

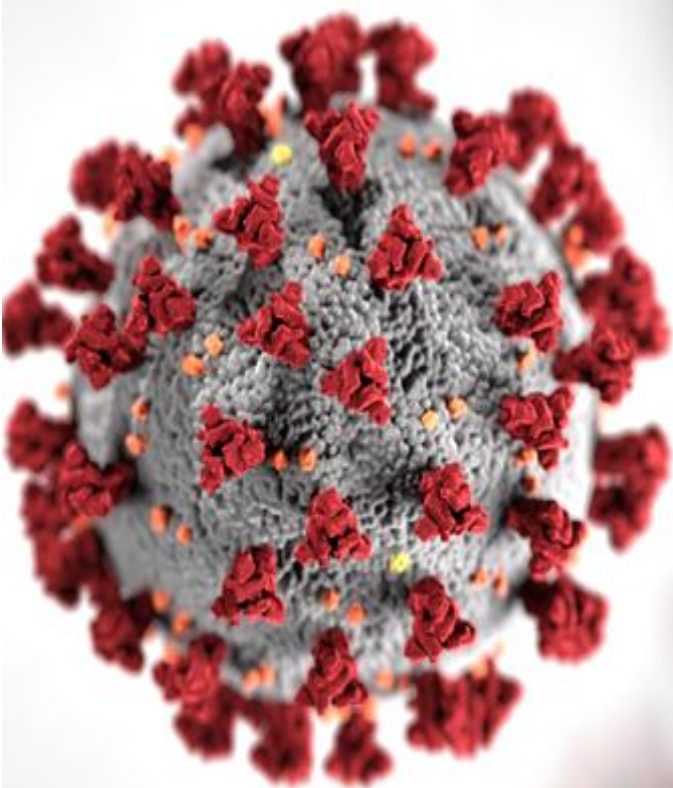


2021

ISSN 1015-5589, Vol. XXX, No. 4

World Safety Journal

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COVID-19

CORONAVIRUS DISEASE 2019

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Cover Photo

The end of 2021 brings a sense of uncertainty. Parts of the world are approaching a transition or a new phase of the COVID-19 pandemic. The window for pursuing the elimination of SARS-CoV-2 has closed. Moving towards a so-called post-pandemic world will be far more complicated than scenarios such as "Zero COVID". The challenge now is to determine the level of COVID-19 that is acceptable for individual nations in a fundamentally interconnected world. In the first *Lancet* Editorial of 2021, it was noted that "Countries might justifiably start to look inward to repair the damage after COVID-19. But equitable access, whether to a vaccine, food, or finance, will require global collaboration." This requirement has not been met. Science has provided the tools and evidence to control the COVID-19 pandemic, but the response has been shaped by political factors and a lack of cooperation, often to the detriment of health. For all its peaks and troughs, 2021 should be heralded as the year of extraordinary COVID-19 science. 2021 began with several new vaccines showing efficacy in randomized trials. There are now 26 COVID-19 vaccines authorized by at least one national regulatory agency and another 200 candidates are in development. Novel treatments have provided further options to prevent death and disability. These achievements allowed for a new sense of hope that should have been the basis for an equitable global response, carried out with the urgency and seriousness that a devastating pandemic demand.

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All articles shall be written in concise English and typed with a minimum font size of 12 point. Articles should have an abstract of not more than 300 words. Articles shall be submitted as Times New Roman print and presented in the form the writer wants published. On a separate page, the author should supply the author's name, contact details, professional qualifications, current employment position, a brief bio, and a photo of the author. This should be submitted with the article.

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**World Safety Journal**

A peer-reviewed journal,
published by the World Safety Organization

Journal Homepage:
<https://worldsafety.org/wso-world-safety-journal/>



COVID-19 Symptoms Differ Between Elderly and Young/Adult Patients, As Do Their Outcomes

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KEYWORDS

Pharmaceutical hazards
Antineoplastic drugs
Wipe samples
Industrial hygiene

ABSTRACT

This is a retrospective study of patients with new coronavirus pneumonia (COVID-19) who were admitted to Labib Medical Center, Sidon - Lebanon, and Jezzine Governmental Hospital, Jezzine - Lebanon, between January 15, 2020 and May 18, 2021. At both hospitals, there were 100 patients, 50 of whom were elderly (65 years or over) and 50 were young and middle-aged.

The study revealed that elderly patients were more likely to have a weakened immune system and comorbidities, as compared to patients under 65 years of age. During hospitalization, 50% of the elderly patients developed acute respiratory distress syndrome, compared to 24% for patients under 65 years of age; 100% of the elderly patients developed pneumonia, compared to 78% for patients under 65 years of age. Except for the troponin test, there were no significant differences between the two age groups in lymphopenia, leukopenia, thrombopenia, D-dimer, or CRP. Further, there was a substantial difference in the number of patients discharged with disability and the number of patients who died. The death rate in the studied population was 30%, with elderly patients accounting for 40%, and under 65 years patients accounting for 20%. During their stay at the hospital, elderly patients were more likely to have complications than under 65 years old patients.

