

SOCIAL AND PSYCHOLOGICAL IMPACT OF COVID-19 PANDEMIC ON  
CONSTRUCTION PROJECTS

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**Title**

Social and Psychological Impact of Covid-19 Pandemic on Construction  
Projects

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The Supervisory Committee certifies that this *disquisition* complies with North Dakota  
State University's regulations and meets the accepted standards for the degree of

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## **ABSTRACT**

As the construction workers were impacted during the Covid-19 period from social distancing to eventual lack of human interaction, it is necessary to understand the changed social and psychological states of construction workers to manage and improve their performance. This study aims to investigate the social and psychological impact of Covid-19 on the performance of construction projects. The survey was carried out by construction professionals including construction managers, superintendents, and laborers. It was found that anxiety and depression, and health risk concern changed significantly in the pre and post-pandemic period. The results also highlighted health risk concerns, sense of belonging, income equality, job stability, stress management, knowledge, and financial stability as the most impactful factors influencing the workforce's performance on construction projects. This study contributes to providing the managerial implications and guidance for improving the construction workforce including managers' and site laborers' performance in the post-pandemic period.

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## **DEDICATION**

My Parents, thank you for all your sacrifice.

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## 1. INTRODUCTION

The pandemic caused by the newest strain of Covid-19 has sent global economies into a tailspin, and the social distancing considerations and quarantines have halted most activities (Assaad et al. 2021). The Covid-19 period brought a different aspect of living and activities regarding projects and their sustainability. Construction contracts have been adversely affected by the Covid-19 pandemic, and the virus will continue to have an impact on the engineering and construction industries (Ataei et al. 2021). Supply chains have been disrupted and will continue to be. State and federal agencies, such as the Occupational Safety and Health Administration (OSHA), will require mandates for new procedures to protect workers from the spread of Covid-19 and future viruses, including new rules for personal hygiene, or in extreme scenarios, suspension of construction operations (Ataei et al. 2021). The U.S. economy continues its slide to potentially historic lows because of the Covid-19 pandemic, and many architectures, engineering, and construction economists are scrambling to sort out how damaging the crisis could be and what a recovery might look like (Carolina 2020).

An increase in the cost of materials was reported as a negative effect of the Covid-19 pandemic, along with significant project delays and difficulties obtaining materials on time (Alsharef et al., 2021). As part of the project's risk management strategy, OSHA introduced a variety of safety and risk-reduction measures on-site such as face masks being mandated, and social distancing protocols being implemented (Ogunnusi et al., 2020). This resulted in staggering construction operations and reduced project productivity (Assaad et al., 2021). Furthermore, the Covid-19 pandemic affected the construction workforce. The Covid-19 pandemic made construction workers adjust their everyday lifestyle and indulge in what is most important from health conditions to social groups involvements all impacting, not just their

personal lives, but also their professional lives, the social and psychological impact of the These newly introduced lifestyles changed workers' perspectives regards work (Sood, 2020). Due to exposure to the virus, physical separation, social stigma and discrimination, and the loss of employment because of the Covid-19 pandemic, many construction workers are experiencing post-traumatic stress disorders, anxiety, depression, and insomnia (Assaad et al., 2021). All these anxieties and imbalances have a knock-on effect on the performance of construction projects. As such, the social and psychological impact of the Covid-19 pandemic on the construction workforce cannot be overstated (Lai et al., 2020).

Despite the importance of the social and psychological states of workers on the construction project, few studies have dealt with social and psychological variables that affect workforce and project performance. Construction workers' decisions are made based on the state of their physical, social, and mental well-being from the decision-making process of the design stage to the construction stage on the job site. Although the Covid-19 pandemic has come to stay, it has changed the workers' social and psychological states on construction sites. Therefore, understanding the social and psychological states of construction workers and providing guidelines to manage them and improve their performance should be conducted in the post-pandemic period.

To this end, this study aims to investigate the social and psychological impact of Covid-19 on the performance of construction projects. With questionnaires using selected social and psychological variables, we surveyed the construction workers including laborers, superintendents, and construction managers. Then, this study performed paired *t*-test analysis to investigate the difference in social and psychological states before and after the Covid-19 pandemic. Multiple regression analysis was also employed to examine the most impactful social

and psychological states affecting the performance of construction projects from the perspectives of managers and laborers. The findings of this study are expected to provide managerial implications for improving performance in the post-pandemic.

The remainder of this paper is organized as follows. The next section reviews the literature on the changes in the construction industry caused by the Covid-19 pandemic and the social/psychological theories affecting performance. Then, the research method including the research model, data collection, and statistical techniques used in this study are described. The analysis results are provided, followed by discussions and conclusions.

## **2. LITERATURE REVIEW**

### **2.1. Covid-19 pandemic and construction industry**

The construction industry is a major economic force because of its numerous interconnections with other industries such as manufacturing, financial, and real estate industries (Johari & Jha, 2020). The construction industry accounts for about 13% of global GDP and is predicted that global construction spending will have increased by more than 70% to \$15 trillion by 2025 (Pedrosa et al., 2020), (Soekiman et al., 2011). In addition, the United States construction industry employs approximately 4.7 % of the workforce (Pirzadeh & Lingard, 2021). As such, the construction industry plays a significant role in the global and national economies.

Construction is by nature much dominated by project-based one-off approaches and projects tend to be complex and uncertain (Raoufi & Fayek, 2018). The construction industry is labor intensive, and factors such as labor skill and talent are important in influencing construction performance (Gatti et al., 2013). However, the workforce in construction is vulnerable because employment is temporary, the employer and employee relationship are very fragile and most of the time short-lived. In this respect, labor supervision is an important factor in driving performance (Johari & Jha, 2020) (Ruiz-Frutos et al., 2020).

The Covid-19 pandemic struck the world without warning and has affected every aspect of the construction process including contract or project notices for default, scheduling, and adjustments, project suspension, termination and reinstatement, material, subcontractor, and supply chain delays, and workforce management. Several studies discussed the impact of the Covid-19 pandemic on the construction industry. Ogunnusi et al., (2020) investigated the effects of the pandemic on the procurement process and the emergence of new ways to perform the

work through qualitative research. They highlighted the disruptions in the supply chain, workers' anxiety, and the cancelation of several contracts and projects because of the pandemic. Bsisu, (2020) described the effect of the pandemic on Jordanian civil engineers and the construction industry reviewing other literature as disastrous with workers forced to work from home due to their failure to adhere to social distancing at work and use of personal protective equipment. Alsharif et al., (2021) discussed one of the early impacts of the pandemic on the US construction industry was significant delays in project delivery, inability to obtain materials quickly, low productivity rates, and an increase in material prices.

The construction industry after the pandemic is still experiencing several effects of the Covid-19 strain as workers battle with mental health issues (Peters & Bennett, 2020), (Sood, 2020). As a result of exposure to the virus, physical separation, social stigma and discrimination, and the loss of employment because of the Covid-19 pandemic, many people are experiencing post-traumatic stress disorders, anxiety, depression, and insomnia affect healthcare workers, patients with Covid-19 and other illnesses (Assaad et al., 2021). The pandemic altered workers' views of the world, their sense of social responsibility, and their psychological perceptions of the construction industry (Pirzadeh & Lingard, 2021). All these anxieties and imbalances have a knock-on effect on performance. Assaad et al., (2021) investigated the short- and long-term impacts of the pandemic on workforce-related issues, project and workplace considerations, procurement, and supply chain implications, and contractual, legal, and insurance aspects. Carrying out the research through literature reviews and available guidelines, they provided further research areas into the impact of the pandemic on the construction industry, one of which is the social and psychological impacts of the pandemic on construction workers in terms of performance which this research is about. Ogunnusi et al. (2020) explored the effects and

prospects of the pandemic thus giving insight into researching the effects of the pandemic on the workforce in general in terms of their social and psychological status.

## **2.2. Social and psychological states and performance of the construction project**

The construction industry was designed to allow for workers' communications and interactions to achieve a common goal of completing the project (Venselaar et al., 2015). According to social interaction theory, peoples' social behaviors are determined by the social pressor they encounter. This means that behavior is created in response to peoples' surroundings. When one people's behavior including overt actions, mental considerations, and psychological processes is consciously rearranged by another people's behavior and vice versa, social interaction occurs (Memon et al., 2015). As such, to complete the project, it is needed for workers to interact with one another to foster relationships and progress. However, the advent of Covid-19 reduced workers' interaction on construction sites and projects due to social distancing and safety procedures (Ogunnusi et al. 2020, Alsharef et al. 2021). The impact of Covid-19 on the construction industry reduced site activities, interactions of workers, social gatherings, and strained communications between field workers (Ruiz-Frutos et al., 2020). In addition, new safety introductions on construction sites affected the psychological states of workers, and this led to a negative impact on the performance of workers (Ogunnusi et al. 2020). The lack of social interactions between workers can lead to devastating impacts on the performance of construction projects (Srivastava & Agarwal, 2020).

The construction industry is controlled by decision-making skills and the way people perceive thoughts, processes, and information (Ankrah et al., 2008). Planning, scheduling, controlling, and managing project activities are all subjected to cognitive thinking which is different in the way everyone carries out this activity (Schunk & Dibenedetto, 2020). According

to cognitive and behavioral theory, thoughts are changeable and by changing thoughts, people can change their feelings and, ultimately, their behaviors. People are governed by their emotions in the decision-making process in their lives (Esa et al., 2020). Schunk & Dibenedetto, (2020) described the cognitive theory as a psychological approach to human functioning that stresses the importance of the social environment in influencing motivation, learning, and self-regulation. Covid-19 came with the burden of adjusting project timelines, schedules, and safety measures to accommodate the new safety guidelines as well as maintaining the performance of workers (Pedrosa et al., 2020). To better improve the performance of workers, there is a need to study the social and psychological impacts the pandemic had on the construction workforce and provide managerial implications and practices to help improve performance.

### **2.3. Knowledge gap**

Previous studies focused on how to generally improve project performance in terms of work environment and workforce-related issues, but none investigated the social and psychological effects of the pandemic on the workforce in general. The social and psychological states of everyone collectively determine the direction of the project as these two important variables tend to control how individuals act, behave, and generally make cognitive decisions that affect everyday life on the job. The social and psychological states of the construction workforce were tested during the pandemic and after the pandemic as several changes were introduced by the management on project activities. Investigating these new social and psychological variables that affect project performances and determining the most important variables that affect the workforce is indeed necessary to better improve performances and advise management on the best form of practices, ensuring the best out of their workforce and their project performances.



### 3. RESEARCH METHOD

#### 3.1. Research model

This study investigated the impact of the social and psychological states of construction workers on the performance of construction projects before and after the Covid-19 pandemic and compared them. To this end, based on the previous works, this study selected seven social variables including ‘work ethics’, ‘team inclusion’, ‘financial stability’, ‘social support’, ‘income equality’, ‘knowledge’, and ‘sense of belonging’, and six psychological variables including ‘anxiety and depression’, ‘motivation’, ‘health risk concerns’, ‘job satisfaction’, ‘job stability’, and ‘stress management’, as shown in Table 1. Multiple performance variables including ‘cost’, ‘time’, and ‘quality’ were adopted to examine the impact of social and psychological states on project performance.

