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Post-recovery symptoms of infected cases after Omicron pandemic: a quick online cross-sectional study based on C19-YRSm in China

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Abstract

Background The post COVID-19 health condition of Chinese residents infected with Omicron is not clear after the change of epidemic prevention policies. This study aimed to clarify the epidemiology and associated factors about health status of rehabilitation patients.

Methods A quick questionnaire study based on C19-YRSm was conducted in mainland China through internet from May 1, 2023, to May 7, 2023. Chinese native speakers infected with Omicron variant agreed to participate were included. Persisting symptom and living habits were simultaneously inquired. Logistic regression analysis was used to identify the associated factors.

Results In this study 753 individuals were included. Of whom 57.90% were males, 89.38% did not seek medical service, 99.47% recovered within less than 120 days. Breathlessness (47.68%), cognitive impairment (44.89%), Anxiety/mood changes (33.20%), pain/discomfort (32.94%), fatigue or tiredness not improved by rest (32.27%) and post-exertional malaise (30.01%) were the top reported key symptoms. Less than 10% respondents reported functional limitations. The prevalence of fever was reported greater than that of other symptoms, with dry eyes at 14.87%, appetite change at 14.34%, and hair loss at 12.22%. Middle age (OR: 2.353, 95%*CI*: 1.171 ~ 4.729), underlying diseases (OR: 2.293, 95%*CI*: 1.216 ~ 4.324), severe key symptom (OR: 6.168, 95%*CI*: 1.376 ~ 27.642) and at least one

Introduction

Since the outbreak of the novel coronavirus epidemic in 2019, variants of concern (VOC) such as Alpha, Delta, and Omicron have emerged one after another. Research highlights and anti-epidemic policies in various countries have continued to change along with pathogenic and transmission capabilities of SARS-COV-2.

In addition to acute phase symptom such as fever, sore throat, and muscle aches, the novel coronavirus infections can also lead to problems or disorders in personal physiology, psychology, and functional ability in long term, also known as "long COVID-19" or

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other symptom (OR: 1.847, 95%*CI*: 1.225 ~ 2.718)during the recovery were the risk factors of poor overall health after infection (current overall health score <8; 74.10%), while daily exercise in recovery period (OR: 0.457, 95%*CI*: 0.229 ~ 0.913), a low-fat diet (OR: 0.600, 95%*CI*: 0.401 ~ 0.898) and the recovery time from 2 to 4 months (OR: 0.639, 95%*CI*: 0.445 ~ 0.918) were the protective factors.

Conclusion This is the first time to use the C19-YRSm scale to evaluate the health status in China. The study revealed prevalence of persistent symptoms within 120 days after Omicron onset.

Keywords C19-YRSm, Post recovery, COVID-19, Omicron

"post COVID-19". To confirm the direct effect of SARS-COV-2, a research described the prevalence of one-year persistent symptoms and functional impairment in SARS-CoV-2 positive and negative individuals indicating the existence and severity of post COVID-19 [1, 2]. Fatigue, malaise, breathlessness and "brain fog" were the most popular symptom among those recovered from acute phase [3–7].

The epidemiological distribution of the post COVID-19 caused by Omicron infection is different from that caused by some previous strains [8, 9]. Some longitudinal research has indicated that the post COVID-19 may last for more than two years and the treatment during hospitalization may be closely related to sequelae [10, 11]. The main participants who were recruited in aforementioned research were inpatients during the epidemic of early variant strain. A cohort study observed abnormal chest imaging manifestations of patients 6 months after discharging from hospital [12]. The use of medical instruments or other industry scales to measure certain situation at different points among discharged patients is a common and precise way to explicit recovery status [13–17]. It may only shed light on the one aspect of post COVID-19 symptom, functional ability or mental health, but the health status of people after infection comprehensively includes all aspects of the appeal.

Most infected patients mainly rested at home for isolation treatment without seeking for a medical service after being infected during Omicron pandemic because of the mild acute symptoms [9, 18] and protection of vaccine [2, 19]. Since the publication of *Notice on further optimization of the implementation of measures for the prevention and control of the new crown pneumonia outbreak* on December 8, 2022, there is a lack of medical records to follow up. Few studies reported the short-term and long-term symptoms of the recovered residents in China after the Omicron pandemic.

The modified COVID-19 Yorkshire Rehabilitation Scale (C19-YRSm), an outcome measure for capturing symptom severity, functional disability, and overall health state, had been used to monitor of health status of those post infection of COVID-19 through self-assessment and -reporting [20, 21]. This study is the first use of this scale in the Chinese residents to elucidate the overall health status of the population after Omicron pandemic. Comparation of the prevalence intensity of related symptoms and assessment of related risk factors was also conducted in order to provide complementary information of population recovery conditions and related rehabilitation recommendations.

Method

Study design

This quick one week sectional study aimed at health condition during recovery was conducted in mainland China through an online survey from May 1, 2023, to May 7, 2023 targeted residents infected since December 8, 2022 after the optimization of domestic epidemic prevention policy, therefore, the longest duration of recovery was no more than 143 days among target population. A preliminary self-report questionnaire was conducted mainly based on C19-YRSm which was strongly recommended by World Health Organization (WHO) and used by many countries for monitoring the symptoms of post infection with Omicron virus [21, 22], the perfection of this questionnaire was proceeded after pre-survey in a small group and receiving expert guidance. The final edition was established by an online questionnaire creation system named "PowerCX" (https://www.powercx.com/product) in Chinese, then it was posted by chain promotion to moments and WeChat groups through network. Inclusion criteria were as follows: (a) All Chinese native speakers, aged 18 years or more; (b) Those could understand the content of the poster; (c) Living in mainland China; (d) Recovering from Omicron infection; (e) Agreed to participate in the study. The participants could complete the questionnaire following the instructions via clicking the link or scanning the QR code. This study was approved by Ethics Committee of the Western Theater Center for Disease Control and Prevention on January 1, 2023 (Code Number: IRB22112101).

