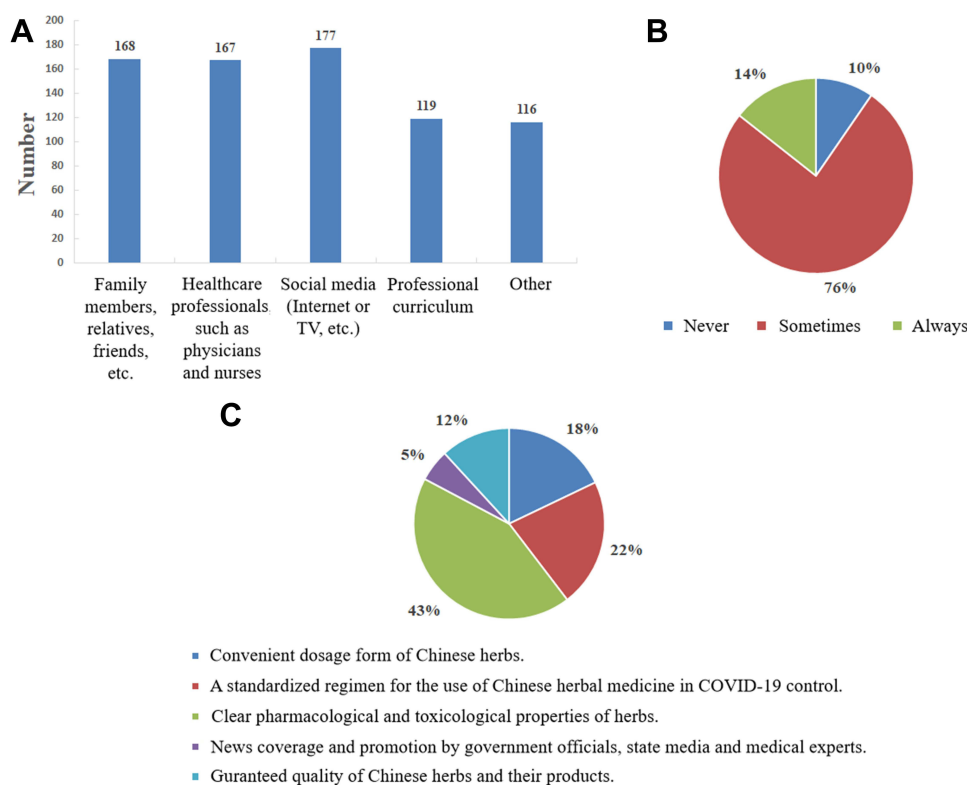


Figure 1 Practice of Chinese university students to use Chinese herbs to fight COVID-19 ($n = 313$). (A) Information sources; (B) Attention degree; (C) Most important promoting factor.

“sometimes” (Figure 1B). Then, the respondents were required to identify the most important factor that can promote their own application of Chinese herbs to fight COVID-19. As shown in Figure 1C, most students (43%) appeared to be worried about the unclear pharmacological and toxicological properties of Chinese herbs; 22% of respondents appealed to a standardized regimen for the use of Chinese herbal medicine in COVID-19 control; in addition, the convenient dosage form and the guaranteed quality of Chinese herbs were supported by 18% and 12% student respondents, respectively, suggesting that the modernization of Chinese herbal medicine might also play an important role in promoting application of Chinese herbs to fight COVID-19. When assessing for differences in demographic factors, we found the responses from two questions (Q6 and Q8) could be significantly influenced by profession. Compared with non-medical students, more medical students got the information about Chinese herbs for COVID-19 control from their professional curriculum ($p < 0.001$); were worried about the unclear pharmacological and toxicological properties of Chinese herbs ($p = 0.019$); but paid less attention to the news coverage and official promotion ($p = 0.003$).