Table 1. Definition of selected variables

Variables	Description	Sources
<i>Social variables</i>		
Work ethic	This is a set of values centered upon the desire to carry out work diligently and with integrity and discipline.	(Dixit et al., 2017), (Chih et al., 2016), (Habibi et al., 2018), (Abas et al., 2015)
Team Inclusion	A valued member of the group trusted and relied upon to contribute to the decision-making in the group.	(Sood, 2020), (Benfante et al., 2020), (Solís-Carcaño et al., 2015), (Wright & Dent, 2007), (Tope Femi Okuntade, 2015)
Financial stability	This is a measure of ones earning and savings. The ability to spend less and save more.	(Alsharif et al., 2021), (Alefari et al., 2020), (Cairó & Cajner, 2018), (Liu et al., 2015)
Social Support	One's network of family, friends, and colleagues who are available to provide help whenever needed.	(Ataei et al., 2021), (Chen et al., 2021), (Thomson Reuters, 2018)

Table 1. Definition of selected variables (continued)

Variables	Description	Sources
Income equality	The distribution of income and earnings in a society.	(Johari & Jha, 2020), (Abas et al., 2015), (Halvitigala, 2019), (Zaballos Palop, 2017)
Knowledge	The level of knowledge about the said project or organization, management of the process involved in the activity, and knowledge of the product sought after.	(Assaad & El-adaway, 2021), (Thomson Reuters, 2018), (Habibi et al., 2018), (farkas & romaniuk, 2020)
Sense of Belonging	A feeling of togetherness, of belonging to a group, a crew, family, and society.	(Sood, 2020), (Jana et al., 2019), (Elbarkouky et al., 2016), (Stumpf et al., 2009)
<i>Psychological variables</i>		
Anxiety/depression	Panic, self-loath, and mental breakdown because of one's inability to function effectively.	(Hashiguchi et al., 2020), (Gupta et al., 2018), (Salari et al., 2020), (Lund et al., 2020), (Zou et al., 2010)
Motivation	The inspiration behind doing something and the intention to want to do work.	(Johari & Jha, 2020), (Vogl & Abdel-Wahab, 2015), (Chen et al., 2021), (Xia et al., 2017), (Chih et al., 2016)
Health risk concern	This fear for the health and safety of oneself on the job is due to factors beyond an individual's control.	(Hashiguchi et al., 2020), (Abas et al., 2015), (Sritharan et al., 2020), (Cipolotti et al., 2021), (Abas et al., 2015)
Job satisfaction	The feeling that comes with the accomplishment of a job well done and the need to celebrate a milestone with your co-workers.	(Pirzadeh & Lingard, 2021), (Nguyen et al., 2021), (Choi & Mahadevan, 2008)
Job stability	Assurance of one's job in an organization.	(Ogunnusi et al., 2020), (Assaad & El-adaway, 2021), (Zeynalian et al., 2013), (Sritharan et al., 2020)
Stress management	Managing the workforce burnout, providing avenues to take time off to be energized to continue the job again.	(Ruiz-Frutos et al., 2020), (Benfante et al., 2020), (D'ettore et al., 2021),
<i>Performance variables</i>		
Cost performance	The measure of costs on a project in terms of budget earned value analysis.	(Rahman et al., 2012), (Liu et al., 2015), (Zou et al., 2010), (Memon et al., 2015), (Xia et al., 2017)

Table 1. Definition of selected variables (continued)

Variables	Description	Sources
Time performance	Measurement of a period of the project in terms of schedule and delays.	(Issn, 2010), (Gurmu & Aibinu, 2017), (Rahman et al., 2012), (Guo et al., 2016)
Quality performance	The basis of the output produced in terms of finishes, specifications, and level of rework.	(Allas et al., 2020), (Chen et al., 2021), (Fang et al., 2016), (Jalaei & Jrade, 2014)

Construction projects are performed by construction workers including managers and laborers. Even though managers and laborers collaborate to achieve the same goal of the construction project, their roles, responsibilities, and thinking can differ. Managers are the personnel that coordinate, monitor, and organize construction works, making sure that it is delivered safely on time, and within the budget. Managers are goal-oriented, and they consider cost, time, and quality performance as they undertake any project. On the other hand, laborers are skilled craftsman who performs actual construction work with relevant training and experience. Laborers are the personnel that is majorly responsible for the on-site tasks and ensuring the quality performance of the construction project. Therefore, this study separately investigates the impact of social and psychological variables before and after the Covid-19 pandemic from the perspective of managers and laborers, considering their backgrounds, roles, and responsibility, as depicted in Fig. 1.

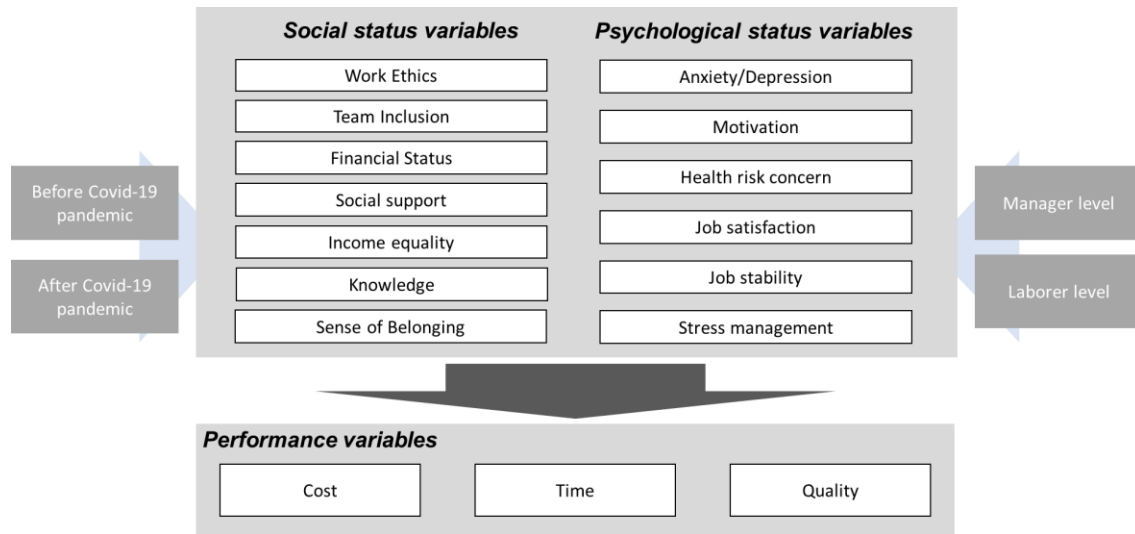


Fig. 1. Research model.

### 3.2. Data collection

The questionnaire survey was conducted on randomly selected construction companies in Minneapolis, Minnesota, which is the closest metropolitan city where a ton of construction companies have their firm situated. The questionnaire was devised to investigate the participant's relative states of the selected social and psychological variables and their relative deemed project performance before and after the pandemic using a 5-point Likert scale (strongly disagree, disagree, neutral, agree, and strongly agree). The questions for social and psychological variables were as follows: 1) My work ethic is outstanding; 2) I enjoy being a part of the team; 3) My financial status (income and revenue) is stable; 4) The support from friends and family for my well-being is encouraging; 5) There is an even distribution of income among work colleagues and individuals; 6) I am knowledgeable about the construction process; 7) I have support from my team member; 8) I often feel anxiety and depression on the job; 9) My motivation to work on the job is outstanding; 10) I am concerned about my health on the job; 11) I am satisfied with my job and its provisions for me; 12) I am confident of my job status and my ability to keep my job; and 13) Time off was provided to avoid burnout and improve stress management. The

questionnaire for performance also used a 5-point Likert scale (unacceptable, poor, fair, good, and very good) and the questions are as follows: 1) the project is within the budget; 2) the project is on the schedule; and 3) the project meets the required quality. With the questionnaire, the data was collected in two ways to ensure proper representation for all parties involved such as the laborers, superintendents, and construction managers. Survey papers were distributed to the construction job site for available laborers and superintendents while online Qualtrics was used to get information from construction managers. The period of collection of data spanned from March 5, 2022, to April 10, 2022. A total of 63 participants, including seven superintendents, twenty-seven construction managers, and thirty-one laborers, responded. The detailed profile of survey participants and descriptive statistics are described in Tables 2 and 3, respectively.

Table 2. Profile of survey participants

Description		Number	Percentage (%)
Gender	Male	45	71.4
	Female	17	26.9
	Not Indicated	1	1.5
Race	White	35	55.5
	Black or African American	25	39.6
	Asian	3	4.7
Age	20-30	15	23.8
	31-40	21	33.3
	41-50	21	33.3
	50 and above	6	9.5
Company Size	Small (0-49)	33	52.3
	Medium (50-199)	18	28.5
	Large (200 and above)	12	19.0
Years of industry Experience	1-5	14	22.2
	6-10	20	31.7
	11-15	17	26.9
	16-20	9	14.2
	Above 20	3	4.7
Job positions	Laborer	31	49.2
	Superintendent	7	11.1
	Construction manager	25	39.6

Table 3. Descriptive statistics

Variables		Min.	Max.	Mean	S.D.
Social state	Work ethic	3.65	4.18	3.78	0.758
	Team inclusion	3.91	4.27	4.05	0.668
	Financial stability	3.58	4.15	3.90	1.187
	Social support	3.72	4.08	3.65	1.122
	Income equality	3.55	4.24	3.78	1.109
	Knowledge	3.87	4.02	3.82	1.058
	Sense of belonging	3.92	4.14	4.05	0.981
Psychological state	Anxiety/depression	3.49	4.15	3.64	1.257
	Motivation	3.68	4.32	3.66	0.884
	Health risk concern	3.88	4.26	4.01	0.760
	Job satisfaction	3.35	4.14	3.47	1.112
	Job stability	3.75	4.25	3.89	0.726
	Stress management	3.75	4.23	4.00	0.778
Performance	Time	3.86	4.37	4.18	0.799
	Cost	3.49	4.33	3.73	0.920
	Quality	3.58	4.19	3.75	0.892

### 3.3. Statistical techniques

This study employed a paired *t*-test to compare the mean difference between social and psychological states before and after the Covid-19 pandemic to see if the difference in means is statistically different from zero. Given that paired *t*-tests can only be used when the difference between each pair of values is normally distributed, this study ensured the sample size is larger than 30 and conducted a Shapiro-Wilk normality test. The results showed that the differences between pairs are normally distributed. In addition to the paired *t*-test, multiple regression analysis is used to determine the most impactful social and psychological variables affecting the performance. Multiple regression analysis is a statistical method used to estimate the relationship between a dependent variable and independent variables. It can provide an assessment of the model as a whole and the relative contribution of each variable that makes up the model. In this

study, thirteen social and psychological variables and three performance variables were employed as independent variables and dependent variables, respectively. Separate statistical analyses were performed on each of the three performance variables. To control other variables that are important to performance, gender and years of industry experience which are constant and unchanged variables were also used. This study used the beta coefficient, which is the standardized coefficient of each independent variable. Before analysis, Variance Inflation Factor (VIF) was used to check the multicollinearity between the variables of the regression model. In regression analysis, VIF quantifies the extent of correlation between one predictor and the other predictors in a model. Higher values signify that it is difficult to impossible to assess accurately the contribution of predictors to a model. Detecting multicollinearity is important because while multicollinearity does not reduce the explanatory power of the model, it does reduce the statistical significance of the independent variables. A large VIF on an independent variable indicates a highly collinear relationship to the other variables that should be considered or adjusted for in the structure of the model and selection of independent variables. The formula is as shown in Eq. (1)

$$VIF_i = \frac{1}{1-R_i^2} = \frac{1}{\text{Tolerance}} \quad \text{Eq. (1)}$$

where  $R_i^2$  represents the unadjusted coefficient of determination for regressing the independent variable (i) on the remaining variables. The reciprocal of VIF is reflected by ‘Tolerance’, which can also be used to calculate the VIF.