Questionnaire design

The questionnaire consists of three parts, demographic information, lifestyle related information and C19-YRSm. Demographic information mainly includes age, gender, height, weight, time of infection, diagnosis, treatment measures, recovery duration and underlying diseases.

Lifestyle related information includes exercise and diet habits, such as protein intake and weekly exercise frequency, etc. Self-assessment of participant's actual status was achieved with Likert scale in this part.

The Modified C19-YRS (C19-YRSm) is a 17-item patient-reported outcome measure (PROM) conducted by Manoj Sivan et al., the PDF of which was available on the University of Leeds website and free for non-commercial use [20]. The questionnaire followed the process of forward-translation forming two Chinese drafts, integration two drafts forming one consolidated draft and then back-translation to form one fourth edition. Other five experts formed the final Chinese version of the C19-YRSm by discussing all four drafts in the context of the original questionnaire. Each item in this questionnaire rated on a 0–3 numerical rating scale. 0 represents the symptom not being present; 1 represents a mild problem (not affecting daily life); 2 represents a moderate problem (affecting daily life to a certain extent); and 3 represents a severe problem (life disturbing or affecting all aspects of daily life). The C19-YRSm, similar to the original version, is broken down into four sub-scales concerned with the severity of patients' key symptoms, functional limitations, other symptoms, and overall health. The severity of each item from Question 1 to Question 15 is rated by the respondent from 0 to 3, where 0 indicates the absence of the symptom or functional impairment and 3 indicates that it is severe and life disturbing. The worst scores for each item (Questions 1–10) sum to give the Symptom Severity sub-scale (score 0–30), Questions 11–15 sum to give the Functional Disability sub-scale (0–15). Question 16 is the other symptoms sub-scale (0–25) while add 1 point for each other symptom when respondents choose. Current and pre-infection self-reported health status was asked on a scale from 0 to 10 in Question 17, where 0 means the worst health and 10 means the best health. In addition to this, questions about participants' occupations and the impact of their work were contained in the C19-YRSm. The median score of overall health status before infection among the total respondents was 8 and the person who scored more than 8 was accounting 25.37% of the total in the pre-survey. The cutoff value should be 70% or higher of adequate score in usual [23]. Consequently, we assumed that a respondent's current overall health status score greater than 8 was defined as being in good overall health. This questionnaire is reliable with a Cronbach's alpha value of 0.915. The content validity of the final Chinese version was evaluated by experts' discussion with a highly valid index.

Data collection and verification

The data was collected by exported excel from the questionnaire system, then the verification was conducted by two independent researchers. If different opinions existed, the other inspector was needed (Fig. 1). Data of those unwilling to participate, uninfected since December 8, 2022 or illogical were deleted. The score of "now overall health" greater than 8 was considered to be in good health considering that the median score of overall health status before infection among the total respondents was 8 in the pre-survey, otherwise in poor health currently.

Analysis

The continuous variables conforming to the normal distribution were presented by means and standard deviation (mean ± SD), otherwise median and interquartile (median, IQR). Classification variables were expressed as frequency and percentage. Chi-square or Fisher's test was used for categorical variables. Wilcoxon matched-pairs signed rank test was used to examine the difference in symptom scores between pre- and post- infection. Logistic regression was used for multivariate analysis. All variables were included in the multiple variable logistic regression analysis model (**Enter logistic regression**). A two-sided test was performed with test level $\alpha = 0.05$. Data analysis and visualization was realized by IBM SPSS Statistics 25 and GraphPad Prism 8.

Results

Demographic characteristics and basic information

A total of 1000 participants (response rate = 62.03%) completed the questionnaire during the research. 753 valid data were included in the analysis after eliminating questionnaires that did not meet the requirements or contained logical confusion. (Fig. 1)

This study enrolled participants who had recovered from Omicron disease, representing a diverse range of provinces and occupations. Of the total participants, 317 (42.10%) were females and 436 (57.90%) were males. More than half of responders (53.78%) were between the ages of 18 and 30, with only a small proportion (11.69%) over the age of 50. The percentages of responders who were underweight, overweight and obese were 5.71%, 26.16% and 8.50% respectively. Additionally, 16.87% and 20.58% of responders reported ever smoking and drinking, respectively. 17.66% of the people had at least one underlying disease. The most common underlying conditions were liver-related diseases such as fatty liver (4.65%) and high blood pressure (4.52%). Meanwhile, 185 (24.57%) of people thought they were infected based solely on symptoms, the number of people who performed Polymerase Chain Reaction (PCR), antigen testing or both were 155 (20.58%), 284 (37.72%) and 129 (17.13%) respectively. 89.38% of the participants were in home rehabilitation without seeking medical service, while only 32 (4.25%) outpatients and 15 (1.99%) inpatients were treated in hospitals after infection with

