Changes in compliance to personal preventive measures and mental health status among Chinese factory workers during the COVID-19 pandemic: observational prospective cohort study

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Abstract

Background: Factory workers who resumed work during the pandemic is a sub-population of higher risk of COVID-19 infection than that of the general population. Maintaining good compliance with personal preventive measures during the pandemic plays an important role in achieving the balance between COVID-19 control and work resumption.

Objective: This observational prospective cohort study investigated the changes in compliance to personal preventive measures (i.e., facemask wearing, hand hygiene, household disinfection, avoiding social/meal gathering and avoiding crowed places), depressive symptoms and sleep quality among factory workers who resumed work within a 3-month follow-up period.

Methods: Inclusion criteria for this cohort study were the following: 1) full-time employees aged ?18 years who had resumed work, and 2) willing to leave contacts (mobile or social media account) to complete the follow-up survey. A stratified two-stage cluster sampling design was used. We randomly selected 12 factories in Shenzhen. And all eligible employees in these factories were invite to complete two web-based surveys three months apart. A total of 1311 Chinese adult factory workers completed the baseline survey in March 2020, and 663 (50.6%) completed the follow-up survey three months later.

Results: Significant decline was observed in consistent facemask wearing in workplace (from 98.0% at baseline to 90.3% at Month 3, P<.001) and in other public spaces (from 97.1% at baseline to 94.4% at Month 3, P=.02), sanitizing hands (from 70.9% at baseline to 48.0% at Month 3, P<.001), household disinfection (from 47.7% at baseline to 37.9% at Month 3, P<.001) and moderate-to-severe depression (from 6.0% at baseline to 0.6% at Month 3, P<.001) over the follow-up period. Significant improvement in avoiding crowed places (from 69.8% at baseline to 77.4% at Month 3, P=.002) and sleep quality (proportion of participants reporting poor sleeping quality dropped from 3.9% at baseline to 1.2% at Month 3, P=.002) was also observed.

Conclusions: There were significant decline in some personal preventive measures and significant improvement in mental health status among a cohort of Chinese factory workers who resumed work during COVID-19. Health promotion are needed to maintain good compliance to personal preventive measures. Psychological support for workers during work resumption is necessary.

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during COVID-19. Health promotion are needed to maintain good compliance to personal preventive

measures. Psychological support for workers during work resumption is necessary.

Keywords: Compliance to personal preventive measures; Depressive symptoms; Sleep quality;

Chinese factory workers; Prospective observational cohort study; COVID-19

Introduction

Globally, the COVID-19 pandemic remains out of control. As of January 1, 2021, there have been 81,658,440 confirmed cases of COVID-19, including 1,802,206 deaths [1]. China reported 92,513 confirmed COVID-19 cases and 4,749 deaths [1]. Factory workers who resumed work during the pandemic is a sub-population of higher risk of COVID-19 infection than that of the general population, as many factories are crowed settings and it is hard for them to maintain physical distancing [2]. COVID-19 outbreak in the workplace was reported in China and other countries [2-4]. Moreover, most of the Chinese factory workers are young. Even infected with COVID-19, many of them may be asymptomatic and unaware of their infection; they may become a driving force of COVID-19 transmission in workplace and community [5, 6].

Since COVID-19 vaccination has just became available, personal preventive measures still play important roles in pandemic control. Universal use of facemask [7], hand hygiene [8], and physical distancing (e.g., avoiding social/meal gathering and avoiding crowded places) [9] are strongly advocated by the World Health Organization (WHO) and have been implemented worldwide [10, 11]. Recent study suggested that physical distancing and population behavioral change that have a less disruptive economic impact than total lockdown could meaningfully control COVID-19 [12]. The effectiveness of these personal preventive measures crucially relied on compliance by the public [13]. Studies conducted in China, Australia and Thailand consistently supported that achieving a very high compliance (80-95%) with personal preventive measures were important to control the COVID-19 pandemic in these countries [10, 14, 15]. Cross-sectional studies showed good compliance to personal preventive measures at the beginning of work resumption following COVID-19 outbreak among Chinese factory workers had [2, 16]. However, there are concerns that when the daily reported confirmed COVID-19 cases began to decline, people's compliance to these personal preventive measures would start to drop as they believed the pandemic is under control. Modelling works showed that decline in compliance with some personal preventive

measures (e.g., facemask wearing and physical distancing) might result in new waves of COVID-19 outbreak in China [14]. In fact, new waves of COVID-19 community outbreak occurred in some Chinese cities since June 2020 (e.g., Beijing, Hong Kong, Urumqi, and Dalian) [17, 18]. Therefore, maintaining good compliance with personal preventive measures during the pandemic plays an important role in achieving the balance between COVID-19 control and work resumption.

