



The Vulnerability of the Construction Ergonomics to Covid-19 and Its Probability Impact in Combating the Virus

Ahmed Fahim Elgendi ¹, Ashraf Elhendawi ^{2,*}, Waleed Mahfouz M. A. Youssef ³, Abdul Salam Darwish ⁴

¹ Faculty of Graduate Studies for Statistical Research, Cairo University, Egypt

^{2,4} Civil Engineering and Construction, School of Civil Engineering and Built Environment, University of Bolton, UK

³ Structural Engineering, Faculty of Engineering, Cairo University, Giza, Egypt

Emails: engfahem1@gmail.com, ashrafnasr86a1@yahoo.com, cvlmaster@yahoo.com,

a.darwish@bolton.ac.uk

Abstract

Currently, the world encounters the outbreak of an unprecedented epidemic named novel coronavirus COVID -19. World Health Organization (WHO) advises maintaining social distancing, preserving personal hygiene, and staying informed with the latest guidelines. WHO also reports the patients with robust immunity can combat the virus. However, the workers in the construction industry work and live in a crowded and non-hygiene environment. Moreover, they are characterized by illiteracy, a dearth of awareness, and chronic health problems that prove weak immunity. Therefore, this study aims to find the relationship between the virus and the prevailing conditions and the environment of the construction industry, under focus, and study so that the construction industry is not a vulnerability gap that may exacerbate the crisis. An extensive literature exploration for the latest research deals with coronavirus, the construction industry ergonomics, and its relevant diseases. This study makes robust alerts to motivate the governments, organizations, and individuals to collaborate to find solutions to close the gap between the current situation in the construction of ergonomics and the required precaution to avoid the outbreak of the virus. This study makes a crucial and novel contribution by paving the way for providing solutions to save humanity worldwide. The management system should review the conventional risk assessment procedures, and developed criteria must be introduced and become an everyday practice of all construction projects. This will help identify the gaps within the safety procedures associated with the COVID – 19 protection aspects. This article also introduces a framework in this regard.

Keywords: COVID-19, Occupational Health, Occupational Safety, Construction Industry Health and Safety

1 Introduction:

The novel Coronavirus (nCoV) descended from a large family of viruses, for instance, Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS). A novel coronavirus (nCoV) is a new strain which has not been previously transmitting to humans [1]. It infects humans and causes respiratory tract infection disease which ranges from mild to lethal [1]. The first case appeared in China early 2019, then the virus outbreak in the entire China. It has since spread to Europe, thereafter to all over the world. Scientists have discovered a new strain of the virus which is much more dangerous [1].

Up till the time of writing this study, and after two years since the global outbreak, the confirmed total number of coronavirus cases reached (183.5M M), (179.5M) recovered and (4M) death [1].

Generally, the world was not well prepared to face such a pandemic, especially the construction industry, which is considered the second contributor to the nations' national economy [1,2]. Besides, the construction workforces represent approximately 15% of national workforces in each country (Youssef, 2014/2019), and therefore their direct contacts and families tend to represent almost the entire population. Thus, the construction workers should strictly follow the required precautions to protect themselves and their connections.

An extensive review of the published research within the last 15 years in the construction industry work and the related diseases from different countries to represent all the world environmental discrepancies and the published studies deal with the novel coronavirus.

This study consists of main seven sections: 1) Construction industry characteristics, 2) Epidemics Diseases and Workplaces, 3) Work Conditions in Construction Industry, 4) Occupational Diseases in Construction Ergonomics, 5) Discussion of the Coronavirus, 6) Construction Organizations, and Combating Epidemics and Infection 7) Conclusions and Recommendations.

2 Construction Industry Ergonomics Characteristics:

Recently, the Architecture, Engineering, and Construction (AEC) industry is considered the most influential contributor to development all over the world. However, the AEC industry is facing myriads' challenges due to the vast construction evolution [2,3,4,5,6,7].

The construction sector has the potential to play an important role in the country's intersectoral approach to coping with the epidemic. A sector have already strongly critical terrible situation in health and safety compared with almost all other industries. In "Recent figures published by the HSE put this into perspective, revealing that a total of 144 workers were killed at work in Great Britain in 2017/18, with 38 deaths in the construction industry accounting for the greatest number of occupational fatalities from an individual sector"[9], thus the effect of this situation, within the high international risk of coronavirus is highly important and extremely risky.

A situation that has increased the severity of coronavirus is mainly associated with lung diseases that are already very poor in this sector, as HSE data indicate that approximately 12,000 lung disease deaths occur each year in previous trade exhibitions.

For every worker killed on-site, approximately 100 die from health problems due to past exposure [9]. Harmful Dust particles can be transported through the air after active construction and dry sweeping and can remain in the environment even long after busywork [8]. Besides, HSE also highlighted that 56% of all occupational cancers in the UK were in the construction sector. In addition, Mesothelioma and cancer that mainly affect lungs that were caused by exposure to asbestos claimed the lives of 2,595 people in 2016 [9].

