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Knowledge, attitude and practice regarding occupational protection against COVID-19 among midwives in China: A nationwide cross-sectional study

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ABSTRACT

Midwives assume the roles in protecting perinatal women and newborns, meanwhile defending their own safety during the epidemic of COVID-19. Since there is currently no specific treatment available that targets the disease, strictly compliance with various infection prevention and control measures appears utmost important to achieve their occupational safety. We then explored the status quo and influencing factors of the knowledge, attitude and practice (KAP) of occupational protection against the COVID-19 among midwives in China. This online cross-sectional survey was conducted on 2663 midwives across the China during the early stages of the pandemic with a self-reported structured questionnaire. 97.4% and 92.9% of them were identified with positive attitude and appropriate practice, respectively, whereas only 6.4% showed good level of knowledge about the occupational protection toward the COVID-19. Midwives with older age, keeping on working during the breakout period, completing the training programs, caring the confirmed COVID-19 cases and having family members with cold-like symptoms were significantly associated with their KAP status. This study could provide valuable information not only for policy makers and administrators to optimize resource allocation and design education programs on targeted midwives, but also serve as a baseline for measuring changes in subsequent, post-intervention KAP studies.

1. Introduction

The Coronavirus Disease 2019 (COVID-19) has led to the unparalleled growth of infection transmission worldwide [1]. As of December 23rd, 2021, the number of confirmed cases has reached 270 million and a total of 5,374,744 deaths have been identified in the world [2]. The rapid escalation of pandemic has put unprecedented pressure on health care systems globally. Medical staffs who...
are fighting in the forefront, are exposed to various occupational hazards and faced with increased risks of sickening and death [3–5]. It was reported that around 14% of COVID-19 cases are from health professions throughout the world [6]. The increasing number of infected health workers would cause a decrease in capacity of the health care systems to cope with the epidemic and an increase in secondary infection to colleagues, families and friends [7]. In spite of various therapeutics under trail, the current management of COVID-19 is still limited to symptomatic treatment and supportive care. In addition, the vaccines which are regarded as useful methods to prevent infection were unavailable at that time. Therefore, compliance with various infection prevention and control measures appears of fundamental importance to achieve the health workers’ occupational safety and restrict the deterioration of epidemic [8,9].

Midwives, whose clients are mainly perinatal women and newborns, are also the forefront in fighting against the public health disasters. The perinatal women and neonates have been identified as vulnerable groups during various disasters [10]. Particularly, due to the physiological and immunological changes associated with pregnancy, the perinatal women are more predisposed to suffer severe complications (e.g. perinatal mortality, fetal growth restriction, preterm birth) with respiratory infections [11]. As increasing pregnant women contracted COVID-19 globally, the potential risk from maternal-neonatal transmission of virus is of concern [12]. It was detected that the viral RNA shedding is frequent in the faecal samples of infected individuals [13], which implies that faecal contamination of the vagina and vulva could potentially cause the SARS-CoV-2 transmission to the neonates during the vaginal delivery [14]. In addition, the environmental contamination, due to the droplets, aerosols and the faeces generated by infected labour women, could lead to a greater risk of infection on midwives [15]. The midwives have to face enormous difficulties for medical care and self-protection during the epidemic. It is extremely crucial for them to implement appropriate occupational protection in their clinical practice.

It was found in studies that the effects of occupational protection are immensely affected by individual’s knowledge, attitude and practice (KAP) [16,17]. KAP is a mature theoretical model about how to change individuals’ health-related behaviors, which identifies the associations among knowledge, attitude and practice [18]. A KAP survey could collect information on what is known, believed and done regarding a certain topic among a specific population. In the current study, we investigated the knowledge, attitude and practice of occupational protection toward the COVID-19 on midwives, which could provide reference on training for them and improve the effect of occupational protection. According to the WHO recommendation, a KAP investigation can be launched at any time in a pandemic, but it would be most helpful in the early phases [19]. In this context, findings from the KAP survey can be applied to orienting resource allocation, designing interventions, and establishing a baseline for measuring changes in subsequent, post-intervention KAP studies.