1. INTRODUCTION

An outbreak of pneumonia with an unknown origin has been reported in Wuhan, Hubei Province, China, in December 2019. Following the outbreak, the World Health Organization (WHO) identified a novel coronavirus, SARS-CoV-2, as the pandemic causing virus in China and other areas of the world. With 170 million confirmed cases and 3.5 million resulting deaths in approximately 200 countries, Covid-19 is still spreading around the world. COVID-19 is thought to be

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related to severe acute respiratory syndrome (SARS), which can be transmitted from animals to humans. However, contact with a local seafood dealer in Wuhan who illegally sold several wildlife creatures, including bats, has been linked to SARS-CoV-2 infection (Li J-Y et al., 2020)

COVID-19 infection causes a wide range of symptoms, including respiratory failure and organ failure, which can lead to death. Prior to the COVID-19 pandemic, a number of studies revealed that people of all ages are susceptible to SARS-CoV-2 infection; however, elderly people had greater positive rates in real-time reverse transcriptase-PCR (RT-PCR) assays and a larger hospitalization burden (Jiang F et al., 2020)

Patients with COVID-19 have been observed to have a higher rate of mortality and worse clinical outcomes than those with SARS. Because age is a host factor that increases the likelihood of severe COVID-19 infection and poor prognosis, it is crucial to better understand age-related susceptibility and pathogenesis. However, there is a scarcity of published evidence on age differences in COVID-19 clinical characteristics.

The low specificity of the symptoms most commonly associated with SARS-CoV-2 infection, on the one hand, and the presence of possible atypical or asymptomatic disease, on the other hand, are both issues in the clinical presentation of Covid-19. In fact, most of the signs and symptoms mentioned, such as fever, cough, or myalgia, can also be indicative of influenza or other prevalent respiratory illnesses, complicating the differential diagnosis of Covid-19 in both autumn and winter seasons.

1.1 Research Questions

The research questions addressed in this study are:

- Is there a difference in clinical characteristics between the under 65 years and the elderly COVID-19 patients?
- Why does the elderly population have a higher mortality rate than the young/adult population?

1.2 Hypotheses

In this study, we expected that aging and multimorbidity would impact the clinical presentation of SARS-CoV-2 infection. We also postulated that the patterns in which symptoms cluster together can form many symptom clusters, each of which could be more or less highly predictive of SARS-CoV-2 infection in persons under 65 years of age and the elderly.

1.3 Research Objectives

The study objectives are as follows:

- investigate the differences in COVID-19 clinical characteristics between the elderly and the under 65 years hospitalized patients, as well as their association with death rates.
- compare the clinical manifestations of COVID-19 in the two groups, in order to discover the age-specific clinical presentations of COVID-19.

2. LITERATURE REVIEW

2.1 The Corona Virus

2.1.1 Historical background

Since the 1918 flu pandemic, COVID-19 has become the fifth confirmed pandemic to be discovered. Its symptoms first appeared on December 1, 2019; fever, lethargy, dry cough, and dyspnea were among the symptoms associated with viral pneumonia (Huang C et al., 2020; Zhu N et al., 2020; Wu F et al., 2020). Due to location and pneumonia symptoms, the disease was initially dubbed Wuhan pneumonia by the media. The WHO ultimately declared COVID-19 a pandemic on March 11, 2020. The pandemic was later classified as SARS-CoV-2 by the International Committee on Taxonomy of Viruses (ICTV) based on phylogeny, taxonomy, and established practice (Coronaviridae Study Group, 2020).

A timeline of five pandemics since 1918 is presented in Figure 1.