COVID-19 resulted in an increase in known risk factors of mental health problems [19]. Together with the unpredictability, uncertainty and fatal outcomes, measures used to control COVID-19 (e.g., lockdown and physical distancing) might lead to social isolation, loss of income, loneliness and limited access to basic services [20]. Several rapid cross-sectional studies reported that COVID-19 pandemic had triggered mental health problems in the general public, such as stress, panic, depression, anxiety and poor sleep quality [21-23]. One of these studies reported high a prevalence of depression (19.6%), anxiety (12.3%) and poor sleep quality (14.9%) among Chinese workers who returned to work [24]. Longitudinal studies in the U.K. observed an increase in anxiety and a decline in wellbeing during the pandemic as compared to the time before COVID-19 [25]. However, it was unclear whether impact of COVID-19 on mental health would be long-lasting.

It is also important to identify which sub-groups of factory workers who may be at greater risk of not complying with personal preventive measures and poor mental health during work resumption during the pandemic to inform health promotion and service planning. Cross-sectional study reported being female was associated with higher adoption of personal preventive measures [26]. However, the associations between mental health status and personal preventive measures were mixed, as one study showed that those being more anxious were more likely to adopt physical distancing measures [26], while the other study found a negative association between depression and compliance with personal preventive measures [27]. Regarding mental health status, longitudinal studies showed that depression and anxiety were greater in younger population, women, and those with pre-existing mental and physical conditions, and those in socio-economic adversity during

COVID-19 [25]. In addition, a cross-sectional study showed that older age, higher education level, depression and anxiety were associated with poor sleep quality during COVID-19 [24]. These factors were considered in our study.

To our knowledge, there was a dearth of longitudinal studies investigating changes in compliance with personal preventive measures and mental health among working population during the COVID-19 pandemic. To address these gaps, this observational prospective cohort study investigated the changes in compliance to personal preventive measures, depressive symptoms and sleep quality among factory workers who resumed work within a 3-month follow-up period. The baseline survey was conducted during March 1-14, 2020 when the number of daily confirmed cases began to decline from its peak in China, while the follow-up survey was conducted before the second wave of outbreak in China (June 1-8, 2020). Factors predicting compliance to different personal preventive measures, depressive symptoms and sleep quality were also investigated.

Methods

Study design

We conducted an observational prospective cohort study among factory workers in Shenzhen, China during March 1 to June 8, 2020. Participants completed two online survey at baseline and three months later. Of the 13 million residents in Shenzhen in 2018, 65.1% were internal migrants and 34.3% were factory workers [28].

Participants and data collection

Inclusion criteria for this cohort study were the following: 1) full-time employees aged ≥18 years who had resumed work, and 2) willing to leave contacts (mobile or social media account) to complete the follow-up survey. The baseline survey was conducted in parallel with a cross-sectional survey targeting factory workers using the same design [2, 16]. A stratified two-stage cluster sampling design was used to recruit study participants. By March 1, 2020, one hundred factories in

Shenzhen had resumed work. The research team randomly selected 14 factories for the cross-sectional survey, and another 12 factories for this prospective cohort study. These 12 factories manufactured electronic devices (n=8), watches (n=2), beverages (n=1), and biotechnology products (n=1). All eligible employees in these factories were invited to join the study.