In order to rapidly deal with the pandemic, the Chinese government and hospitals had rolled out several occupational protection training for medical staffs, including midwives, based on the available evidence in the early stage before vaccines were available [20]. Since the series of training were designed and conducted immediately after the outbreak of the epidemic without a wealth of experience, the effect of those training programs might not as well as anticipated. However, there was no study summarizing the effect of the series of training, whether the midwives could appropriately implement the occupational protection measures to protect their clients and themselves remains unknown. There is a pressing necessity to understand the KAP of occupational protection among midwives during the initial phases of pandemic [21]. In view of this, a cross-sectional study was conducted to examine the KAP status of the occupational protection towards COVID-19 among midwives during the early period of pandemic without the availability of vaccines, in order to evaluate the effect of the early training and provide references for designing training programs for midwives, which could further promote the pandemic control.

2. Materials and methods

2.1. Setting and participants

This nationwide cross-sectional survey was carried out on Chinese midwives from Feb 10th to Mar 21st 2020, which was considered to be the peak period of the epidemic in China because of 81,054 identified cases and 3261 deaths [22]. Most of Chinese hospitals, including general and specialized ones, were prepared to receive suspected and confirmed cases. The midwives in those hospitals would inevitably contact such kind of patients, and hence became the potential participants for the current study.

A convenient sampling technique was applied for subject recruiting. The participants, who were registered midwifery practitioners and without any known auditory, language, or cognitive impairment would be included. The midwives would be excluded if they were: 1) retired; 2) midwifery students and visiting scholars; and 3) currently participating in other similar nature of studies. A single population proportion formula was used to determine the sample size:

\[ N = N_o \alpha^2 P(1 - P) / d^2 \]

\(N_o\) is set as 1.96, which refers that the reliability coefficient of standard error is at 5% level of significance. The acceptable margin of error for proportion \(d\) was 3%, and the proportion of nursing staff with appropriate preventive practice in China was estimated as 80% [23]. The sample size of 682 was regarded as a minimum value to represent the target population. However, in considering of the limitations on the convenient sampling and online survey, a design effect (DE) factor was included in the equation to enhance our sample. Based on the previous findings, the minimal acceptable DE for convenience sampling study is 2 [24,25]. Hence, an adjusted minimum sample of 1364 (682 \times 2) was achieved.

2.2. Data collection and procedures

A letter that introduces the research purpose and procedures was sent to the Midwife Branch of Chinese Maternal and Children...
Health Care Association and sought for their support in recruiting midwives. This branch is the most authoritative and representative organization of midwives in China and most of the members were midwifery managers in their hospitals around the country. The information sheet, which includes the purpose of study, estimated time of completion, participants’ authority and privacy policy, would be provided to all participants and require them to sign the informed consent form if they indicated their agreement to join the survey. All participants would complete the questionnaires via an online survey platform (‘Survey Star’).

2.3. Measures

The survey tools of the current study contained two parts, which were the general information section and the questionnaire about the KAP of occupational protection against COVID-19. The general information section collects the socio-demographic characteristics, which includes age, gender, residence, the rank of their hospitals, working status, working years, whether having a cold, whether home isolation, whether having family members with cold-like symptoms, whether encountering with a suspected or confirmed patient, and whether attending a training program against COVID-19.

On the basis of the KAP model [26], a self-reported questionnaire about the KAP of occupational protection against COVID-19 was developed according to literature [27–29], the recommendations and guidelines from WHO [30] and the National Health Commission of the People’s Republic of China [31]. An expert panel consisting of 5 experts in the fields of infection prevention and control, midwifery practice, and epidemiology reviewed the questionnaire and assessed the content representativeness of the items regarding the KAP scale. The content validity (SCVI/Ave) for each KAP sub-scale (knowledge, attitude, practice) was 0.935, 0.924 and 0.911, respectively. The questionnaire was piloted with 50 midwives to ascertain the intelligibility and reliability. The internal consistency of the knowledge scale, which was determined by using the Kuder-Richardson-21 formula, was demonstrated as 0.725. The subscales of attitude and practice were evaluated by the Cronbach’s α coefficients, which were identified as 0.753 and 0.720, respectively.