Multicollinearity is considered to be acceptable if VIF is between 1 and 10 (Studenmund 2014). Durbin-Watson statistical measures were also employed to test for autocorrelation in a regression model’s output. A value of Durbin-Watson close to 2 is considered appropriate, whereas a value closer to 0 or 4 is considered inappropriate (Unibo 2018).



## 4. ANALYSIS RESULTS

### 4.1. Social and psychological states according to demographic characteristics

This study investigated the social and psychological states according to their demographic characteristics as shown in Table 4 and Fig. 2 - 7. Gender, race, age, company size, year of industry experience, and position were considered as the demographic characteristics. The result shows that females had higher mean values for social variables. Females had higher social support from friends and family for their well-being than males. On the other hand, males had higher mean values for psychological variables except for anxiety and depression. This result is aligned with the result of the study that females experience more anxiety in their job in construction for fear of being undermined by their male colleagues (Sritharan et al., 2020). The Asian race reacted the most to both social and psychological states with the Asian race ranking the most in financial stability, income equality, anxiety and depression, health risk concerns, job satisfaction, and job stability. The black workers also reacted mostly to both variables ranking highest in some social variables while coming second in most psychological variables. The white race workers reacted more to social variables such as team inclusion and social support. Ages 31-50 are greatly influenced by the social variables because this age group is social beings who need each other company to fully function well in their job roles, from work ethics to team inclusion. On the other hand, ages 51 and above reacted more to their psychological variables which could be because both age groups are more concerned with their health than the standard of living around them. Small and medium-sized companies with a staff size of 0-199 are mostly impacted by social variables such as team inclusion, social support, and a sense of belonging. On the other hand, large-sized companies are reacting mostly to their psychological variables. The results show that a medium-sized group of people is close-knit that highly depends on each other to

fully function and act well. The 6- 10 years of industry experience groups were more affected by psychological variables while 1-5 years and 21 and above years of industry experience groups were more affected by social variables. The remaining groups were found to be affected similarly by social and psychological variables. Finally, the results showed that laborers were mostly impacted by social variables while superintendents and managers were more impacted by psychological variables. To sum up, there existed differences in social and psychological states according to the different demographic characteristics. The results showed that the white race, ages 34-50, small and medium companies, 1-5 years and 21 and above industry experiences, and laborers were more impacted by social variables, while ages 51 and above, large companies, 6-10 years of industry experiences, superintendent and managers were more impacted by psychological variables.

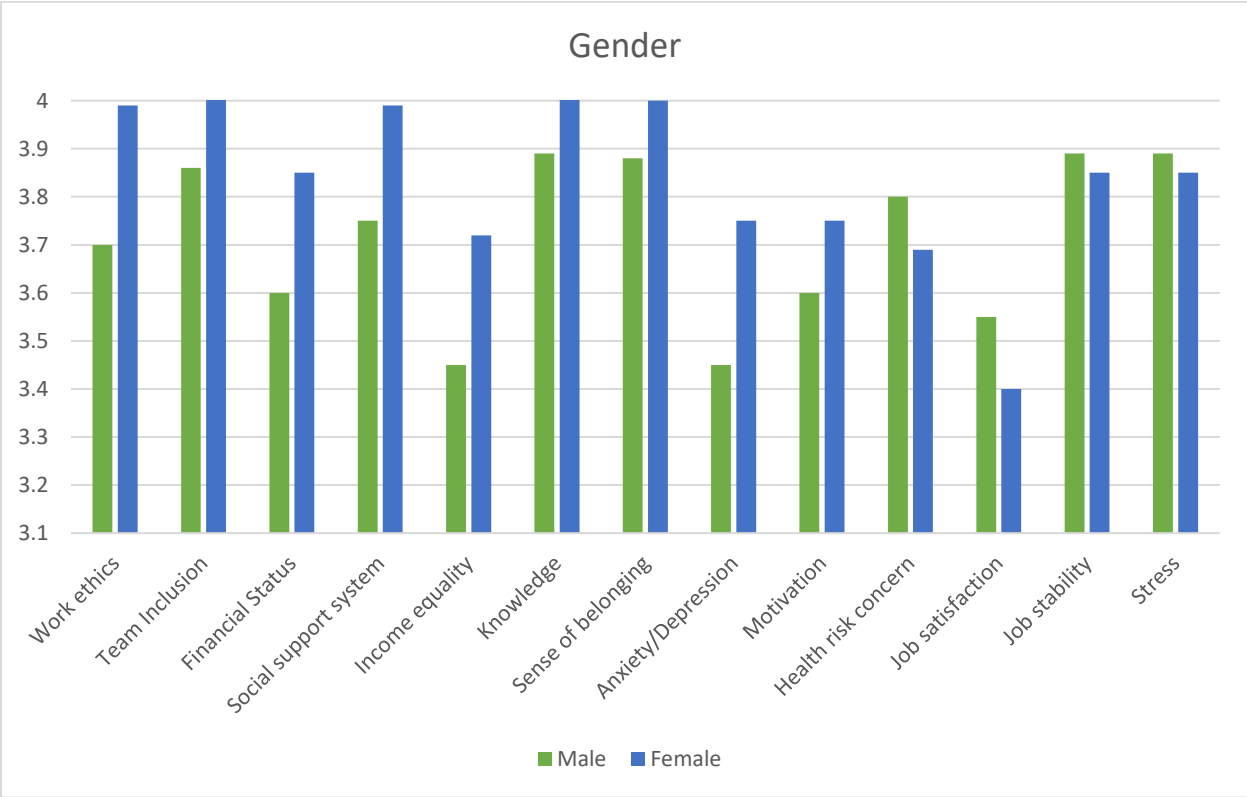


Fig. 2. Social and psychological state of the workforce according to gender.

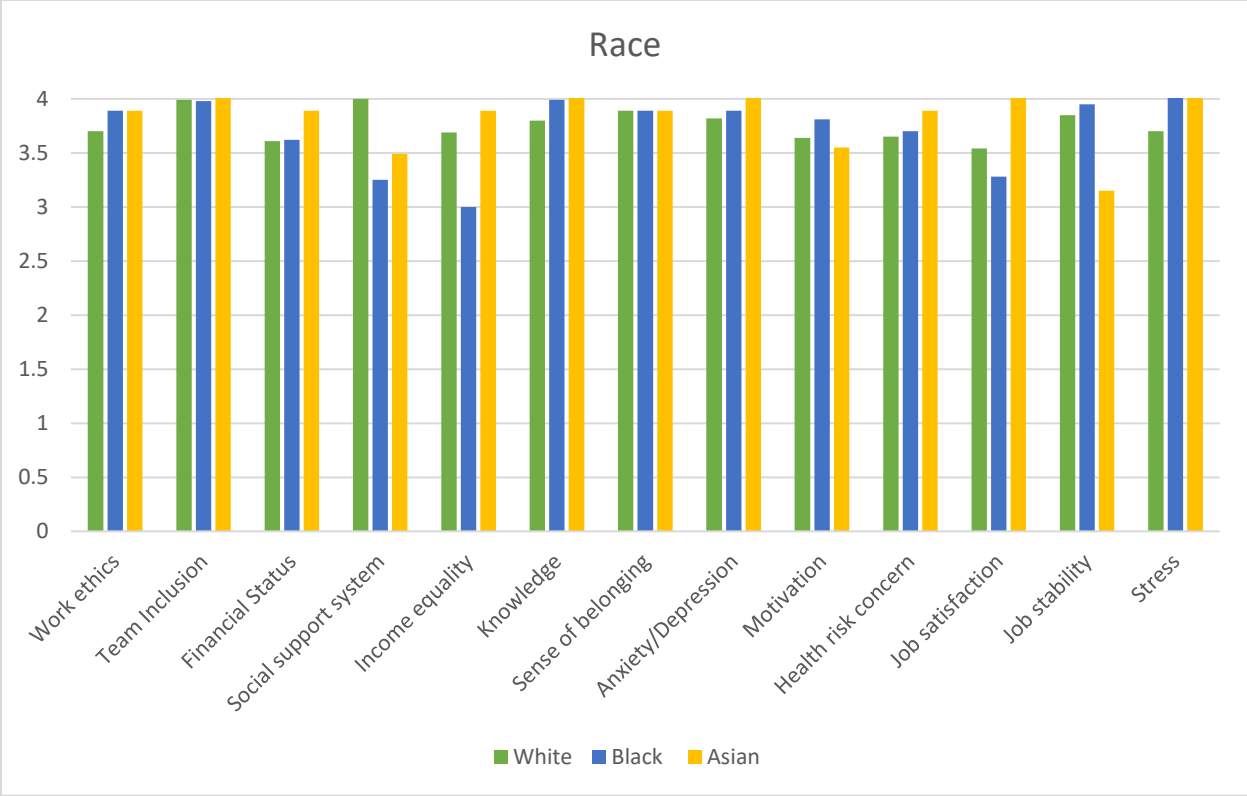


Fig. 3. Social and psychological state of the workforce according to race.

