Safety and Health at Work 13 (2022) 294–301

Contents lists available at ScienceDirect

Safety and Health at Work

journal homepage: www.e-shaw.net

Original article

Preventive Measures Against COVID-19 in Small- and Mid-sized Enterprises from an Early Stage of the Epidemic in Daegu and Gyeongsangbuk-do

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ARTICLE INFO

Article history:
Received 3 March 2022
Received in revised form
19 May 2022
Accepted 8 June 2022
Available online 13 June 2022

Keywords:
COVID-19
Epidemic
Preventive measures
Small- and medium-sized enterprises

ABSTRACT

Background: In the early stage of the coronavirus disease 2019 (COVID-19) epidemic, small- and mid-sized enterprises (SMEs) may be an important transmission consideration. The study aimed to identify the pattern of COVID-19 prevention measures during the outbreaks in Daegu and Gyeongsangbuk-do at the early stage of COVID-19. Moreover, we investigated whether SME size and past experiences affected the preventive measures implemented in the region.

Methods: A survey detailing the general characteristics and implementation of 12 preventive activities was conducted in 122 SMEs in Daegu and Gyeongsangbuk-do. The survey was analyzed by size and operation period.

Results: The study subjects consisted of 53 (43.4%) workplaces with 1–5 employees, 50 (40.9%) workplaces with 6–30 employees, and 19 (15.6%) workplaces with 31–49 employees. The lowest three items among those surveyed were 'symptomatic workers to stay home for 3–4 days' (17.2%), 'work remotely' (18.9%), and 'video meetings' (20.5%). There were significant differences in the rate of several preventive measures implemented. The larger sized SMEs, the higher the number of implementations ($p < 0.01$). The operation period had no significant relationship with the implementation of preventive measures. The same pattern was observed in multiple generalized linear regression with covariate adjustment.

Conclusion: Preventive measures among SMEs with fewer than 50 employees were identified. Even within SMEs, a gap in preventive measures according to size was confirmed. To prevent the spread of infection and protect workers' right to health, different support for different sized SMEs is necessary.

1. Introduction

The coronavirus disease 2019 (COVID-19) epidemic, which started in China in 2019, spread to the Republic of Korea in early 2020 [1]. In the Republic of Korea, COVID-19 infections transmitted from foreigners occurred sporadically in the early stages of COVID-19. In early February 2019, before social quarantine guidelines were established, the first epidemic in the Republic of Korea occurred in Daegu and Gyeongsangbuk-do due to the large-group gatherings and community living of a religious group called "Shincheonji" [2]. Since then, the number of patients with COVID-19 has continued to increase and decrease over time. As the COVID-19 epidemic continued, the Korean government has been conducting various quarantine and epidemiological investigations through institutions, such as the Korea Centers for Disease Control and Prevention and has made available various guidelines for the implementation of infection preventive measures in private companies and among individuals [3–5].

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Abbreviations: SMEs, Small- and Mid-sized Enterprises; COVID-19, Coronavirus disease 2019; MERS, Middle East Respiratory Syndrome; ANOVA, Analysis of Variance.

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2093-7911/$ – see front matter
https://doi.org/10.1016/j.shaw.2022.06.001