The knowledge section embraces the “disease-related knowledge” (6 items), the “common precaution knowledge” (12 items), and the “specialty precaution knowledge for midwifery situations” (12 items). The “disease-related knowledge” focuses on the modes of transmission, susceptible population, clinical manifestation, incubation period, inactivation method and therapeutic measures of the COVID-19. The “common precaution knowledge” includes the questions about hand hygiene, mask-wearing, application and removal of personal protective equipment, cleaning and sterilization methods. The “specialty precaution knowledge for midwifery situations” concerns about the precautions in the situations of skin-to-skin care, rooming-in and breastfeeding. Each correct answer in this section would be awarded 1 point. Incorrect answer or non-response would be awarded no credit. The total score ranged from 0 to 30. Based on the modified Bloom’s cut off standards, the score of each participant in this section was classified into poor (<18), moderate (18–23) and good (24–30) [32].

The attitude section is composed of 12 items, which are categorized into two dimensions. The first dimension contains 7 items about the midwives’ awareness of the necessity of prevention and control measures, and their perception of the possibility of infection when implementing preventive measures. The other dimension examines the midwives’ attitude toward the actions suggested by the local health authorities to fight against the disease. All items are scored on a 5-point Likert scale, from 1 (Strongly Disagree) to 5 (Strongly Agree). The result was ranked negative with total score of 12–35, neutral with score of 36–47 and positive with score of 48–60 according to the modified Bloom’s cut off standards as well [32].

The practice section was designed to assess the midwives’ compliance in applying various preventive measures (e.g. hand hygiene, cough etiquette, wearing masks and PPE, environmental cleaning and disinfection). Each item is ranked from 1 (never) to 5 (always). According to the same score classification criteria as the former two sections, the total score lower than 18, 18 to 24, and over 24 represents inappropriate, acceptable, and appropriate levels of practice, respectively [32].

2.4. Ethical considerations

The cross-sectional study was approved by the ethics committee of the West China Second University Hospital of Sichuan University with the ethical number of 2020165.

2.5. Statistical analysis

All statistical analyses were undertaken with IBM SPSS 23.0 for Windows. The distribution of data was identified with the Kolmogorov–Smirnov test. In order to compare the differences in the levels of knowledge, attitude, and practice against the socio-demographic and professional variables, non-parametric tests were carried out, which included two independent sample Mann-Whitney and multiple samples Kruskal-Wallis test. Spearman correlation analysis was performed to examine the associations among the KAP scores. The ordered multi-classification logistic regression was applied to determine the independent factors associated with the levels of midwives’ knowledge, attitude and practice. The alpha level adopted for significance (2-tailed) was set at 0.05 for all analyses.

3. Results

A total of 2773 midwives across 22 provinces in China recruited in the survey among which there were 2663 valid questionnaires. The effective response rate was 96.1%.

3.1. Socio-demographic and professional characteristics of midwives

The mean age of the participants was 32.99 years (ranging from 20 to 60), and about half of them were under 30 years. The mean year of working experience was 11.65 years, and the average year of working experience in delivery room was 8.68 years. More
Table 1
Socio-demographic characteristics of midwives.

| Characteristics | Groups | N (%)       |
|-----------------|--------|-------------|
| Gender          | Male   | 5 (0.2%)    |
|                 | Female | 2658 (99.8%)|
| Age, yr         | 20–30  | 1304 (49.0%)|
|                 | 31–40  | 904 (33.9%)  |
|                 | 41–50  | 369 (13.9%)  |
|                 | >50    | 86 (3.2%)    |
| Residence       | Hubei  | 74 (2.8%)    |
|                 | Other parts of China | 2589 (97.2%) |
| Working experience, yr | <1 | 16 (0.6%) |
|                 | 1–5    | 704 (26.4%)  |
|                 | 6–10   | 891 (33.5%)  |
|                 | 11–20  | 607 (22.8%)  |
|                 | >20    | 445 (16.7%)  |
| Working experience in the delivery room, yr | <1  | 188 (7.0%) |
|                 | 1–5    | 1054 (39.6%) |
|                 | 6–10   | 695 (26.1%)  |
|                 | 11–20  | 449 (16.9%)  |
|                 | >20    | 277 (10.4%)  |
| Hospital grade  | Public tertiary hospital | 1582 (59.4%) |
|                 | Public secondary hospital | 1055 (39.6%) |
|                 | Public primary hospital  | 26 (1.0%)    |
| Working status  | on the job | 2471 (92.8%) |
|                 | vacation| 192 (7.2%)   |
| Having cold-like symptoms | Yes | 55 (2.1%) |
|                 | No     | 2608 (97.9%) |
| Being at home isolation | Yes | 18 (0.7%) |
|                 | No     | 37 (1.4%)    |
| Having family members with cold-like symptoms | Yes | 38 (1.4%) |
|                 | No     | 2625 (98.6%) |
| Having encountered the suspected COVID-19 patient/s | Yes | 308 (11.6%) |
|                 | No     | 2355 (88.4%) |
| Having encountered the confirmed COVID-19 patient/s | Yes | 16 (0.6%) |
|                 | No     | 2647 (99.4%) |
| Having attended the training on COVID-19 at least once | Yes | 2460 (92.4%) |
|                 | No     | 203 (7.6%)   |