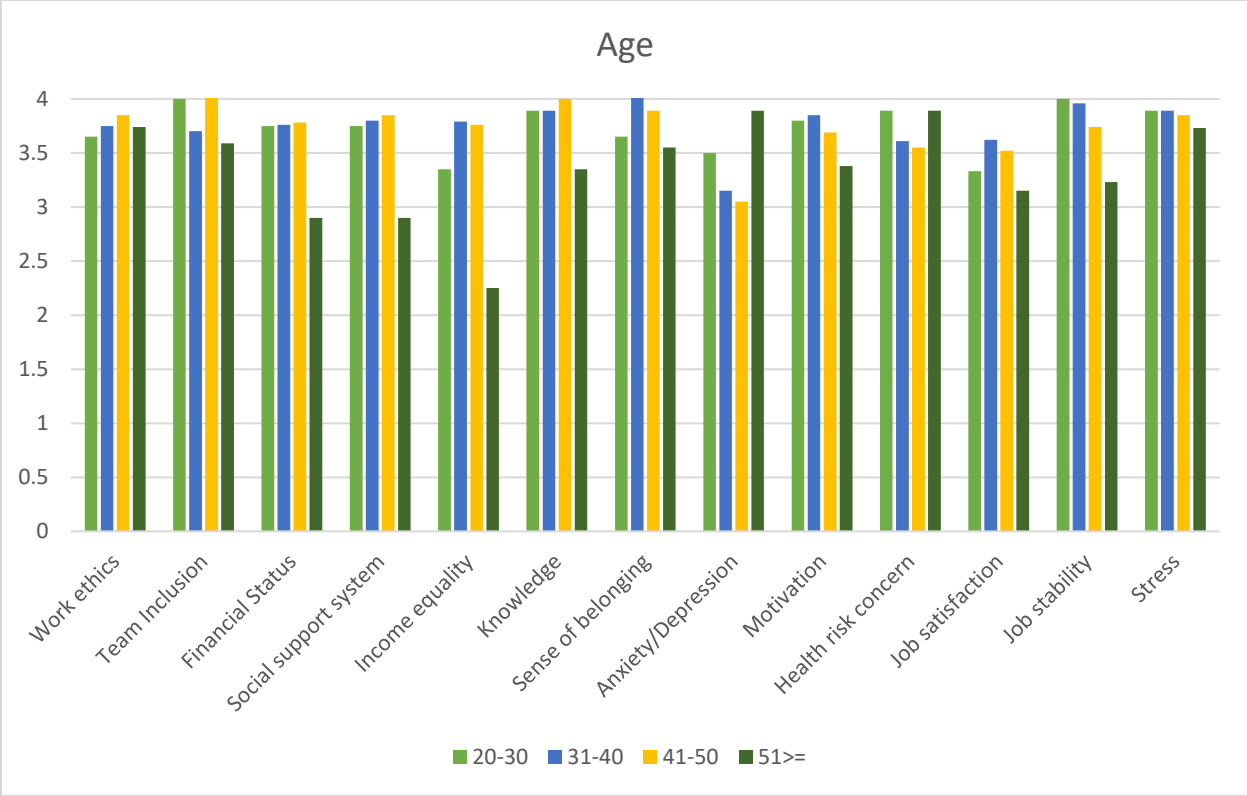


Fig. 4. Social and psychological state of the workforce according to age.

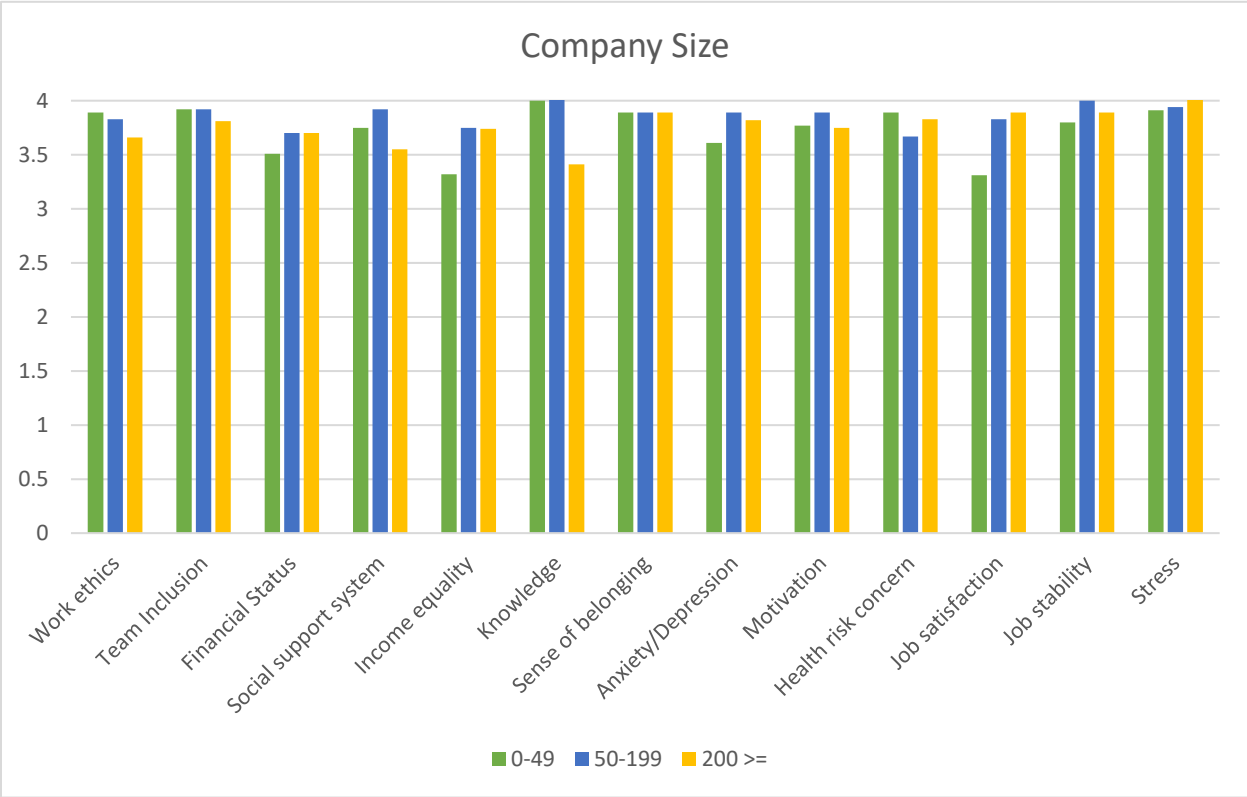


Fig. 5. Social and psychological state of the workforce according to company size.

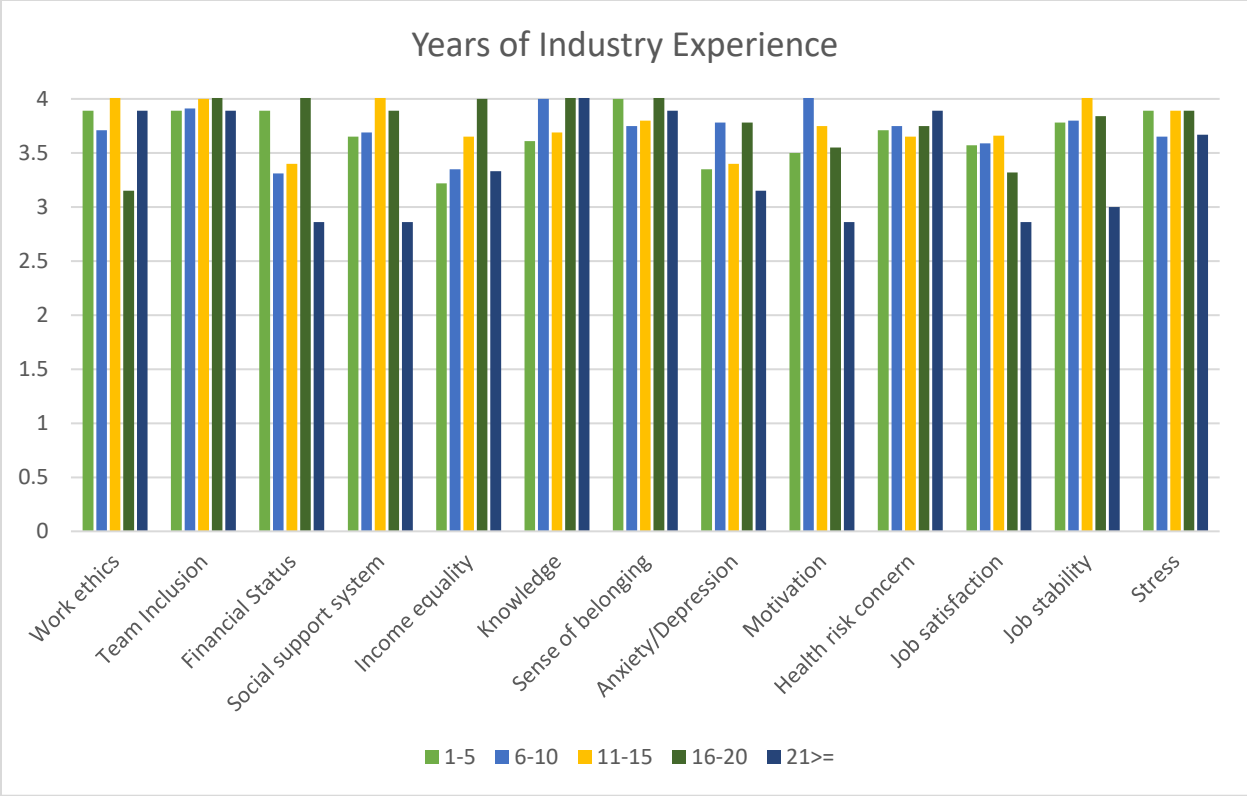


Fig. 6. Social and psychological state of the workforce according to year of industry.

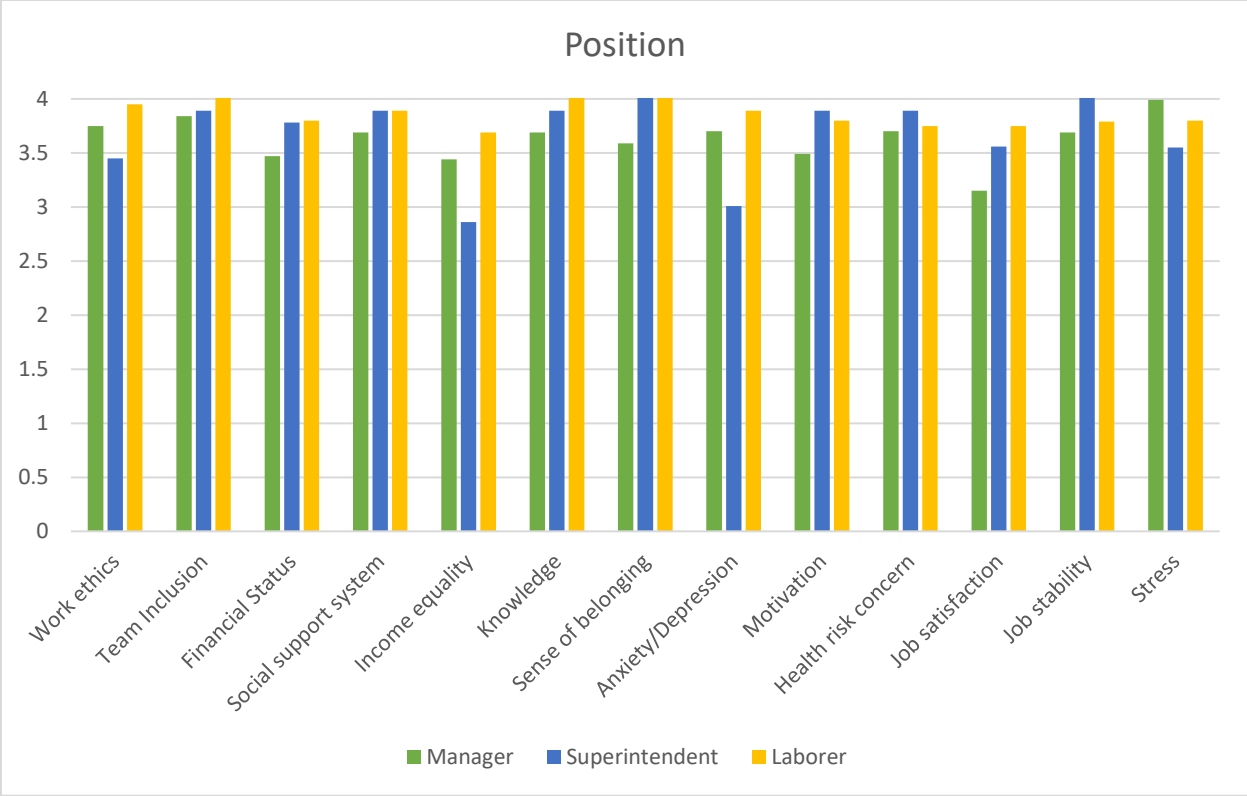


Fig. 7. Social and psychological state of the workforce according to job positions.