Knowledge Levels Regarding Using Chinese Herbs for COVID-19 Control

The knowledge levels regarding using Chinese herbs for COVID-19 control were assessed using five close-ended questions (each question when answered correct had a score of 1). The mean assessed knowledge score for 313 student participants was 1.64 ± 0.96 out of a total of 5, suggesting a poor understanding of Chinese herbs for COVID-19 control. Table 1 also shows the mean scores of knowledge among students classified according to their demographic characteristics. There was no significant difference in the knowledge score by gender, age and profession ($p > 0.05$). However, the students having the history of Chinese herb administration achieved significantly higher knowledge score ($p < 0.01$).

Furthermore, we compared the knowledge scores of students who had and had not used Chinese herbs for the prevention of COVID-19. No significant difference in the knowledge score was found between students who had used Chinese herbs for the prevention of COVID-19 (Score: 1.86 ± 0.89) and those without experience of using Chinese herbs to prevent COVID-19 (Score: 1.60 ± 0.97) ($p = 0.135$), suggesting no significant association between the experience of

using Chinese herbs for the prevention of COVID-19 and the knowledge levels among Chinese university student respondents.

Chinese University Students' Attitudes and Opinions Concerning the Application of Chinese Herbal Medicine to Fight COVID-19

As shown in Table 2, Chinese university students' overall attitudes toward the application of Chinese herbal medicine to fight COVID-19 were very positive. The important role of Chinese herbal medicine in preventing or treating COVID-19 was strongly agreed and agreed by 83% or 82% respondents, respectively. If there were nearby COVID-19 patients, 76% students strongly agreed and agreed that they would like to use Chinese herbs to prevent self-infection. In addition, 89% and 86% supported or strongly supported that the performance of traditional Chinese herbal medicine in the prevention and control of COVID-19 pandemic would effectively promote their own confidence in TCM, as well as contribute to the popularization and globalization of TCM, respectively.

Single-choice questions Q19 and 20 were designed under the assumption that the respondents were mild or severe COVID-19 patients, respectively, and to understand the most preferred drug therapy among only Chinese herbal medicine therapy, only Western Medicine therapy, and integration of Chinese herbal and Western medicine. As shown in Figure 2, we found that, if the respondents were diagnosed as COVID-19 patients, whether mild or severe, most (65% or 57%, respectively) would take the integration of Chinese herbal and Western medicine as the most-preferred drug therapy. Only 4% and 6% wanted to only receive the Chinese herbal medicine therapy for mild and severe cases of COVID-19, respectively.

Then, we investigated the opinions of respondents toward the most important advantage of Chinese herbs to fight COVID-19. As shown in Table 3, the answers to this question were quite scattered. One-fifth of respondents had the opinion that the rich experiences of TCM in applying herbs to combat epidemic diseases over the past thousands of years were the most important advantage of Chinese herbs to fight COVID-19; another one-fifth appreciated the holistic therapy in traditional Chinese herbal medicine to take the human body as a whole. Besides, the individualized therapy based on syndrome differentiation, safety and effectiveness of traditional Chinese herbal medicine were considered as the important advantages of Chinese herbs in COVID-19 control by 16%, 14% and 10% student respondents, respectively.

Before the survey, the Chinese news media broadcasted a research finding from a Chinese scientific research team,²⁹ reporting that in a clinical study involving 75 moderate type COVID-19 patients, a plant microRNA enriched in honeysuckle decoction was found to dramatically improve the negative conversion rate of patients, suggesting that honeysuckle decoction treatment might be greatly helpful in curing infected patients and in stopping the COVID-19 pandemic. The attitude of respondents toward this report was assessed in the last question. As shown in Table 4, despite

Table 2 Chinese University Students' Attitudes and Opinions Toward the Application of Chinese Herbs to Fight COVID-19 (n = 313)

Survey Question/Statement	Responses, Number (%)				
	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Q14: The application of Chinese herbal medicine is important to prevent COVID-19 in healthy individuals.	114(36)	146(47)	50(16)	1(0.4)	2(0.6)
Q15: The application of Chinese herbal medicine is important for the treatment of COVID-19 patients to improve their symptoms and prognosis.	113(36)	143(46)	51(16)	5(2)	1(0.4)
Q16: If there are COVID-19 patients around me, I would like to use Chinese herbs to prevent self-infection.	85(27)	154(49)	70(22)	3(1)	1(0.4)
Q17: The performance of traditional Chinese herbal medicine in the prevention and control of COVID-19 pandemic would effectively promote my confidence in TCM.	113(36)	167(53)	29(9)	3(1)	1(0.4)
Q18: The performance of traditional Chinese herbal medicine in the prevention and control of COVID-19 pandemic would contribute to the popularization and globalization of TCM.	121(39)	146(47)	42(13)	3(1)	1(0.4)