In addition to national guidelines, the Shenzhen government requested that each factory set up WeChat groups covering all employees as part of preparations for work resumption [29, 30]. A designated coordinator responsible for COVID-19 control in each factory facilitated the data collection. He/she posted the study information and the link to access the online self-administered baseline questionnaire in the WeChat groups, and invited all eligible workers who had resumed work to participate. He/she also sent out four bi-weekly reminders in the WeChat groups. These designated coordinators did not participate in the actual survey. Before starting the baseline survey, participants read a statement indicating that participation is voluntary, refusal would have no effect on them, and data would only be used for research purposes. Online informed consent was obtained. The baseline survey took 10-15 minutes to complete. Participants were invited to complete another self-administered online questionnaire 3 months later. A link to access the online questionnaire was sent to participants via SMS. Five reminders were sent to participants at different time slots before considering the participant lost to follow-up. Upon completion of each survey, an e-coupon of 10RMB (1.3USD) was sent to participants as compensation for their time. Each individual WeChat account was allowed to access the online questionnaire once to avoid duplicate responses. Out of 1311 participants who completed the baseline survey (response rate: 70%), 663 completed the follow-up survey at Month 3 (50.6%). Ethics approval was obtained from the Seventh Affiliated Hospital, Sun Yat-sen University (reference: KY-2020-005-001).

Measures

Development of the questionnaire

A panel consisting of two public health researchers, a health psychologist, two clinicians, a senior

factory manager, and a factory worker was formed to develop the questionnaire used in the current study. The questionnaire was pilot tested among 10 factory workers to assess clarity and readability. These 10 workers did not participate in the actual survey. Based on participants' comments, the panel revised and finalized the questionnaire.

Baseline background characteristics

Participants were asked to report on socio-demographics, such as age, gender, internal migrant status, highest education level, relationship status, monthly personal income, and status as frontline workers or management staff.

Compliance to personal preventive measures in the past month

Compliance to six different personal preventive measures in the past month was measured at baseline and Month 3. Participants were asked to report frequency of wearing facemasks in workplace and in other public settings (public places/transportation) (response categories: every time, often, sometimes, never). Types of facemask used and whether they had re-used facemasks were also collected. Participants also reported frequency of sanitizing hands using soaps/liquid soaps/alcohol-based hand rubs after returning from public spaces/touching public installations/equipment (e.g., handrails, escalator control panels or door knobs) (response categories: every time, often, sometimes, never), and household disinfection (response categories: always, sometimes, seldom, never). In addition, participants were asked whether they avoided social/meal gathering with people who do not living together and crowed places.

Depressive symptoms and sleeping quality

Depressive symptoms were measured using the validated Chinese version of Patient Health Questionnaire (PHQ-9) [31]. Participants were asked to rate the frequency of experiencing each of nine depressive symptoms over the past two weeks (0=never to 3=nearly every day). A mean score was calculated and used for analysis (alpha reliability=0.91). A summative score of 10 and above indicated the presence of probable moderate-to-severe depression [32]. Global sleep quality over a 7-

day recall period was measured using a single-item Sleep Quality Scale with a rating range from 0 to 10. Higher score indicated better sleep quality [33]. This instrument has been demonstrated to be a reliable and validate measure without significantly increasing respondents' burden.

Data analysis

Baseline characteristics (background characteristics, compliance to personal preventive measures, depressive symptoms, and sleeping quality) of participants who were followed up at Month 3 and those who were lost to follow-up were compared using Chi-square tests (for categorical variables) or independent sample t test (for continuous variables). The subsequent analysis was performed among those who had completed both surveys. Changes in compliance to personal preventive measures, depressive symptoms, and sleeping quality over the follow-up period were investigated using McNemar tests (for categorical variables) or paired sample t test (for continuous variables). Using compliance to personal preventive measures, depressive symptoms and sleeping quality measured at Month 3 as dependent variables, and baseline characteristics as independent variables, crude odds ratios (OR) and unstandardized coefficients (B) were obtained using logistic regression or linear regression models. Multivariate logistic regression or linear regression models were then fitted using all baseline characteristics as candidates, adjusted OR (AOR) or adjusted B were obtained. SPSS version 23.0 for Windows (SPSS, Inc, Chicago, IL, the United States) was used for data analysis, with p<0.05 considered statistically significant.

Results

Baseline characteristics

Over half of the participants were younger than 30 years old (50.5%, n=664), male (56.1%, n=736), internal migrants (97.6%, n=1279), married (60.9%, n=799), did not receive tertiary education (63.3%, n=830), with monthly income level lower than 5,000RMB (714USD) (53.4%, n=700), and were front-line workers (56.1%, n=736).