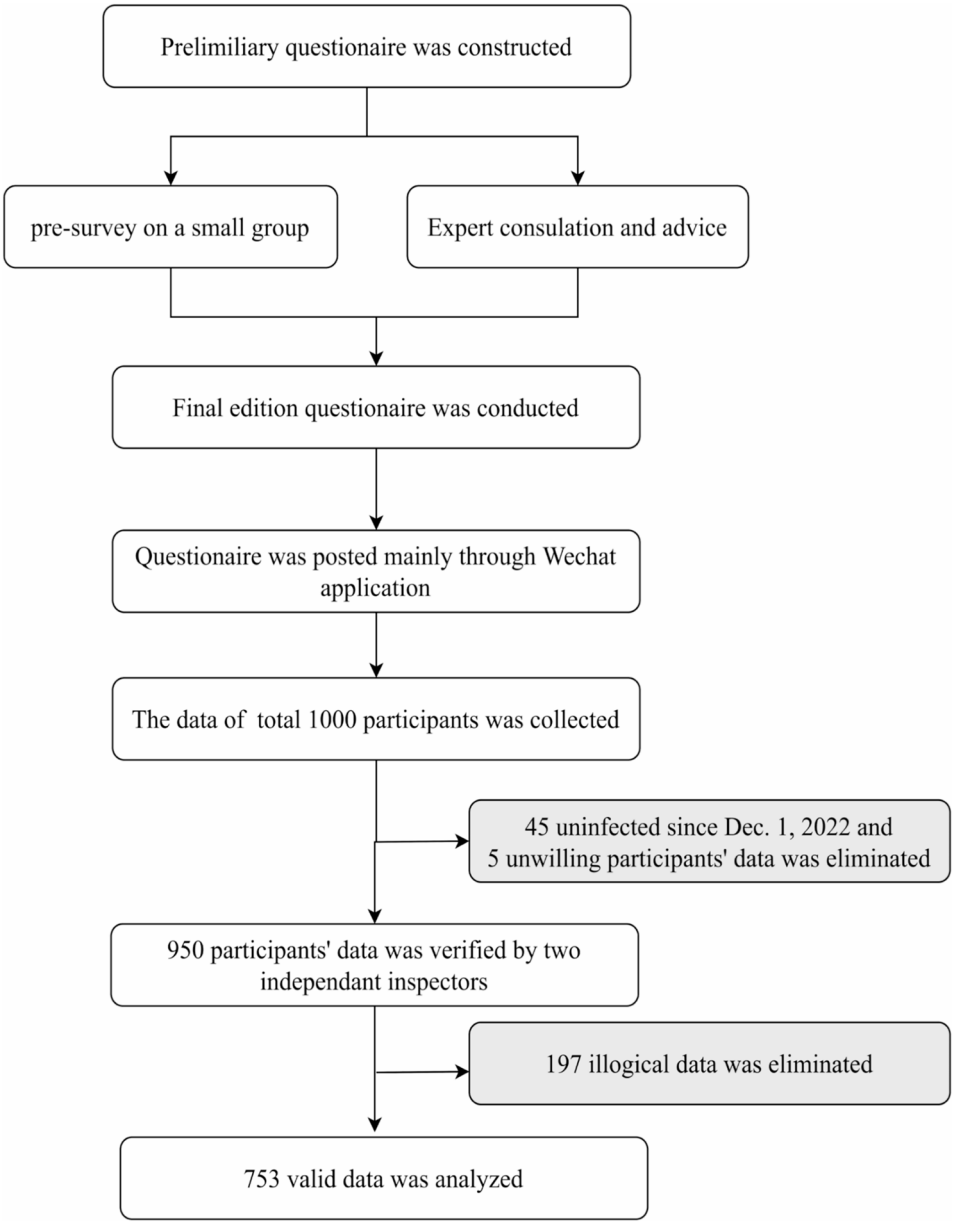

Fig. 1 The process of this quick sectional internet questionnaire survey

Omicron virus. 379 (50.33%) responders recovered within less than 60 days, 370 (49.14%) responders recovered within 60 to 120 days, while 4 (0.53%) responders recovered after more than 120 days (Table 1).

In this questionnaire, we also asked the respondents about their sleep, exercise and diet habits in parallel. According to results, the majority of participants (61.35%) reported staying up late almost every day. Additionally, the number of people who reported never exercising increased from 155 before infection to 301 after infection. Furthermore, there was a significant decrease in the number of people who reported exercising every day after infection compared to before infection. The survey also found that a high percentage of people (71.98%, 70.39%, 79.55%, and 61.89%) had a balanced diet to get adequate fruits, grains, proteins, and fat (Table 1).

Prevalence of post-recovery symptoms based on C19-YRSm

561 (74.50%) respondents had at least one key symptom persisting after recovering from acute phase. Common persisted symptoms included: breathlessness 359 (47.68%), cognitive impairment 338 (44.89%), Anxiety/mood changes 250 (33.20%), pain/discomfort 248 (32.94%), fatigue or tiredness not improved by rest 243 (32.27%) and post-exertional malaise 226 (30.01%)

Table 1 Demographic and general characteristics of participants ($N = 753$)