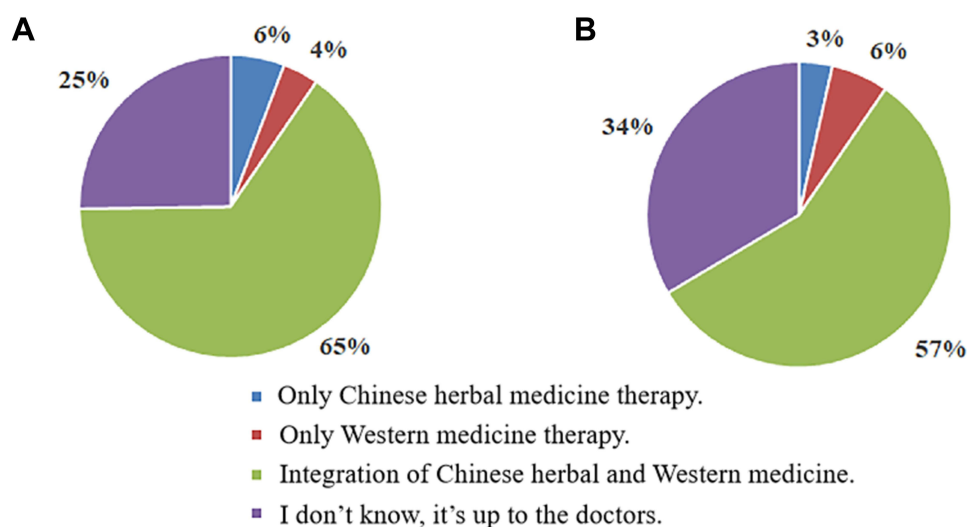


Figure 2 The preferred treatment option for mild (A) or severe (B) cases of COVID-19 (n = 313).

that the majority of (75%) respondents considered that this research finding need further confirmation, 67% students advocated that they would take the honeysuckle decoction for their own COVID-19 infection prevention.

Group comparisons showed significant gender differences in responses to attitude-related questions Q15–18 and 20. Females offered significantly more support to the important role of Chinese herbal medicine in the treatment of COVID-19 patients to improve their symptoms and prognosis (Q15, $p = 0.004$), reported more intentions to use Chinese herbs to prevent self-infection (Q16, $p = 0.026$), and more appreciated the performance of Chinese herbal medicine in this

Table 3 The Most Important Perceived Advantage of Chinese Herbs to Fight COVID-19 (n = 313)

Answer Choice	Responses, Number(%)
• Effectiveness.	31(10)
• Safety.	44(14)
• Individualized therapy based on syndrome differentiation.	50(16)
• Etiologically oriented therapy to treat the underlying causes of disorders.	28(9)
• Multi-target therapy.	3(1)
• Holistic therapy taking the human body as a whole.	63(20)
• Rich experiences of TCM in applying herbs to combat epidemic diseases over the past thousands of years	63(20)
• The concept of “prevention before disease onset” in TCM.	28(9)
• No advantage.	3(1)

Table 4 The University Students' Opinions About an Academic Report Supporting the Efficacy of Honeysuckle Decoction in Curing Infected Patients and Stopping the COVID-19 Pandemic (n = 313)