On the other hand, the construction sector has a predominantly migratory labor force that could potentially contribute to the spread of any epidemics, especially coronavirus [10]. Therefore,, the construction sector might be considered one of the riskiest sectors in severity and probability and could be highly qualified to be a very weak point in internationally combating the virus. Moreover, the FIDIC also recognizes construction sites in developing countries are potential centers of HIV-AIDS, by comparison, the sector possesses various conducive conditions to spread any pandemic, such as excessive labor intensity in labors' site camps that are always below international standards as well as the weak health awareness among construction workers [8].

Their study [11] highlighted that approximately 1.1 million people die every year of occupational injuries and work-related diseases. Comparing this rate with other industries, the construction industry has the highest work-related risk injuries and illnesses (17%) of injuries and deaths.

3 Epidemic Diseases and Workplace:

Construction sites are one of the most dangerous areas for human health and safety [11]. In developing countries, enforcing safety rules is often negligible to minimize occupational injuries and illnesses. Consequently, work-related injuries are widely rampant [11].

Also, construction companies in developing countries hardly pay attention to the safety of their workers. Besides, most construction workers are illiterate and unorganized; they do not have a formal relationship with their employers, and the construction place of work by itself is temporary [11].

[12] illustrated that the workplace is a key setting for promoting the health of adults. The time that individuals spend working during their lifetime makes the workplace an arena that is especially amenable to developing and delivering more integrated health care [12].

4 Work Conditions In Construction Industry:

The construction work conditions make the industry very risky due to the challenges of providing PPE, training, and other HSE services to employees [13,14]. Furthermore, construction employees are three times more likely to be killed and twice more likely to be injured than workers in other jobs [11].

The construction industry produces temporary construction outdoors [15]. In a study for spread an epidemic (Lyme Disease) in New York, The duration of outdoor work for those who tested positive was significantly longer than that of outdoor workers who tested negative, suggesting that working outdoors is a risk factor [16].

Workers who work outdoors in hot weather or indoors without effective temperature controls such as air-conditioning are more vulnerable to workplace health and safety (WHS) risks posed by high heat and humidity. Those engaged in strenuous physical work confront particular risks, as this form of exertion makes metabolizing heat more difficult, hence low immunity [17].

At a temperature above 35°C, the risk of heat stress for workers engaging in heavy manual labor is high. Under temperatures equal to or exceeding 37°C, workers are likely to face acute physiological effects threatening their health and safety. Heat exposure increases the risk of health issues related to physical fatigue, hence low immunity due to continuous physical stress [17].

In India, as an example of building conditions in developing countries, 52% of construction workers have unfavorable habits such as drinking (26%), smoking (32%), eating bread (12%), smoking tobacco (10%), Bethel stops to chew (4%). Also, 86% of the population suffer from the mental health problem due to way of work. Change of work schedule daily (30%), change of workplace daily (26%), lack of sanitary facilities (6%), and 42% of the employees live in cabins [18].

4.1 Construction Worker Problems:

CDC report (2010) shows that employees in architecture, engineering, and construction are at high risk of suicide [19]. Suicide rates differ across industry and occupational groups, with the construction sector identified as one of the highest occupational risk groups for suicide in Australia. Despite their poor mental health, many British construction workers do not seek help because of the shame of masculine mental health problems [20]. In general, the demographic–social and working–living situations of the workers in the construction industry are extremely pathetic and vulnerable till now [18].

In general, construction workers face many problems every day, such as no adequate provisions for the waste disposal system, sewage supply, pollution, entertainment and leisure facilities, sickness facilities, non-availability of health, medical, education institutions, lack of good quality of food, and nutritional level [15]. In addition, the construction sector, in general, has migratory and transitional nature of work which increases the probability of labors infection of the epidemics of communicable and non-communicable diseases [16].

5 Occupational Diseases In Construction Ergonomics:

Injuries and occupational diseases at construction sites are identified as significant public health and development problem throughout the world [11]. In India, workers are primarily illiterate; it is challenging to impart health education [22]. In Korea, 28% of all fatal accidents occur in the construction industry [15].

Due to the complexity of the construction industry, the health and safety sector is particularly vulnerable [15]. It has been evidenced by number of studies that the construction industry is one of the most hazardous works place industries with higher rates of fatalities, injuries, and health problems [23].

The proper remedial measures should be carried out to reduce identified health problems on-site such as heat stroke, eye irritation, lung irritation, skin disease, nose irritation, blood poisoning, throat irritation, and hearing disorder [23].

Their study [18] indicated that the construction industry does not provide the basic facilities and safety measures to the workers at the site [18]. Most of the construction workers themselves or their family members also suffer from diseases, such as silicosis, malaria, tuberculosis (TB), anemia, chronic bronchitis, pleurisy, pneumonia, asbestos-related diseases, pulmonary diseases (Chronic Obstructive Pulmonary Disease (COPD) and genetic diseases [24], Tables 1, 2 and 3 illustrate the frequency of Occupational diseases withing construction workers in various countries.