Characteristics		Number (%)
Age, years	18 ≤ age<30	405 (53.78)
	30 ≤ age<50	260 (34.53)
	age ≥ 50	88 (11.69)
Sex	Males	436 (57.90)
	Females	317 (42.10)
Body Mass Index	18.5 ≤ BMI<24 (normal)	449 (59.63)
	BMI<18.5 (underweight)	43 (5.71)
	24 ≤ BMI<228 (overweight)	197 (26.16)
	BMI ≥ 28 (obesity)	64 (8.50)
Underlying disease	None	620 (82.34)
	At least one	133 (17.66)
Diagnose	PCR	155 (20.58)
	Antigen detection	284 (37.72)
	Both	129 (17.13)
	None but with symptoms	185 (24.57)
Treatment	Asymptomatic infection with no treatment	33 (4.38)
	Hospitalization	15 (1.99)
	Outpatient treatment	32 (4.25)
	Home rehabilitation	673 (89.38)
Time since infection, days	Days<60	379 (50.33)
	60 ≤ Days<120	370 (49.14)
	Days ≥ 120	4 (0.53)
Smoke	Yes	127 (16.87)
	No	626 (83.13)
Drink	Yes	155 (20.58)
	No	598 (79.42)
Stay up late (not fall asleep after 22:30)	Never	62 (8.23)
	Once a week	62 (8.23)
	Twice a week	115 (15.27)
	Every two days	52 (6.91)
	Everyday	462 (61.35)
Pre-infection exercise frequency	Never	155 (20.58)
	Once a week	126 (16.73)
	Twice a week	149 (19.79)
	Every two days	111 (14.74)
	Everyday	212 (28.15)
Current exercise frequency	Never	301 (39.97)
	Once a week	167 (22.18)
	Twice a week	127 (16.87)
	Every two days	68 (9.03)
	Everyday	90 (11.95)
Protein intake, such as egg or milk	High	133 (17.66)
	Normal	599 (79.55)
	Low	21 (2.79)
Fruit intake	High	86 (11.42)
	Normal	542 (71.98)
	Low	125 (16.60)
Coarse grains intake, such as cereals	High	57 (7.57)
	Normal	530 (70.39)
	Low	166 (22.05)
High-fat foods intake, such as hotpot	High	56 (7.44)
	Normal	466 (61.89)
	Low	231 (30.68)

(Fig. 2A). Most of them occurred breathlessness when they walked up a flight of stairs, while this is less common when getting dressed or changing positions. Inattention and memory loss are two of the most common aspects of cognitive impairment in Omicron recovery. In this survey, 294 (39.04%) people thought that their memory was significantly impaired, and 247 (32.80%) people thought that they had difficulty concentrating compared with before infection. In addition, some respondents still had anxiety and depression after recovery (Supplemental Fig. 1). Sleep disorders and palpitations were also accounted for 29.62% and 29.21%, respectively (Fig. 2A). Palpitations were reported in 180 cases, while dizziness in 145 cases (Supplemental Fig. 1).

For functional limitations, the reported incidence was no more than 10%, with communication problem (8.63%) ranking first, followed by difficulties with walking or moving around (7.30%), difficulties with extended activities of daily living (5.98%), social role impairment (4.78%) and personal care difficulties (2.92%) (Fig. 2B).