Answer Choice	Responses, Number(%)
• It is a very exciting research finding, and I will take honeysuckle decoction to prevent self-infection of COVID-19.	78(25)
• This finding needs further confirmation, but I still want to take honeysuckle decoction to prevent self-infection of COVID-19.	131(42)
• Before this finding is further confirmed, I will not take honeysuckle decoction to prevent self-infection of COVID-19.	88(28)
• This finding needs further confirmation, and I do not believe that honeysuckle decoction really has this effect.	16(5)

pandemic to effectively promote their own confidence in TCM and to the popularization/globalization of TCM (Q17 and 18, $p = 0.019$ and 0.046 , respectively). Moreover, as for the preferred treatment option for severe cases of COVID-19 (Q20), more females chose the integration of Chinese herbal and Western medicine ($p = 0.016$), and more males chose only Western Medicine therapy ($p = 0.007$). These data collectively suggested a significantly more positive attitude of female university students towards the application of traditional Chinese herbal medicine in COVID-19 control.

Discussion

In line with the remarkable progress achieved by TCM in the global fight against the pandemic, as well as the strong official promotion by the Chinese government, TCM therapy for COVID-19 has been a current research hotspot.^{7–33} In order to examine the acceptance of TCM for COVID-19 control among stakeholders, several studies have investigated the related practices, knowledge, and/or attitudes of medical professionals,^{32,33} Chinese immigrants,²³ and supermarket staff.³⁰ There are diversified traditional healing techniques under the umbrella of TCM, such as the herbal remedies, acupuncture, breathing exercises, massage, dietary therapy, moxibustion.^{15,16} However, these previous related studies^{23,30,32,33} did not specify these technique types in their questionnaires, which might confuse the respondents, thereby affecting their responses.²⁹ Among the TCM healing techniques, the application of traditional Chinese herbs based on the TCM principle has been considered as the mainstay and principal form of TCM practice.^{8–12,32} Accordingly, among the comprehensive TCM interventions for COVID-19 officially recommended by the Chinese government, the traditional Chinese herbal medicine has been paid the most attention and used widely for the management of COVID-19 pandemic.³² To the best of our knowledge, our survey is the first to examine the use practices for traditional Chinese herbs under COVID-19 conditions among Chinese university students, and to analyze their associated knowledge and attitude factors.

Previous studies on the factors affecting participants' attitudes toward TCM treatment have found that the age was one of independent determinants.^{23,32} In a survey conducted among Chinese medical professionals, older participants were found to tend to agree more with a statement "TCM can be for the prevention and treatment of COVID-19", with 79.3% of older than 51 years selecting the answer choice "very much agree and somewhat agree", but only 47.7% in participants between 21 and 30 years.³² Similarly, Kong et al²³ reported that older Chinese immigrants in Canada were more confident in the effectiveness of TCM for COVID-19. The possible reason might be more traditional upbringings and more understanding about TCM of older people than younger generations.^{23,32} However, individuals within young adult population are just beginning to use drugs without the supervision of caregivers,³⁴ and their attitudes and behavioral intentions to use the traditional Chinese herbs especially under COVID-19 conditions will determine the future of TCM over the coming decades. In particular, as an insightful, open-minded and educated population,³⁴ the Chinese university students are responsible for the future popularization and globalization of TCM, thus should be included as the targeted population investigating their acceptance and confidence in TCM especially traditional Chinese herbal medicine.

TCM emphasizes the importance of health maintenance and prevention before the occurrence of diseases.¹¹ Previous study also showed that people often felt more comfortable relying on TCM for COVID-19 prevention, but less comfortable relying on TCM in the case of symptoms.²³ Another survey studying the public's need for preventive TCM products also suggested the good market prospects of TCM products for COVID-19 prevention.³⁰ Especially for the healthy university students, the preventive role of Chinese herbal medicine against self-infection is important under the condition that no specific agent in Western Medicine had yet been proven effective for COVID-19 prevention. Moreover, student individuals can self-determine whether they use Chinese herbal medicine for the COVID-19 prevention before disease onset. Once they are diagnosed with COVID-19, decisions about their treatment would be primarily up to their physicians. Therefore, when this study explored the respondents' practices of Chinese herb use under COVID-19 conditions, whether they had used Chinese herbs for the prevention of COVID-19 before the occurrence of disease was focused on. In the present study, we found that, despite the fact that nearly half of respondents had recently used Chinese herbs to treat or prevent disorders excluding COVID-19, only 18% had used Chinese herbs for the prevention of COVID-19 in this pandemic. In China, the TCM especially traditional Chinese herbal medicine is the most popular complementary and alternative therapy.³⁵ A study conducted among 3410 community residents in Beijing, China, showed that 56.8% of resident respondents had used Chinese herbal decoction,³⁵ which was consistent with our data about the

