



Article

Safety Climate and the Impact of the COVID-19 Pandemic: An Investigation on Safety Perceptions among Farmers in Italy

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Abstract: The diffusion of the COVID-19 pandemic has generated numerous interventions aimed at reducing the contagion by means of specific prevention measures, also characterized by stricter occupational health and safety (OHS) procedures at the workplace. To better understand how this novel working context has impacted on farmers' safety behavior and attitude, a safety climate assessment was carried out by means of the Nordic Safety Climate Questionnaire (NOSACQ-50), which was augmented to include specific items related to the modifications of working conditions due to COVID-19. This allowed us to analyze changes in safety climate perceptions, pointing out worker-manager discrepancies in safety behavior and attitude. Additionally, the COVID-19 questionnaire contributed to analyzing the effects of the specific OHS measures due to the pandemic from the workers' standpoint. Results showed that concerns related to the COVID-19 pandemic have augmented the attention paid to OHS, demonstrating a correlation between the safety climate dimensions and the OHS measures due to COVID-19. Besides, farmers' risk-taking behavior and attitude appeared still critical, highlighting the need for more specific and contextual interventions in terms of safety information and training. Overall, this study aims to expand knowledge on shared safety awareness and perceptions in the COVID-19 period.

Keywords: occupational health and safety (OHS); safety climate; NOSACQ-50; COVID-19; ergonomics; human factors; risk perception; safety culture; agriculture; prevention measures



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1. Introduction

Our society has been dealing with the COVID-19 pandemic since 2020. This situation is affecting, more or less, all countries worldwide, modifying not only our lifestyles but also the organization of working activities in all sectors, due to the safety measures aimed at reducing the spread of the virus [1–3]. In particular, Italy has been one of the most affected countries, considering both the number of total cases and deaths in comparison with the population; actually, according to data provided by Worldometer [4], 59,333 cases and 1811 deaths per million of inhabitants were registered by the end of March 2021. In such a context, besides the changes to daily life that concern all of us, also working activities and the organization of workplaces have been modified in order to face the pandemic [5,6]. In fact, on the one hand, the new rules adopted by governments have introduced specific prevention measures to reduce the possibility of being infected at the workplace (e.g., minimum distances between workers, disinfecting and sanitizing the workplace and working tools, etc.). On the other hand, quarantines, lockdowns and limitations in travelling and moving have affected the workforce as well, especially in sectors such as agriculture, where mobility is essential for the production process. Hence, farm companies have been dealing with the need to continue producing food as it is an indispensable product in this novel working context, characterized by a limited number of seasonal workers (especially temporary migrants) as well as by stricter occupational health and safety (OHS) procedures. To better understand how this has affected safety behavior

and attitude of farmers, a safety climate assessment was carried out by means of the Nordic Safety Climate Questionnaire (NOSACQ-50) [7], which was augmented to include specific items related to the modifications of the working conditions due to COVID-19. It has to be noted that, in this study, the term “farmer” is used to indicate both managers and workers (employees) operating in agricultural enterprises. In small-sized companies, managers are usually the owners of the companies that are involved in production activities, as in the study context. Safety climate evaluation represents a powerful tool to collect information regarding safety problems at the workplace, providing an effective way of addressing how to improve occupational health and safety [8–10]. In more detail, the present study aims to screen farmers’ safety perceptions, providing an overview on how they are correlated with the additional OHS measures implemented at workplaces because of the pandemic. Accordingly, to better evaluate this aspect, a comparative analysis was made with the results of previous investigations carried out among similar companies when the emergency due to the COVID-19 outbreak was at its beginning [8]. Such an approach allowed us to bring to light changes in safety climate perceptions, pointing out worker-manager discrepancies in safety behavior and attitude. Additionally, the inclusion of a COVID-19 questionnaire contributed to analyzing the effects and the adequacy of the specific OHS measures due to the pandemic. This survey allowed us to understand how farmers perceive the impact of the COVID-19 OHS measures, providing contextual information on their impact on safety climate perceptions.

The remainder of the paper is organized as follows. In Section 2, a background analysis is provided, illustrating the survey context and research motivations. Section 3 introduces the research approach, depicting the main features of the questionnaires used in the survey. The output of these analyses is described in Section 4, while Section 5 provides discussion of the results. Concluding remarks are summarized in Section 6.

2. Research Background and Motivations

In this section, the study context is addressed from the occupational health and safety point of view, focusing on the main features of agriculture activities and the safety procedures introduced in Italy for this sector because of the COVID-19 outbreak.

2.1. OHS in Agriculture

Agriculture is considered a very hazardous sector worldwide [11–14]. The main reasons for such a phenomenon are due to the peculiarities of agriculture activities, which affect working conditions extensively. In fact, the pressure due to tight deadlines of seasonal work, the continual mutation of the working environment due both to weather conditions and the change of sites, the multiplicity of different working tasks a farmer has to carry out, etc. are all factors affecting the health and safety of farmers [15–17]. Additionally, the use of hazardous equipment (e.g., tractors) and materials (e.g., pesticides) contribute to augment the risks farmers are exposed to daily, making agriculture a very dangerous activity [18–20]. For instance, focusing on the Italian context, a comparison was made between recent accident statistics related to the agriculture and industry/services sectors. Data shown in Figure 1 illustrate the higher rate of accidents (i.e., the ratio between the number of accidents and the number of workers officially employed in the sector in a given year) in agriculture compared to other sectors.

It is worth noting that the data reported in Figure 1 were obtained by merging information concerning the number of employees in the industry/services and agriculture sectors (published by the Italian National Institute of Statistics [21]) together with accident statistics provided by the Italian Compensation Authority [22] in the same sectors. It has to be underlined that, in these data, the agriculture sector also includes forestry and animal husbandry activities.