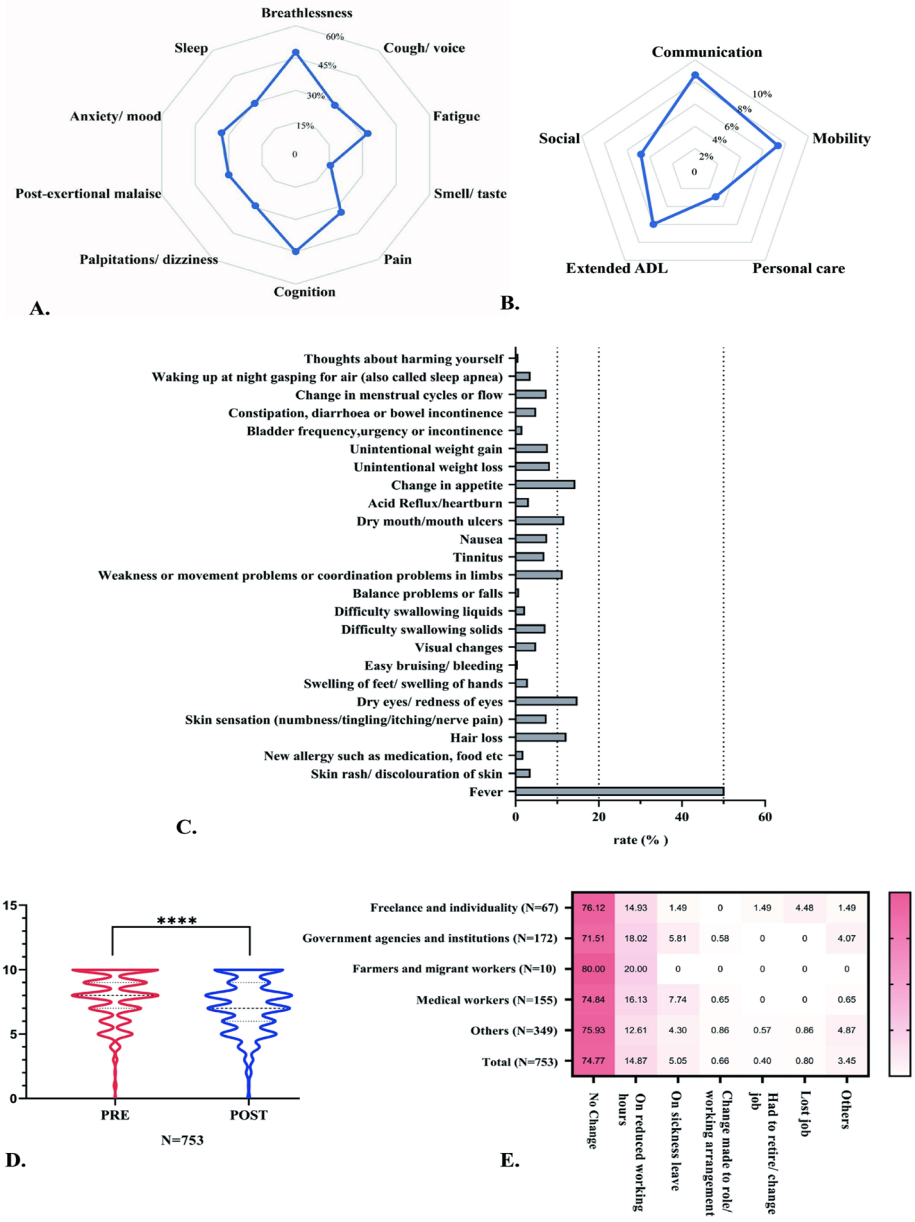

Fig. 2 The prevalence of total 753 participants about every sub-scale in C19-YRSm. **A**, **B**. The prevalence of participants with current key symptom (**A**) and problems of functional ability (**B**), "now" score of which items greater than 1 was defined as the existence of a relevant problem. **C.** The incidence rate of 25 other typical symptoms. **D.** The overall health score of the total under pre- and post-infection, the higher score indicates the better overall health, ****p value < 0.0001. **E.** The influence in work status about various different occupational person after infection. Color depth represents various value of proportion

The functions of the above five dimensions worsened after recovering from COVID-19 compared to the pre (Supplemental Fig. 1).

In addition, other symptoms that may occur during the COVID-19 recovery period were also interviewed in the C19-YRSm. As shown in Fig. 2C, the prevalence of fever was notably greater than that of other symptoms, with dry eyes at 14.87%, appetite change at 14.34%, and hair loss at 12.22%.

The next section of the survey was concerned with overall health in the last 7 days. There was a significant difference ($P<0.001$) in overall health score between pre- and post-Omicron infection. What stands out in this chart was the markedly decrease in overall health score, the median of which has turned from 8 to 7 (Fig. 2D).

In the final part of the questionnaire, respondents were asked about employment status to evaluate impact on work caused by Omicron illness (Fig. 2E). The majority of those responded to this item felt that there was no change compared with before whatever their occupation is. A reduction in working hours was reported in less than 20% of participants. Only a few people who were on sickness leave or lost their jobs because of poor health after the infection.

Associated factors of overall health score after infection

In light of the aforementioned findings, we undertook a supplementary analysis aimed at identifying the factors that influence respondents' current overall health. A score exceeding 8 on the overall health status scale was designated as indicative of good overall health. Initial analyses revealed several variables correlated with self-reported overall health, including gender, age, underlying diseases, duration of recovery, smoke and exercise habits, etc. The odds of poor health among females was 55% more likely than among males (OR: 1.551, 95%*CI*: 1.104–2.177). Individuals aged between 30 and 50 exhibited a higher likelihood of experiencing poor overall health compared to those aged over 50 (OR: 2.115, 95%*CI*: 1.222–3.661). Additionally, respondents with underlying diseases demonstrated an increased odds ratio of 2.081 (95% *CI*: 1.265–3.423). Factors such as frequent late-night activities (OR: 1.884, 95% *CI*: 1.084–3.274), the presence of severe key symptoms (OR: 10.339, 95% *CI*: 2.497–42.820), and the experience of at least one additional symptom post-recovery (OR: 2.119, 95% *CI*: 1.490–3.014) were also associated with poor overall health. Conversely, engaging in regular exercise (OR: 0.408, 95% *CI*: 0.245–0.677) and adhering to a low-fat diet during the recovery phase (OR: 0.661, 95% C*I*: 0.465–0.938) were linked to improved overall health outcomes. Notably, an unexpected finding was that smokers were more inclined to self-report good health, with an odds ratio of 0.600 (95% C*I*: 0.398–0.903). (Table 2).

A logistic regression analysis was performed to control for potential confounding variables. The Hosmer-Lemeshow test yielded a value of 0.380, suggesting a satisfactory fit of the model. The prediction accuracy for determining the likelihood of experiencing poor overall health was found to be 76.8% when a cut-off point of 0.500 was applied. The findings revealed that age between 30 and 50 years (OR: 2.353, 95% *CI*: 1.171–4.729), the presence of at least one pre-existing medical condition (OR: 2.293, 95% *CI*: 1.216–4.324), a key symptom score exceeding 10 (OR: 6.168, 95% *CI*: 1.376–27.642), and the presence of at least one additional symptom (OR: 1.847, 95% *CI*: 1.225–2.718) were identified as risk factors associated with current health status. Conversely, engaging in daily exercise during the recovery phase (OR: 0.457, 95% *CI*: 0.229–0.913), adhering to a low-fat diet (OR: 0.600, 95% *CI*: 0.401–0.898), and having a recovery duration of two to four months (OR: 0.639, 95% *CI*: 0.445–0.918) were recognized as protective factors contributing to better health outcomes. (Table 2).