detailed information about the socio-demographic and professional characteristics are given in Table 1.

3.2. Perceived levels of knowledge, attitude and practice about midwives’ occupational protection towards COVID-19 pandemic

The scores of knowledge, attitude and practice section presented as skewed distributions based on the Kolmogorov-Smirnov test. The median score, range and the number of participants at each level are shown in Table 2. The median knowledge score of respondents was 20 (ranging from 0 to 30 out of 30). Over half of the respondents (70.2%) displayed moderate level of knowledge, whereas only 6.4% showed good knowledge. The median attitude score was 57 (ranging from 12 to 60 out of 60). The vast majority of them (97.4%) had a positive attitude level toward occupational protection. Similarly, the median practice score was 28 (ranging from 6 to 30 out of 30) and 92.9% of the participants showed an appropriate practice level.

3.3. Univariate analysis of the levels of knowledge, attitude and practice against socio-demographic and professional variables

The univariate analysis was performed to compare the levels of knowledge, attitude and practice against socio-demographic and professional factors by group (Table 3). Statistical differences in the knowledge level were observed in different groups of age, working experience, working experience in the delivery room, working status, having family members with cold-like symptoms, and having attended the training on COVID-19 at least once.

Table 2
The knowledge, attitude, practice median scores and levels of respondents toward occupational protection.

| Variables          | Median scores (min, max) | Levels                  | N (%)       |
|--------------------|--------------------------|-------------------------|-------------|
| Knowledge          | 20 (9, 28)               | good: 169 (6.4%)        |             |
|                    |                          | moderate: 1870 (70.2%)  |             |
|                    |                          | poor: 624 (23.4%)       |             |
| Attitude           | 57 (29, 60)              | positive: 2593 (97.4%)  |             |
|                    |                          | neutral: 65 (2.4%)      |             |
|                    |                          | negative: 5 (0.2%)      |             |
| Practice           | 28 (6, 30)               | appropriate: 2473 (92.9%) |             |
|                    |                          | acceptable: 188 (7.0%)  |             |
|                    |                          | inappropriate: 2 (0.1%)  |             |
Table 3
Univariate analysis of the levels of knowledge, attitude and practice against socio-demographic and professional variables.