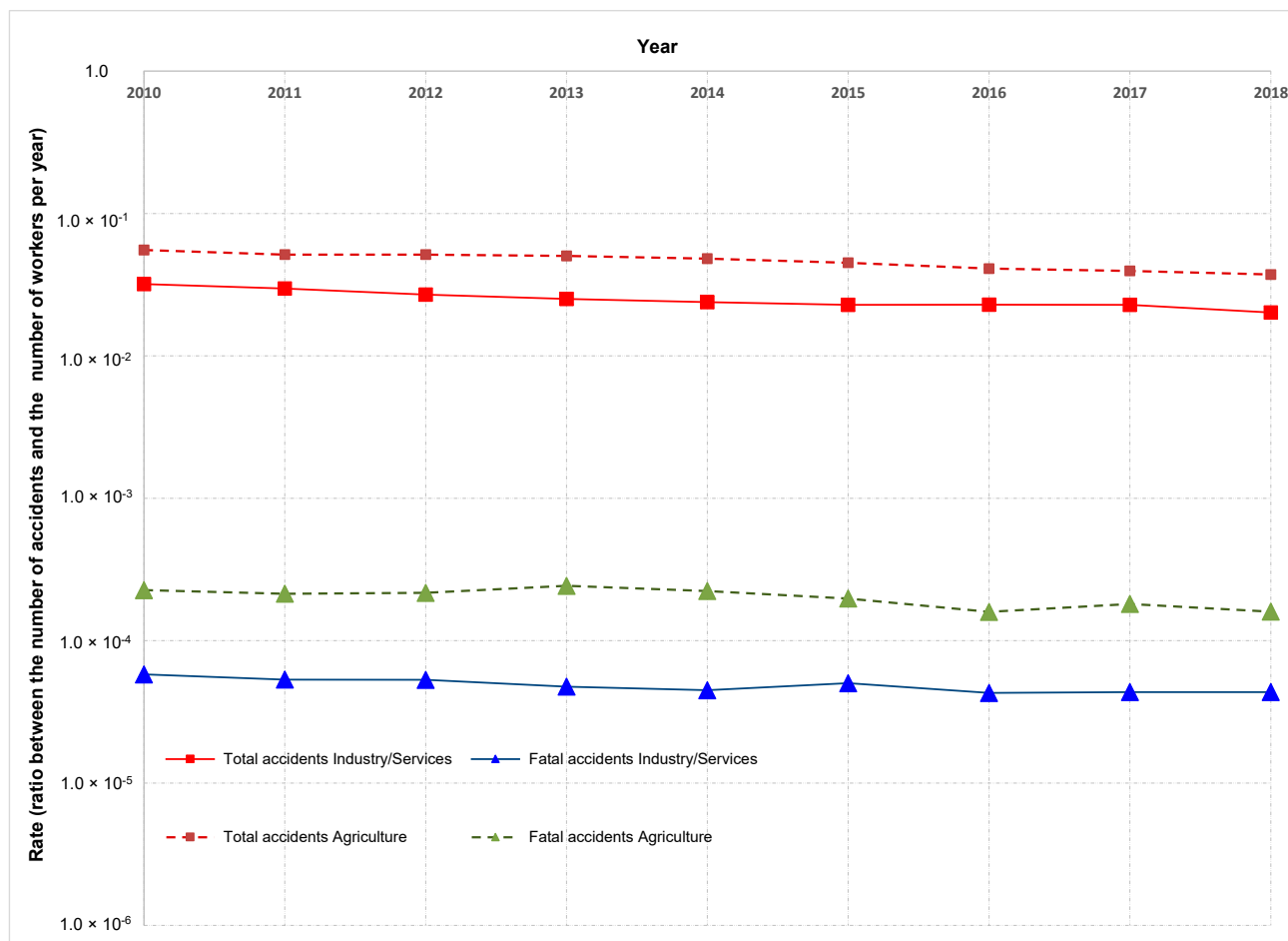


Figure 1. Occupational accidents' rates in Italy in the period 2010–2018.

To deal with such a phenomenon, together with an ever stricter normative framework, numerous studies have investigated the safety problems in agriculture, mainly focusing on technical aspects, such as the use of work equipment, the conformity of machinery to technical standards, the use of chemicals, etc., that can lead to injuries or diseases [23–28]. However, these issues are not sufficient to explain the high rate of accidents and fatalities in agriculture activities. In fact, as noted by Svennefelt et al. [29], the scarce attitude of farmers in adhering to safety procedures and rules has to be investigated, taking into account their behavioral features and motivations toward safety issues. Such a criticality also emerged from the results of Wilmsen et al. [30], who reported the positive impact on worker safety behavior due the presence of safety organizational factors in forestry worker companies. In particular, these authors underlined the role played by safety climate in improving worker safety behavior and commitment. These findings complement the study by Fugas et al. [31], according to which safety climate is at the basis of the process to achieve workers' proactive and compliance safety behavior. However, as noted by several authors [32–34], in the literature there is a scarcity of studies investigating safety perceptions and attitudes among farmers. Hence, this research gap needs to be addressed to expand knowledge on farmers' risk-taking attitude and behavior with the goal of providing specific improvement solutions.

2.2. Safety Measures to Prevent COVID-19 in Agriculture

The diffusion of the COVID-19 pandemic at a global level has generated numerous interventions aimed at reducing infection at the workplace by means of specific prevention measures [35–37]. In Italy, these measures have been modified continuously depending on the spread of the pandemic (e.g., considering the number of infected people and

deaths, as well as hospital capacity, etc.), ranging from lockdown periods alternated with periods characterized by fewer restrictions. In this situation, unlike other types of activities, because agriculture is considered an essential sector, it has almost never been interrupted, not even during the national or regional lockdown periods. To reduce the risk of infection, regulations containing specific OHS measures were issued [38,39], which can be summarized as follows:

- Use of specific personal protective equipment (PPE), such as respiratory protection masks and disposable gloves;
- Distancing, reduction of the number of workers allowed to stay at the workplace simultaneously, definition of specific routes to avoid workers' gathering, working shifts;
- Disinfection and cleaning procedures for workers, work equipment, workplaces;
- Worker screening, such as temperature checking, COVID-19 test campaigns, etc.;
- Specific information and training of workers.

Furthermore, farm companies had to update their OHS documents and identify a so-called "COVID-19 Referent", i.e., the person in charge of supporting managers and workers in implementing these additional OHS measures correctly. Such changes have modified the safety management of farm companies (Figure 2), widely affecting daily activities of farmers.

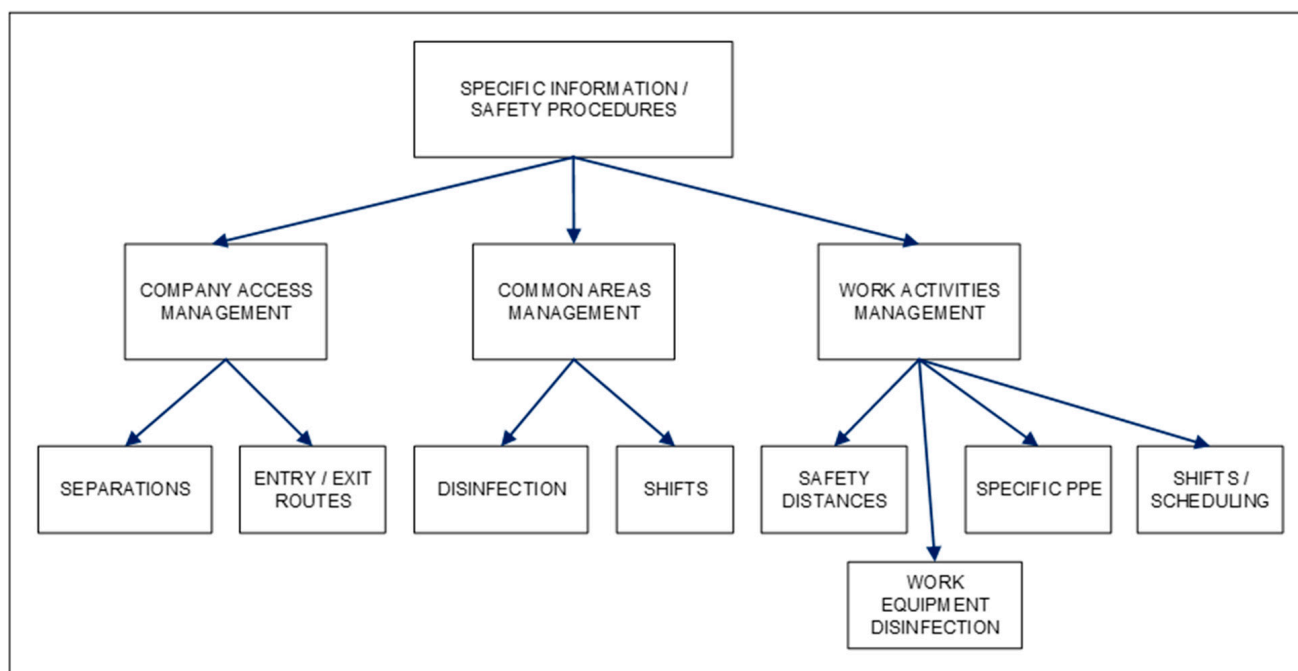


Figure 2. Scheme of occupational safety measures in agricultural activities.

2.3. Research Issues

Although COVID-19 additional OHS measures have modified, not only people's daily life, but also working contexts, to the authors' knowledge, scarce attention has been paid to the impact of this situation on the safety climate of workers. For instance, Kim et al. [40] investigated the relationship between safety climate and safety motivation, as well as the impact of COVID-19 on safety compliance and safety participation among hospitality enterprises' employees, as the health sector has been considerably stressed by the COVID-19 pandemic. They argued that, because of the current pandemic, employees who are under social pressure can reduce their safety performance and commitment at the workplace. Differently, Xie et al. [41] demonstrated that the level of health risk perceptions regarding the COVID-19 pandemic has a positive impact on the adoption of the social distancing behavior by means of an online survey performed among randomly-collected internet

users. Other studies have focused their attention on the health and safety needs of specific categories of farmers to deal with the COVID-19 outbreak [42], as well as on mitigation strategies aimed at guaranteeing food supply [43–45]. However, these studies have not considered the safety climate perceptions, and few studies have dealt with the farmers' situation from the OHS standpoint [46].