In the past month, 98.2% (n=1287) and 96.9% (n=1271) of participants wore a facemask every time in the workplace and in other public settings, respectively. Sanitizing hands every time after returning from public spaces or touching public installation (72.3%, n=948), avoiding social/meal gathering (74.2%, n=973), avoiding crowed places (67.4%, n=884) and always disinfect household (52.4%, n=687) were less common. Mean scores of the PHQ-9 and sleep quality were 2.2 (standard deviation: 3.9) and 7.6 (standard deviation: 2.1), respectively.

As compared to those with follow-up data available (n=663), those who were lost to follow-up at Month 3 (n=648) were more likely to be younger (P=.002), had lower education level (P<.001), with lower monthly personal income (P=.02), and being frontline workers (P=.01). Those who were lost to follow-up were less likely to avoid social/meal gathering (P=.04), and had higher frequency of household disinfection (P=.002). (Table 1)

Table 1 Baseline characteristics of the participants

	All participants (n=1311)	Being followed up at Month 3 (n=663)	Loss-to-follow-up (n=648)	P value
	n (%)	n (%)	n (%)	
Socio-demographics				
Age group (years)				
18-25	264 (20.1)	125 (18.9)	139 (21.5)	
26-30	400 (30.5)	215 (32.4)	185 (46.3)	
31-40	509 (38.8)	272 (41.0)	237 (36.6)	
>40	136 (10.5)	51 (7.7)	87 (13.4)	.002
Gender				
Male	736 (56.1)	378 (57.0)	358 (55.2)	
Female	575 (43.9)	285 (43.0)	290 (44.8)	.52
Internal migrants				
Yes	1279 (97.6)	648 (97.7)	631 (97.4)	
No	32 (2.4)	15 (2.3)	17 (2.6)	.67
Relationships status				
Currently single	375 (28.6)	203 (30.6)	172 (26.5)	
Having a stable boyfriend/girlfriend	137 (10.5)	70 (10.6)	67 (10.3)	
Married	799 (60.9)	390 (58.8)	409 (63.1)	.234
Highest education level attained				
Junior high or below	463 (35.3)	208 (31.4)	255 (39.4)	
Senior high or equivalent	367 (28.0)	180 (27.1)	187 (28.9)	
College or university	422 (32.2)	234 (35.3)	188 (29.0)	
Postgraduate	59 (4.5)	41 (6.2)	18 (2.8)	<.001

Monthly personal income (RMB)			
<3,000	68 (5.2)	38 (5.7)	30 (4.6)	
3,000-4,999	543 (41.4)	249 (37.6)	294 (45.4)	
5,000-9,999	500 (38.1)	261 (39.4)	239 (36.9)	
≥10,000	200 (15.3)	115 (17.3)	85 (13.1)	.02
Type of work			
Frontline workers	736 (56.1)	348 (52.5)	388 (59.9)	
Management staff	575 (43.9)	315 (47.5)	260 (40.1)	.01
Compliance with personal preventive measures in the past month			
Frequency of facemask wearing in workplace			
Every time	1287 (98.2)	650 (98.0)	637 (98.3)	
Often	21 (1.6)	11 (1.7)	10 (1.5)	
Sometimes	1 (0.1)	1 (0.2)	0 (0.0)	
Never	2 (0.2)	1 (0.2)	0 (0.2)	.80
Frequency of facemask wearing in public places/transportation other than workplace			
Every time	1271 (96.9)	644 (97.1)	627 (96.8)	
Often	38 (2.9)	17 (2.6)	21 (3.2)	
Sometimes	1 (0.1)	1 (0.2)	0 (0.0)	
Never	1 (0.1)	1 (0.2)	0 (0.0)	.48
Sanitizing hands (using soaps, liquid soaps or alcohol-based sanitizer) after returning from public spaces or touching public installation			
Every time	948 (72.3)	470 (70.9)	478 (73.8)	
Often	204 (15.6)	113 (17.0)	91 (14.0)	
Sometimes	109 (8.3)	57 (8.6)	52 (47.7)	
Never	50 (3.8)	23 (3.5)	27 (4.2)	.42
Avoided social/meal gathering with other people who do not live together			
No	338 (25.8)	155 (23.4)	183 (28.2)	
Yes	973 (74.2)	508 (76.6)	465 (71.8)	.04
Avoided crowed places			
No	427 (32.6)	200 (30.2)	227 (35.0)	
Yes	884 (67.4)	463 (69.8)	421 (65.0)	.06
Frequency of household disinfection			
Always	687 (52.4)	316 (47.7)	371 (57.3)	
Sometimes	435 (33.2)	232 (35.0)	203 (31.3)	
Seldom	143 (10.9)	86 (13.0)	57 (8.8)	
Never	46 (3.5)	29 (4.4)	17 (2.6)	.002
Mental health status			
PHQ-9 (Mean/SD)	2.2 (3.9)	2.4 (4.0)	2.0 (3.8)	.06
Sleep quality (Mean/SD)	7.6 (2.1)	7.6 (2.1)	7.5 (2.2)	.66