| Variables                        | Knowledge Groups | Attitudes | Practice |
|----------------------------------|------------------|-----------|----------|
|                                  | Moderate (%)     | Neutral   | Acceptable (%) |
|                                  | Poor (%)         | Negative  | Inappropriate (%) |
| Sex                              | Gender           |           |           |
| Male                             | 1 (20.0%)        | 0 (0.0%)  | 0 (0.0%)  |
| Female                           | 168 (6.3%)       | 186 (70.2%) | 179 (23.5%) |
| Age, yr                          | 0 (0.0%)         | 0 (0.0%)  | -0.368    |
| 20–30                            | 58 (4.6%)        | 867 (66.5%) | 1257 (96.3%) |
| 31–40                            | 72 (8.0%)        | 653 (72.2%) | 887 (98.1%) |
| 41–50                            | 32 (8.7%)        | 294 (79.7%) | 363 (98.4%) |
| >50                              | 7 (8.1%)         | 56 (65.1%)  | 86 (60.0%)  |
| Residence                        | Hubei (10.8%)    | 52 (70.3%)  | 73 (98.6%)  |
|                                  | Other parts of   | 1818 (70.2%) | 2520 (97.4%) |
| China                            |                  |           | 64 (2.5%)  |
| Working experience, yr           | <1 (0.0%)        | 1 (62.5%)   | 16 (100.0%) |
|                                  | 1–5 (4.3%)       | 469 (66.6%) | 682 (96.9%) |
|                                  | 6–10 (5.5%)      | 49 (68.4%)  | 861 (96.6%) |
|                                  | 11–20 (8.7%)     | 53 (68.4%)  | 595 (98.0%) |
|                                  | >20 (8.3%)       | 344 (77.3%) | 439 (98.7%) |
| Working experience in the delivery room, yr | <1 (3.7%) | 119 (63.3%) | 184 (97.9%) |
|                                  | 1–5 (5.1%)       | 709 (67.3%) | 1020 (97.9%) |
|                                  | 6–10 (5.8%)      | 40 (70.7%)  | 673 (96.8%) |
|                                  | 11–20 (10.2%)    | 46 (75.5%)  | 442 (98.5%) |
|                                  | >20 (7.9%)       | 22 (76.2%)  | 274 (98.9%) |
| Hospital grade                   | Tertiary (6.3%)  | 1124 (71.0%) | 1540 (97.9%) |
|                                  | Secondary (6.5%) | 728 (69.0%) | 1028 (97.4%) |
|                                  | Primary (1.8%)   | 169 (69.3%) | 25 (96.2%)  |
| Working status                   | On the job (6.5%) | 1750 (70.8%) | 2406 (97.3%) |
|                                  | Vacation (4.2%)  | 8 (22.7%)   | 61 (2.5%)   |

(continued on next page)
Table 3 (continued)

| Variables                                      | Knowledge | Attitudes | Practice |
|------------------------------------------------|-----------|-----------|----------|
| Having cold-like symptoms                      | 120 (62.5%) | 64 (33.3%) | 187 (97.4%) | 168 (87.5%) |
| Yes                                            | 4 (7.3%)  |          |          | 49 (6.0%)   |
| No                                             | 116 (6.3%) | 615 (23.6%) | 2538 (97.3%) | 2424 (19.2%) |
| Being at home isolation                        | 3 (16.7%)  | 3 (16.7%)  | 37 (100.0%) | 18 (100.0%)  |
| Yes                                            | 30 (2.7%)  |          |          | 31 (1.6%)   |
| No                                             | 12 (6.6%)  | 615 (23.6%) | 2538 (97.3%) | 2424 (19.2%) |
| Having family members with cold-like symptoms  | 5 (13.2%)  |          |          | 18 (100.0%) |
| Yes                                            | 29 (76.3%) | 4 (10.5%)  | 38 (100.0%) | 34 (89.5%)  |
| No                                             | 164 (6.2%) | 620 (23.6%) | 2555 (97.3%) | 2439 (92.9%) |
| Having encountered the suspected COVID-19 patient/s | 19 (6.2%)  | 59 (19.2%)  | 300 (97.4%) | 287 (93.2%)  |
| Yes                                            | 230 (74.6%) |          | 2293 (97.3%) | 2186 (92.8%) |
| No                                             | 150 (6.4%) | 565 (24.0%) | 58 (2.5%)   | 167 (7.1%)  |
| Having encountered the confirmed COVID-19 patient/s | 2 (12.5%)  |          |          | 15 (93.7%)  |
| Yes                                            | 11 (68.7%) |          | 13 (81.2%)  | 1 (6.3%)   |
| No                                             | 167 (6.3%) | 621 (23.5%) | 2580 (97.5%) | 187 (7.1%)  |
| Having attended the training on COVID-19        | 164 (6.7%) | 536 (21.8%) | 2938 (97.4%) | 2288 (93.0%) |
| Yes                                            | 1760 (71.5%) |          | 58 (2.4%)   | 171 (7.0%)  |
| No                                             | 5 (2.5%)  | 88 (43.3%) | 195 (96.1%) | 185 (91.1%) |

*P < 0.05 is statistically significant.
attended the training on COVID-19. The attitude level was statistically different among the groups with different age and whether having encountered a confirmed COVID-19 patient. The practice level was statistically different between the midwives on the job and on the vacation.