Table 1: The frequency of diseases within the construction worker, (study in Iran)[25]

	Respiratory problems	Hearing problem	Vision problems	Skin diseases	Diseases caused by vibration	Mental illness	Allergies	Heart disease
Frequency	36	21	25	55	11	29	12	12
Frequency%	6.3	3.7	4.4	9.6	1.9	5.1	2.1	2.1
Frequency Cum.	6.3	9.9	14.4	23.9	25.9	30.9	33.1	35.2

Pain in back	Pain in neck	Lung problems	Pain in wrist	Pain in shoulder	Pain in knee	Pain in ankle	Cancer	Sum
74	33	28	69	39	82	37	8	571
12.9	5.8	4.9	12.1	6.8	14.3	6.5	1.6	100
48	53.8	58.7	70.8	77.6	92	98.4	100	

Table 2: Various occupational diseases in the construction industry in the world, (study in Iran) cited in [25].

	Iran	UK	Malaysia
The most common diseases	Musculoskeletal disorders	Respiratory disease	Hearing loss
Percentage	59.1%	47%	58%
Method	Questionnaire distribution and analysis	Reviewing reports	Questionnaire distribution and analysis
Sample size	245	6385	863
Time of study	2014–2015	1996–2001	2002–2006

China	Egypt	Venezuela	Germany
Lung disease	Eye disease	Musculoskeletal disorders	Hearing loss
70–80%	23%	76.5%	-
Reviewing reports	-	Reviewing reports	Reviewing reports
-	487	-	-
1997–2007	2003	2005–2013	2010–2014

Table 3: The frequency of diseases with regard to each profession, (study in Iran) [25].

	Respiratory problems	Hearing problem	Vision problems	Skin diseases	Diseases caused by vibration	Mental illness	Allergies	Heart disease
Welder	4	5	8	8	0	2	1	0
Mason	3	3	1	4	4	1	3	2
Stone installer	2	3	3	7	1	0	3	2
Tile installer	0	0	0	4	0	1	0	0
Scaffolding worker	1	0	0	1	0	6	0	0
Electrician	0	0	1	2	0	2	2	2
Armature person	0	0	0	0	0	0	0	0
Plaster worker	3	0	0	3	0	0	0	0
Unskilled workers	7	7	7	10	6	9	3	2
Painter	4	0	2	6	0	0	0	0
Carpenter	7	2	1	0	0	0	1	0
Driver	2	1	1	2	1	7	0	5
Siding worker	0	0	1	2	0	1	0	0
Door and window builder	3	0	0	5	0	0	0	0
Sum	36	12	25	51	11	29	12	12

Pain in back	Pain in neck	Lung problems	Pain in wrist	Pain in shoulder	Pain in knee	Pain in ankle	Cancer	Sum
0	0	1	4	3	0	15	0	29
12	2	2	11	7	6	9	0	30
9	2	3	7	1	4	10	0	29
1	0	2	4	0	2	7	0	11
4	1	0	4	6	2	4	0	10
2	2	0	1	0	2	1	0	5
2	0	0	3	0	0	1	0	5
8	8	3	0	0	9	4	1	15
17	6	3	12	8	0	20	0	52
3	6	5	3	2	0	2	1	16
5	0	7	8	5	0	1	0	16
5	1	0	1	0	0	0	1	11
1	3	3	2	3	2	2	0	5
5	3	0	9	4	8	6	0	11
74	33	27	69	39	37	82	8	245

[25] studied the frequency of disease concerning construction workforces and found that the maximum professions are Unskilled workers while the lowest frequency for Armature person [25].

5.1 Endemic Diseases:

Several Studies argued that outdoor workers in endemic areas incur a significantly increased risk of exposure than the general population [16,19].

5.2 Respiratory Diseases:

As an example, people that can loads 50 bus, dying each year from respiratory diseases[26].

Industries/workplace activities that have high incidence and/or a large number of workers potentially exposed to respiratory disease and construction workers are in the top rank to exposed to this disease.

Exposing to a host of toxins, including asbestos; for general people, however, for a construction worker is normal; between them, thousands told chronic respiratory diseases and died yearly in silence. Where exposed to dust in Rock, Sands, Clays, Shells, Gravel daily. And finally cause: Form of lung damage known as silicosis, Small nodules of scar tissue develop in the lungs, paired lung function, leading to chronic bronchitis with cough and breathlessness, Lung Cancer.

A review suggests that COPD (occurs more often among construction workers than among workers who are not exposed to construction dust [26].

COPD resulted in severe morbidity and was the fifth leading cause of death worldwide in 2002 [19]. COPD includes two main conditions, emphysema, and chronic bronchitis, associated with fixed airway obstruction [26].

Nowadays, Chronic respiratory disease morbidity in construction workers lead to permanent disability and mortality y [27].

Work-related respiratory diseases are caused or exacerbated by the inhalation of dangerous substances that damage the lungs. The most common diseases in the construction industry are COPD, asthma, and silicosis [1].

Wang et al. claimed increased risk of malignant and not-malignant respiratory disease onset in older construction workers. The authors state that some respiratory hazards, e.g. asbestos, silica, and dust make unhealthy workplaces and can lead, in the years, to COPD and lung cancer, as well as other studies found [28].

Dust respiratory disease (35.4%) of the sample of diseases in the study of Korea [15]. It has been observed that the ill health of the worker causes more deaths. It has been recorded that around 13000 deaths cases occur each year due to various health problems including occupational lung disease and cancer [23].

[29] has concluded that workers in tunnel construction in the United States are at increased risk for airway disease and probably for COPD .