Based on the above considerations, the study aim to reduce this research gap by analyzing safety climate changes that have occurred at the company level due to the COVID-19 outbreak. More specifically, the analysis has the purpose of investigating if and how the attention paid to COVID-19 can improve safety perceptions at the workplace. Accordingly, the following research hypothesis can be made: the COVID-19 outbreak has generated an augmented safety climate perception among farmers. Moreover, exploring the possible relationship between safety climate perceptions and COVID-19 OHS issues is essential to better understand to what extent this situation has affected farmers' safety perception and attitude.

3. Research Approach

With this goal in mind, a safety climate investigation among a sample of farmers was performed by means of an augmented version of NOSACQ-50. In fact, together with the traditional NASACQ-50 questionnaire [7], additional items to elicit information regarding the impact of COVID-19 in working activities were implemented (COVID-19 questionnaire). In more detail, the first step of the analysis consisted of comparing new data on safety climate perceptions obtained by means of the NOSACQ-50 questionnaire to the ones derived from a previous study carried out in a similar context [8]. Then, the results of the COVID-19 questionnaire were screened and a correlation analysis was performed to evaluate how the different aspects of the safety climate perceptions were affected by the implementation of the specific OHS measures due to COVID-19.

3.1. The NOSACQ-50 Questionnaire

The Nordic Safety Climate Questionnaire was presented in 2011 [47]; it represents the output of studies carried out by a Nordic network of occupational safety researchers and it was tested primarily in the construction industry [48]. The questionnaire consists of 50 statements/items that are divided into the following main safety climate dimensions [7]:

- Dim1—Management safety priority, commitment, and competence: 9 items to assess how workers perceive safety management;
- Dim2—Management safety empowerment: 7 items to assess how workers perceive management empowerment;
- Dim3—Management safety justice: 6 items to assess workers' perceptions of accident management;
- Dim4—Workers' safety commitment: 6 items to estimate the perception of workers' commitment to safety;
- Dim5—Workers' safety priority and risk non-acceptance: 7 items to evaluate risk-taking attitudes and safety prioritization in working tasks;
- Dim6—Safety communication, learning, and trust in coworkers' safety competence: 8 items to assess the perception of the exchange of safety knowledge and experiences among workers;
- Dim7—Trust in the efficacy of safety systems: 7 items to evaluate how workers perceive the benefits due to safety planning, training, monitoring, etc.

The score for each one of the 50 statements is assigned based on a 1–4 Likert scale, and the final score assigned to each dimension is represented by the mean value of the scores related to the items pertaining to that dimension [7]. The criteria suggested to evaluate the safety climate dimensions are reported in Table 1.

Table 1. Scoring values to evaluate the results of the NOSACQ-50 questionnaire (source: [7]).

Score (s)	Level	Meaning
$s > 3.30$	good	maintain and continue the development of the safety climate dimension
$3.00 < s < 3.30$	fairly good	the safety climate dimension requires a certain improvement
$2.70 < s < 2.99$	fairly low	the safety climate dimension requires an improvement
$s < 2.70$	low	the safety climate dimension requires a considerable improvement

Despite its recent validation, searching in the Scopus database, several studies can be found addressing the use of NOSACQ-50 in different working contexts (in Table 2, the list of journal articles in English reflecting in Scopus is reported).

Table 2. Articles addressing the use of NOSACQ-50 (listed according to the publication year).

Authors	Year	Investigation Sector/Industry
Fargnoli and Lombardi [8]	2020	Agriculture
Marín, L.S. et al. [9]	2019	Construction
Voon and Ariff [49]	2019	Teachers
Lagerstrom et al. [50]	2019	Logging
Sukapto et al. [51]	2019	Footwear
Kwon et al. [52]	2019	Construction
Sukapto et al. [53]	2018	Footwear
Nadhim et al. [54]	2018	Construction
Arifin et al. [55]	2017	Public sector (office workers)
Yousefi et al. [56]	2016	Iron and steel
Sutalaksana et al. [57]	2016	Chemical, Mining, Oil, Gas
Lipscomb et al. [58]	2015	Construction
Guldenmund et al. [59]	2013	Construction, Industry, Agriculture
Bergh et al. [60]	2013	Chemical
Kines et al. [47]	2011	Construction, Food industry

From this analysis, it emerges that few studies used the NOSACQ-50 questionnaire to investigate the safety climate in agricultural activities up to now. For instance, Fargnoli and Lombardi [8] provided a cross-sectional analysis of safety climate perceptions among farmers, pointing out the critical role of farmers' risk-taking attitude and safety prioritization in their working tasks. Differently, Lagerstrom et al. [50], investigated safety climate among workers involved in the logging industry, because such activities in some countries are considered forestry work belonging to the agriculture world (e.g., in Italy). Additionally, it is worth mentioning the research by Guldenmund et al. [59], who investigated safety climate among migrants in different working fields (construction, agriculture, and industry) by means of interviews with inspectors, safety managers, and trade unionists, while a direct feedback from the workers was not considered. Overall, these studies underline a low perception of safety issues among farmers. Such a low level of safety perception is consistent with the high rate of occupational accidents in the sector, strengthening the relationship between OHS and safety climate, in line with similar outputs that emerged in other sectors, such as the construction industry [61–63]. In particular, Marin et al. [9] used NOSACQ-50 to investigate the relationship between safety perceptions and the injury rate among construction personnel, demonstrating the reliability of such a tool in investigating safety perceptions across the organizational hierarchy within the company.

3.2. The COVID-19 Questionnaire

This questionnaire was implemented to investigate how farmers perceive the impact of the COVID-19 OHS measures. With this goal in mind, four items were defined by the authors, and refined in collaboration with OHS experts as well as occupational health

physicians (Four experts in total). Each item corresponds to an additional OHS measure that should be implemented by companies to reduce the risk of COVID-19 infection:

- C1. The management provides adequate information on the OHS risks related to COVID-19.
- C2. OHS procedures for preventing COVID-19 have been modified adequately.
- C3. The use of safety devices and Personal Protective Equipment (PPE) is adequate.
- C4. Work procedures (i.e., those related to daily activities) have substantially changed due to the COVID-19 outbreak.

Similarly to the NOSACQ-50 assessment criteria, the terms strongly disagree, disagree, agree, and strongly agree were used to rate each statement, which correspond to a respective score of 1–4. Following such an approach, the evaluation of each item was made based on the criteria shown in Table 3. Accordingly, the mean value of the responses (C_{tot} , representing the overall value) is evaluated in the same manner.

Table 3. Criteria used to evaluate the mean scores resulting from the COVID-19 questionnaire.

Score (s)	Level	Meaning
$s > 3.30$	good	High impact of the COVID-19 measure
$3.00 < s < 3.30$	fairly good	Moderate impact of the COVID-19 measure
$2.70 < s < 2.99$	fairly low	Little impact of the COVID-19 measure
$s < 2.70$	low	Scarce impact of the COVID-19 measure

In addition, an open question regarding which measure has impacted more on work situations was included for workers (employees) only. This extra question is aimed at collecting additional information on how companies have modified their activities and safety measures from the workers' standpoint. It has to be observed that, in such a context, "work situation" is intended as the combination of the worker, the work equipment, and the work environment, as suggested by Sadeghi et al. [64]. Due to the compelling nature of the safety measures related to COVID-19, managers were excluded from this analysis, because they are in charge of implementing and verifying the application of such measures.

3.3. Survey Features

With the support of local farmers' trade unions, 47 companies were selected in the Lazio and Campania regions; among them, 23 companies agreed to collaborate. Most companies operate in fruit and vegetable cultivation, olive growing, viticulture, and dairy farming. In two cases, the latter companies also run a shop annexed to the holdings where dairy products are sold. Therefore, the workers in the dairy factories' shops were also involved in the interview. Similarly, one company of the sample holds a winery and an annexed wine shop to sell its products directly. Overall, 83 responses were collected; among them, 80 were considered valid, while 3 were excluded as they were incomplete. In Table 4, additional information on the sample composition is provided.

Table 4. Background information concerning the interviewed sample.

Title 1	Title 2	Title 3
Age	Mean	42.9 years
	Max	67 years
	Min	25 years
Gender	Male	57 (71.2%)
	Female	23 (28.7%)
Position	Manager	26 (32.5%)
	Worker	54 (67.5%)

All the interviewed companies are small-sized enterprises, mainly consisting of 1 manager and 1 or 2 workers, where managers usually share working activities with workers. These companies also employ seasonal workers when necessary (e.g., during grape or olive harvesting periods) and contractors for work needing specialized machinery. However, during the survey no seasonal workers were found, probably because of the restrictions due to the pandemic. All the interviewed companies confirmed that additional OHS measures had been implemented due to COVID-19, including specific information/training.