3.4. Correlations between knowledge, attitude and practice scores of respondents

Correlation analysis between knowledge, attitude and practice scores are demonstrated in Table 4. The results indicated that knowledge, attitude and practice scores were positively correlated with each other.

3.5. The regression analysis of the levels of knowledge, attitude, and practice toward occupational protection during the epidemic

Ordered multi-classification logistic regression analysis illustrated that participants who were older, being on duty during the period, having attended the training on the COVID-19 and having family members with cold-like symptoms were significantly associated with a higher level of knowledge. A higher level of positive attitude was associated with higher knowledge scores and the cases that had not encountered with the confirmed COVID-19 patients. Compliance with practice of occupational protection was better in respondents who were on duty and maintained higher attitude scores.

4. Discussion

4.1. The KAP status of occupational protection towards the COVID-19 among midwives during the early period of pandemic in China

The survey demonstrated that majority of the respondents displayed a moderate knowledge level, whereas only 6.4% showed good level (Table 2). It indicated that there is a plenty room for improvement in midwives’ knowledge about occupational protection. In comparison with the reported overall correct response rates of nurses in China (ranging from 80% to 89%) [23,33] and in other countries (ranging from 82% to 96%) [34,35], the rate among midwives in the current study was relatively low. The development history of midwifery in China might explain this discrepancy. In the past decades, the importance of midwifery was grossly underestimated in China. It was considered as a subsidiary of nursing. The undergraduate and graduate education in midwifery hence fell far behind other disciplines of nursing field, which handicapped the improvement and development of the midwifery. Most midwives in China graduated from the secondary and diploma nursing programs [36]. Educational attainment is regarded as one of the key factors to affect cognitive status [37]. There is great possibility that the midwives’ lower levels of education influenced their degree of emphasis on the disease and occupational protection, and led to insufficient learning and understanding of the knowledge towards COVID-19. The substantial knowledge gap in the nature and pathological mechanism of SARS-CoV-2 might also contribute to the insufficient knowledge level of midwives.

Although the WHO encouraged all medical staffs to apply the standard precaution and hand hygiene to all patients in clinical practice, there was still no consistent agreement regarding the best perinatal care at the time of data collection, e.g. skin-to-skin care, rooming-in, and breastfeeding [38]. It would make the midwives to think that occupational protection against the COVID-19 was far from them and there was limited necessities to understand the occupational protection knowledge. Nevertheless, since there were diversities in the items and scoring method of questionnaires, we should be cautious about making conclusion when comparing the knowledge levels between those studies.

Although the participants reported undesirable knowledge level, the vast majority of them held a positive attitude and practiced with an appropriate level of occupational protection towards the COVID-19. The disparity between the level of knowledge and the levels of attitude and practice might be attributed to the pertinence of the items in knowledge section. Besides the questions associated with occupational protection, there are still some issues targeting the basic principles of the virus (e.g. manifestation of the disease and detection method). The midwives’ positive attitude and practice toward occupational protection did not necessarily require their proficiency in the knowledge about the disease. In order to rapidly improve the midwives’ capability to cope with the epidemic, the emphasis of training for them should be placed more on the practical techniques. The results of positive attitude and appropriate practice level are consistent with the findings of other studies on healthcare workers [23,33,39]. This could be elucidated by the fact that the timely initiatives of the Chinese government, including publicly available information about COVID-19 and effective infection prevention and control measurements. Since the broke out of the pandemic, a wide range of measures, which included isolating suspected and confirmed patients, tracking the travel information of confirmed ones, developing diagnostic and therapeutic protocols and undertaking various training about epidemic prevention, had worked to contain the pandemic. The severe epidemic was under effective control promptly in three months [40,41]. Medical staffs’ ignorance and fear of the disease could be alleviated by this series of measures and further strengthen their confidence to deal with the epidemic. All medical staffs, including midwives, would readily held a positive attitude and practice with an appropriate level of occupational protection.