The overall prevalence of chronic bronchitis, CEA, SOB, and medically diagnosed asthma was 10.7%, 25%, 29%, and 6.6%, respectively [29].

In control subjects, 4.76% showed restrictive type pulmonary function impairment. The study results demonstrated that occupational exposure created harm to the workers' respiratory system, causing respiratory function impairment [30].

Holland, COPD was present in (21%) of workers. Conclusion: silicosis seems still common among silica exposed construction workers, together with co-existing comorbidities [31].

Construction workers employed in a unique type of tunnelling called tunnel lifting were exposed to respirable crystalline silica (RCS) for 18 months at concentrations that exceeded the OSHA-approved exposure limit, shown in Fig. 1,2 [29].



Figure 1: Construction worker exposure to RCS, cited in [32].



Figure 2: Health impacts of Chronic Obstructive Pulmonary Disease (COPD) on construction workers (X-Ray), [32].

In addition, acute respiratory distress syndrome (ARDS) is a type of respiratory failure that is characterized by the rapid activation of generalized inflammation in the lungs. Symptoms include shortness of breath, rapid breathing and bluish skin discoloration cited in [26].

5.2.1 Respiratory Smoking in Construction and Respiratory Diseases

Smoking is associated with an increased risk of occupational disability among construction workers, as shown in Figure 6 and the Hazard ratio analysis in Fig. 3, particularly occupational disability due to respiratory, cardiovascular, and cancer diseases [33].

Construction is a key sector accounting for over 500 of the annual lung cancer deaths.

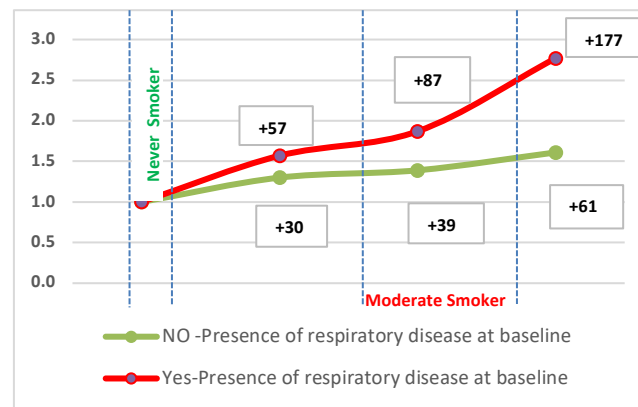


Figure 3: Hazard ratios of respiratory disease in construction

The particularly strong association of smoking with occupational disability due to respiratory diseases among workers with the pre-existing respiratory disease might point to potential synergistic effects with other factors such as occupational dust exposure, and they underline the particular importance of promotion of smoking cessation in this occupational group [33].

5.3 Cardiovascular Disease:

The prevalence of overweight and high risk of cardiovascular disease (CVD) among workers in the construction industry is relatively high [34].

Results of the obtained dependence made it possible to develop a scheme for rapid assessment of occurrence and development cardiovascular system diseases risk of the workers of surface and underground facilities, in contact with fine dust during the construction process. The scheme is presented in Fig. 4. [35].

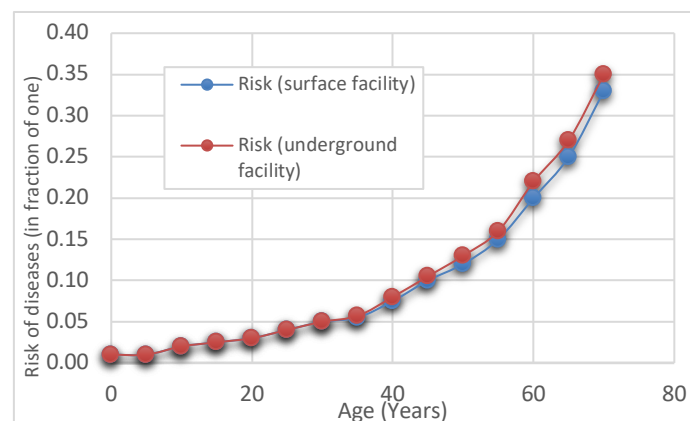


Figure 4: Risk accumulation model of the cardiovascular system's pathology when exposed to fine dust [35].

About two-thirds of construction workers have reached only three of the seven "ideal" indicators of cardiovascular health [36].

5.4 Dermatitis Disease:

Dermatitis - Contact dermatitis is inflammation of the skin that can arise from contact with a range of materials. Work-related dermatitis is caused or exacerbated by work [37].

Contact dermatitis and allergy Occupational skin disease in the construction industry. Construction workers have a significant risk of developing irritants and/or allergic contact dermatitis. Unfortunately, there are only a few population-related epidemiological data on occupational diseases of the skin (OSD) in the European construction industry that make it possible to evaluate preventive measures [37].

6 Coronavirus, COVID-2019-nCoV:

Contact The nCoV associated pneumonia cases were reported to st. the World Health Organization (WHO) on 31 December 2019 by the Chinese government. These cases were from Wuhan, Hubei Province, China. From that time, the number of deaths due to this disease has increased rapidly. The disease has also spread to 4 continents according to the st confirmed cases reported to the WHO. As of February 1, 2020, there are 11953 confirmed cases globally. Among these cases, 11821 confirmed cases (98.89%) are from China. According to WHO's risk assessment, the risk at the global level is high.