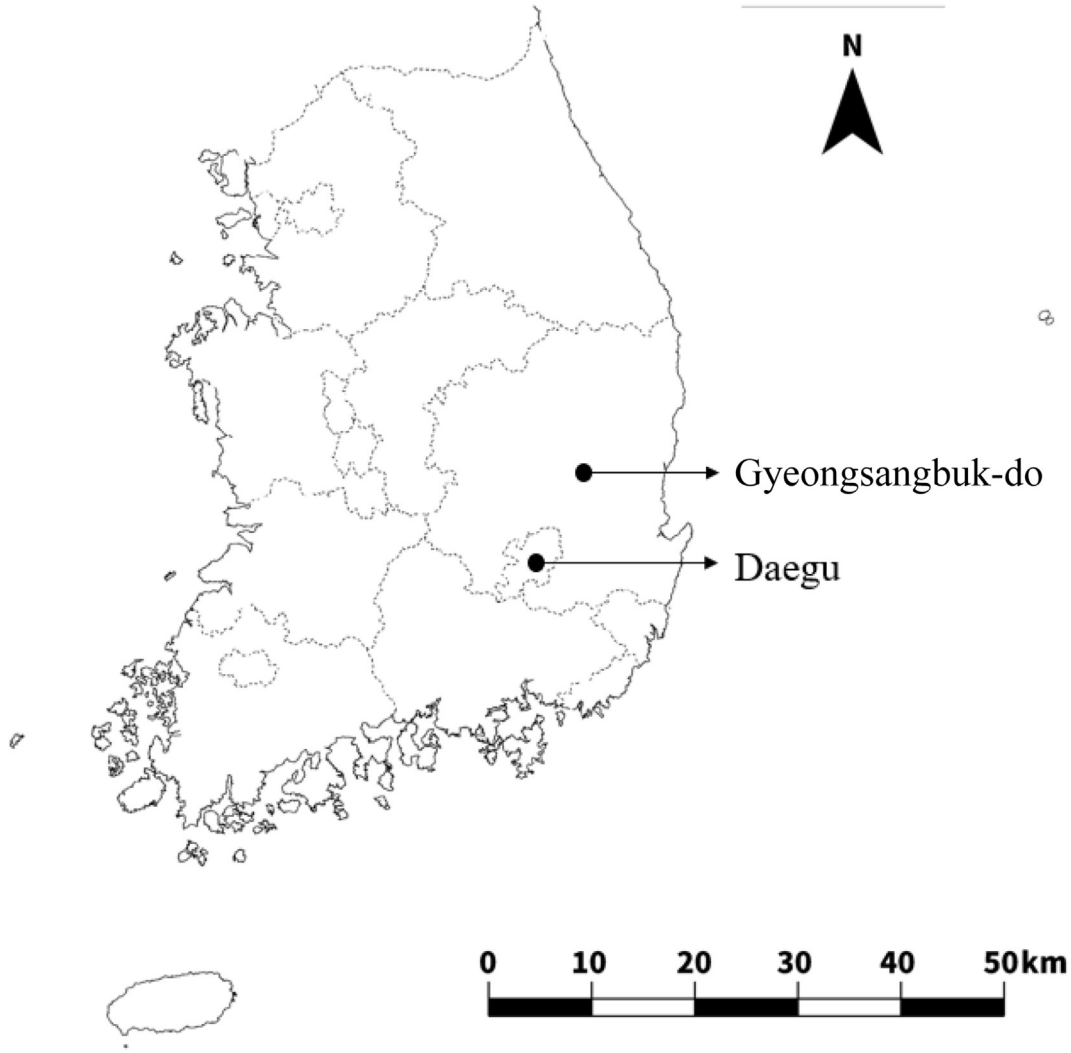

Fig. 1. Geographical location of Daegu and Gyeongsangbuk-do within Republic of Korea.

Infectious diseases that are transmitted from person to person can be spread in the workplace. The workplace conducts economic activities that are unavoidable in modern society. In the Republic of Korea, about 15% of COVID-19 infections occurred at the workplace [5]. Therefore, appropriate preventive measures in the company can help prevent the spread of infectious diseases such as COVID-19 [6]. The current pandemic situation has lasted more than two years, so far. During this time, guidelines for preventive activities have been developed for companies and various preventive measures have been implemented by each company [7].

However, it is difficult to respond to infectious diseases in small- and mid-sized enterprises (SMEs), which lack an organizational structure and manpower to take charge of health within the company, compared to large corporations with relatively more comprehensive health management and manpower [8]. This difference may have been most distinct in the early pandemic when guidelines from governments and related agencies were not clearly established. An epidemic of infectious disease has a cycle of about 5 years in the Republic of Korea. This is evident from epidemics of different types of pathogens, including influenza A virus subtype H1N1 (influenza H1N1) [9] in 2009 and the Middle East Respiratory Syndrome (MERS) epidemic in 2015 [10]. Recognizing the importance of preventive activities after each epidemic of these diseases, preparations for the next epidemic or pandemic were developed, such as improving the legal system and expanding infrastructures based on the failures and successes of past epidemics [11]. However, the beginning of any epidemic or pandemic of a completely novel infectious disease is usually chaotic. Little is known about how the accumulation of past experiences affects the preventive measures in SMEs.

This study investigated the COVID-19 prevention activities in SMEs after the first COVID-19 outbreak in Daegu and Gyeongsangbok-do in early 2020 [12]. Moreover, we analyzed how the size of the SMEs and past pandemic experiences affect preventive activities in the initial stage of a new disease outbreak, by analyzing preventive measures by the number of employees and the operation period of the SMEs.

2. Materials and methods

2.1. Subjects

With a population of 2.4 million, Daegu ranks 4th among Korean cities. Daegu has an area of 883.5 km^2. Gyeongsangbuk-do is an area of 19,030 km^2 that embraces Daegu and has a population of about 2.6 million (Fig. 1). This study was carried out among companies in Daegu, and part of Gyeongsangbuk-do regions. Adjacent to Daegu. To briefly describe the industrial characteristics of the

region, SMEs with fewer than 50 employees account for the majority in Daegu. The number of companies in Daegu is 205,319, and those with fewer than 50 employees are 203,180. Among them, there are 26,876 manufacturing companies, of which 26,414 are companies with fewer than 50 employees [13]. From October 2020 to March 2020, 122 workplaces with less than 50 workers in Daegu and Gyeongsangbuk-do were surveyed by safety and health officers at the workplaces. Health officers of the enterprises were informed of the study's purpose before consenting to participate in the study. Since no similar studies were published, the number of samples required was calculated based on the sample size with a statistical power of 95%, and an alpha error of 0.05 to detect the medium effect size (standard effect size with $|\rho| = 0.3$) based on the t-test was determined [14]. G*Power 3.1.9.7 (Düsseldorf, Njemačka) was used to calculate the required sample size. Aiming for a total of 111 samples, considering the dropout rate, 122 workplaces were visited to recruit participants following an explanation of the purpose and method of the study and obtaining consent. After consent was obtained, the person in charge of the safety and health affairs of the company filled in the self-reported structured questionnaire for the relevant workplace.