Table 4
Bivariate correlation analysis between knowledge, attitude and practice scores.

| Variables   | Practice | Attitude | Knowledge |
|-------------|----------|----------|-----------|
| Knowledge   | 0.039*   | 0.148**  | 1         |
| Attitude    | 0.294**  | 1        | 0.148**   |
| Practice    | 1        | 0.294**  | 0.039*    |

*Correlation is significant at 0.05.
**Correlation is significant at 0.01.
4.2. Factors associated with the levels of KAP regarding occupational protection towards COVID-19 pandemic among midwives

According to the regression analysis (Table 3, Tables 4 and 5), the midwives’ age, working status, having attended the COVID-19 related training and having family members with cold-like symptoms were significant predictive factors for knowledge levels. Similar to the previous findings of other KAP studies regarding the COVID-19 and the Middle East Respiratory Syndrome (MERS) [42,43], participants with older age showed a higher level of knowledge. A convincing explanation is the enhancement in the understanding of the acquired knowledge consistent with the advancement of age [44]. In addition, midwives would accumulate abundant work experience with increasing age and clinical practice, and they might be designated to deal with critical situations, which could drive them to keep pace with the development of knowledge. Logistic regression analysis also revealed that participants who had completed the related training programs displayed a higher proportion of good knowledge. It is not difficult to understand that training is one of the effective strategies to improve ones’ knowledge about a particular topic. This finding is in line with some other studies on healthcare workers towards the COVID-19 in China and Nepal [39,45]. The midwives, whose family members had cold-like symptoms demonstrated a better knowledge level as well. As the COVID-19 is an infectious disease caused by the newly identified virus, there is currently no known complete immunity in humans. Based on the epidemiological features obtained to date, people with underlying illness might have an increased risk of developing the disease [46]. The midwives whose family members having cold-like symptoms were more susceptible to the virus. The higher infection risks may improve their concerning degree of the epidemic prevention and control, and motivate them to enhance their knowledge to protect family and themselves.

According to the regression analysis about the attitude level of midwives, encountering with a confirmed COVID-19 patient was the only significant influencing factor for attitude level among the socio-demographic and professional variables (Table 5). It is surprising to find that midwives who had cared the confirmed patients during the epidemic had a lower proportion of positive attitude. The result is similar to another study targeted on frontline healthcare workers in Nepal [45]. It might be attributed to the heavier workloads, higher risk of infection and witness of patients’ adverse outcomes on those midwives, which would increase the suffering of psychological problems and undermine their confidence to cope with the epidemic, and further presented a lower proportion of positive attitude toward occupational protection. In addition, the standard procedures for preventing the contagion that midwives had to implement (e.g. dressing and taking off protective suit) were complicated, which would cost them over 15 min [47]. The airtight protective suit may cause uncomfortableness to midwives, together with the heavy work during the women’ labor, would make them dislike the occupational protection measures [48]. Those terrible experience may cause the midwives’ negative attitude. Since the sample size of the midwives who held negative attitude was small, the result needs further exploration in the future research.

It was found that the midwives staying on their duties demonstrated a higher proportion of good knowledge and appropriate practice in comparison with those on vacation (Table 5). This might be attributed to the higher risk of exposure to the virus that the midwives on duty would face than those on vacation, including the aerosols and droplets produced by infected women during labour and delivery. The greater risk of exposure in beside care may motivate them to expand their knowledge and skills of practice to realize self-protection.