It has an incubation period of about 2-14 days and is capable of direct human to human transmission [38].

The patients usually show respiratory illness with fever, cough, and shortness of breath. No specific antiviral treatment is currently available for the 2019-nCoV infection. So symptomatic treatment is recommended.

The results revealed how the disease would be very dangerous and killer globally unless several potential impacts are implemented (i.e. limit the transportation to and from the infected areas, and reduce within-population contact rates, etc.) [39].

6.1 Coronavirus, COVID -2019-nCoV and Infectious Diseases:

According to the WHO, the worldwide spread of nCoV 2019 continues and evolves rapidly, which raises the risk assessment to a high level. [40]. Emerging viruses and pathogens represent a global public health threat [40]. Infectious diseases and associated mortality have declined but remain a major threat worldwide. People have to continue fighting the old pathogens like the plague that has been affecting humanity for thousands of years and the new pathogens like the human immunodeficiency virus (HIV), which has mutated or spread from animal reservoirs [41].

6.2 Coronavirus, COVID -2019-nCoV and Respiratory Diseases:

Among the symptom compositions of the 45 mortality cases compiled from published official reports, the four most important symptoms are fever, cough, shortness of breath, and tightness/pain in the chest [42].

About half of the patients developed dyspnea a week later, and the severe cases quickly turned into acute respiratory distress syndrome, septic shock, challenging to correct metabolic acidosis and coagulation disorders. Serious and seriously ill patients may have moderate to low fever or even no obvious fever. Some patients have mild symptoms, no fever, and generally recover after a week. Most patients have a favorable prognosis, although some patients are seriously ill or do not survive. Elderly patients and patients with underlying diseases have a poorer prognosis [42].

In fact, recent data suggest that mild respiratory disease can also be part of the clinical spectrum of MERS-CoV infection. In addition to mild or acute respiratory problems, abdominal pain and diarrhea, fever, and in some cases, kidney failure is other clinical symptoms. Many hospital cases have occurred in people with chronic illnesses or immunosuppression. The viral load is higher in samples from the lower respiratory tract, although low concentrations of viral RNA can also be found in stool, urine, and blood samples [42].

Chinese health authorities have reported that patients have experienced fever, cough, difficulty breathing, and pneumonia. Such viruses cause several respiratory tract illnesses, ranging from the common cold to severe diseases like SARS. According to the World Health Organization, fever, cough, and difficulty breathing, such as shortness of breath, are common signs of infection. Severe cases can lead to pneumonia, kidney failure, and even death [43].

A strong relationship between COVID -19 and Respiratory Diseases have shown clearly in Fig. 5.

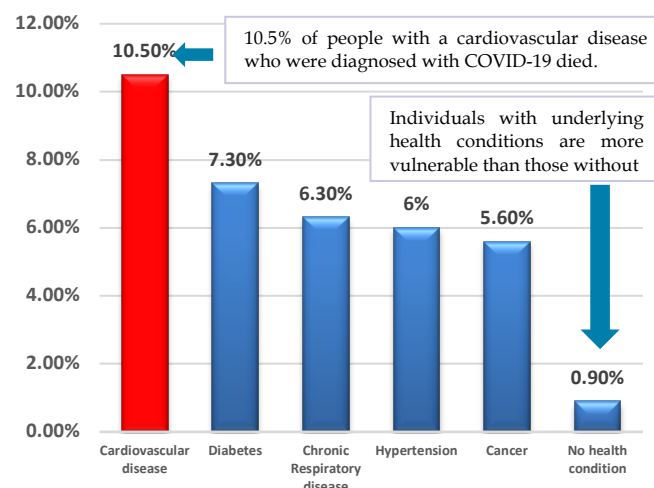


Figure 5: The case fatality rate of COVID-19 by preexisting health conditions in China, cited in [44], Data source: Novel Coronavirus pneumonia emergency response epidemiology team

6.3 Coronavirus, COVID -2019-nCoV and Maladjusted Immune:

A better understanding of the interaction between coronaviruses and the host's innate immune system can provide insight into the development and persistence of inflammation in the lungs and hopefully reduce the risk of pneumonia caused by CoVs. The role of the innate immune system in the pathogenesis and clinical treatment. In the past few years, in-depth knowledge

of the innate immune response to viruses has been acquired. This type of immune response inhibits virus replication, promotes virus elimination, and induces tissue repair, and triggers an extended adaptive immune response against viruses. In most cases, the innate immune system triggers pulmonary and systemic inflammatory responses associated with CoVs when it detects viruses. Although a widely protective universal vaccine is considered the ultimate protection against the spread of the virus, the development of the vaccine can take some time. To meet the urgent need, we need to propose effective therapeutic measures based on the accumulated knowledge of the innate immune response system. Targeted immunotherapy is a good alternative to certain antivirals with narrow treatment windows and easily encounters drug resistance [45].