Discussion

Several studies described persistent symptoms in patients who recovered from COVID-19 disease [1, 10, 12, 24, 25]. The post-recovery symptoms of infected cases after late Omicron pandemic remain unclear in China. In this study, we used C19-YRSm to evaluate the incidence and features of post COVID-19 syndrome.

A total of 753 valid respondents were included. Our results indicated that most participants (74.50%) recovered from Omicron infection had at least one persisting symptoms. The prevalence of post COVID-19 syndrome varies in different studies in the attributes of the population, evaluation indexes or major variants, et al. Breathlessness and cognition impairment were the most popular syndromes in our study. It is not surprising that impaired lung function is the main persistent symptom because the respiratory tract is primary target organ for COVID-19 [26]. A systematic review indicated that the incidence of breathlessness was up to 26% (95%*CI* : 23 ~ 29) [27]. A prospective study included 83 patients hospitalised for severe COVID-19 to describe the temporal trends in respiratory outcomes after 12 months. Significant reduction in DLCO (diffusing capacity of the lungs for carbon monoxide) and radiological changes persisted was observed in 20 (24%) patients 12 months after discharge [28]. The above results suggest that it may take longer to recover impaired lung function. Cognitive impairment named "brain fog" before, was also observed in many studies, including forgetfulness, difficulty concentrating and cognitive slowness [29]. 39.04% and 32.80% of respondents reported having problems with memory or concentration respectively in our study. The incidence of cognitive dysfunction in our study was

Table 2 The risk factor analysis of current overall health score among 753 participants

Variables	Total	Poor overall health	Good overall health	Univariate analysis		Multivariate analysis	
	N (%)	*N* (%)	*N* (%)	OR (95%CI)	*P*	aOR (95%CI)	*P*
Gender							
Female	317 (42.10)	250 (78.86)	67 (21.14)	1.551 (1.104 ~ 2.177)	**0.012**		
Male	436 (57.90)	308 (70.64)	128 (29.36)	Reference			
Age, years					**0.002**		
18 ≤ age<30	405 (53.78)	285 (70.37)	120 (29.63)	1.108 (0.674 ~ 1.821)	0.685		
30 ≤ age<50	260 (34.53)	213 (81.92)	47 (18.08)	2.115 (1.222 ~ 3.661)	**0.007**	2.353 (1.171 ~ 4.729)	**0.016**
Age ≥ 50	88 (11.69)	60 (68.18)	28 (31.82)	Reference		Reference	
Body Mass Index (BMI)					0.204		
BMI<18.5	43 (5.71)	30 (69.77)	13 (30.23)	0.804 (0.406 ~ 1.594)	0.531		
24 ≤ BMI<28	197 (26.16)	141 (71.57)	56 (28.43)	0.877 (0.603 ~ 1.276)	0.493		
BMI ≥ 28	64 (8.50)	54 (84.38)	10 (15.63)	1.881 (0.928 ~ 3.815)	0.076		
18.5 ≤ BMI<24	449 (59.63)	333 (74.16)	116 (25.84)	Reference			
Underlying disease							
At least one	133 (17.66)	112 (84.21)	21 (15.79)	2.081 (1.265 ~ 3.423)	**0.003**	2.293 (1.216 ~ 4.324)	**0.010**
None	620 (82.34)	446 (71.94)	174 (28.06)	Reference		Reference	
Recovery duration, days					**0.015**		
Days ≥ 120	4 (0.53)	2 (50.00)	2 (50.00)	0.276 (0.038 ~ 1.990)	0.173		
60 ≤ Days<120	370 (49.14)	259 (70.00)	111 (30.00)	0.644 (0.463 ~ 0.897)	**0.009**	0.639 (0.445 ~ 0.918)	**0.015**
Days<60	379 (50.33)	297 (78.36)	82 (21.64)	Reference		Reference	
Smoke							
Yes	127 (16.87)	83 (65.35)	44 (34.65)	0.600 (0.398 ~ 0.903)	**0.014**		
No	626 (83.13)	475 (75.88)	151 (24.12)	Reference			
Drink							
Yes	155 (20.58)	108 (69.68)	47 (30.32)	0.756 (0.512 ~ 1.116)	0.158		
No	598 (79.42)	450 (75.25)	148 (24.75)	Reference			
Stay up late (not fall asleep after 22:30)					0.134		
Everyday	462 (61.35)	346 (74.89)	116 (25.11)	1.884 (1.084 ~ 3.274)	**0.023**		
Every two days	52 (6.91)	40 (76.92)	12 (23.08)	2.105 (0.924 ~ 4.794)	0.074		
Twice a week	115 (15.27)	90 (78.26)	25 (21.74)	2.274 (1.156 ~ 4.472)	**0.016**		
Once a week	62 (8.23)	44 (70.97)	18 (29.03)	1.544 (0.730 ~ 3.267)	0.255		
Never	62 (8.23)	38 (61.29)	24 (38.71)	Reference			
Exercise frequency before infection					0.069		
Everyday	212 (28.15)	146 (68.87)	66 (31.13)	0.669(0.417 ~ 1.074)	0.095		
Every two days	111 (14.74)	82 (73.87)	29 (26.13)	0.855(0.487 ~ 1.504)	0.587		
Twice a week	149 (19.79)	107 (71.81)	42 (28.19)	0.771(0.460 ~ 1.291)	0.322		
Once a week	126 (16.73)	104 (82.54)	22 (17.46)	1.430 (0.791 ~ 2.585)	0.235		
Never	155 (20.58)	119 (76.77)	36 (23.23)	Reference			
Exercise frequency currently					**0.006**		
Everyday	90 (11.95)	55 (61.11)	35 (38.89)	0.408 (0.245 ~ 0.677)	**0.000**	0.457 (0.229 ~ 0.913)	**0.026**
Every two days	68 (9.03)	47 (69.12)	21 (30.88)	0.581 (0.323 ~ 1.043)	0.067		
Twice a week	127 (16.87)	90 (70.87)	37 (29.13)	0.631 (0.393 ~ 1.014)	0.056		
Once a week	167 (22.18)	127 (76.05)	40 (23.95)	0.824 (0.524 ~ 1.294)	0.400		
Never	301 (39.97)	239 (79.40)	62 (20.60)	Reference		Reference	
Protein intake, such as egg or milk					0.302		
Low	21 (2.79)	17 (80.95)	4 (19.05)	1.420 (0.470 ~ 4.286)	0.532		
High	133 (17.66)	92 (69.17)	41 (30.83)	0.750 (0.497 ~ 1.132)	0.169		
Normal	599 (79.55)	449 (74.96)	150 (25.04)	Reference			
Fruit intake					0.625		
Low	125 (16.60)	93 (74.40)	32 (25.60)	0.983 (0.629 ~ 1.536)	0.940		
High	86 (11.42)	60 (69.77)	26 (30.23)	0.781 (0.474 ~ 1.286)	0.330		
Normal	542 (71.98)	405 (74.72)	137 (25.28)	Reference			