Changes in compliance to personal preventive measures, depressive symptoms, and sleeping quality over the follow-up period

Among 663 participants who completed both surveys, significant decline was observed in consistent facemask wearing in workplace (from 98.0% to 90.3%, P<.001), consistent facemask wearing in other public settings (from 97.1% to 94.4%, P=.02), sanitizing hands (from 70.9% to 48.0%, P<.001) and household disinfection (from 47.7% to 37.9%, P<.001). As compared to baseline data, more participants avoided crowed places at Month 3 (from 69.8% to 77.4%, P=.002). The change in avoiding social/meal gathering was not statistically significant (P=.18). Patterns of facemask wearing also changed over time, as less participants wore surgical masks (35.0% versus 43.4%, P<.001), N-95 masks (8.7% versus 28.2%, P<.001) and cloth masks (1.2% versus 5.0%, P<.001) at Month 3 as compared to baseline data. In addition, prevalence of re-using facemask also declined over time (from 22.8% to 8.4%, P<.001). Significant improvement in mental health was observed during the follow-up period, the prevalence of moderate-to-severe depression decreased from 6.0% at baseline to 0.6% at Month 3 (P<.001), and the proportion of participants reporting poor sleeping quality also dropped from 3.9% at baseline to 1.2% at Month 3 (P=.002). (Table 2)

Table 2 Changes in personal preventive measures and mental health status (among participants who completed both baseline and Month 3 surveys, n=663)

	Baseline	Month 3	P value
	n (%)	n (%)	
Compliance with personal preventive measures			
Consistent facemask wearing in workplace			
No (never/sometimes/often)	13 (2.0)	64 (9.7)	
Yes (every time)	650 (98.0)	599 (90.3)	<.001
Consistent facemask wearing in public places/transportation other than workplace			
No (never/sometimes/often)	19 (2.9)	37 (5.6)	
Yes (every time)	644 (97.1)	626 (94.4)	.02
Types of facemask used			
Surgical masks	288 (43.4)	232 (35.0)	.001
Non-surgical grade respirators	454 (68.5)	452 (68.2)	.95
N-95 masks	187 (28.2)	58 (8.7)	<.001

Cloth masks	33 (5.0)	8 (1.2)	<.001
Re-used facemask			
No	512 (77.2)	607 (91.6)	
Yes	151 (22.8)	56 (8.4)	<.001
Sanitizing hands (using soaps, liquid soaps or alcohol-based sanitizer) after returning from public spaces or touching public installation			
Never/sometimes/often	193 (29.1)	345 (52.0)	
Every time	470 (70.9)	318 (48.0)	<.001
Avoided social/meal gathering with other people who do not live together			
No	155 (23.4)	134 (20.2)	
Yes	508 (76.6)	529 (79.8)	.18
Avoided crowed places			
No	200 (30.2)	150 (22.6)	
Yes	463 (69.8)	513 (77.4)	.002
Household disinfection			
Never/seldom/sometimes	347 (52.3)	412 (62.1)	
Always	316 (47.7)	251 (37.9)	<.001
Mental health status			
PHQ-9 (Mean/SD)	2.4 (4.0)	0.7 (1.9)	<.001
Probable moderate-to-severe depression (PHQ-9 score $\geq$10)			
No	623 (94.0)	659 (99.4)	
Yes	40 (6.0)	4 (0.6)	<.001
Sleep quality (Mean/SD)	7.6 (2.1)	8.4 (1.4)	<.001
Poor sleeping quality (sleep quality score $\leq$3)			
No	637 (96.1)	655 (98.8)	
Yes	26 (3.9)	8 (1.2)	.002

Baseline factors predicting compliance to personal preventive measures at Month 3