The output of the NOSACQ-50 analysis involving this sample was compared with the results of a similar study performed by the authors at the beginning of the COVID-19 emergency in Italy [8]. Indeed, the previous study was designed before the pandemic and carried out during its first stages. Hence, the effects of COVID-19 had not been registered because, at that time, agricultural activities were partially involved in the emergency status as a few effects on the population were registered in the sample area. Differently, the current study was carried out in the winter season during the second wave of COVID-19, when not only the population was (unfortunately) aware of the effects of the situation, but also additional safety measures had already been implemented to reduce the possibility of infection. It has to be noted that, although the sample of this study is different from the one interviewed in the previous work [8], the current companies belong to the same area and are involved in similar activities. Finally, it has to be outlined that all subjects gave their informed consent for inclusion before they participated in the current study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the DICMA Department.

4. Results

4.1. The NOSACQ-50 Output

Results achieved by means of the NOSACQ-50 questionnaire show a general low perception of safety climate among the interviewed farmers, as schematized in Figure 3.

In more detail, in Table 5 the output of the interview is shown, where the scores achieved per each dimension are reported for the full sample (Total), as well as differentiating between managers and workers. These data were verified by means of the estimation of the Cronbach's Alpha index [65], according to which the test reliability is considered acceptable when the alpha values are higher than 0.70.

Screening these data, it emerges that, at a general level, most dimensions range from 3.00 to 3.30, meaning that, overall, the safety climate perception is good. Only the value related to dimension 5 (workers' safety priority and risk non-acceptance) results as "fairly low", based on the criteria shown in Table 1. This dimension reflects the workers' risk-taking attitude and safety prioritization in working activities, indicating that the level of the perceived priority given to safety issues over the production goals is low.

Actually, this is particularly true among workers, whose scores also indicate a low level of perception of the safety climate dimensions related to management commitment, as shown in Figure 4, where the discrepancies between managers and workers can be depicted in a clearer manner.

Comparing these results with those that emerged in the previous study [8], a general improvement in the safety climate level can be noted (Figure 5), although the safety climate perceptions have not increased in the same manner considering its different dimensions.

In particular, these discrepancies between old and new data are more considerable in the case of managers, rather than for workers (Table 6).

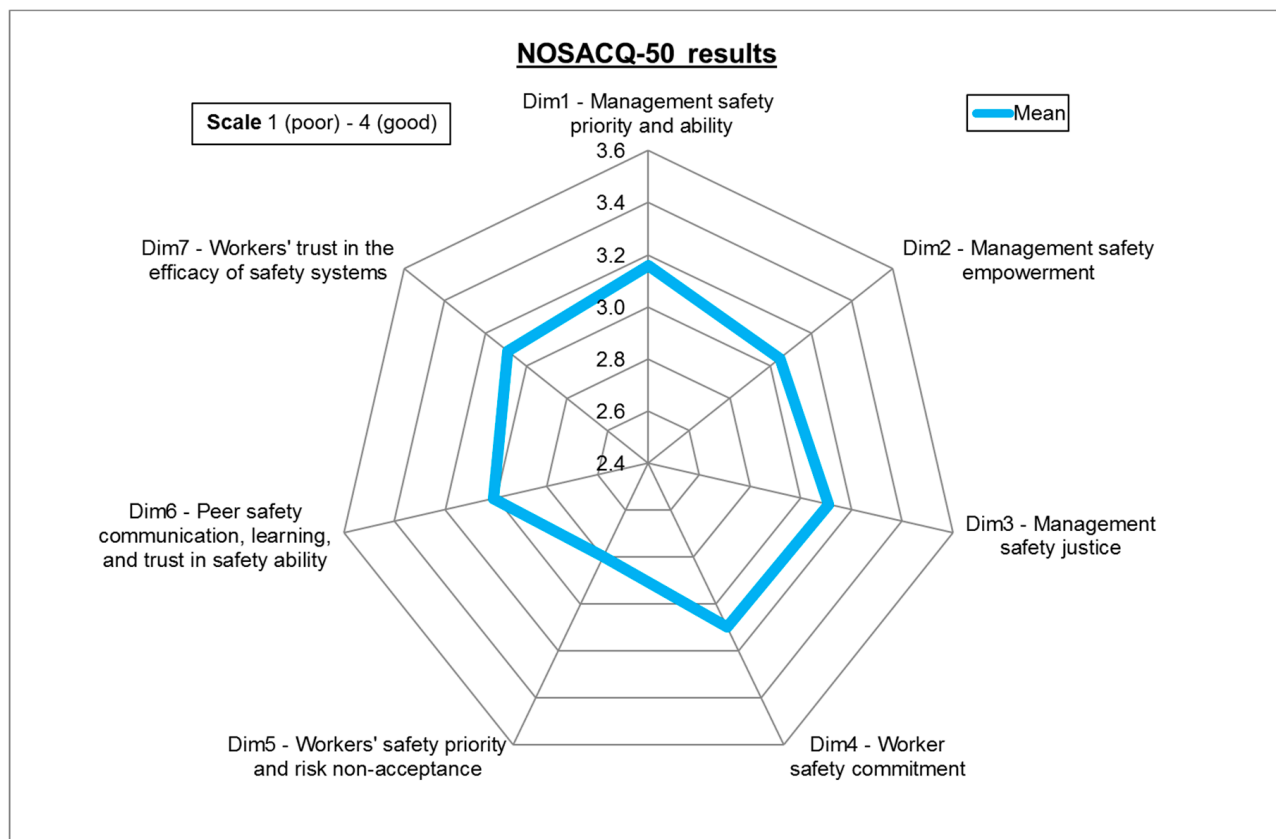


Figure 3. Overall results of the NOSACQ-50 questionnaire.

Table 5. Scores of NOSACQ-50 divided per dimensions (expressed as mean values) and the related Cronbach's Alpha indexes.

Dimensions	Meaning	Total	Managers	Workers
Dim1	Management safety priority, commitment, and competence	3.16	3.51	2.99
Dim2	Management safety empowerment	3.04	3.40	2.88
Dim3	Management safety justice	3.11	3.38	2.98
Dim4	Workers' safety commitment	3.10	3.17	3.06
Dim5	Workers' safety priority and risk non-acceptance	2.80	3.00	2.70
Dim6	Safety communication, learning, and trust in co-workers safety competence	3.01	2.98	3.03
Dim7	Trust in the efficacy of safety systems	3.09	3.38	2.95
Cronbach's Alpha	Test reliability $\alpha > 0.70$	0.82	0.83	0.71



Figure 4. Scores of NOSACQ-50 divided per dimensions (mean values) achieved by managers and workers.