students' history of Chinese herb administration. However, this study showed that fewer students had used herbs to prevent COVID-19. This finding was in line with insufficient confidence of younger generations about TCM for COVID-19.^{23,32} It has been reported that, among Chinese medical professionals, 89.3% have eaten Chinese herbs for COVID-19 prevention provided by their hospital.³² This difference in actual use might be because that, as a high-risk group during COVID-19 pandemic, the medical professionals have been officially provided with special focus and strong preventive measures, among which the application of TCM is included. As for the university students, if they want to use Chinese herbs for the prevention of COVID-19, they need to acquire the herbal medicines depending on their own or their caregivers' willingness.

According to the Information-Motivation-Behavioral Skills (IMB) model widely used in studies in health-promoting behaviors,^{34,36} it is generally believed that the awareness and understanding are prerequisite to willingness, acceptance and subsequent behavioral change. The knowledge-level assessment in this study showed a poor awareness and understanding of Chinese herbs for COVID-19 control, which could explain at least in part the poor practice of Chinese herb use under COVID-19 conditions. Currently, in line with the official promotion of traditional Chinese herb use for control of the pandemic in China, the key recommended herbal products used for COVID-19 prevention and treatment, such as three Chinese patent medicines and three herbal prescriptions, are easily accessible in the retail pharmacy stores for the public. But, the lack of knowledge and understanding would result in poor practice of acquiring and using the Chinese herbal products for COVID-19 control. Therefore, more should be done to enhance the young adults' knowledge on Chinese herbal medicine especially under COVID-19 conditions. However, despite the fact that the significantly higher knowledge levels were found in students having the history of Chinese herb administration for disorders other than COVID-19, this study showed that the main knowledge score was 1.86 for students who had used Chinese herbs for the prevention of COVID-19, and 1.60 for those without experience of using Chinese herbs to prevent COVID-19. But, no significant difference was found between the Chinese herb use experience for COVID-19 prevention and the knowledge levels. Although further studies with a greater sample size are needed to verify this finding, one of possible explanations might be that some students' practices of using Chinese herbs for COVID-19 prevention were not pushed by their own willingness.

This explanation was partly supported by the observation that above half of students obtained the information about Chinese herbs for COVID-19 control from the healthcare professionals and/or their family members, relatives, friends, etc. In line with the previous studies,^{23,32} the first information source selected was social media. However, when the respondents were asked about their attention degrees of Chinese herbs for COVID-19 control in social media platforms, only 14% declared that they always paid close attention to the related information. Information on social media is timely and easily accessible.^{23,32} However, the studied university is located at Wuhan city, where the first cases of COVID-19 were identified. Conceivably, their family members, relatives, or friends would be anxious about the possible COVID-19 infection of students in Wuhan during the post-epidemic period. For the university students who are just out of the close supervision of caregivers, the information and advice on COVID-19 prevention from their parents and relatives might be more reliable.

Although the student respondents experienced poor practice and lacked knowledge of using the Chinese herbal medicine for COVID-19 control, the positive attitudes were found among the Chinese university students. The vast majority of students agreed or strongly agreed with the important role of Chinese herbal medicine in preventing and treating COVID-19, declared that they would like to use Chinese herbs to prevent self-infection when exposed, and appreciated the performance of traditional Chinese herbal medicine in the prevention and control of COVID-19 pandemic. Co-administration of TCM and Western medicine has long been well-accepted to show synergistic therapeutic efficacy via taking both of their advantages, and is becoming a new trend in the treatment of disorders including COVID-19 in modern society.^{37,38} In accord to the recommended COVID-19 treatment protocols in China supporting the integration of TCM and Western medicine,⁹⁻¹² the preference for using both Chinese herbal medicine and Western medicine to treat COVID-19 after disease onset was found among student respondents. When expressing their attitude toward a pilot scientific study reporting the possible role of honeysuckle decoction in COVID-19 control, most students claimed that they would take the honeysuckle for their own COVID-19 infection prevention, suggesting a certain level of confidence in Chinese herbs.