Table 2 (continued)

Variables	Total	Poor overall health	Good overall health	Univariate analysis		Multivariate analysis	
	N (%)	*N* (%)	*N* (%)	OR (95%CI)	*P*	aOR (95%CI)	*P*
Coarse grains intake, such as cereals					**0.045**		
Low	166 (22.05)	132 (79.52)	34 (20.48)	1.394 (0.912 ~ 2.129)	0.123		
High	57 (7.57)	36 (63.16)	21 (36.84)	0.615 (0.347 ~ 1.090)	0.094		
Normal	530 (70.39)	390 (73.58)	140 (26.42)	Reference			
High-fat foods intake, such as hotpot					0.062		
Low	231 (30.68)	158 (68.40)	73 (31.60)	0.661 (0.465 ~ 0.938)	**0.020**	0.600 (0.401 ~ 0.898)	**0.013**
High	56 (7.44)	43 (76.79)	13 (23.21)	1.010 (0.524 ~ 1.947)	0.977		
Normal	466 (61.89)	357 (76.61)	109 (23.39)	Reference		Reference	
Symptom severity subscale							
>10	56 (7.44)	54 (96.43)	2 (3.57)	10.339 (2.497 ~ 42.820)	**0.000**	6.168 (1.376 ~ 27.642)	**0.017**
≤10	697 (92.56)	504 (72.31)	193 (27.69)	Reference		Reference	
Functional disability subscale							
>5	7 (0.93)	7 (100.00)	0 (0.00)	1.354 (1.297 ~ 1.413)	0.200		
≤5	746 (99.07)	551 (73.86)	195 (26.14)	Reference			
Other symptoms subscale							
>1	313 (41.57)	257 (82.11)	56 (17.89)	2.119 (1.490 ~ 3.014)	**0.000**	1.847 (1.225 ~ 2.718)	**0.002**
≤1	440 (58.43)	301 (68.41)	139 (31.59)	Reference		Reference	

lower than 48%, which was reported in a research published by UK professor Andrea Dennis [30]. Besides, mood disorder and anxiety are also a matter of concern as mentioned before. They can be lasted for more than one year after infection [31]. These results suggest that Omicron infection may still cause damage to the brain. The latest research indicated that SARS-CoV-2 infection induces fusion between neurons and between neurons and glia and therefore altering their function [32], but the mechanisms about neuropsychiatric consequences such as brain fog or anxiety/mood disorder are still unclear [33]. Further studies are still needed to clarify it.

Fatigue is considered as overlapping physical and psychopathological symptoms [34], and the exact mechanisms involved in developing post COVID-19 virus infection fatigue remain unclear [35]. Nearly a third of the people in our study reported fatigue that could not be relieved by rest. It was close to a prospective research launched in Italy which found that the incidence was slightly increasing with recovery time in one year [36]. Another study reported that more than 80% patients felt fatigue at 60 days from onset and it showed a decreasing prevalence over time [37]. These results suggest that although the incidence of fatigue after infection is high, it is mainly a self-limiting symptom that may gradually alleviate with time. Sleep disturbance was not noticed during previous epidemics of other virus strains because of their low incidence. The prevalence rate of sleep disturbance in patients infected in the Omicron phase was twice as much as it had been in the Delta phase. The incidence in this study was 24.8%, which was similar to our results [38]. Whether infection with Omicron variants can lead a certain endocrine disorder is not clear, the high incidence of sleep disturbance during recovery period has been indeed evident.