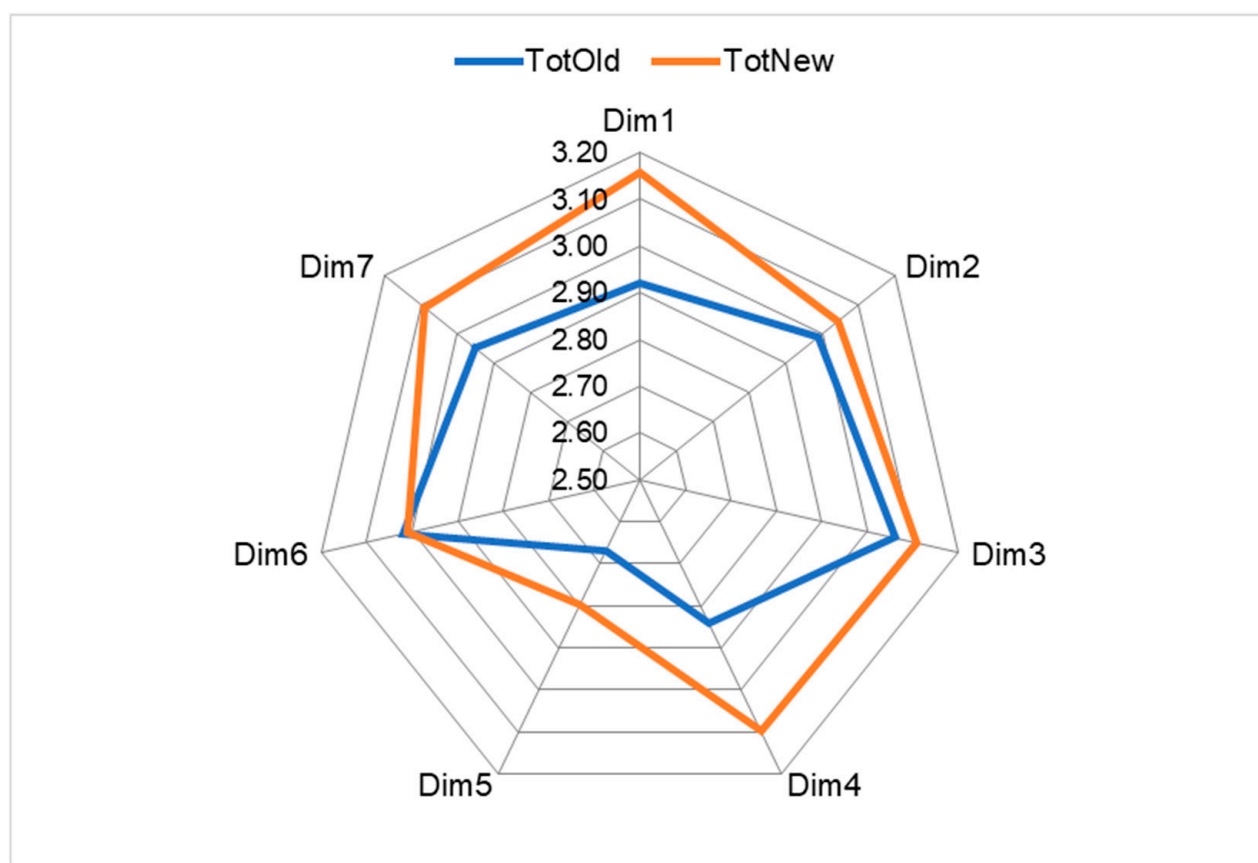


Figure 5. Overall results of the NOSACQ-50 questionnaire in the current study (TotNew) compared to those of previous research [8] (TotOld).

Table 6. Discrepancies emerged for each dimension of the NOSACQ-50 questionnaire between the current study and previous research [8].

	Total		Managers		Workers	
	Value	%	Value	%	Value	%
Dim1	0.24	5.92	0.36	8.96	0.19	4.75
Dim2	0.05	1.37	0.11	2.64	−0.05	−1.25
Dim3	0.05	1.21	0.15	3.87	0.00	0.00
Dim4	0.26	6.40	0.26	6.58	0.27	6.75
Dim5	0.13	3.16	0.24	6.00	0.08	2.00
Dim6	−0.01	−0.23	−0.09	−2.35	0.04	1.00
Dim7	0.14	3.48	0.21	5.23	0.10	2.50

More specifically, considering the differences among managers (Figure 6), it emerged that most relevant improvements in safety climate perception are related to Dim1 (Management safety priority) and Dim4 (Workers' safety commitment).

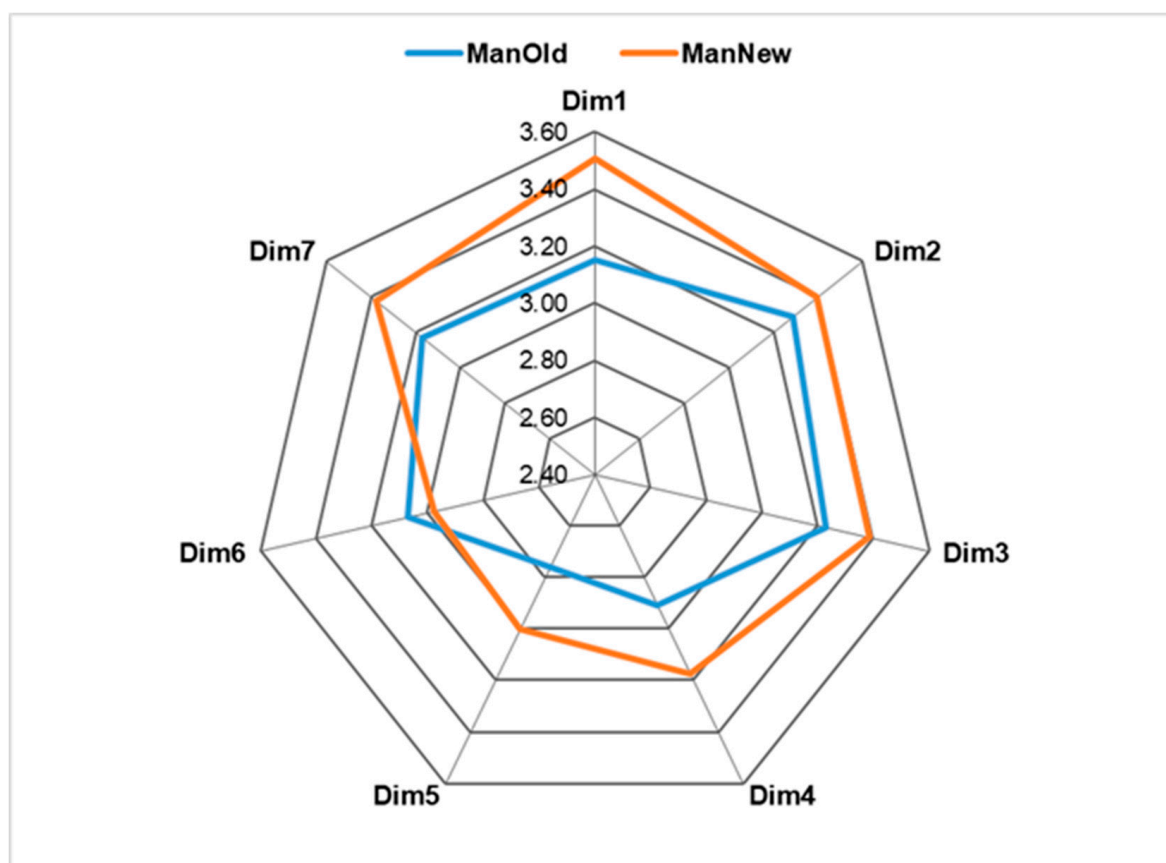


Figure 6. Results of the responses of managers to NOSACQ-50 in the current study (ManNew) compared to those of previous research [8] (ManOld).

Results concerning the former aspect show an increase of almost 9% in the safety perceptions related to the commitment of the management on safety issues.

Such a result could be expected, taking into account the additional efforts needed to run the companies in a period of COVID-19, reflecting the higher involvement of managers. Similarly, the improvement in Dim4 brings to light an augmented effort of workers in dealing with safety issues from the managers' standpoint. Conversely, a decrease related to Dim6 (Safety communication) was registered, showing that managers perceive an augmented lack of communication and mutual trust in safety issues among workers. Such

a trend could be explained by the fact that the need to implement distancing measures as well as work shifts has reduced the opportunities of talking and sharing experiences at the workplace.

Safety climate perceptions of workers, however, seem to increase slightly, as schematized in Figure 7. In particular, major differences can be found, as in the previous case, in Dim1 (Management safety priority) and Dim4 (Workers' safety commitment), confirming an augmented commitment on safety issues both from managers and workers.