Participants who had higher education level (senior high or equivalent: AOR: 4.20, 95%CI: 1.41, 12.52; reference group: junior high or below) and higher monthly personal income (5000-9999 RMB: AOR: 5.43, 95%CI: 1.15, 25.62; reference group: <3000RMB) were more likely to wear facemask consistently in public spaces other than workplace at Month 3. Being female (AOR: 1.53, 95%CI: 1.05, 2.24) and always sanitizing hands at baseline (AOR: 2.13, 95%CI: 1.45, 3.14) were associated with higher frequency of sanitizing hands at Month 3, while higher education level (senior

high or equivalent: AOR: 0.56, 95%CI: 0.35, 0.89; reference group: junior high or below) and depressive symptoms at baseline (AOR: 0.94, 95%CI: 0.89, 0.99) were negatively associated with this dependent variable. Moreover, older participants were less likely to avoid crowded places at Month 3 (>40 years: AOR: 0.38, 95%CI: 0.15, 0.96; reference group: 18-25 years). Furthermore, always sanitizing hands (AOR: 1.90, 95%CI: 1.26, 2.85) and disinfecting household (AOR: 1.65, 95%CI: 1.16, 2.35) at baseline were positively associated with household disinfection at Month 3, while education level (college or university: AOR: 0.41, 95%CI: 0.23, 0.73; reference group: junior high or below) was negatively associated with this dependent variable. (Multimedia Appendix 1)

Baseline factors predicting depressive symptoms and sleeping quality at Month 3

Multivariate analysis showed that those who had higher depressive symptoms at baseline were more likely to depressive symptoms at Month 3 (adjusted B: 0.11, 95%CI: 0.06, 0.15). Having higher education level (adjusted B: -0.20, 95%CI: -0.37, -0.04) and depressive symptoms (adjusted B: -0.05, 95%CI: -0.09, -0.02) at baseline were associated with poorer sleep quality at Month 3, while being management staff (adjusted B: 0.38, 95%CI: 0.10, 0.66) and having better sleep quality (adjusted B: 0.13, 95%CI: 0.07, 0.19) at baseline were associated with better sleep quality during the follow-up period. (Table 3)

Table 3 Baseline factors predicting depressive symptoms and sleeping quality at Month 3 (n=663)

	Depressive symptoms		Sleeping quality	
	B (95%CI)	Adjusted B (95%CI)	B (95%CI)	Adjusted B (95%CI)
Socio-demographics				
Age group	-0.19 (-0.35, -0.03)[a]	-0.10 (-0.29, 0.10)	0.10 (-0.03, 0.22)	-0.05 (-0.20, 0.10)
Gender	-0.03 (-0.32, 0.25)	-0.08 (-0.39, 0.24)	0.17 (-0.05, 0.39)	0.18 (-0.06, 0.41)
Internal migrants	0.21 (-0.75, 1.16)	-0.06 (-1.01, 0.89)	-0.17 (-0.91, 0.57)	0.21 (-0.51, 0.93)
Relationships status	-0.08 (-0.24, 0.08)	0.09 (-0.10, 0.28)	0.14 (0.01, 0.26)[a]	0.002 (-0.14, 0.15)
Highest education level attained	0.11 (-0.04, 0.26)	0.18 (-0.04, 0.40)	-0.19 (-0.30, -0.07)[b]	-0.20 (-0.37, -0.04)[a]