As to functional limitation, less than 10% respondents reported relevant symptoms affecting daily life in this survey. Dysfunction of daily life is more likely to occur on COVID-19 inpatients, which may be due to long-term movement restrictions or invasive treatment [39, 40]. In our survey, few people were hospitalized during the epidemic, it suggests that infection with Omicron under this epidemic may not cause dysfunction to people who were in good health before [2]. The score of overall health was decreased obviously than before. Another study from Ireland which used 6-minute walk test, short-form 36 health survey questionnaire (SF-36) and chalder fatigue scale indicated that 31% of participants don't feel back to full-health at 1-year following infection [14]. Although there is little impact on daily function after infection, patients may feel less healthy over a period of time. Some studies have shown that the symptoms of post COVID-19 may be closely related to the working ability and status of patients. The presence of post COVID-19 symptom was associated with a lower likelihood of working full-time and a higher likelihood of being unemployed [41]. Our survey shows that, regardless of occupation, nearly 10% of people have reduced their working hours because of long-term symptoms while few lost jobs. It is worth noting that the symptoms of post Omicron infection may have some impact on the personal life and work.

The health status of COVID-19 patients at 12 months was still lower than that in the healthy control population [14]. In order to identify the risk factors affecting health

status and find targeted measures, we further analyzed the relationship between the assessment of overall health status and living habits. It's understandable that having underlying diseases before was a risk factor to poor overall health. As is known, the presence of prior medical comorbidities could induce a more severe COVID-19 disease progression which leads to the aggravation of post COVID-19 symptoms. This was also confirmed by the findings of a meta-analysis [41]. The participants who presented at least one other symptom or whose score of key symptom was greater than 10 are more likely to be in poor health. The more discomfort appeared, the more effects they would have on people's normal life [40], which can lead to a poor overall health status in self-evaluation. Surprisingly, people between the age of 30 and 50 are more likely to have poor overall health than those over 50 years old. There may be several reasons: (1) The elderly have a higher tolerance for mild symptoms themselves. (2) The elderly may have a mild state of immune stress. (3) Middle-aged people face greater life and work pressure, and the long-term symptoms after infection with Omicron are more likely to affect their daily life. The same result was observed in a large-scale retrospective study among nonhospitalized patients who infected with the Omicron variant in Hong Kong [42]. Our study also found that patients' dietary and exercise habits during the recovery period were closely related to their overall health status scores. Both daily exercise and a low-fat diet were the protective factors. Some researches indicated that obese patients are more prone to have post COVID-19 symptoms and their duration is longer [42, 43]. We also found that obesity may be a risk factor in univariate analysis. People with low-fat diet got a better evaluation of overall health status in multivariate analysis, whether it is related to obesity needs further verification. It was recommended that physical activity of all forms might benefit some people living with Long COVID by WHO and Long COVID Physio. Physical training including aerobic, resistance, and breathing exercises could improve body composition, dyspnea, fatigue and physical capacity in long COVID-19 patients [44, 45]. That daily exercise at recovery stage may contribute to recovery post Omicron infection was also observed in our study. It is important to note that exercise should be carried out step by step, and self-assessment of physical condition during the process should be strengthened. At the initial stage of rehabilitation, low-intensity exercise like Baduanjin Rehabilitation can be selected [46].

Limitation

This study provides a preliminary assessment of the health status of the Chinese population infected with Omicron, there are still some limitations. First, the convenient sampling method could not avoid the bias of subjective selection, thus diminishing the internal validity. All survey results are self-reported based on the C19-YRSm questionnaire, which may have participant recall bias and measurement bias of outcome indicators. In addition, due to the promotion form and time of this, the number of surveyed people and the time span of recovery period are not sufficient. This might not reflect the actual situation of residents in Chinese mainland as a whole. Given the recurrence of the subsequent epidemic, our research still provides some reference information for the evaluation of the health status of the infected population and the development of intervention measures. Follow-up and guidance of recovered individuals should be strengthened in the future.

Conclusion

This is the first time in China to use the C19-YRSm scale to evaluate the health status during recovery after the Omicron epidemic. The study revealed epidemiology of health condition among rehabilitation patients within 120 days after Omicron infection onset. Middle-aged people should be one of the objects of continuous attention in the later stage. Strengthening exercise and a low-fat diet may do favor to recover from post infection with Omicron.

Supplementary Information

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Supplemental Fig. 1. The pre- and post-infection score of those currently with the existence about each sub-items of key symptoms and functional ability subscale. The number of people was shown as "N" below each figure, the higher score indicated the more severe symptom. ****p value < 0.0001.

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Author contributions

Xiao-Lei Ye conceived and designed the study, analyzed the data, contributed the regents and materials, drafted the manuscript and revised the manuscript. Wei-Long Tan, Qing-Ming Shi, Jun-Feng Zheng and Xiao-Bing Hu conceived and designed the study, analyzed the data, drafted the manuscript and revised the manuscript.Ying Zhang conceived and designed the study, contributed the regents and materials, analyzed the data, drafted the manuscript and revised the manuscript.Jun Gan and Xin-Hua Dai analyzed the data, drafted the manuscript and revised the manuscript.Yue Liu, Ai-Miao Liao and Li-Zhi Zhao collected the data, drafted the manuscript and revised the manuscript.Chao Xie, Jing Zuo, Ping Wang, Le-Le Ai, Yi-Fan Zhang, Yan Huang and Juan Zhang collected the data.

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Data availability

No datasets were generated or analysed during the current study.

Code availability
Not applicable.

Declarations

Ethical approval
This study was approved by Ethics Committee of the Western Theater Center for Disease Control and Prevention on January 1, 2023 (Code Number: IRB22112101).

Consent to participate
Informed consent was obtained from the participants. All respondents were aware of the purpose of the study and volunteered to participate.

Consent for publication
All researchers and respondents were consent for publication of in this study.

Competing interests
The authors declare no competing interests.

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