### Table 5
Ordered multi-classification logistic regression models for knowledge, attitude and practice.

| Variables                                      | β     | SE   | Wald   | p    | OR (95%CI)   |
|------------------------------------------------|-------|------|--------|------|--------------|
| Knowledge                                      |       |      |        |      |              |
| Age, yr                                        | 0.049 | 0.022| 5.155  | 0.023*| 1.050 (1.007–1.096) |
| Working experience, yr                         | −0.027| 0.021| 1.629  | 0.202| 0.973 (0.934–1.015) |
| Years of practice in the delivery room, yr     | 0.021 | 0.011| 3.593  | 0.058| 1.021 (0.000–1.043) |
| Working status                                 |       |      |        |      |              |
| Working                                        | 0.337 | 0.158| 4.524  | 0.033*| 1.400 (1.027–1.910) |
| Having family members with cold-like symptoms  |       |      |        |      |              |
| (reference:No)                                 |       |      |        |      |              |
| Yes                                            | 0.892 | 0.376| 5.640  | 0.018*| 2.440 (1.169–5.096) |
| Attitude                                       |       |      |        |      |              |
| Age, yr                                        | 0.033 | 0.019| 3.134  | 0.077| 1.011 (0.996–1.026) |
| Attitude                                       |       |      |        |      |              |
| (reference:No)                                 |       |      |        |      |              |
| Yes                                            | −2.435| 0.676| 12.990 | 0.000**| 0.324 (0.157–0.669) |
| Knowledge scores                               | 0.212 | 0.045| 22.350 | 0.000**| 1.093 (1.052–1.136) |
| Practice                                       |       |      |        |      |              |
| Working status                                 |       |      |        |      |              |
| Working                                        | 0.710 | 0.239| 8.841  | 0.003**| 1.409 (1.100–1.805) |
| Knowledge scores                               | 0.044 | 0.029| 2.332  | 0.127| 1.021 (0.993–1.050) |
| Attitude scores                                | 0.156 | 0.017| 80.905 | 0.000**| 1.805 (1.066–1.105) |

95%CI 95% confidence Interval.

*P < 0.05 is statistically significant.

**P < 0.01 is statistically significant.
Surprisingly, we found that there was no difference in the KAP status of midwives between in the epicenter (Hubei) and in the other parts of China during the initial stage of epidemic (Table 3). This is inconsistent with the results from prior psychological research under other disasters, which suggested that the undesirable consequence would be more critical in the epicenter area of disasters [49, 50]. Different from the earthquakes and hurricanes, the COVID-19 epidemic does not destroy people’s dwelling and cause homelessness directly. The measurements fighting against the epidemic are uniform throughout the nation, even the world. Every health workers should acquire approximately similar contents about occupational protection, and hence there would be little difference in midwives between the epicenter and the other parts. This suggests that policy makers and administrators could design prevention and control measures from an overall perspective without considering regional factors in the event of public health disasters.

The correlation analysis illustrated that knowledge, attitude and practice scores were positively correlated with each other (Table 4). However, the knowledge score was the only independent factor for attitude score and the attitude score was also the single independent factor for practice score (Table 5). This is consistent with the principle of KAP model. It is believed in the KAP model that knowledge is the basis and attitude is the driving force for behavior change. Only when knowledge becomes belief can people take a positive attitude to change behavior [51]. The attitude might act as a median factor between knowledge and behavior. This suggests that merely increasing knowledge of occupational protection among midwives was insufficient to change their behaviors. Transferring knowledge into a positive attitude and further change behavior is more feasible and effective. Although it might cost more time, it deserves our effort in training.

4.3. Limitations

Due to the resources and time constraints, a convenient sampling was employed, which would increase the possibility of selection bias. Furthermore, this study was conducted at the initial stage of the pandemic, which might only reflect the KAP status of occupational protection at a certain time point. The pattern of the development of KAP on midwives needs further exploration through longitudinal studies. Finally, although the participants were assured of the anonymity and confidentiality of their responses, social desirability bias might still exist.

5. Conclusions

The overall attitude and practice of occupational protection among midwives was positive and appropriate, respectively. However, the knowledge was insufficient during the initial stage of COVID-19 pandemic. Some predictive factors, including age, working status, having attended the training programs, caring patients with confirmed disease and having family members with cold-like symptoms were associated with their KAP status. This study could provide valuable reference not only for policy makers and administrators to optimize resource allocation and design education programs on targeted midwives in order to promote their occupational safety and health, but also serve as a baseline for subsequent studies to explore changes about the topic following the continuously evolving COVID-19 situation, which would further help health authorities to respond properly to any future public health emergencies. A follow-up study on the situation of KAP among the midwives and a qualitative research on the experience of midwives about the occupation protection could be suggested in the future to enrich the database about the improvement in the training of midwives.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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