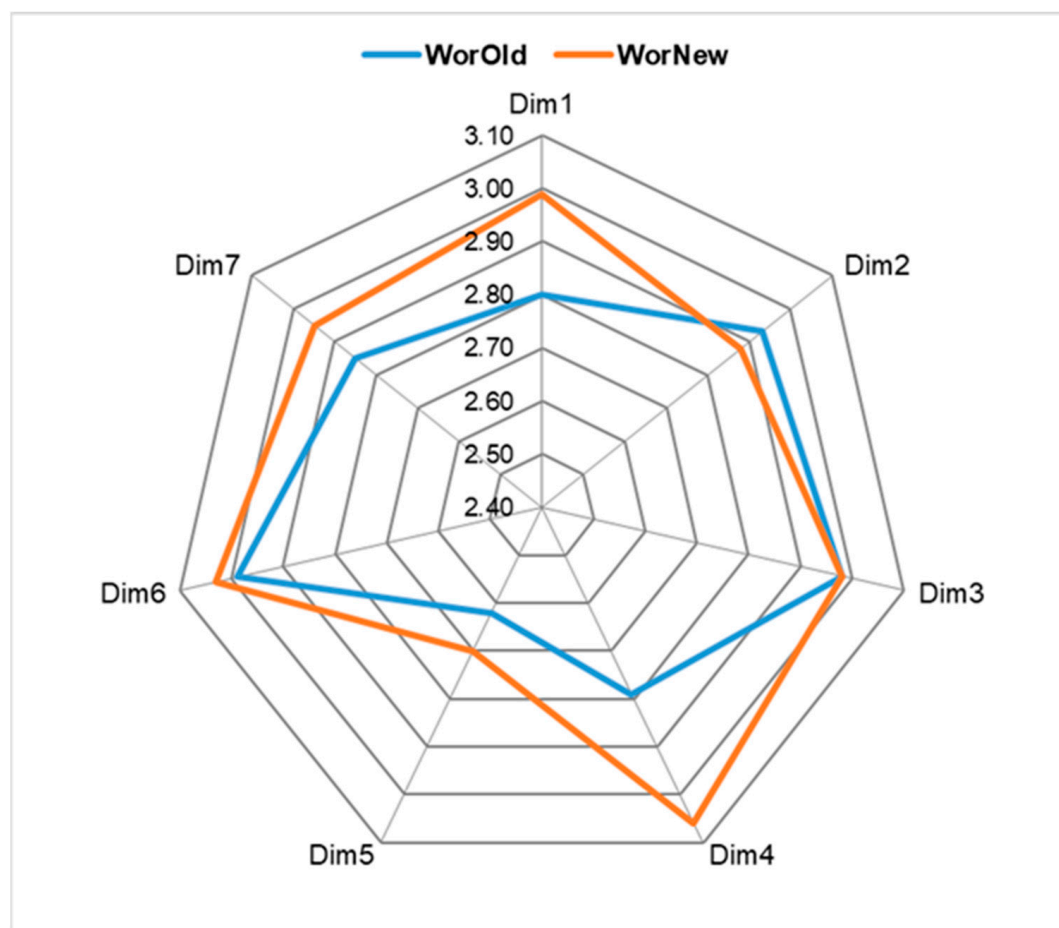


Figure 7. Results of the responses of managers to NOSACQ-50 in the current study (WorNew) compared to those of previous research [8] (WorOld).

Conversely, for two safety climate dimensions (Dim2 and Dim3), no improvements were registered; indeed, in the case of Dim2 a decrease occurred. The latter aspect shows that, although a higher management commitment is perceived by workers (Dim1), they do not consider the empowerment of safety measures sufficient (e.g., the management involves employees in decisions regarding safety). Additionally, the perception of the management safety justice (Dim3) results are equal to the ones registered in the previous study. Overall, these results validate the hypothesis that, due to the COVID-19 outbreak, an augmented safety climate perception can be registered at workplaces.

4.2. The COVID-19 Questionnaire

The COVID-19 questionnaire was aimed at investigating how farmers perceived specific measures implemented due to COVID-19 by means of the following 4 statements (items):

- C1. The management provides adequate information on the OHS risks related to COVID-19.
- C2. OHS procedures for preventing COVID-19 have been modified adequately.

- C3. The use of safety devices and Personal Protective Equipment (PPE) is adequate.
 C4. Work procedures (i.e., those related to daily activities) have changed due to the COVID-19 outbreak substantially.

It has to be noted that, while statements C1–C3 are aimed at evaluating the adequacy of COVID-19 OHS measures, C4 refers to the perception of whether work procedures had changed. As explained above, all these statements were evaluated by means of a 1–4 Likert scale, as in the case of the NOSACQ-50 questionnaire. As reported in Table 7, the output of this analysis shows a fairly good value considering both the overall results and those related to managers and workers (results are expressed as mean scores). As for the NOSACQ-50 results, in the last column, the output of the Cronbach's alpha tests is reported.

Table 7. Results of the COVID-19 questionnaire ¹.

	C1	C2	C3	C4	Ctot	Cronbach's Alpha
Total	3.61	2.90	3.31	2.45	3.07	0.73
Managers	3.54	3.04	3.38	2.62	3.14	0.70
Workers	3.65	2.83	3.28	2.37	3.03	0.76

¹ Ctot represents the mean score of the whole assessment, while C1, C2, C3, and C4 refer to the responses to the different items of the questionnaire.

However, analyzing the discrepancies between managers and workers, it can be noted that, while the former have a sufficiently positive perception of the safety measures implemented, the latter showed a lower mean score (Figure 8). In particular, it seems that, from the workers' point of view, no significant changes had occurred in work procedures (i.e., those related to daily activities) due to COVID-19 (C4 in Figure 8). This aspect can be explained by the nature of agricultural activities, which are mostly carried out in fields (outdoors), where distancing among co-workers is normally ensured.

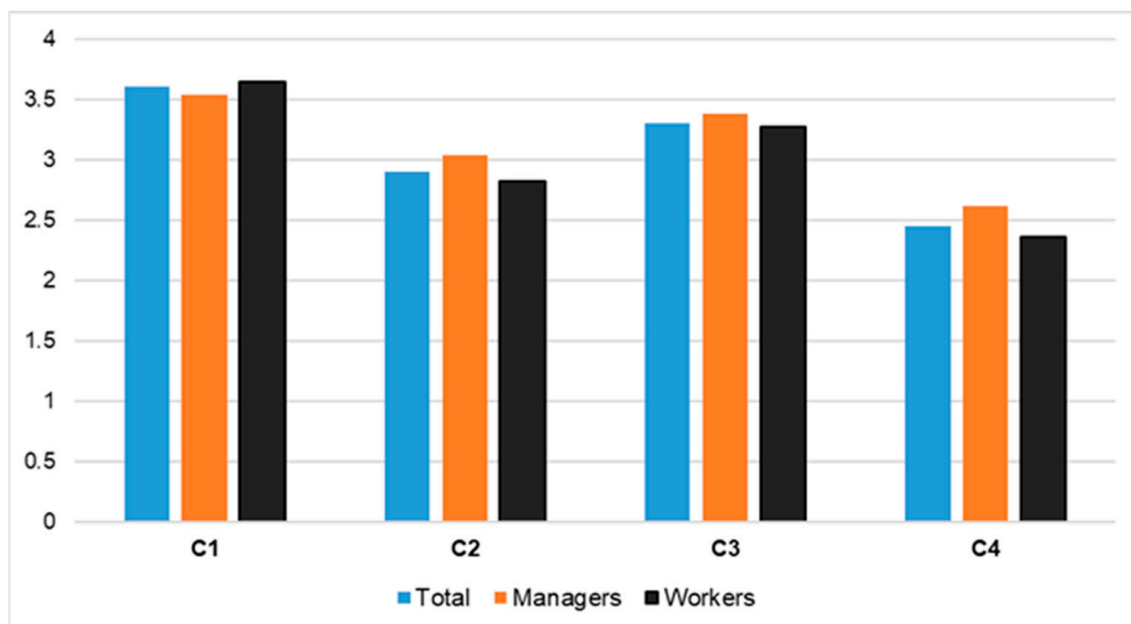


Figure 8. Results of the COVID-19 questionnaire expressed as mean scores (C1, C2, C3, and C4 refer to the responses to the different items of the questionnaire).

Then, a further analysis was carried out to verify the correlation between the results of the COVID-19 questionnaire and those of NOSACQ-50. For this purpose, Pearson's

correlation index [66] was used, and the output is summarized in Table 8, where the results of the COVID-19 survey (Ctot represents the overall results, while Cman and Cwor represent those related to managers and workers, respectively) were correlated to those related to each dimension of NOSACQ-50 (for each dimension, overall results, and those obtained by managers and workers, were used).

Table 8. Pearson's correlation indexes between the output of the COVID-19 questionnaire and that of NOSACQ-50 ¹.