This study also explored the perceived advantages and disadvantages of traditional Chinese herbal medicine in COVID-19 control among university students in China. We found multiple advantages of Chinese herbal medicine, including rich experiences in combating epidemic diseases, holistic and individualized nature of TCM, safety and effectiveness, etc. were identified by university students as their reasons why they chose TCM for COVID-19 prevention and treatment. However, the unclear pharmacological and toxicological properties of Chinese herbs appeared to be the greatest concern, which was in line with the recognized bottlenecks of TCM.^{39,40} In the recent decades, the Chinese government has officially state-supported effort to “modernize” TCM.⁴⁰ Modern evidence-based medical concepts and scientific research methods were greatly encouraged for efficacy and safety evaluations of traditional Chinese herbs. It can be speculated that, along with further progress of modern scientific researches on Chinese herbs, the confidence of the young generation on Chinese herbal medicine would be stronger.

Group comparison of practice showed that students having used Chinese herbs to treat or prevent other disorders were more likely to also use herbs to prevent COVID-19, suggested a possible habit of using Chinese herbal medicine. In addition, the present study showed that more male students had experience of using Chinese herbs for COVID-19 prevention than females, however, females showed significantly more positive attitudes towards the application of traditional Chinese herbal medicine in COVID-19 control, and the gender difference in knowledge levels was not found. The study conducted among Chinese immigrants in Canada showed that females were more likely to use TCM especially when they had symptoms of COVID-19, perhaps because females as caregivers for their family members usually need to pay more attention to health-related information.²³ However, in spite of the similar positive attitudes of females, the present study revealed a higher use of Chinese herbs for COVID-19 prevention among males. The possible reason might be due to that some male students used Chinese herbs for COVID-19 prevention depending on their caregivers’ willingness, because boys are often valued more than girls in most traditional Chinese families.

The major limitations of this survey were the single-center nature of the study and the convenience sample methodology. This study was conducted based on a convenience sample of 313 student respondents from one university in China, which might limit the generalisability of findings. Better sampling methodology is needed to replicate and expand our findings. Nevertheless, our study provided some information about the practical implementation of officially state-supported Chinese herbal therapy for COVID-19 control in China, as well as knowledge and attitudes of the young adult generation about Chinese herbal medicine under COVID-19 conditions.

Conclusion

This survey firstly assessed the practices, knowledge, and attitudes of Chinese university students, a healthy young adult population, toward traditional Chinese herbal medicine for the control of COVID-19. The results showed that only 18% respondents had used Chinese herbs for the prevention of COVID-19 before the occurrence of disease, suggesting a poor practice of using Chinese herbal medicine under COVID-19 conditions. Most of responding university students lacked the related knowledge, but showed positive attitudes toward traditional Chinese herbal medicine for COVID-19 control. Multiple advantages of Chinese herbal medicine, including rich experiences in combating epidemic diseases, holistic and individualized nature of TCM, safety and effectiveness, etc. were identified by university students as their reasons why they chose TCM for COVID-19 prevention and treatment. Further modern scientific researches on Chinese herbs to clarify their pharmacological and toxicological properties might be conducive to enhance confidence of the young generation on TCM, and increase the wider outreach of the TCM in the country or outside.

Ethics Approval and Consent to Participant

All procedures performed in studies involving human participant were in accordance with the ethical standards of the institutional and with the Declaration of Helsinki. The study was approved by the Ethics Committee of Medical college, Wuhan University of Science and Technology (No.: WUST-22189). Written informed consent was obtained from all participants.

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Supplementary Material

S1 Questionnaire used for data collection.

Disclosure

The authors report no conflicts of interest in this work.

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