**Table 4.** Mean value of social/psychological states according to demographic characteristics

Demography		1	2	3	4	5	6	7	8	9	10	11	12	13
Gender	Male	3.70	3.86	3.60	3.75	3.45	3.89	3.88	3.45	3.60	3.80	3.55	3.89	3.89
	Female	3.99	4.18	3.85	3.99	3.72	4.10	4.00	3.75	3.75	3.69	3.40	3.85	3.85
Race	White	3.70	3.99	3.61	4.00	3.69	3.80	3.89	3.82	3.64	3.65	3.54	3.85	3.70
	Black	3.89	3.98	3.62	3.25	3.00	3.99	3.89	3.89	3.81	3.70	3.28	3.95	4.05
	Asian	3.89	3.45	3.89	3.49	3.89	4.15	3.89	4.15	3.55	3.89	4.15	3.15	4.15
Age	20-30	3.65	4.00	3.75	3.75	3.35	3.89	3.65	3.50	3.80	3.89	3.33	4.00	3.89
	31-40	3.75	3.70	3.76	3.80	3.79	3.89	4.18	3.15	3.85	3.61	3.62	3.96	3.89
	41-50	3.85	4.15	3.78	3.85	3.76	4.00	3.89	3.05	3.69	3.55	3.52	3.74	3.85
	51>=	3.74	3.59	2.90	2.90	2.25	3.35	3.55	3.89	3.38	3.89	3.15	3.23	3.73
Company size	0-49	3.89	3.92	3.51	3.75	3.32	4.00	3.89	3.61	3.77	3.89	3.31	3.80	3.91
	50-199	3.83	3.92	3.70	3.92	3.75	4.05	3.89	3.89	3.89	3.67	3.83	4.00	3.94
	200 >=	3.66	3.81	3.70	3.55	3.74	3.41	3.89	3.82	3.75	3.83	3.89	3.89	4.17
Year of industry experience	1-5	3.89	3.89	3.89	3.65	3.22	3.61	4.00	3.35	3.50	3.71	3.57	3.78	3.89
	6-10	3.71	3.91	3.31	3.69	3.35	4.00	3.75	3.78	4.03	3.75	3.59	3.80	3.65
	11-15	4.20	4.00	3.40	4.15	3.65	3.69	3.80	3.40	3.75	3.65	3.66	4.01	3.89
	16-20	3.15	4.05	4.15	3.89	4.00	4.48	4.15	3.78	3.55	3.75	3.32	3.84	3.89
	21>=	3.89	3.89	2.86	2.86	3.33	4.67	3.89	3.15	2.86	3.89	2.86	3.00	3.67
Position	Manager	3.75	3.84	3.47	3.69	3.44	3.69	3.59	3.70	3.49	3.70	3.15	3.69	3.99
	Superintendent	3.45	3.89	3.78	3.89	2.86	3.89	4.18	3.01	3.89	3.89	3.56	4.20	3.55
	Laborer	3.95	4.05	3.80	3.89	3.69	4.12	4.09	3.89	3.80	3.75	3.75	3.79	3.80

Note: 1=work ethics; 2=team inclusion; 3=financial stability; 4=social support; 5=income equality; 6=knowledge; 7=sense of belonging; 8=anxiety/depression; 9=motivation; 10=health risk concern; 11=job satisfaction; 12=job stability; 13=stress management.

#### **4.2. Differences in social/psychological states before and after the pandemic**

To understand the influence of the Covid-19 pandemic on the social and psychological states, this study conducted the paired *t*-test for all variables at the manager level and laborer level. Table 5 shows the analysis result of the differences in social and psychological states at the manager level. The results indicated statistically significant differences between before and after the pandemic periods for only ‘anxiety and depression’. At a 95% level of significance, there is a difference between the two sets (before and after the pandemic) since the *p-value* which is 0.011 is less than 0.05. Managers responded that they feel more anxiety and depression after the pandemic. According to World Health Organization (2021), the Covid-19 pandemic, which is responsible for millions of deaths and infections, has caused a big rise in the rate of depression and anxiety.

As Covid-19 restrictions lift such as social distancing, covering faces, forceful vaccinations, and stay-at-home lockdown, the manager may experience post-lockdown anxieties. Managers have become used to working online during the lockdown. Going back to in-person workdays resulted in anxiety and depression for some managers. For instance, construction managers may be anxious about traveling on crowded transportation to go to work. Construction managers may also feel that they no longer know how to handle the interaction of their fellow construction laborers. When Covid-19 restrictions are lifted, they may crave some level of loneliness, may like some space, or may not want to socialize with anyone, not even colleagues because of the trauma of what they have experienced during the pandemic. Everyone’s post-lockdown boundaries are valid as it is because of the pandemic experience.

**Table 5.** Differences in social/psychological states before and after the pandemic at the manager level

Variables	Before pandemic		After pandemic		95% confidence interval of the difference		t	p-value
	Mean	SD	Mean	SD	Lower	Upper		
1	3.82	1.086	3.97	0.834	-0.481	0.187	-0.895	0.377
2	3.94	0.919	4.12	0.728	-0.441	0.087	-1.358	0.184
3	3.62	0.921	3.76	0.889	-0.543	0.247	-0.758	0.454
4	3.79	1.09	3.73	1.14	-0.250	0.367	0.387	0.701
5	3.44	1.13	3.64	1.15	-0.568	0.156	-1.156	0.256
6	3.79	1.20	3.76	1.129	-0.339	0.398	0.162	0.872
7	3.82	1.11	4.00	0.887	-0.454	0.101	-1.292	0.205
8	2.85	1.282	3.53	1.376	-1.19	-0.163	-2.681	0.011
9	3.65	0.981	3.82	0.716	-0.555	0.202	-0.947	0.350
10	3.82	0.904	4.12	0.879	-0.654	0.065	-1.664	0.106
11	3.53	1.203	3.059	1.153	-0.131	0.719	1.407	0.169
12	3.91	0.965	3.94	0.850	-0.445	0.387	-0.144	0.887
13	3.97	1.058	4.05	0.885	-0.377	0.201	-0.620	0.540

Note: 1=work ethics; 2=team inclusion; 3=financial stability; 4=social support; 5=income equality; 6=knowledge; 7=sense of belonging; 8=anxiety/depression; 9=motivation; 10=health risk concern; 11=job satisfaction; 12=job stability; 13=stress management.

Table 6 shows the analysis result of the differences in social and psychological states at the laborer level. The results indicated statistically significant differences before the pandemic and after the pandemic periods for ‘anxiety and depression’, and ‘health risk concern’. At a 95% level of significance, there is a difference between the two sets (before and after the pandemic) since the *p-value* which is are 0.000 and 0.018 respectively is less than 0.05. Laborers responded that they experienced anxiety and depression the most after the pandemic. When the Covid-19 pandemic hit and everyone were forced to stay at home, they were isolated from their friends and family, increasing fear and anxiety about whether their loved ones are infected with Covid-19. Laborers can also be depressed upon the news of a colleague that is tested Covid-19 positive.

Along with the anxiety and depression, laborers responded that their health risk concerns increased after the pandemic. Before the Covid-19 pandemic, laborers' day-to-day activities involved going outside, doing hard labor, and keeping busy with one or two other duties. However, all these activities were temporarily halted during the Covid-19 pandemic when everyone was asked to stay at home. Laborers that used to burn fat from their day-to-day activities gained fats from sitting idle during the lockdown. Sitting idle for more than two or more consecutive days is associated with an increased risk of heart disease, diabetes, and the cause of immature death (LifeScience 2011). In this regard, laborers are increasingly concerned about their health risks.

**Table 6.** Differences in social/psychological states before and after the pandemic at the laborer level

Variables	Pre-pandemic		Post-pandemic		95% confidence interval of the difference		t	p-value
	Mean	SD	Mean	SD	Lower	Upper		
1	4.10	0.976	4.21	0.77	-0.445	0.239	-0.619	0.541
2	4.138	1.026	4.24	0.988	-0.605	0.398	-0.422	0.676
3	3.862	1.186	3.759	1.123	-0.307	0.514	0.516	0.610
4	3.97	1.295	4.00	1.03	-0.471	0.402	-0.162	0.873
5	3.76	1.41	3.79	1.235	-0.527	0.458	-0.143	0.887
6	4.20	1.013	4.24	0.786	-0.378	0.310	-0.205	0.839
7	4.13	0.99	4.24	0.739	-0.461	0.253	-0.593	0.558
8	2.97	1.149	4.28	0.88	-1.788	-0.832	-5.616	0.000
9	3.90	1.21	3.97	1.09	-0.743	0.605	-0.210	0.835
10	3.83	1.23	4.38	0.73	-1.00	-0.102	-2.512	0.018
11	3.83	1.167	4.10	1.012	-0.762	0.211	-1.162	0.255
12	4.00	1.164	3.72	1.03	-0.307	0.859	0.969	0.341
13	4.00	1.03	4.14	0.88	-0.528	0.252	-0.727	0.475

Note: 1=work ethics; 2=team inclusion; 3=financial stability; 4=social support; 5=income equality; 6=knowledge; 7=sense of belonging; 8=anxiety/depression; 9=motivation; 10=health risk concern; 11=job satisfaction; 12=job stability; 13=stress management.

### **4.3. Impact of social/psychological states on performance**

#### **4.3.1. Impact of social/psychological states on performance before the pandemic**

This study examined the impact of social and psychological states on performance in terms of cost, time, and quality before a pandemic from the perspectives of both managers and laborers. Literature reviews and multiple regression analysis was used to identify the most impactful social and psychological variables affecting the performance of the construction projects before the pandemic. As shown in Tables 7 and 8, the results of VIF and Durbin-Watson's residual test are found to be satisfactory.