The innate immune system is the first line of defence against pathogens. The cells of this system react immediately to foreign intruders. (The adaptive immune system, on the other hand, learns to recognize certain pathogens, but takes longer to join the fight.) If the innate immune response is stronger in children who are exposed to nCoV 2019, they can fight it more quickly than adults who only have mild symptoms.

6.3.1 Aging and the Immune System:

The vast majority of cases in China, 87%, affected people aged 30 to 79 years, the China Center for Disease Control [46].

Overall, the Chinese CDC found that 2.3% of the confirmed cases had died. However, the mortality rate in people over 80 was 14.8%, which is likely due to the presence of other diseases, a weakened immune system, or simply poor general health. In contrast, the mortality rate was 1.3% in the 1950s, 0.4% in the 40 to 40 age group and 0.2% in the 10 to 39 age group [46].

Just over half of these patients were men [46]. Men represent the majority of coronavirus cases so far. Researchers think smoking could play a role [47].

6.4 Coronavirus, COVID -2019-nCoV and Maladjusted Immune and Respiratory Diseases:

COVID-2019 infects respiratory and enteric mucosal areas, and thus, induction of mucosal immunity is necessary to protect these tissues from infection. Live attenuated viruses are expected to elicit mucosal immunity more efficiently than nonreplicating antigens, which elicit reduced secretory immune responses [48].

6.5 Coronavirus, COVID -2019-nCoV and Combating epidemics and infections:

Due to the mild nature of the disease and its ability to be transmitted directly between humans, it will be very hard to contain the disease. Even though China has established cordon sanitarian in the Hubei province, its effectiveness in controlling the spread of the disease is yet to be assessed. In order to bring this outbreak in control, the scientific community must conduct thorough research to fully understand the disease and find a suitable global action plan. Till then, we will have to rely on conventional non-pharmaceutical preventive measures and symptomatic treatment [38]. [1] and [43] suggested precautions be followed such as:

- People should stay home while being sick
- People should wash their hands frequently with soap and water or an alcohol-based rub.
- People should Maintain social distancing (minimum 1 meter).
- People should avoid touching their eyes, nose, and mouth.
- People should avoid close contact with other people. Cover your mouth and nose when you cough or sneeze with a tissue, throw the tissue in the trash, and wash your hands.
- People should clean and disinfect objects and surfaces.
- People should practice Respiratory hygiene. If you have fever, cough and difficulty breathing, seek medical care early
- People should stay informed, follow advice from your healthcare provider.

7 Construction Organizations, and Combating Epidemics and Infections:

Social organizations work to prevent and fight epidemics and advise patients and families with close contacts on disease prevention. All organizations are responsible for the general direction of disease control and the provision of means and equipment for disease prevention and control: monitoring and managing close contacts. In accordance with the functional principle of "prevention first, prevention and control combined, scientific guidance and rapid treatment", prevention and control work are carried out in a coordinated and standardized manner [42].

As a result of an international study [49], the increasing awareness of the epidemic, increased use of personal protective measures and travel restrictions are associated with a reducing overall infection rate. However, it is not known whether this reduction is sufficient to stop the virus from spreading. And these results explain that it will be particularly difficult to contain this virus. Very mild and asymptomatic infections remain without papers.

This high proportion of undocumented infections, many of which are unlikely to have serious symptoms, appears to have favored the virus's rapid spread across China. Increasing media coverage and awareness of the virus in the general population has likely already led to an increased rate of medical treatment for respiratory symptoms.

In addition, awareness among health care providers, public health officials, and virus identification tests' availability indicates that the ability to identify previously overlooked infections has increased. In addition, the general public and government efforts have increased the use of face masks, restricted movement, delayed reopening, and isolated suspects, which could also delay the spread of COVID-19 [45].

These measures are expected to increase reporting rates, reduce the proportion of undocumented infections, and reduce the growth and spread of infections [45].

The data and results depict that travel restrictions and control measures have significantly reduced the transmission of COVID-19 to eliminate the disease locally, and it is unclear whether the resumption of the epidemic can be prevented as soon as the control measures are relaxed [45].

The late detection of an imported case in developing countries without adequate measures to prevent and fight infection would lead to a high likelihood of human-to-human transmission, so there is a risk of secondary transmission in the community in such a scenario valued [50].

In a world where infections are boundless, the new strain of coronavirus shows that international collaboration is critical to curbing the spread of the disease, while the population also needs to take professional advice [51].

Due to the increase in international travel and trade; The global epidemiology of infectious diseases is changing rapidly [52,53,54].

8 Conclusions and Recommendations:

An extensive review of the last 15 years of health and safety research in the construction industry and nCoV. This paper found that there is a clear relationship between construction industry workers and respiratory diseases and COVID-19 virus which could be an alarm for many risks, which can summarized as follows:

First, the construction sector, which suffers mainly from health problems of labor and conditions of crowded housing and bad facilities, may represent a major weakness in confronting the COVID-19 virus, even could be an accessible starting point for the spread of the COVID-19 virus to levels of spreading much broader than the current situations.

Second, given their suffering from respiratory and other diseases associated with an increased mortality rate for those infected with coronaviruses, construction workers may represent an easy catch for victims of the COVID-19 virus.

Consequently, the international community, international bodies, and organizations should monitor the construction sector to direct and obligate construction entities to take the necessary actions and precautions to protect construction workers from being victims of such pandemics.