2.2. Survey

For general characteristics, the number of workers, the period of operation, and the type of industries, were investigated and analyzed. For COVID-19 exposure characteristics, the presence of COVID-19-infected workers, close contacts, and quarantine workers, were investigated. Operation-related characteristics consisted of 4 items, including 'changes in production volume and sales', 'changes in the number of workers', 'changes in work patterns', and 'experiences of being unfairly treated or disadvantaged because the workplace was located in an epidemic area'. A survey questionnaire of prevention measures was developed with reference to the COVID-19 prevention guidelines from the Korea Centers for Disease Control and Prevention and the Ministry of Employment and Labor [15]. Prevention measures include 'fever check for visitors', 'fever check for workers', 'use of hand sanitizers', 'compulsory mask-wearing, 'controlled entry into company', 'regular ventilation', 'social distancing of 2 meters or more', 'change of eating habits', 'symptomatic workers to stay home for 3–4 days', 'working remotely', 'video meeting', and 'educate via personal hygiene materials and posters'.

2.3. Statistical analysis

The size of each workplace (based on the number of employees, 1–5, 6–30, 30-49), and the characteristics of general operations and COVID-19 exposure-related operations of the workplace were presented and compared using the chi-square test. COVID-19 preventive measures implemented in the workplace according to the size, and operational period of the workplace, were compared by item. The linear-by-linear association chi-square test was used to show the trend relating to the size of the workplace (defined by the number of employees). The operating period was classified into 1–5 years, 5–10 years, and >10 years, with consideration to the workplace's experience of the 2015 MERS pandemic and 2009 influenza H1N1. When the questionnaire was a choice-type question about the type of behaviors with responses other than yes/no, positive and negative answers were classified by two occupational and environmental medicine physicians. Linear-by-linear association chi-square test was also used to determine the trend relating to the operation period. The number of preventive activities performed by each workplace among the 12 types of preventive measures specified in the questionnaire was summed and compared according to the size and operating period of the workplace. P values were calculated using the one-way analysis of variance (ANOVA) test. Multiple logistic regression was used to calculate the effect of workplace size and operating period on the number of preventive actions after adjusting for the covariates. Odds ratio was calculated for more than the median of preventive measurements implementation. Additionally, the industry type, a factor identified in past literature [16], was adjusted. As part of the sensitivity analysis, multiple generalized linear regression with quasi-Poisson link function, which considered the outcome variable as a count variable, was additionally performed. Findings from previous studies also revealed that knowing a close contact with COVID-19 infection increases COVID-19 fear [17]. Hence, the presence of workers who were COVID-19 infected, close contact of someone infected, or workers who were quarantined in the workplace, may affect preventive behaviors. These were assessed, and the relevant factors were corrected. The statistical significance level was set to 0.05. SPSS version 20.00 (IBM Corp., Armonk, NY, USA) was used for statistical analyses.

2.4. Ethics statement

The authors obtained approval from the Yeungnam University Institutional Review Board (IRB No. YU 2020-06-004-002). Written informed consent was obtained from all participants.

3. Results

3.1. General characteristics of study subjects

At the time of the survey, the COVID-19 epidemic was accelerating in the Republic of Korea. However, the Daegu and Gyeongsangbuk-do regions had been relatively stable and had managed to contain the number of infections to less than 100 per day since the start of the pandemic (Fig. 2). The population size of Daegu and Gyeongsangbuk-do is about 2.5 million and 2.7 million, respectively [18]. Officers from all 122 enterprises visited consented to and participated in the survey. Data from 122 SMEs were analyzed. In order of size, there were 53 (43.4%) workplaces with 1–5 employees, 50 (40.9%) workplaces with 6–30 employees, and 19 (15.6%) workplaces with 31–49 employees. Among all workplaces, there were 30 (24.6%) manufacturing workplaces and 101 (82.8%) non-manufacturing workplaces (Fig. 3). As for the operating experience, 38 (31.1%) had 1–5 years of operation, 30 (24.6%) with 6–10 years, and 54 (44.3%) with >10 years. After the beginning of the COVID-19 epidemic, a total of 82 (75.4%) workplaces with changes in sales and income reported an increase of 9 (7.4%) and a decrease of 73 (59.8%). The type of industry, the operating period, and the change of sales and income, were significant according to the business size. Table 1 shows the participant characteristics according to the size of the workplaces.