The results showed for the manager level, knowledge of the construction process impacted the quality performance of work done with the  $p$ -value at 0.013. This is understandable as managers need to keep improving themselves with trainings and workshops to understand the changes in trends of the construction industry and how to better improve the quality of work done. Construction managers are responsible for the direction and quality output of the project, therefore knowledge about the project in hand is encouraged and puts them at an advantage of improving the quality performance of the project.

In pre-pandemic period, several literatures highlight the importance of motivation, knowledge, and financial capability on the social and psychological status of managers in relation to their performance on the job. In management, managers are the sole group to whom motivation or encouragement is directed (Cairó & Cajner, 2018). Motivation is how to channel the strength and potential of subordinates to successfully accomplish and realize the goals that been established. Motivation concerns how to increase the zeal for their subordinates to work, making them eager to put forth their full effort and skill set to achieve organizational objectives (Tuuli & Rowlinson, 2009). The company not only demands workers who are capable and

competent, but the most crucial factor is that they want to put in a lot of effort and are prepared to get the best possible job results. This demand affects the performance of managers on construction projects as their need to be constantly motivated to work. When someone has achieved financial well-being, they are able to satisfy all of their immediate and long-term financial commitments while also feeling confident about their future and free to pursue their passions and interests without worrying about money (Abdullah et al., 2019). This financial freedom impacts the state of workers towards performance on the job. The ability to focus on the task at hand without worrying about providing for themselves and loved ones help sharpen their mind towards the project at hand.

However, it can be shown that none of the social and psychological variables influenced performance before the pandemic for laborer level using the multiple regression analysis. Several studies showed that there was a balanced level of social and psychological states of laborers before the pandemic, however some highlighted stress management and financial stability as factors influencing performance of workers on construction projects. Laborers being the one carrying out the job on site often experience burnouts and stress on the job having been working over long hours on the project. Effective management of workers burnout on the job, keeping work hours within the required labor requirements, allowing time off work for laborers has been found to impact and improve the performance of workers on the projects (Garabiles et al., 2019). These provisions often allow renewed energy and enthusiasm for the project at hand thus improving their performances. Financial motivation is important to construction workers as this ensures their continual focus and reward for a job well done (Hameed Memon et al., 2014). This system of rewarding workers financially has proven effective as workers work more and perform better than usual thus improving the performance of the project (Choudhry et al., 2014).

**Table 7.** Impact of social/psychological states on performance before the pandemic at the manager level

Var.	Cost			Time			Quality		
	Beta	<i>p</i> -value	VIF	Beta	<i>p</i> -value	VIF	Beta	<i>p</i> -value	VIF
1	-0.368	0.226	4.097	0.178	0.635	4.097	0.053	0.878	4.097
2	-0.201	0.490	3.887	-0.500	0.180	3.887	-0.048	0.887	3.887
3	-0.056	0.835	3.397	-0.054	0.874	3.397	-0.271	0.391	3.397
4	-0.046	0.860	3.084	0.160	0.622	3.084	-0.193	0.520	3.084
5	0.136	0.526	2.103	-0.645	0.125	2.103	-0.149	0.548	2.103
6	-0.121	0.629	2.898	0.052	0.869	2.898	0.784	0.013	2.898
7	0.336	0.200	3.052	0.227	0.484	3.052	0.030	0.920	3.052
8	0.323	0.132	1.999	0.101	0.700	1.999	0.130	0.590	1.999
9	-0.100	0.687	2.822	-0.080	0.796	2.822	-0.511	0.086	2.822
10	0.165	0.574	3.264	0.479	0.153	3.117	0.113	0.707	3.117
11	0.143	0.519	2.262	0.069	0.803	2.262	0.278	0.284	2.262
12	0.167	0.390	1.702	0.193	0.427	1.702	0.586	0.559	1.702
13	-0.022	0.935	3.475	-0.264	0.447	3.475	-0.183	0.565	3.475
<i>R</i> <sup>2</sup> ( <i>Adj.R</i> <sup>2</sup> )	0.622(0.308)			0.405 (-0.091)			0.496(0.075)		
<i>F</i>	2.166			0.800			1.33		
<i>Durbin-Watson</i>	2.189			1.992			2.154		

Note: 1=work ethics; 2=team inclusion; 3=financial stability; 4=social support; 5=income equality; 6=knowledge; 7=sense of belonging; 8=anxiety/depression; 9=motivation; 10=health risk concern; 11=job satisfaction; 12=job stability; 13=stress management.

Note: the regression coefficients were standardized. Standard error terms are in parentheses.

**Table 8.** Impact of social/psychological states on performance before the pandemic at the laborer level

Var.	Cost			Time			Quality		
	Beta	<i>p</i> -value	VIF	Beta	<i>p</i> -value	VIF	Beta	<i>p</i> -value	VIF
1	-0.234	0.724	4.632	0.217	0.724	4.632	0.373	0.474	4.632
2	-0.387	0.470	6.322	0.045	0.926	6.322	-0.532	0.211	6.322
3	0.856	0.138	6.843	0.119	0.816	6.843	0.086	0.842	6.843
4	0.803	0.322	7.554	-0.141	0.848	7.554	-0.062	0.921	7.554
5	-1.335	0.143	7.180	0.183	0.821	7.180	0.246	0.718	7.180
6	0.837	0.200	8.102	0.009	0.988	8.102	0.367	0.460	8.102
7	0.108	0.847	7.012	0.374	0.474	7.012	-0.013	0.976	7.012
8	-0.423	0.269	3.140	-0.328	0.351	3.140	-0.162	0.579	3.140
9	-0.025	0.960	5.626	0.217	0.641	5.626	-0.210	0.592	5.626
10	0.333	0.335	2.588	0.308	0.335	2.588	0.285	0.290	2.588
11	-0.128	0.833	8.223	-0.344	0.542	8.223	-0.009	0.986	8.223
12	0.043	0.941	7.664	-0.023	0.966	7.664	0.018	0.969	7.664
13	-0.247	0.622	5.601	-0.078	0.867	5.601	0.341	0.387	5.601
<i>R</i> <sup>2</sup> ( <i>Adj.R</i> <sup>2</sup> )	0.444 (-0.198)			0.523 (-0.027)			0.743 (0.446)		
<i>F</i>	0.791			0.818			2.722		
<i>Durbin-Watson</i>	2.022			2.146			1.985		

Note: 1=work ethics; 2=team inclusion; 3=financial stability; 4=social support; 5=income equality; 6=knowledge; 7=sense of belonging; 8=anxiety/depression; 9=motivation; 10=health risk concern; 11=job satisfaction; 12=job stability; 13=stress management.

Note: the regression coefficients were standardized. Standard error terms are in parentheses.

#### 4.3.2. Impact of social/psychological states on performance after the pandemic

To compare the differences in impactful social and psychological variables affecting performance before the pandemic and after the pandemic, this study also investigated the impact of social and psychological variables on performance after the pandemic from the perspectives of both managers and laborers. As shown in Tables 9 and 10, the VIF for each of the performance variables showed that multicollinearity does not exist.



The results of the impact of social and psychological variables on performance from the manager's perspective are described in Table 9. Cost performance is influenced by the 'health risk concerns' of the construction managers with a  $p$ -value of 0.014. Health risk concerns aided the effective management of cost performance on projects after the pandemic as managers carry out their duties quickly, managing resources and ensuring minimal contact with people for fear of contacting Covid-19, thus improving and increasing managers' productivity (Ogunnusi et al. 2020). The managers have had the fear of contacting Covid-19 all through the pandemic season and resolved to work at their own pace and avoid contact which allows for more concentration on their path as working alone and in their own time reduced idle time usually spent on jobs (Gamil and Alhagar 2020). The monitoring and managing of resources led to an effective cost-performance management system in the post-pandemic period (Lai et al. 2020).

The analysis results show that time performance is influenced by 'income equality', 'sense of belonging', 'health risk concerns', 'job stability, and 'stress management' with a  $p$ -value of 0.012, 0.031, 0.018, 0.011, and  $p = 0.005$  respectively. Construction managers mostly get their income calculated based on their skill, position in the firm, and their years of relevant experience, coupled with the fact that they are being paid well, get less concerned with the even distribution of income (Sood 2020). This in turn helps takes their mind off their financial stability and ensure complete focus on the task at hand. Less worry about income equality and earnings allows for more time to concentrate and carry out the duties required of them as the construction manager on the project (Lai et al., 2020). The time performance of a project is very important and dependent on the construction manager's effectiveness on the project with scheduling and change order approvals which may in turn stall the project if delayed (Nguyen et al. 2021).

Collaborative problem-solving produces better results (Bsisu 2020). When a construction manager has the backing and support of a team, he/she is more likely to take the calculated risk that leads to innovation. This innovation, therefore, can improve the proficiency of the construction managers, they can save time doing things that they spend a lot of time doing, during and before the Covid-19 pandemic (Bsisu 2020). Working as part of a team promotes personal development, which in turn strengthens performance generally. In this regard, the above suggests that support from team members greatly influences the time performance of construction projects (Ataei et al. 2021).

Construction manager tends to quicken their work on the given projects to focus on their health and that of their colleagues, this tends to keep the project within schedule and cost limits which is a positive thing for a project (Salari et al. 2020). As aforementioned, the managers resolved to work on reducing idle time because of the fear of contacting Covid-19. This reduction in idle time spent improved time performance as it allows for more work to be done and carried out effectively.

Furthermore, construction managers with stable and a future at the company tend to do their jobs in due time as this also induces their quarterly bonus improvement which in turn improves their financial wellbeing and social status in society (Nguyen et al. 2021). He/she with more stability at their job after the pandemic focused on improving the project's time performance by allowing laborers to work more just to complete the project on time thus improving the time performance of the project (Cipolotti et al. 2021).

Stress management impacted the time performance of construction managers on projects have been able to effectively manage the satisfaction that comes with the job, feeling like a part of a social group, thus reducing stress generally and improving the performance of projects (Lai

et al. 2020). The better the provisions for stress management like for example paid time off, providing rooms in the office for rest, and allowing workers to self-perform, the more productive their time performance on projects has become (Xing et al. 2021).

The analysis results reveal that ‘knowledge’ and ‘job stability’ influence the quality performance of construction projects with a *p*-value of 0.018, and 0.012. Knowledge about the construction process impact quality performance from the manager’s perspective. A construction manager is one saddled with the responsibility of making salient decisions and strategic planning of the construction projects (Kognisi et al. 2021). Therefore, a construction manager with adequate knowledge about the construction process will yield increased performance while a construction manager with less knowledge will yield lower performance (Assaad & El-adaway 2021). Job stability affects the team's performance as well as the overall organizational performance (James 2012). Organizations with low job security led people to lose faith in the future and consequently affect performance. A construction manager with job security will put more effort into his/her duties because he/she is likely to effectively perform his task well. This makes an improved motivation which is reflected in the overall quality of the construction project (Chen et al. 2021).