Monthly personal income (RMB)	-0.08 (-0.20, 0.05)	-0.11 (-0.29. 0.08)	-0.001 (-0.10, 0.10)	0.06 (-0.08, 0.20)
Type of work	-0.05 (-0.33, 0.24)	-0.15 (-0.52, 0.22)	0.08 (-0.14, 0.30)	0.38 (0.10, 0.66)[b]
Compliance with personal preventive measures in the past month				
Consistent facemask wearing in workplace	-0.26 (-1.29, 0.76)	-0.12 (-1.14, 0.91)	0.30 (-0.50, 1.09)	0.24 (-0.53, 1.02)
Consistent facemask wearing in other public places	0.20 (-0.65, 1.05)	0.24 (-0.61, 1.08)	-0.41 (-1.07, 0.25)	-0.33 (-0.97, 0.31)
Sanitizing hands after returning from public spaces or touching public installation	-0.21 (-0.52, 0.10)	0.04 (-0.29, 0.36)	0.10 (-0.14, 0.35)	-0.12 (-0.36, 0.13)
Avoided social/meal gathering with other people who do not live together	-0.03 (-0.37, 0.30)	0.26 (-0.23, 0.74)	-0.29 (-0.55, -0.03)[a]	-0.32 (-0.69, 0.05)
Avoided crowed places	-0.18 (-0.49, 0.13)	-0.43 (-0.89, 0.03)	-0.19 (-0.43, 0.05)	-0.12 (-0.23, 0.46)
Household disinfection	-0.17 (-0.45, 0.11)	-0.02 (-0.32, 0.28)	0.19 (-0.03, 0.41)	0.05 (-0.18, 0.27)
Mental health status				
PHQ-9	0.12 (0.08, 0.15)[c]	0.11 (0.06, 0.15)[c]	-0.09 (-0.12, -0.06)[c]	-0.05 (-0.09, -0.02)[b]
Sleep quality	-0.14 (-0.21, 0.07)[c]	-0.03 (-0.11, 0.05)	0.20 (0.15, 0.25)[c]	0.13 (0.07, 0.19)[c]

[a] P<.05, [b] P<.01, [c] P<.001
B: unstandardized coefficients
Adjusted B: adjusted unstandardized coefficients obtained by multivariate linear regression model using all variables listed in Table 1 as candidates.

Discussion

We reported a longitudinal study to track change in compliance to personal preventive measures and

mental health from the early phase of the outbreak to the initial control of the COVID-19 pandemic

in China, providing potentially important new information for intervention development and policy planning.

The results confirmed our concerns that people's compliance to some personal preventive measures declined when the pandemic is under initial controlled. Significant decline in compliance to consistent facemask wearing was observed, especially in workplace. In workplace where physical distancing cannot be guaranteed, consistent facemask wearing is especially important for COVID-19 control. In the early phase of the outbreak, factories in China were implementing very strict measures, including providing free facemask for employees and requiring consistent facemask wearing in workplace [29, 30], which might explain the very high prevalence of consistent facemask wearing at the baseline. It is possible that these strict control measures are lifted when the pandemic is under initial controlled. Since the risk of outbreak in workplace always exists, factories should maintain effective measures to ensure high compliance to consistent facemask wearing during the pandemic. Although the guideline on facemask wearing established by the Chinese Centre for Disease Control and Prevention no longer required consistent facemask wearing in public spaces where physical distancing can be guaranteed [34], 94.4% of factory workers reported consistent facemask wearing in public spaces other than workplace. As compared to baseline data, less participants used surgical masks and N-95 masks. It is possible that more factory workers followed the aforementioned guideline which recommended non-surgical grade respirators in settings where the risk of COVID-19 transmission was relatively low (e.g., workplace) [34]. Facemask was in limited supply in China in the early phase of the COVID-19 outbreak. The supply issue was quickly addressed, as China had largely increased its facemask wearing capacity. It is hence expected that less participants use cloth mask or re-used facemask at Month 3.

Despite the WHO recommendation on hand hygiene [8], only 70% of participants always sanitized their hands at baseline, such proportion dropped substantially to less than 50% at Month 3. The importance of hand hygiene might be less emphasized than consistent facemask wearing in

China during the outbreak. Moreover, there might be a lack of appropriate places for workers to sanitize their hands, especially in workplace. Similarly, regular household disinfection was less common and was declining over time. Majority of the factory workers in Shenzhen are internal migrants who lived in dormitories provided by the employers. Factories should pay more attention to the hygiene of these dormitories, as COVID-19 outbreak in tightly-packed dormitories of foreign workers occurred in Singapore. In contrast to the aforementioned personal preventive measures, prevalence of avoiding social/meal gathering and avoiding crowded places remained stable or even slightly increased over time. Such trends might reflect the nationwide health education and health promotion of physical distancing [35].

Our study observed significant improvement in both depressive symptoms and sleep quality among the participants. Although the COVID-19 outbreak triggered mental health problems among participants at the beginning of work resumption, prevalence of moderate-to-severe depression and poor sleep quality dropped substantially at Month 3 when the pandemic in China is under initial controlled. The prevalence of moderate-to-severe depressive symptoms was even lower than the population-level observed before the pandemic (2.4%) [36].