9 References:

- [1] WHO, 2020. Protect yourself and others from coronavirus also known as COVID-19. [Online] Available at: <https://www.who.int/>
- [2] Elhendawi, A.I.N., 2018. Methodology for BIM implementation in KSA in AEC industry. Master of Science MSc in Construction Project Management), Edinburgh Napier University, UK.
- [3] Evans, M., Farrell, P., Elbeltagi, E., Mashali, A. and Elhendawi, A., 2020. Influence of partnering agreements associated with bim adoption on stakeholder's behaviour in construction mega-projects. *International Journal of BIM and Engineering Science*, 3(1), pp.1-20.
- [4] Elhendawi, A., Omar, H., Elbeltagi, E. and Smith, A., 2019. Practical approach for paving the way to motivate BIM non-users to adopt BIM. *International Journal*, 2(2), pp.1-22.
- [5] Elhendawi, A., Smith, A. and Elbeltagi, E., 2019. Methodology for BIM implementation in the Kingdom of Saudi Arabia. *International Journal of BIM and*

Engineering Science, 2(1).

- [6] Shaban, M.H. and Elhendawi, A., 2018. Building Information Modeling in Syria: Obstacles and Requirements for Implementation. *International Journal of BIM and Engineering Science*, 1(1).
- [7] Ahmed, S., Dlask, P., Selim, O. and Elhendawi, A., 2018. BIM Performance Improvement Framework for Syrian AEC Companies. *International Journal of BIM and Engineering Science*, 1(1), pp.21-41.
- [8] FIDIC, 2015. Background-the HIV-AIDS epidemic, s.l.: s.n.
- [9] Oswald, D., Borg, J. & Sherratt, F., 2019. Poor mental health in construction industry. s.l., Conference: Proc. 27th Annual Conference of the International. Group for Lean Construction.
- [10] Haupt, T. C., 2014. The vulnerability of the construction industry to HIV/AIDS Influence of socio-cultural factors on the under-representation of women in the South African Construction Industry View project construction plant and equipment View project, s.l.: s.n.
- [11] Lette, A., Ambelu, A., Getahun, T. & Mekonen, S., 2018. A survey of workrelated injuries among building construction workers in southwestern Ethiopia. *International Journal of Industrial Ergonomics*, 1 11, Volume 68, pp. 57-64.
- [12] Zungu, L. I. & Setswe, K. G., 2007. An integrated approach to the prevention and promotion of health in the workplace: A review from international experience. *South African Family Practice*, 49(6), pp. 6-9.
- [13] Waleed M. Youssef, Karim M. El-Dash, Osman M. Ramadan, "Construction Activities Duration Patterns in the Middle East", *International Journal of Construction Engineering and Management*, Vol 2 (4), 2013
- [14] Karim M. El-Dash, Osman M. Ramadan, Waleed M. Youssef, "Duration Prediction Models for Construction Projects in Middle East", *Engineering, Technology & Applied Science Research*, Vol 9 (2), 2019
- [15] Kwon, Y., 2010. Occupational Diseases of Construction Industry , s.l.: s.n.
- [16] Parkinson, D. K. et al., 1996. Lyme Disease Prevalence Among Construction Workers On Long Island, New York Building and Construction Trades Council, Nassau and Suffolk Counties, s.l.: s.n.
- [17] Newman, F. & Humphrys, E., 2019. Construction Workers in a Climate Precarious World. *Critical Sociology*.
- [18] Selvam, T., 2017. Problems of Construction Workers at Tirupattur.
- [19] Perlman, C.M., Neufeld, E. and Martin, L., 2011. Suicide Risk Assessment Guide: A Resource for Health Care Organizations Toronto, ON.: Ontario Hospital and Canadian Patient Safety Institute.
- [20] Ross, V., Caton, N., Gullestrup, J. & Kølves, K., 2020. A longitudinal assessment of two suicide prevention training programs for the construction industry. *International Journal of Environmental Research and Public Health*, 1 2.17(3).
- [21] Okoye, P., Ezeokonkwo, J. & Ezeokoli, F., 2016. Building Construction Workers' Health and Safety Knowledge and Compliance on Site. *Journal of Safety Engineering*.