3.2. Characteristics of preventive measures of subjects

A total of 122 workplaces were investigated for COVID-19 prevention practices. The most frequently performed prevention was 'regular ventilation' (121 cases, 99.2%), followed by 'use of hand sanitizer' (120 cases, 98.4%) and education via personal hygiene materials and posters (95 cases, 77.9%). The most infrequently performed behavior was 'symptomatic workers to stay home for 3–4 days' (21 cases, 17.2%), followed by 'perform remote work' in 23 cases (18.9%). The average number of preventive activities performed among the 12 actionable preventive measures was 6.0 ± 1.48. Items that were significantly different according to the

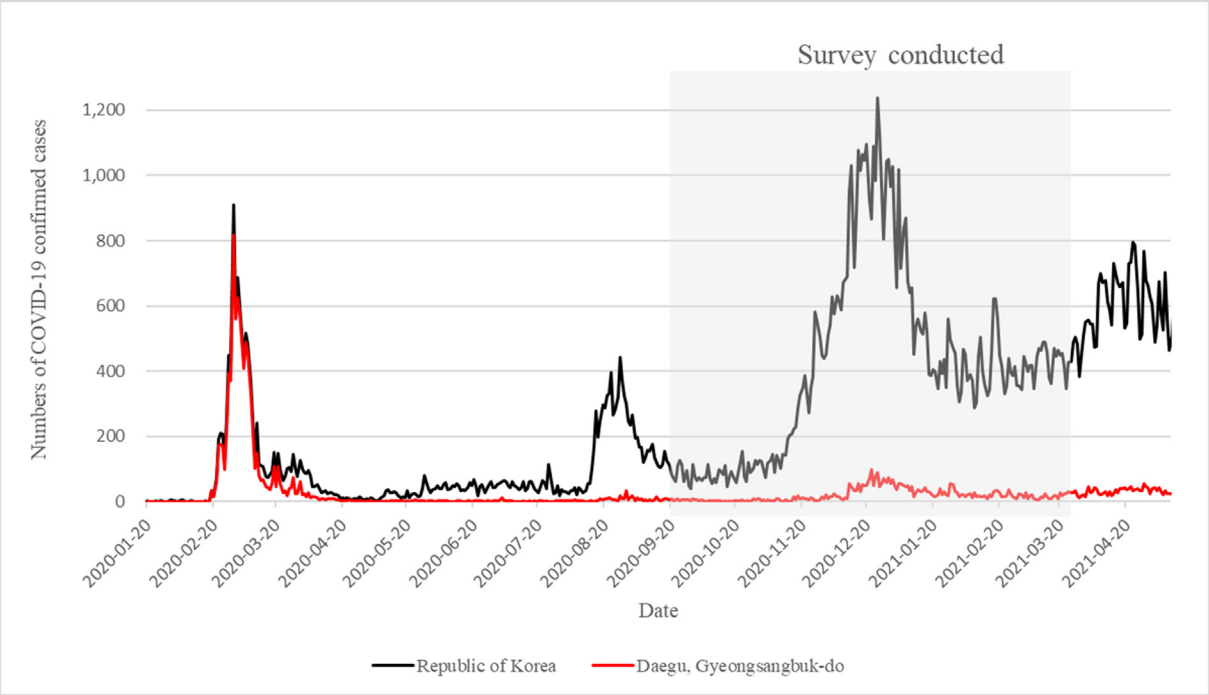

Fig. 2. Daily confirmed cases of Coronavirus Disease-19 (COVID-19) in Daegu, Gyeongsangbuk-do and Korea, near the date of survey, data from https://kosis.kr/covid/covid_cityStatus.do.

size of the company were 'fever check for workers' ($p < 0.01$), 'changes in eating habit' ($p < 0.05$), 'working remotely' ($p < 0.05$), 'video meetings' ($p < 0.05$), and 'education via personal hygiene materials and posters' ($p < 0.001$). Table 2 shows the implementation frequency of the preventive measures for COVID-19 by company size. The implementation frequency of the preventive measures for COVID-19 by operating period is presented in Table 3. There was no significant difference according to the operating period for each preventive activity or the number of preventive actions implemented. Implemented preventive measures by type of industry was shown in Table S1.

In the multiple linear regression model using the total number of preventive measures as an outcome variable, there was no significant relationship between the operating period, type of industry, presence of those who were infected, close contacts, or quarantined workers, and the preventive measures. As for the company size, more preventive measures were implemented in SMEs with 6–30 ($p < 0.01$) and 31–49 ($p < 0.05$) employees than those with <5 employees (Table 4). A similar pattern was also observed in sensitivity analysis by generalized linear regression with quasi-Poisson link function (Table S2).

4. Discussion

In this study, the preventive measures used in the early pandemic in SMEs with less than 50 people were analyzed. The study showed that preventive measures differed according to the SME size. The operation period of the companies did not appear to have any effect on the implementation of preventive actions and considering that the period of operation was classified according to whether the companies operated at the time of MERS and influenza H1N1 epidemics, the impact of past pandemic experiences did not significantly impact on the preventive measures for COVID-19.