**Table 9.** Impact of social/psychological states on performance after the pandemic at the manager level

Var.	Cost			Time			Quality		
	Beta	<i>p</i> -value	VIF	Beta	<i>p</i> -value	VIF	Beta	<i>p</i> -value	VIF
1	0.274	0.370	3.496	-0.22	0.923	3.496	-0.024	0.946	3.496
2	-0.303	0.213	2.177	0.006	0.972	2.177	-0.164	0.551	2.177
3	0.303	0.340	3.770	0.300	0.22	3.770	0.420	0.250	3.770
4	-0.345	0.190	2.539	0.328	0.107	2.539	-0.437	0.149	2.539
5	-0.692	0.082	5.556	0.583	0.012	4.117	0.472	0.286	5.556
6	0.485	0.141	3.908	0.419	0.097	3.908	0.312	0.018	6.324
7	0.374	0.140	2.323	0.386	0.031	5.556	0.307	0.284	2.323
8	0.174	0.538	3.029	0.250	0.251	3.029	-0.043	0.894	3.029
9	0.234	0.297	1.873	0.103	0.543	1.873	0.038	0.881	1.873
10	0.165	0.014	3.264	0.315	0.018	3.997	0.062	0.852	3.264
11	0.282	0.240	2.118	0.201	0.270	2.118	-0.225	0.408	2.118
12	0.185	0.498	2.815	0.652	0.011	4.303	0.335	0.012	2.078
13	-0.651	0.057	6.709	0.365	0.005	3.115	0.319	0.508	6.709
<i>R</i> <sup>2</sup> ( <i>Adj.R</i> <sup>2</sup> )	0.543 (0.163)			0.735 (0.514)			0.402 (-0.096)		
<i>F</i>	1.454			3.83			0.924		
<i>Durbin-Watson</i>	1.657			2.015			2.088		

Note: 1=work ethics; 2=team inclusion; 3=financial stability; 4=social support; 5=income equality; 6=knowledge; 7=sense of belonging; 8=anxiety/depression; 9=motivation; 10=health risk concern; 11=job satisfaction; 12=job stability; 13=stress management.

Note: the regression coefficients were standardized. Standard error terms are in parentheses.

Table 10 shows the results of the impact of social and psychological variables on performance from the laborer’s perspective. Cost performance is significantly influenced by ‘knowledge’ with a *p*-value of 0.025). Knowledge plays a great role in the performance of construction projects. An adequate construction process saves construction laborers from doing one work more than once (Kognisi et al. 2021). When laborers possess adequate knowledge of a construction process, they use the relevant materials required to achieve the quantity of the item

that is required without using excess materials thereby preventing waste of materials. Thus, this increases the performance of laborers on construction projects (Gamil and Alhagar 2020).

The results also show that ‘financial stability’, ‘sense of belonging, knowledge’ effect on the time performance of construction projects with a  $p$ -value of 0.020, 0.006, and 0.004 respectively. Knowledge about the construction process greatly impacts quality performance from the laborer’s perspective after the pandemic. The laborers are the skilled personnel that is mainly responsible for the on-site tasks and ensuring the work is being done on the construction project (Lai et al. 2020). Laborers with adequate knowledge of the construction process will yield increased performance. Mistakes during the construction phase are very costly. Because the Covid-19 pandemic has forcefully increased time spend on construction projects due to the inactivity during the pandemic, construction firms are more likely to expect double productivity to make up for the lost time (Oluwananumi et al. 2020). Therefore, the necessary knowledge required must be acquired by the laborers for the time performance of the construction projects. Sense of belonging improves your social character and helps you to have discussions as a member of a team or group where your opinion matters thus helping you to self-perform accurately, build confidence to help you navigate the item of work at hand and how to go about performing your work knowing fully well you have the support of your work colleagues (Saiz et al. 2021). This highlights the need to have the support of your group members and the need to feel like a social member of a group where your thought process matters (Godinic et al. 2020). In addition, financial stability influences the time performance of laborers for construction projects. The financial motivation of laborers has been suggested as one of the major factors that can stimulate performance in the construction industry as this helps to increase their time on the job, allowing for payment of overtime thus improving their finances (Abdelalim et al. 2019). Most

construction laborers motivate themselves by thinking about how they would spend the money they earn. This motivation brings a better performance rate in terms of time and quality (Tannady et al. 2019).

The results revealed that quality performance, from the perspective of the laborer, is influenced by ‘financial stability’ and ‘income equality’ with a  $p$ -value of 0.035, and 0.019. Dyan and Ravina (2007) examined levels of happiness for various socioeconomic groups over 25 years and proposed that an individual’s level of happiness was influenced by both their income and how it compared to others’ incomes. Laborers, as seasonal workers in the Midwest region of the United States, found it difficult to afford some basic commodities because they could not work due to the total lockdown (Godinic et al. 2020). This led to the realization of how low they earn (Cipolotti et al. 2021). This abated their vehement zeal for the job thereby reducing the performance of the laborers. Given this and because of the favorable increase in the rate of estate developments in the United States, especially after the Covid-19 pandemic, some construction firms are increasing the wages and salaries of their laborers by approximately 6% more than the previous year (Sood 2020). This increase would in turn help improve their focus on the job thus improving the quality of work done on site (Allas et al. 2020).

**Table 10.** Impact of social/psychological states on performance after the pandemic at the laborer level

Var.	Cost performance			Time performance			Quality performance		
	Beta	P-value	VIF	Beta	P-value	VIF	Beta	P-value	VIF
1	0.613	0.42	3.716	0.234	0.175	3.716	-0.463	0.217	3.716
2	0.003	0.990	3.557	0.039	0.812	3.557	-0.483	0.301	3.557
3	0.086	0.849	7.662	0.350	0.02	7.662	0.375	0.035	7.662
4	-0.550	0.099	4.828	-0.319	0.110	4.828	0.572	0.183	4.828
5	0.046	0.905	7.154	0.133	0.568	7.154	0.283	0.019	7.154
6	0.548	0.025	4.532	0.621	0.004	4.532	0.569	0.221	4.532
7	-0.029	0.917	3.831	0.308	0.006	3.831	-0.733	0.261	3.831
8	0.290	0.354	4.587	0.347	0.078	4.587	0.397	0.334	4.587
9	0.195	0.359	2.125	-0.047	0.711	2.125	0.082	0.767	2.125
10	-0.144	0.572	3.109	-0.08	0.600	3.109	0.293	0.386	3.109
11	-0.150	0.478	2.132	-0.410	0.281	2.132	-0.468	0.107	2.132
12	-0.179	0.381	1.978	0.356	0.510	1.978	0.547	0.055	1.978
13	0.553	0.48	3.263	0.275	0.095	3.263	-0.434	0.216	3.263
$R^2$ ( $Adj.R^2$ )	0.907 (0.800)			0.555 (0.042)			0.228 (0.016)		
$F$	2.738			1.094			0.962		
<i>Durbin-Watson</i>	1.892			2.058			2.147		

Note: 1=work ethics; 2=team inclusion; 3=financial stability; 4=social support; 5=income equality; 6=knowledge; 7=sense of belonging; 8=anxiety/depression; 9=motivation; 10=health risk concern; 11=job satisfaction; 12=job stability; 13=stress management.

Note: the regression coefficients were standardized. Standard error terms are in parentheses.

## 5. DISCUSSIONS

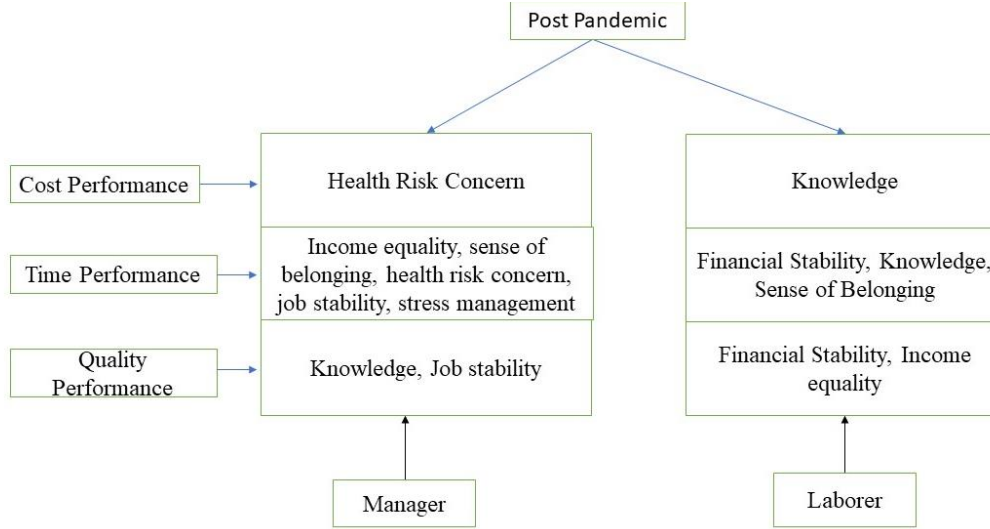


Fig. 8. Analysis results

As a result of the analysis, it was found that the Covid-19 pandemic influenced on social and psychological states of construction workers and there existed differences in social and psychological state changes between managers and laborers. After the Covid-19 pandemic, the manager and laborers felt more anxiety and depression (Fig. 3). Noteworthy, their anxiety and depression levels were similar before the pandemic, but the laborers' anxiety and depression levels noticeably increased after the Covid-19 pandemic. The evidence of this can be traced back to the fact the laborers were completely inactive during the lockdown because of the Covid-19 restriction, but some managers still worked from wherever they were (Salari et al., 2020). Managers could engage in bid submissions, quality assurance practices, estimation of future construction projects, preparation of schedules, online training, and seminars (Nguyen et al., 2021). However, the site laborers could not do any of these and were instead forced to stay idle because of the total lockdown. Along with the increase in anxiety and depression, the laborers had more health risk concerns after the Covid-19 pandemic. The increase in health risk concern is because of them being the personnel on site that comes in contact directly with other laborers



with fear for both their jobs and life. Laborers are hourly paid workers which simply means they only get paid when they work (Ayodele et al. 2020), which means they must be on-site physically to carry out their duties before and after the pandemic. With the advent of the pandemic and spread of Covid-19, laborers became skeptical about working around people leading to general panic and anxiety for their health for fear of catching Covid-19, also cannot be absent from work for fear of losing their jobs and source of income (Godinic et al. 2020). This fear of contracting Covid-19 from colleagues led to an increase in concern for their health status and anxiety for fear of losing their job (Sood 2020). Managers, however, do not have to experience being on-site as their work allows them to carry out activities remotely thus reducing their human contact to as little as possible.