	Dim1	Dim2	Dim3	Dim4	Dim5	Dim6	Dim7
Ctot	0.27	0.10	0.01	−0.05	−0.07	0.04	0.18
Cman	0.03	−0.07	−0.38	−0.32	−0.31	−0.08	−0.16
Cwork	0.39	0.14	0.18	0.11	0.01	0.17	0.30

¹ Ctot indicates the overall results, while Cman and Cwor indicate those related to managers and workers, respectively. Dim1 = Dimension1; Dim2 = Dimension 2; Dim3 = Dimension 3; Dim4 = Dimension 4; Dim5 = Dimension 5; Dim6 = Dimension 6; Dim7 = Dimension 7.

At a general level (Ctot), most safety climate dimension results correlate positively to the concerns due to COVID-19, even if the values are not particularly high. The output of this analysis is more interesting when considering the correlation indexes related to the managers and workers separately. Actually, while managers' responses to the COVID-19 questionnaire (Cman) suggest a negative correlation or almost no correlation with the safety climate aspects, the workers' perception of COVID-19 safety issues (Cwor) appears influenced by safety climate in a positive manner. Moreover, it has to be noted that these differences are related, not only to the impact on the managerial dimensions of NOSAC-50 (i.e., Dim1–Dim3), but also to those regarding the employees (Dim4–Dim7). Such an output is in line with the discrepancies brought to light by Marin et al. [9], who analyzed safety climate in the construction industry. To verify the reliability of these data from a statistical point of view, *t*-test analysis was performed (Table 9).

Table 9. Results of the *t*-test analyses related to the correlation between the NOSACQ-50 and COVID-19 questionnaires ¹.

	Dim1		Dim2		Dim3		Dim4		Dim5		Dim6		Dim7	
	<i>t</i>	<i>p</i>	<i>t</i>	<i>p</i>	<i>t</i>	<i>p</i>	<i>t</i>	<i>p</i>	<i>t</i>	<i>p</i>	<i>t</i>	<i>p</i>	<i>t</i>	<i>p</i>
Ctot	1.177	0.241	0.322	0.748	0.532	0.596	0.334	0.739	3.386	0.001 *	0.870	0.386	0.264	0.792
Cman	2.907	0.005 *	1.843	0.071	1.779	0.081	0.179	0.859	0.982	0.331	1.333	0.189	1.788	0.080
Cwork	0.531	0.596	1.953	0.053	0.683	0.496	0.285	0.776	3.571	0.001 *	0.060	0.953	0.912	0.364

¹ *t* indicates the *t*-test output, *p* indicates the level of statistical significance, and * indicates *p* < 0.05.

The results of this analysis showed a lack of statistical significance because most values obtained did not satisfy the minimum level of significance at *p* < 0.05 [67]. Accordingly, this output has a qualitative value. In addition, the *t*-test was also used to investigate if causal inferences exist between managers and workers. The output of these analyses is reported in Table 10 (NOSACQ-50 questionnaire) and Table 11 (COVID-19 questionnaire).

Table 10. Results of the *t*-test analyses related to the correlation worker–manager in the NOSACQ-50 questionnaire ¹.

Workers (Dataset 1)—Managers (Dataset 2)														
	Dim1		Dim2		Dim3		Dim4		Dim5		Dim6		Dim7	
Dataset	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Sample size	54	26	54	26	54	26	54	26	54	26	54	26	54	26
Average value	2.99	3.51	2.88	3.40	2.98	3.38	3.06	3.17	2.70	3.00	3.03	2.98	2.95	3.38
Standard Deviation	0.32	0.37	0.26	0.46	0.31	0.45	0.42	0.64	0.44	0.54	0.21	0.38	0.40	0.42
<i>t</i>	6.475		6.459		4.734		0.959		2.674		0.781		4.395	
<i>p</i>	7.73 × 10 ^{−9} *		8.27 × 10 ^{−9} *		0.00001 *		0.3403		0.00913 *		0.43701		0.00003 *	

¹ *t* indicates the *t*-test output, while *p* indicates the level of statistical significance and * indicates *p* < 0.05.

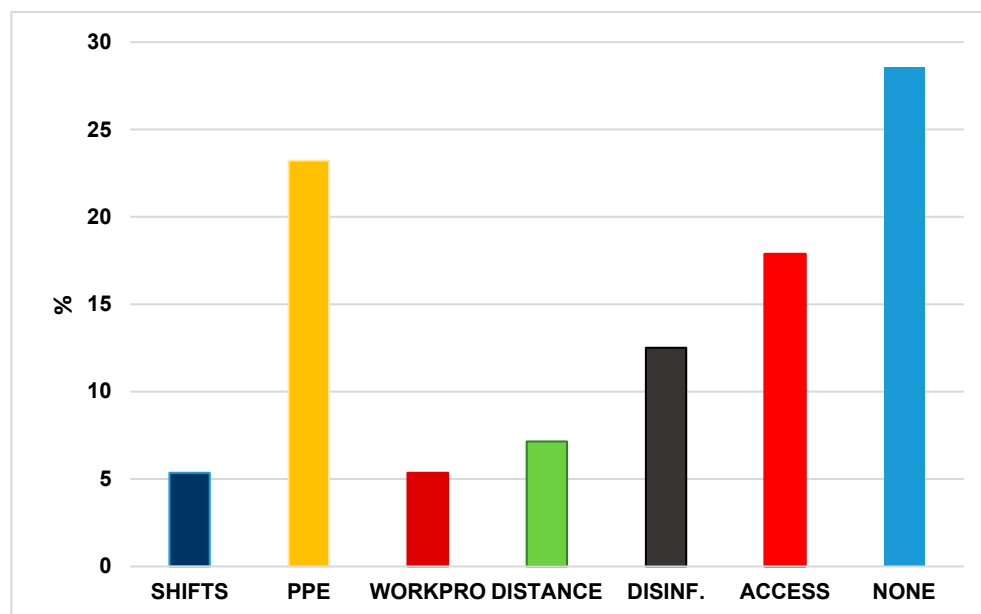
Table 11. Results of the *t*-test analyses related to the correlation worker–manager in the COVID-19 questionnaire ¹.

	Workers (Dataset 1)—Managers (Dataset 2)				
	C1	C2	C3	C4	Ctot
Dataset	1	2	1	2	1
Sample size	54	26	54	26	54
Average value	3.65	3.54	2.83	3.04	3.28
Standard Deviation	0.48	0.58	0.72	0.72	0.66
<i>t</i>	0.89	1.193	0.668	1.182	0.889
<i>p</i>	0.376	0.236	0.505	0.2405	0.37667

¹ *t* indicates the *t*-test output, while *p* indicates the level of statistical significance.

As a result, it emerged that the differences between managers and workers in safety climate perceptions are statistically significant for most dimensions, while this sample subdivision does not statistically impact on the output of the COVID-19 questionnaire.

Finally, an additional analysis was conducted among workers only to investigate the most impacting changes in work situations by means of an open question. The results of this investigation showed that the main modifications concerned the use of specific PPE such as masks and gloves (23.2%), as well as rules to access the company's common areas (17.9%) (Figure 9). Other measures related to the use of common spaces within the company also had a certain impact: disinfection (DISINF. 12.5%); distancing (DISTANCE 7.1%); and SHIFTS (5.4%). Conversely, results suggest that work procedures had not changed significantly (WORKPRO %), while 28.6% of workers did not feel practical changes. The latter output is in line with the very low correlation score ($r = 0.01$) between Dim5 (workers' safety priority and risk non-acceptance) and Cwor, because this safety climate dimension is the most related to the practical aspects of working activities.