In a pandemic situation, workplace-led preventive activities can play an important role in preventing the spread of diseases in society. Preventive measures are also important in terms of workers' right to health [7]. However, there seems to be a limited response to various preventive measures in the early stages of the pandemic among SMEs, due to the relative lack of manpower and material resources to invest in health management. In this study, the SMEs surveyed whether 12 items recommended for workplaces in the early Korean guidelines were performed. In total, 7 of the preventive activities were implemented in less than 50% of SMEs during

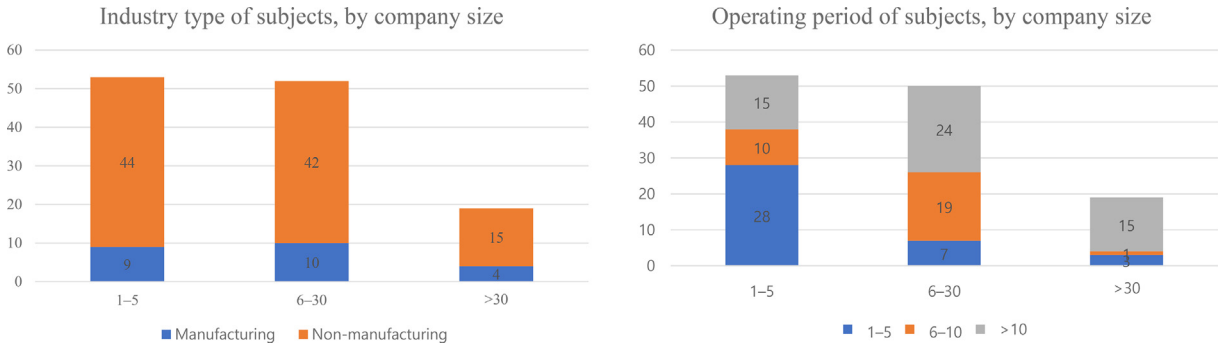

Fig. 3. A brief graphical summary of the subjects by company size (the numbers of workers).

Table 1
General and COVID-19 exposure-associated characteristics of study subjects

Company size (workers)	Total	1–5	6–30	31–49	p^*
	$n = 122$ (100.0%)	$n = 53$ (43.4%)	$n = 50$ (40.9%)	$n = 19$ (15.6%)	
Type of industry					
Manufacturing	23 (18.9%)	9 (17%)	10 (20%)	4 (21.1%)	<0.05†
Machine manufacturing	3 (2.5%)	1 (1.9%)	0 (0%)	2 (10.5%)	
Auto parts manufacturing	8 (6.6%)	2 (3.8%)	4 (8%)	2 (10.5%)	
Metal and steel manufacturing	2 (1.6%)	0 (0%)	2 (4%)	0 (0%)	
Textile product manufacturing	8 (6.6%)	4 (7.5%)	4 (8%)	0 (0%)	
Meat and dairy manufacturing	2 (1.6%)	2 (3.8%)	0 (0%)	0 (0%)	
Non-manufacturing	101 (82.8%)	44 (83.0%)	42 (84.0%)	15 (78.9%)	
Textile processing industry	5 (4.1%)	1 (1.9%)	4 (8%)	0 (0%)	
Automobile and motorcycle repair business	7 (5.7%)	3 (5.7%)	4 (8%)	0 (0%)	
Wholesale and retail, consumer goods repair business	11 (9%)	4 (7.5%)	6 (12%)	1 (5.3%)	
Restaurant, lodging	14 (11.5%)	9 (17%)	4 (8%)	1 (5.3%)	
Healthcare and social welfare	7 (5.7%)	1 (1.9%)	6 (12%)	0 (0%)	
Comprehensive management of buildings, etc.	12 (9.8%)	3 (5.7%)	3 (6%)	6 (31.6%)	
Sanitary and similar service businesses	5 (4.1%)	2 (3.8%)	2 (4%)	1 (5.3%)	
Else	40 (32.8%)	21 (39.6%)	13 (26%)	6 (31.6%)	
Operating period (years)					
1–5	38 (31.1%)	28 (52.8%)	7 (14%)	3 (15.8%)	<0.001
6–10	30 (24.6%)	10 (18.9%)	19 (38%)	1 (5.3%)	
>10	54 (44.3%)	15 (28.3%)	24 (48%)	15 (78.9%)	
Changes in sales and income					
Increased	9 (7.4%)	4 (7.5%)	4 (8%)	1 (5.3%)	<0.05
Decreased	73 (59.8%)	39 (73.6%)	28 (56%)	6 (31.6%)	
Not changed	30 (24.6%)	10 (18.9%)	18 (36%)	2 (10.5%)	
Changes in the numbers of workers					
Increased	6 (4.9%)	1 (1.9%)	3 (6%)	2 (10.5%)	0.388
Decreased	33 (27%)	14 (26.4%)	16 (32%)	3 (15.8%)	
Not changed	83 (68%)	38 (71.7%)	31 (62%)	14 (73.7%)	
Changes in work patterns of workers					
Leave of absence	19 (15.6%)	8 (15.1%)	8 (16%)	3 (15.8%)	0.513
Shorten work hours	21 (17.2%)	12 (22.6%)	8 (16%)	1 (5.3%)	
Else	5 (4.1%)	1 (1.9%)	2 (4%)	2 (10.5%)	
Not changed	77 (63.1%)	32 (60.4%)	32 (64%)	13 (68.4%)	
Disadvantage due to located in Daegu					
Yes	20 (16.4%)	8 (15.1%)	10 (20%)	2 (10.5%)	0.601
No	102 (83.6%)	45 (84.9%)	40 (80%)	17 (89.5%)	
Presence of COVID-19 associated infection, contact or quarantined worker					
Yes	10 (8.2%)	3 (5.7%)	4 (8%)	3 (15.8%)	0.385
No	112 (91.8%)	50 (94.3%)	46 (92%)	16 (84.2%)	