It was also found that knowledge, motivation, financial capability, and stress management had a significant impact on the performance of construction projects before the Covid-19 pandemic while several variables had a significant impact on the performance of construction projects after the Covid-19 pandemic. This means that the social and psychological states have become to play an important role in the performance of the projects. It is noteworthy that there existed differences in social and psychological variables that affected the performance of the construction projects between managers and laborers. From the perspective of managers, both social and psychological variables, including 'health risk concerns', 'income equality', 'sense of belonging', 'job stability', 'stress management', and 'knowledge', impacted the performance of the project in terms of cost, time, and quality. From the perspective of laborers, social variables including 'financial stability', 'income equality', 'knowledge', and 'sense of belonging' were the most impactful factors on the performance of construction projects. It shows the difference between the managers' and laborers' perceptions of what impacts the performance

of construction projects. Namely, managers are influenced by both social and psychological variables while laborers are only influenced by social variables.

With these analysis results, management would be able to focus more on what affects all parties involved and provide resources for improvements. First, management should provide continual trainings and regular workshops for the workforce to help improve their knowledge and keep them updated about the constant changes in the industry, keeping them in check with the trends in with the required quality and standards in the industry. Management should provide means to allay managers of their anxieties and depression because of non-physical work during the Covid-19 and the adjustment that came with construction activities after Covid-19. Management should make available mental health professionals to allow managers to discuss their state of mind regards work, life, and everything else in general. Management should provide and allow time off work to recharge and help facilitate stress management and burnouts. This helps in improving the state of well-being of the workers and focus on the job knowing time offs are allocated to each worker should need be to leave the job for a while.

Second, management should focus on providing avenues to improve the social state that affects managers' performance, including 'income equality', 'sense of belonging', and 'knowledge'. Income equality should be closely monitored by the management and improved upon quarterly by everyone's performance and contribution to the growth of the firm. These bonuses in turn motivate the managers to put in more work and allow for healthy competition amongst them thus benefiting the company. Managers should be allowed to network and socialize with colleagues from other companies and sectors of the construction industry, sharing time away from the job to discuss ways forward and generally have a feeling of belonging to greater society and industry that helps improve both professionally and personally, this, in turn,

makes them feel they belong to the right group of people where they can be heard and seen thus helping with their sense of belonging as humans. Provisions should be made for managers to continually improve their education in the construction world by having them take professional certifications at a reduced cost thus motivating them to want to keep learning and improving on their education and knowledge in general. Companies should provide avenues to attend conferences on the current trends in the industry and allow for collaborations with colleagues across from other companies and the engineering industry in general.

Third, management should focus on improving the psychological state that affects managers' performance, including 'health risk concerns', 'job stability', 'stress management', and motivation. Companies should provide adequate health insurance schemes for their employees which allows them to look after their health and manage it effectively thus reducing sick days off the job that may lead to inactivity and elongating time spent on a project. Paid time off should be improved upon to help effectively manage workers' stress and allow them time off the job without worrying about their pay or salary. Due to the intensity of projects and deadlines, managers often experience burn out which requires them to take a couple of days off work to manage this stress and burnout, however, without adequate provisions for this, managers will be inclined to continue working with their burnouts which may affect their focus, coordination, timely delivery and finally their performance on the job. Quarterly reviews and job performances should be made by management involving construction managers on the job showing them areas of improvement and showing appreciation for a job well-done which lets them know they are a part of the company, and their job is secured thus making them put in more efforts in improving their quota to the projects and company's growth in general. Management should continue to help motivate the managers on the project by providing several avenues to show how important

the workers are to the company. Company retreats, trainings, promotions are all ways to motivate workers to continue to be interested in both the project and the company in general.

Finally, management should focus on improving the ‘financial stability’, ‘income equality’, ‘knowledge’, and ‘sense of belonging’ of their laborers. Financial motivations should be provided for laborers to allow them to work effectively to save up for off-seasons when work does not happen due to the harsh winter weather conditions, allowing them to work overtime without any detriment to their health should be encouraged for workers. Working overtime helps ensure the timely delivery of projects which in turn improves the cost performance having made sure the project was completed within schedule and time speculated without delays. These provisions should be made available to workers to help sharpen their focus on the project as an incentive on a job well-done. This will foster healthy competition amongst workers and allow for timely and quality completion of work on projects. Income equality should be made across boards for all laborers and management to look into the constant review of wages to help improve their finances. To motivate them to work effectively on construction sites, bonuses should be assigned to workers with the most improvement in a period thus encouraging everyone to work effectively well. Educating laborers on the construction process and how to carry out site activities should be highly prioritized by the management as this improves both the delivery and quality of the work done by laborers on site. Knowing the process makes the work easier to carry out, timely completion of the project, and improvement of the quality standards of the work. Networking and socializing should be encouraged amongst laborers to help improve their general well-being, and mental state as often laborers work far away from their family and loved ones during the construction peak season thus generally spending time with co-workers and sharing

and enjoying time together often helps improve the well-being of laborers which in turn helps improve their total work outlook.

## 6. CONCLUSIONS

To understand the changed social and psychological states of construction workers throughout experiencing the Covid-19 pandemic and provide the managerial implications and guidelines in the post-pandemic period, this study investigated the social and psychological impact of Covid-19 on the performance of construction projects. First, the workforce reactions to the social and psychological states according to their demographics including gender, years of experience, age, race, company size, and positions were explored. The results showed that there existed differences in social and psychological states according to the different demographic characteristics. Noticeably, laborers were mostly impacted by social variables while superintendents and managers were more impacted by psychological variables. Second, this study investigated the difference in social and psychological states between the pre-and post-pandemic periods from the perspectives of both managers and laborers. There was a difference in the anxiety and depression levels of both the managers and laborers between both periods while there were also differences in the health risk concerns level of the laborers in the post-pandemic period because the workers on site are exposed to more risks of contacting the covid-19 pandemic. Finally, the most impactful variables on both the managers and laborers in the pre-and post-pandemic periods were identified. It was found that none of the variables impacted the performance of projects in the pre-pandemic period. However, in the post-pandemic period, several variables impacted the performance of the project in terms of the social and psychological state of the workforce. The managers were impacted by their income equality, knowledge, sense of belonging, health risk concern, job stability, and stress management. Laborers were impacted by variables such as financial stability, income equality, knowledge, and sense of belonging. The results indicated that site workers were impacted by social variables

while managers were impacted by both social and psychological variables. Management should focus on improving the highlighted variables in this research and implement the strategies suggested in this study.

The results of this study will benefit construction companies in improving their management practices, ensuring performance improvement, and getting the best efforts from their workforce in the post-pandemic period. Construction companies will be able to manage the workforce and be able to identify their weaknesses and improve on these weaknesses. However, there are several limitations to be improved in the future. The dataset collected in this study was limited to particular zone and numbers. Further studies need to consider the characteristics of companies such as size, type, and location with additional social and psychological variables. It should also consider analyzing using the data of people that tested positive for the covid-19 pandemic and see the impact this has on the social and psychological state of performances. Further studies should investigate separating and gathering more information from superintendents and managers without combining both survey responses. It should also look at spreading across the country its survey. Future study should also investigate through literature review variables that affect performances in the pre-pandemic. It would be needed to look deeply into why certain variables occur in influencing performances more than others. Further studies also need to investigate management practices that impede the performance of the workforce and how to improve these practices.

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## APPENDIX A: SURVEY QUESTIONS

Background Information – Please mark appropriately as relevant to you.

Gender

- Male
- Female
- Prefer not to say

Race

- White
- Black or African American
- Hispanic
- Asian
- Prefer not to say

Age

- 20-30
- 31-40
- 41-50
- 50 and above

Indicate company size

- Small 0-49
- Medium 50-199
- Large 200 and above

Years of industry experience

- 1-5

- o 6-10
- o 11-15
- o 16-20
- o Above 20

Which of the following best describes your job position?

- o Manager
- o Superintendent
- o Laborer (i.e., Carpenter, Iron Bender, Mason etc)

Have you in any way been impacted by the Covid-19 pandemic?

- o Yes
- o No

Were you educated about Covid-19? (Training, PPE, procedures...)

- o Yes
- No

The following factors as defined below are various social/psychological factors. Please tick appropriately the degree to which you agree before the pandemic.

	<b>PrePandemic</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Neutral</b>	<b>Agree</b>	<b>Strongly Agree</b>
1	I often feel anxiety and depression on the job.					
2	My motivation to work on the job is outstanding.					
3	I am concerned about my health on the job.					
4	I am satisfied with my Job and					

	its provisions for me.					
5	I am confident of my job status and my ability to keep my job.					
6	I often experience stress on the job.					
7	My work ethic is outstanding					
8	I enjoy being a part of the team.					
9	My financial status (Income and revenue) is stable.					
10	The support from friends and family for my well-being is encouraging.					
11	There is an even distribution of income among work colleagues and individuals.					
12	I am knowledgeable about the construction process.					
13	I have support from my team members.					

The following factors as defined below are various social/psychological factors. Please tick appropriately the degree to which you agree to this after the pandemic.

	<b>Post-Pandemic</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Neutral</b>	<b>Agree</b>	<b>Strongly Agree</b>
1	I often feel anxiety and depression on the job.					
2	My motivation to work on the job is outstanding.					
3	I am concerned about my health on the job.					
4	I am satisfied with my Job and its provisions for me.					
5	I am confident of my job status and my ability to keep my job.					
6	I often experience stress on the job.					
7	My work ethic is outstanding					
8	I enjoy being a part of the team.					
9	My financial status (Income and revenue) is stable.					
10	The support from friends and family for my well-being is encouraging.					
11	There is an even distribution					

	of income among work colleagues and individuals.					
12	I am knowledgeable about the construction process.					
13	I have support from my team members.					

The following are performance variables as defined below. Please tick appropriately as you deem fit before and after the pandemic.

	<b>Pre -Pandemic</b>	<b>Unacceptable</b>	<b>Poor</b>	<b>Fair</b>	<b>Good</b>	<b>Very Good</b>
1	The project is within Budget					
2	The project is on Schedule					
3	The project meets required quality					

	<b>Post -Pandemic</b>	<b>Unacceptable</b>	<b>Poor</b>	<b>Fair</b>	<b>Good</b>	<b>Very Good</b>
1	The project is within Budget					
2	The project is on Schedule					
3	The project meets required quality					

## APPENDIX B: IRB APPROVAL FORM



02/14/2022

Dr. Youjin Jang  
Civil, Construction & Env Eng

Re: IRB Determination of Exempt Human Subjects Research:  
Protocol #IRB0004106, "Exploring the impact of the covid 19 pandemic on the social/psychological status of workers and performance in construction sites"

NDSU Co-investigator(s) and research team:

- Youjin Jang
- Olugbemiga Emmanuel Olatoye

Approval Date: 02/14/2022

Expiration Date: 02/13/2025

Study site(s): North Dakota and its environs

Funding Agency:

The above referenced human subjects research project has been determined exempt (category 2) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, *Protection of Human Subjects*).

Please also note the following:

- The study must be conducted as described in the approved protocol.
- Changes to this protocol must be approved prior to initiating, unless the changes are necessary to eliminate an immediate hazard to subjects.
- Promptly report adverse events, unanticipated problems involving risks to subjects or others, or protocol deviations related to this project.

Thank you for your cooperation with NDSU IRB procedures. Best wishes for a successful study.

*NDSU has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.*