Our study provided empirical insights to inform intervention development to strengthen compliance to personal preventive measures during the pandemic, and suggest the need to tailor interventions to specific groups. More attention should be given to older participants, as they were less likely to avoid social/meal gathering with people who are not living together. The findings is expected as social/meal gathering is an important part for establish and maintain interpersonal relationship in China, especially among older generation [37]. Male factory workers were less likely to sanitize hands regularly, promotion efforts should take gender difference into account. Health promotion for participants with lower education should focus on consistent facemask wearing in public spaces, while interventions targeting workers with higher education should focus on hand and household hygiene. Health communication messages should be at the appropriate literacy levels.

Participants who always sanitize hands and disinfect household at baseline were more likely to do so at Month 3. Participants who made handwashing and household disinfection a habit might be more likely to maintain these behaviors during the COVID-19 pandemic. Creating a supporting environment is important to converting a behavior into a habit. Factories should consider strategically placing hand sanitizer in high traffic locations throughout the workplace, and distributing household bleach and tools regularly to workers' dormitories. In addition, baseline depressive symptoms was associated with lower frequency of sanitizing hands. Non-compliance with personal preventive measures might be used as a negative coping response to depressive symptoms [38]. Providing psychological support to workers during the work resumption is also useful to enhance their compliance with personal preventive measures.

Our results also had implications of mental health promotion during the COVID-19 pandemic. Baseline depressive symptoms and poor sleep quality was associated with the presence of these two mental health problems at during the follow-up period. Such finding was consistent with those of longitudinal studies conducted in the U.K. [19]. Studies suggested that personality traits such as neuroticism and negative thinking pattern are strong factors of mental health problems during the COVID-19 [39]. These factors are modifiable through interventions which could benefit those who are at risk now or in future outbreak [39]. Similar to findings of previous cross-sectional studies, baseline depressive symptoms was a risk factor of sleep quality [24]. In addition, higher education level was also associated with poorer sleep quality at Month 3. Previous studies showed that higher education can increase negative emotions and sleep problems during public health emergencies, probably due to high self-awareness of their health [24]. In contrast, being management staff was associated with better sleep quality. Most management staff are white-collar workers who generally have better sleep quality than blue-collar workers [24]. An alternative explanation was that management staff had higher and more stable income as compared to frontline workers. Studies showed that concerns about pay cut or layoffs due to COVID-19 caused stress among workers [24].

The finding highlighted the importance of providing psychological support to workers during work resumption. Frontline workers, and those with higher education or pre-existing mental health conditions are priority groups of mental health promotion.

Our study was one of the first longitudinal studies tracking changes in compliance with personal preventive measures and mental health status among Chinese population during COVID-19 pandemic. However, this study had some limitations. First, attrition bias existed due to the high drop-out rate (49.4%). Many Chinese factory workers frequently changed their employers [40]. Some of them might move to other Chinese cities. Such situation created challenges for follow-up survey. Second, we only included factory workers in one Chinese city. Generalization should be made cautiously to individuals working in other types of enterprises or to other places in China. Third, non-response may introduce selection bias. Our response rate was relatively high (70.0%) as compared to other online surveys of similar topics [21, 22]. We were not able to collect information of workers who refused to participate in the study. Fourth, data were self-reported and verification was not feasible. Recall bias might exist. Participants might also over-report their compliance with personal preventive measures due to social desirability. Moreover, we did not include important mental health outcomes such as anxiety due to the limited space of the questionnaires. Anxiety was considered as a more sensitive mental health indicator during the COVID-19 pandemic.

In sum, there were significant decline in consistent facemask wearing, hand hygiene and household disinfection and significant improvement in mental health status among a cohort of Chinese factory workers who resumed work during COVID-19. Health promotion are needed to maintain good compliance to personal preventive measures. Providing psychological support to workers during work resumption is necessary.

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Authors' Contributions

Jinqiu Yuan and Bolin Cao contributed equally as first authors. Yihang Pan, Yulong He, and Zixin Wang contributed equally as corresponding authors.

Multimedia Appendix 1: Associations between baseline variables and personal preventive behaviors at Month 3.

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Supplementary Files

Multimedia Appendixes

Associations between baseline variables and personal preventive behaviors at Month 3.
URL: http://asset.jmir.pub/assets/a0898e097a2dccca05ac96ad4bae9718.docx