* p values were calculated by chi-square test.
† p values for comparing manufacturing and non-manufacturing industry.

the early epidemic in the Republic of Korea. It is difficult to assume that a prompt and accurate response was made. Although it is difficult to make a direct comparison due to the different systems and cultures, in a survey performed in Japan that included enterprises of all sizes, the result showed that to prevent COVID-19, 70% or more had to limit worker's attendance at work if they have a fever [19]. In this study, 17.2% of workplaces recommended 3–4 days off for symptomatic workers. Also, in this study, working remotely showed a relatively low implementation rate (18.9%). The adoption of remote work is depending on the labor environment, and difficulty in working remotely in small-sized workplaces in the Republic of Korea was also reported in other studies [20]. Workers in SMEs

Table 2
Frequencies of implementation of preventive measures for COVID-19 by company size

Numbers of employees	Total	1–5	6–30	31–49	p^*
	$n = 122$ (100.0%)	$n = 53$ (43.4%)	$n = 50$ (40.9%)	$n = 19$ (15.6%)	
Fever check in company for visitors	55 (45.1%)	21 (39.6%)	21 (42%)	13 (68.4%)	0.06
Fever check in company for workers	71 (58.2%)	23 (43.4%)	32 (64%)	16 (84.2%)	<0.001
Furnish hand sanitizer	120 (98.4%)	51 (96.2%)	50 (100%)	19 (100%)	0.15
Compulsory mask wearing	46 (37.7%)	25 (47.2%)	16 (32%)	5 (26.3%)	0.06
Control company entrance	72 (59%)	34 (64.2%)	30 (60%)	8 (42.1%)	0.13
Regular ventilation	121 (99.2%)	53 (100%)	50 (100%)	18 (94.7%)	0.07
Recommend 'social distancing' of 2 meters or more	29 (23.8%)	16 (30.2%)	11 (22%)	2 (10.5%)	0.08
Change in eating habit	60 (49.2%)	21 (39.6%)	26 (52%)	13 (68.4%)	<0.05
Stay home for 3–4 days for symptomatic workers	21 (17.2%)	11 (20.8%)	7 (14%)	3 (15.8%)	0.47
Perform remote work	23 (18.9%)	7 (13.2%)	8 (16%)	8 (42.1%)	<0.05
Hold video meeting	25 (20.5%)	6 (11.3%)	12 (24%)	7 (36.8%)	<0.05
Post personal hygiene materials and posters	95 (77.9%)	30 (56.6%)	47 (94%)	18 (94.7%)	<0.001
The number of preventive measures among 12 items	6.0 ± 1.48	5.6 ± 1.50	6.2 ± 1.19	6.8 ± 1.71	<0.01

* p value was calculated by linear-by-linear association among categorical variables, and one-way ANOVA for the number of preventive measures.

Table 3
Frequencies of implementation of preventive measures for COVID-19 by operating period