**Figure 9.** Responses of workers to the open question (percentages).

5. Discussion of Results

The analyses carried out represent an attempt to reduce the lack of research on safety climate among farmers. The study focused on the impact the COVID-19 outbreak had on the perception of farmers' safety issues. For this purpose, the NOSACQ-50 questionnaire was used because it represents a reliable tool to investigate the perceptions of management and workers commitment to safety, highlighting safety motivation, perceived safety level,

and self-rated safety behavior [59]. In particular, to verify the research hypothesis, the NOSACQ-50 results were compared with the ones obtained in a previous study in a very similar context. This allowed us to elicit differences in safety climate perceptions that can be due to the different working situations generated by the COVID-19 outbreak. In detail, results showed an improvement of safety climate perceptions, both at a general level and for managers and workers specifically. Such an output corroborates the posed hypothesis, based on which a positive impact of the COVID-19 safety measures on safety perceptions of workers can be assumed. This is supported by the fact that higher score changes were obtained for the dimensions related to safety commitment issues (Dim1 and Dim4). On the other hand, a different perception between managers and workers emerged considering Dim6 (Safety communication, learning, and trust in co-workers safety competence). Actually, the fact that no relevant differences were found among workers in this dimension could be attributed to the small size of the interviewed companies and the fact that agricultural activities are carried out alone diffusely, which is in line with the research outcomes by Irwin and Poots [32]. On the other hand, the distancing measures and work shifts adopted due to COVID-19, which have reduced the chances to meet each other, could justify the reduced perception of Dim6 among managers.

However, despite an overall improvement of safety climate, current results suggest that the level of perception related to safety priority and risk non-acceptance resulted very low, especially among workers (Dim5), underpinning the fact that, in agricultural activities, risk taking behavior is a critical issue, even when the attention paid to OHS seems higher. Such a finding expands the results of previous studies on farmers' perceptions and attitudes towards risks [68–70]. This aspect is also consistent with workers' behavior in the construction industry [71–73], confirming the similarities between these two sectors, especially in the case of small-sized enterprises.

The output of the questionnaire related to the COVID-19 OHS measures and its correlation with the responses to NOSACQ-50 contributed to support the hypothesized relationship between the emergency situation and safety climate, although the indexes do not show a high level of correlation. On the one hand, this result can be justified by the outdoor nature of agriculture activities, while most COVID-19 OHS measures concern the use of common areas and PPE. On the other hand, beside an augmented safety commitment, the different results obtained by managers and workers are consistent with the research findings of similar studies on occupational safety attitudes and behavior [74,75], according to which these dissimilarities can be attributed to the difference in roles where managers may tend to show the effectiveness of their policies in guaranteeing a safe workplace in any case. Moreover, the different responsibilities in OHS management are evident when considering the different sign of the correlation indexes. Actually, merging the results of the COVID-19 questionnaire and the negative correlation indexes related to managers, it appears that managers do not feel completely confident about the effectiveness of the safety measures implemented to reduce risks related to COVID-19. Such an output reflects the fears that managers have of the effectiveness of the specific safety measures they have implemented, for which they are responsible. This is also confirmed by the results of the *t*-test analysis, according to which the responses to the COVID-19 questionnaire did not seem affected by the different roles (worker–manager) of the interviewed sample. This might be related to the fact that, in the companies in our sample, managers play the double role of administrators and workers at the same time. Hence, they are aware of the COVID-19 risk exposure in a similar manner that workers are, in a period where there is still uncertainty on how to prevent the contagion at the workplace effectively.

These results can certainly augment learning regarding the impact of COVID-19 on workers and managers, responding to the need of further research to analyze the effects of the COVID-19 pandemic in different sectors expressed by Seddighi et al. [76].

5.1. Implications of the Study

Practical contributions of the research methods can be summarized as follows. Overall, this study extends the safety climate research in general, and the application of NOSACQ-50 in particular, in the agricultural context. The use of NOSACQ-50 allowed us to elicit information on the perceived safety level and self-rated safety behaviors of the interviewed sample, pointing out the discrepancies between managers and workers (employees). Such a tool confirmed its effectiveness in depicting the psychological dimension of safety culture [77] and its use can be foreseen to augment safety management within companies as it increases managers' and workers' safety awareness. In this light, it can be considered a proper tool to foster resilience safety culture by means of continuous improvement and learning [78]. Besides, the COVID-19 questionnaire represents a first attempt to analyze the impact of the current pandemic from the OHS point of view. Although such a tool certainly requires an improvement in terms of contents and reliability, it can contribute to analyzing the adequacy of specific OHS measures aimed at reducing the risk of contagion, augmenting both managers' and workers' awareness. Therefore, their inclusion in the OHS management system can allow companies to better identify specific safety climate areas for improvement, taking into account that both are inexpensive to learn and implement in a company.

The theoretical outcomes of this study are related to the results of the investigations, which, despite their qualitative nature, support the following findings.

The output of NOSACQ-50 revealed an augmented level of safety climate perceptions, which can be related to the implementation of the COVID-19 OHS measures. Nonetheless, farmers' risk-taking behavior and risk acceptance resulted critical. Thus, on the one hand, it can be confirmed that safety information/training activities and a larger attention paid to safety at a general level have a positive effect on safety climate, consistently with the outcomes of safety climate studies in the construction sector [79,80]. On the other hand, the low perception of the empowerment of safety measures among workers and their high-level of risk acceptance suggest a more work-situation tailored safety information/training. Such a finding, coherently with the output of Marin et al. [9], stresses the need of OHS measures specifically designed for those practical activities that farmers carry out daily.

As far as the impact of COVID-19 on working activities is concerned, it should be noted that most farmers considered the implementation of OHS measures aimed at preventing the COVID-19 infection at the workplace to be barely sufficient, although they judged the information on this to be fairly good.

Interestingly, the results related to work procedures show that working activities have not been modified substantially because of COVID-19 and the related OHS measures. Such an output is confirmed by the workers' responses to the open question as the most perceived modifications concern the use of PPE and common areas within the company. While this could be expected considering both the nature of agricultural activities and the high risk-taking behavior registered by the NOSACQ-50 survey, a low need of additional safety measures can be outlined. In the authors' opinion, this outcome brings to light the necessity for further investigations on the applicability and appropriateness of the additional OHS measures issued at the national level in the agricultural context. Accordingly, the provision of specific measures, tailored to the type of activities carried out by farmers, could reduce this perception, improving, at the same time, the safety climate level.

5.2. Limitations

The qualitative nature of results and the limited number of the interviewed farmers certainly represent a limit of this study, whose validity has to be related to the case study context only. The sample population was limited to professional farmers operating in a specific area and, due to the restrictions because of COVID-19 when the interviews were performed, no seasonal workers were found, according to the company's declarations. Hence, it was not possible for the authors to understand to which extent this has biased the study. Accordingly, while caution is required in generalizing the findings beyond

the sample concerned [50], the use of a case-study as a research tool for exploratory investigation and to generate new understandings can be recognized [81].

In this light, further research work has to be carried out to augment the number of the interviewed farmers so as to obtain more statistically sound outcomes.

Moreover, the COVID-19 questionnaire presented in this study has to be considered as a tool for general surveys that helped us in better understanding the specific context in which the safety climate investigation was performed. Its improvement is needed for it to be considered as a stand-alone tool, both in terms of contents and reliability. Hence, researchers and practitioners are welcome to participate in its implementation and further applications, also in different occupational settings.

6. Conclusions

Farmers' OHS represents a subject of major concern worldwide, and the investigation of safety climate perceptions can certainly help in better understanding management and worker commitment to safety, as well as their safety behavior and attitude. Moreover, due to the COVID-19 outbreak, an additional element of analysis has to be considered, which greatly impacts daily activities. The present study dealt with the investigation on how the pandemic has been affecting farmers and their safety climate perceptions.

The results from this analysis provided a twofold output. On the one hand, they showed that concerns related to the COVID-19 pandemic have augmented the attention paid to OHS at a general level, demonstrating a correlation between the safety climate dimensions and the specific OHS measures due to COVID-19. On the other hand, despite such an improvement, farmers' risk-taking behavior and attitude resulted to be still critical, requiring additional efforts to improve shared safety knowledge and awareness on safety practices and safety compliance, as well as highlighting the need for more specific and contextual interventions in terms of safety information and training. Overall, the results of the current study can expand knowledge on safety climate and safety culture in agriculture. In this light, the measure of safety climate can improve safety culture as it can contribute to understand how workers and managers feel about safety and safety management at the workplace. However, the qualitative nature of the results achieved should be related to the case study context only, while future research is expected to expand the study findings, providing additional information on the reliability of the tools used in this study and to augment knowledge on the effects of the COVID-19 outbreak on occupational safety and health in different contexts.

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