- [22] Tiwary, G. & Gangopadhyay, P. K., 2011. A review on the occupational health and social security of unorganized workers in the construction industry.s.l.:s.n.
- [23] Khahro, S., Ali, T., Talpur, M. & Siddiqui, F., 2016. Occupational Health Problems in Construction Industry: A Case Study. *Sindh University Research Journal (Science Series)* , 48(4), pp. 737-740.
- [24] Singh, G. P., 2016. Plights of Migrant Construction Workers. *Management and Labour Studies*, 8, 41(3), pp. 181-198.
- [25] Abbasianjahromi, H. & Talebian, R., 2018. Identifying the most important occupational diseases in the construction industry: case study of building industry in Iran. *International Journal of Construction Management*.
- [26] Borup, H., Kirkeskov, L., Hanskov, D. J. & Brauer, C., 2017. Systematic review: Chronic obstructive pulmonary disease and construction workers. *Occupational Medicine*, 1 4, 67(3), pp. 199-204.
- [27] Rothenbacher, D. et al., 1997. Chronic respiratory disease morbidity in construction workers: Patterns and prognostic significance for permanent disability and overall mortality. *European Respiratory Journal*, 10(5), pp. 1093-1099.
- [28] Quarato, M., 2018. Construction workers, occupational exposure to air pollution and pulmonary diseases.
- [29] Oliver, L. C. & Miracle-McMahill, H., 2006. Airway disease in highway and tunnel construction workers exposed to silica. *American Journal of Industrial Medicine*, 12, 49(12), pp. 983-996.
- [30] Chattopadhyay, B., Das, A. & Alam, S., 2015. Pulmonary function status of the construction workers in and around Kolkata city. *Indian J. Environmental Protection*, 35(11), pp. 881-889.
- [31] Rooijackers, J. M. et al., 2016. Silicosis in Dutch construction workers. s.l., European Respiratory Society (ERS), p. OA458.
- [32] HSE, 2010. Chronic Disease & Early Death in The Construction Industry. [Online] Available at: <https://www.iosh.co.uk> [Accessed 2020].
- [33] Claessen, H., Arndt, V., Drath, C. & Brenner, H., 2010. Smoking habits and occupational disability: A cohort study of 14 483 construction workers. *Occupational and Environmental Medicine*, 1 2, 67(2), pp. 84-90.
- [34] Groeneveld, I. F. et al., 2011. Short and long term effects of a lifestyle intervention for construction workers at risk for cardiovascular disease: A randomized controlled trial. *BMC Public Health*, Volume 11.
- [35] Sazonova, A., Kopytenkova, O. & Staseva, E., 2018. Risk of pathologies when exposed to fine dust in the construction industry. s.l., Institute of Physics Publishing.
- [36] Chung, J. W. Y. et al., 2018. Cardiovascular health of construction workers in Hong Kong: A cross-sectional study. *International Journal of Environmental Research and Public Health*, 12 6.15(6).
- [37] HSE, 2020. Skin at Work. [Online] Available at: <https://www.iosh.co.uk> [Accessed 2020].
- [38] Ghosh, R. & Das, S., 2020. A Brief Review of the Novel Coronavirus (2019- Ncov) Outbreak. *Global Journal For Research Analysis*.

- [39] Al-Rousan, N., 2020. Nowcasting and Forecasting the Spreading of Novel Coronavirus 2019-nCoV and its Association With Weather Variables in 30 Chinese Provinces: A Case Study.
- [40] Benvenuto, D. et al., 2020. The global spread of 2019-nCoV: a molecular evolutionary analysis. *Pathogens and Global Health*.
- [41] Bloom, D. E., Cadarette, D. & Sevilla, J. P., 2018. Epidemics and Economics New and resurgent infectious diseases can have far-reaching economic repercussions.
- [42] Deng, S.-Q. & Peng, H.-J., 2020. Characteristics of and Public Health Responses to the Coronavirus Disease 2019 Outbreak in China.. *Journal of clinical medicine*, 20 2.9(2).
- [43] Syed, A., 2020. Coronavirus: A Mini-Review *International Journal of Current Research in Medical Sciences* Coronavirus: A Mini-Review. *Int. J. Curr. Res. Med. Sci*, 6(1), pp. 8-10.
- [44] Max , R., Ritchie, H., Ortiz-Ospina , E. & Hasell, J., 2020. Coronavirus Disease (COVID-19) – Statistics and Research. [Online] Available at: <https://ourworldindata.org/coronavirus> [Accessed 2020].
- [45] Li, G. et al., 2020. Coronavirus infections and immune responses. s.l.:John Wiley and Sons Inc.
- [46] Begley, S., 2020. Who is getting sick, and how sick? A breakdown of coronavirus risk by demographic factors. [Online] Available at: <https://www.statnews.com/2020/03/03/who-isgettingsick-and-how-sick-a-breakdown-of-coronavirus-risk-by-demographicfactors/>
- [47] Bendix, A., 2020. Men represent the majority of coronavirus cases so far. Researchers think smoking could play a role.. [Online] Available at: <https://www.businessinsider.com/coronavirus-cases-whymore-men-than-women-2020-2>
- [48] Almazán, F. et al., 2013. Engineering a replication competent, propagation defective middle east respiratory syndrome coronavirus as a vaccine candidate. *mBio*, 10 9.4(5).
- [49] Frieman, M., Heise, M. & Baric, R., 2008. SARS coronavirus and innate immunity. *Virus Research*, 4, 133(1), pp. 101-112.
- [50] Pappas, S., 2020. Why are children 'missing' from coronavirus outbreak cases?. [Online] Available at: <https://www.livescience.com/why-kids-missingcoronavirus-cases.html>.
- [51] Li, R., 2020. Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (COVID-19).
- [52] Eurosurveillance, 2020. World Health Organization declares novel coronavirus (2019-nCoV) sixth public health emergency of international concern.
- [53] Wood, C., 2020. Infections without borders:a new coronavirus in Wuhan, China.
- [54] Jaye, C. & Wilson, H., 2003. When general practitioners become patients.*Health*, pp. 201-225.