Operating period (years)	Total	1–5 years	6–10 years	>10 years	p^*
	$n = 122$ (100.0%)	$n = 38$ (31.1%)	$n = 30$ (24.6%)	$n = 54$ (44.2%)	
Fever check in company for visitors	55 (45.1%)	19 (50%)	11 (36.7%)	25 (46.3%)	0.529
Fever check in company for workers	71 (58.2%)	20 (52.6%)	16 (53.3%)	35 (64.8%)	0.226
Furnish hand sanitizer	120 (98.4%)	38 (100%)	29 (96.7%)	53 (98.1%)	0.542
Compulsory mask wearing	46 (37.7%)	14 (36.8%)	13 (43.3%)	19 (35.2%)	0.823
Control company entrance	72 (59%)	27 (71.1%)	16 (53.3%)	29 (53.7%)	0.112
Regular ventilation	121 (99.2%)	37 (97.4%)	30 (100%)	54 (100%)	0.188
Recommend 'social distancing' of 2 meters or more	29 (23.8%)	11 (28.9%)	9 (30%)	9 (16.7%)	0.152
Change in eating habit	60 (49.2%)	18 (47.4%)	12 (40%)	30 (55.6%)	0.385
Stay home for 3–4 days for symptomatic workers	21 (17.2%)	6 (15.8%)	4 (13.3%)	11 (20.4%)	0.532
Perform remote work	23 (18.9%)	8 (21.1%)	2 (6.7%)	13 (24.1%)	0.594
Hold video meeting	25 (20.5%)	5 (13.2%)	6 (20%)	14 (25.9%)	0.137
Post personal hygiene materials and posters	95 (77.9%)	27 (71.1%)	23 (76.7%)	45 (83.3%)	0.161
The number of preventive measures among 12 items	6.0 ± 1.48	6.1 ± 1.43	5.7 ± 1.26	6.2 ± 1.60	0.276

* p value was calculated by linear-by-linear association among categorical variables, and one-way ANOVA for the number of preventive measures.

may be unable to work remotely due to the work type, such as in manufacturing, service, and processing and repair industries. There may also be insufficient human resources to provide a replacement when a worker is absent. In contrast, 'regular ventilation' and 'use of hand sanitizer' were implemented in most workplaces. We noted that the measures implemented at a high rate were that could be performed without the need for a large budget or manpower. The overall frequency of performing preventive activities that required independent human and material resources, such as fever checks, video meetings, and remote work, is relatively low, and there is a significant difference based on the size of the workplace. Similarly, it can be assumed that activities such as change of eating habits were difficult to take action at the company level since there was lack of an in-house restaurant for workers. It can be inferred that, despite recognizing the importance of COVID-19 preventive activities, it may not be possible or practical in SMEs. Also, remote work, video meeting, staying home for symptomatic workers, etc. are performed relatively infrequently in the overall SMEs, and preventive measures of SMEs are mainly at the level of personal hygiene management. In other words, activities that can actually reduce personal contact are rarely performed, which shows the main weak point in the prevention control of SMEs' workers.

Among the prevention measures of workplaces with fewer than 5 employees, workplaces with 6–30 employees, and workplaces with more than 30 employees, the percentage of prevention activities increased as the size of the SME increased. There was a significant difference in the number of preventive activities implemented. This can be interpreted that there was a gap in preventive measures according to SME size, even among workplaces with fewer than 50 employees. In the Republic of Korea, enterprises with fewer than 50 employees are classified as small enterprises, and legislations are applied differently to businesses with more than 50 employees in the application of various laws and regulations including regulations on safety and health associated organization [21]. In workplaces with fewer than 50 employees, the vulnerability was recognized in workplaces with 6–30 employees, and fewer than 5 employees, and exceptions in safety and health associated regulation was adopted [22,23]. In this study, the proportion of decline in income and sales was significantly high as the size of the SMEs decreased. This suggests that small businesses are more vulnerable to social chaos. As such, the smaller the workplace, the lower the management capacity for COVID-19 prevention.

Table 4
Multiple logistic regression on implementation of more than six preventive measures by characteristics of SMEs

	OR (95% C.I.)*	$p^\dagger$
Company size (numbers of employee)		
1–5	Reference	
6–30	4.00 (1.58, 10.14)	<0.01
31–49	4.67 (1.29, 16.9)	<0.05
Operating period (years)		
1–5	Reference	
6–10	0.46 (0.15, 1.34)	0.17
>10	0.51 (0.19, 1.38)	0.18
Type of industry		
Manufacturing	Reference	
Non-manufacturing	0.46 (0.17, 1.22)	0.12
Presence of COVID-19 associated infection, contact or quarantined worker		
No	Reference	
Yes	0.95 (0.24, 3.84)	0.94

* OR (95% C.I.) represents odds ratio and 95% confidence interval calculated by multiple logistic regression.
† p value was calculated by multiple logistic regression.

In the Republic of Korea, there are more than 10 million employees working in SMEs with fewer than 30 employees and more than 2 million employees working in SMEs with less than five employees [24]. To break the infection cycle, it is important to manage these SMEs from a public health point of view. Moreover, from a social point of view, it is necessary to create a system that can identify and manage the health and sanitation gaps in these SMEs and among the workers relative to the size of the workplace [25]. In the occurrence of a new epidemic or pandemic, it is important to prepare policies and guidelines to prevent the spread of infection. Support measures for SMEs should also be prepared in advance. In the current COVID-19 pandemic, operational funding for companies is the main source of support [11]. To ensure infection control, a system to support the management of health resources and human resources should be prepared in advance to effectively prevent infection transmission.

As of February 2022, the COVID-19 pandemic has persisted for more than two years. To date, the quarantine guidelines continue to differ depending on time and region [5]. If this pandemic situation continues, it can be expected that experience in infection control will gradually accumulate and develop [26]. However, in this study, there was no significant difference in the preventive measures among SMEs whether they experience MERS epidemic in 2015 or the influenza H1N1 epidemic in 2009. This suggests that past pandemic experiences did not significantly affect the preventive measures of the new pandemic among SMEs. If we apply this finding to a future situation, experiences gained from the COVID-19 pandemic may not have a significant impact on how a new epidemic or pandemic will be dealt with in SMEs. Accordingly, in the process of preparing for a

new pandemic after COVID-19, an appropriate top-down guideline is likely going to be necessary, rather than expecting SMEs to have adequate self-management capacity. Although not presented in the result section, preventive measures among other factors investigated in this study, such as changes in sales, changes in the number of workers, changes in work patterns, etc. (suggested in Table 1), had no significant effect ($p > 0.05$) on the number of implemented preventive measurement.

This study has several limitations. This study did not conduct randomized sampling, and this is one of the biggest limitations. It is difficult to verify that the distribution of characteristics, such as size, period of operation, and COVID-19 experience, is representative of all SMEs in the Daegu and Gyeongsangbuk-do area. In addition, it was not possible to collect enough samples to perform various stratified analyses based on workplace characteristics. Moreover, it was difficult to gather detailed information on the circumstances of the workplace due to the self-reporting survey method utilized. A self-reported survey has the limitation of the responder overestimating or underestimating the situation of the SME concerned, since each SME was represented by only one person who responded to the questionnaire. When developing the questionnaire, the contents were written crudely and in haste, and validation of the survey questionnaire was not performed to validate if the included questions were suitable for the study's participants. Therefore, there may be an underestimation of the level of preventive measures that could not be performed or unnecessary, depending on the type of industry, or type of a specific workplace, since a single-type multiple-choice questionnaire was used. Also, as shown in Fig. 2, during the study period, the number of COVID-19 confirmed cases in Daegu and Gyeongsangbuk-do region was maintained at 10–100 due to strong infection control, which is about 1 per 100,000 of population in that region. Thus, COVID-19 confirmed case did not occurred enough to make statistical comparisons from each company, and empirical investigation of the effectiveness of each measure could not be performed.

Despite these limitations, this study was timely and quickly investigated the early stages of a pandemic. The findings may provide rare data that can identify the characteristics of preventive activities in SMEs with fewer than 50 people after the initial pandemic in the Republic of Korea. A simple questionnaire was developed to quickly identify the early response pattern of SMEs to the COVID-19 epidemic, by showing and analyzing preventive measures at 122 workplaces. The results may assist in understanding the preparedness of SMEs for a future outbreak. The strength of this study is that these preventive actions were analyzed according to factors such as size and operation period. There are gaps in prevention activities according to the size of the workplace. Although it is difficult to regard the fact that there is a difference in preventive activities according to the size of the workplace as an academically novel finding, the study of identifying the actual conditions of the weak point and gaps that appear at each workplace seem to be important results in determining the direction of support for prevention of infection at workplaces in the future. This finding has implications for the future development of policies for the prevention of COVID-19 transmission and other pandemic situations among SMEs. The significance of this study is as basic data for determining the direction of support for respiratory infectious disease pandemic situation with showing weakness of SMEs preventive measurement. Further research should be conducted on the empirical effectiveness of preventive measurement. Then, it is expected that the results of this study can be more appropriately applied to SMEs' support strategies for new pandemic situation.

This study investigated the level of preventive measures available in SMEs in the early stage of the COVID-19 pandemic. The SMEs with less than 50 employees in Daegu and Gyeongsangbuk-do near the area of the initial COVID-19 outbreak in the Republic of Korea were examined. The results show that there are gaps in the preventive measures implemented depending on the size of the business. The preventive measures implemented increased significantly as the size of the business increased. However, there was no significant difference in the level of preventive measures for the operating period of the workplace. This result suggests that exposure to past pandemics had insignificant effects on preventive measures implemented in the current pandemic. This study was conducted relatively quickly in the early days of the COVID-19 pandemic, and provides rare and valuable data showing the response patterns of SMEs during early pandemic situation. The findings of this study may serve as a reference in preparing guidelines and policies relevant to SMEs for future outbreaks in the current COVID-19 pandemic and future pandemics.

Funding

This work was funded by the 2021 Yeungnam University Research Grant (No. 221A480009).

Disclosure

Kiook Baek has nothing to disclose. Seong-Hui Kim has nothing to disclose. Chulyong Park has nothing to disclose. Joon Sakong has nothing to disclose. There is no financial gain from this study to any of authors. This manuscript is an original study which has never been published in another journal. All images here in are original. All authors have contributed to writing this manuscript.

Conflicts of interest

All authors declare that they have no conflicts of interest relevant to the content of this literature.

Acknowledgments

This work was supported by the 2021 Yeungnam University Research Grant (No. 221A480009).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.shaw.2022.06.001.

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