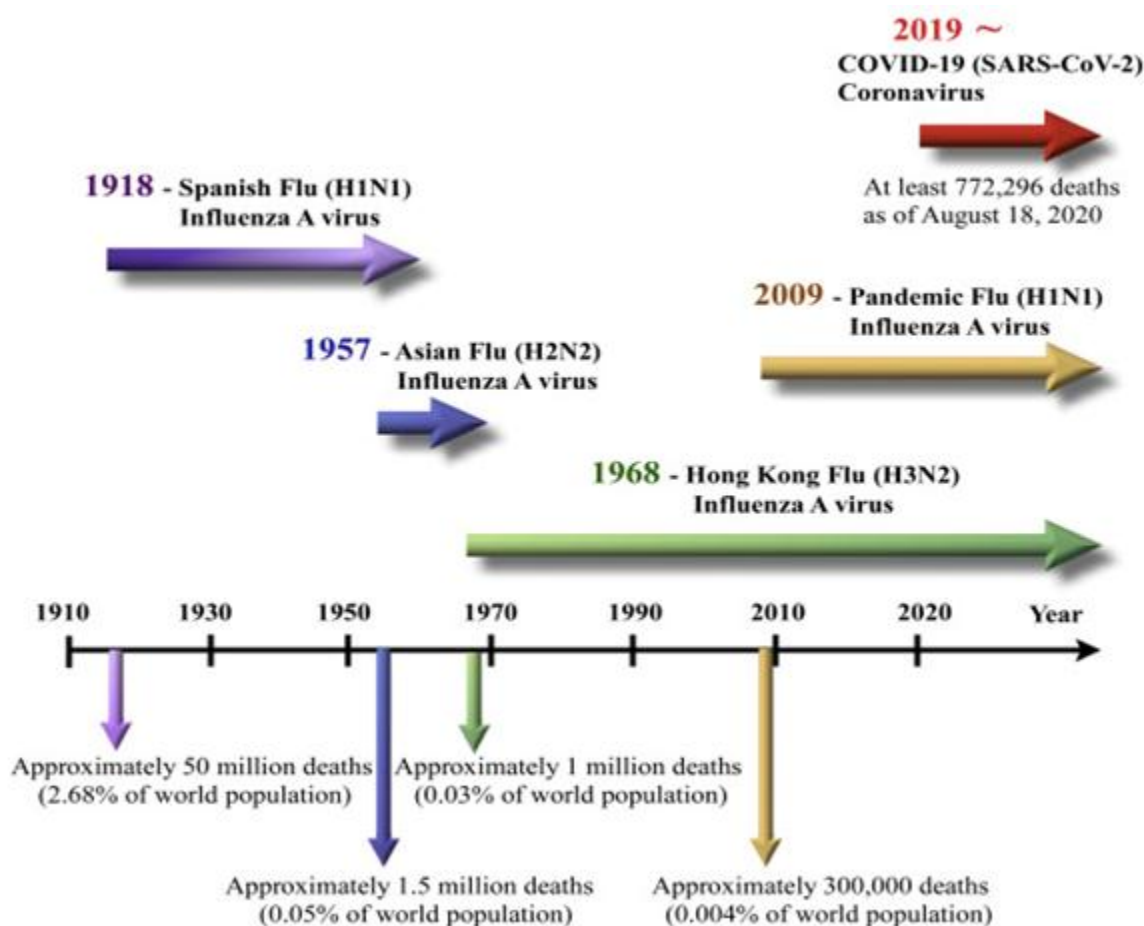


Figure 1: A timeline of five pandemics

(Johnson N-P et al., 2002; Kain T et al., 2019; Simonsen L et al., 1998; Viboud C et al., 2016)

2.1.2 Definition

COVID-19 is a mild to severe respiratory illness caused by a coronavirus (Severe Acute Respiratory Syndrome coronavirus 2 of the genus Beta coronavirus). It is spread primarily through contact with infectious material (such as respiratory droplets) or objects / surfaces contaminated by the causative virus, and is characterized by fever, cough, and shortness of breath.

Other symptoms of COVID-19 include fatigue, chills, body pains, headache, loss of taste or smell, sore throat, runny nose, nausea, vomiting or diarrhea, in addition to fever, cough and shortness of breath.

2.1.3 Clinical presentations

COVID-19 has a variety of effects on various persons. The majority of infected people will experience mild to moderate symptoms and recover without the need for hospitalization. It takes 5–6 days on average for symptoms to appear when a person is infected with the virus; it can also take up to 14 days.

2.1.3.1 Incubation period

The incubation period for COVID-19 is typically 14 days following exposure, with the majority of cases occurring four to five days later (Chan J-F et al., 2020).

2.1.3.2 Initial presentation

Cough, myalgia, and headache are the most commonly reported symptoms among patients with symptomatic COVID-19 infection. Other symptoms include diarrhea, sore throat, and changes in smell or taste. Fever, cough, dyspnea, and bilateral infiltrates on chest imaging are the most common symptoms of pneumonia (Huang C et al., 2020; Chen N et al., 2020; Wang D et al. 2020).

Although some clinical aspects (in particular, smell or taste abnormalities) are more common in COVID-19 than in other viral respiratory infections (Zayet S et al. 2020), there are no specific symptoms or indications that may reliably differentiate COVID-19 from other viral respiratory infections (Struyf T et al., 2020). However, the onset of dyspnea one week after the onset of the initial symptoms could be a sign of COVID-19.

A report of over 370,000 confirmed COVID-19 cases, with documented symptoms, to the CDC in the United States (Stokes EK et al., 2020) revealed the breadth of related symptoms:

- Cough, in 50 percent of the cases;
- Fever (subjective or $>100.4^{\circ}\text{F}/38^{\circ}\text{C}$), in 43 percent of the cases;
- Myalgia, in 36 percent of the cases;
- Headache, in 34 percent of the cases;
- Dyspnea, in 29 percent of the cases;
- Sore throat, in 20 percent of the cases;
- Diarrhea, in 19 percent of the cases;
- Nausea/vomiting, in 12 percent of the cases;
- Loss of smell or taste, abdominal pain, and rhinorrhea, in fewer than 10 percent each of the cases.

Patients with confirmed COVID-19 have reported a comparable spectrum of clinical symptoms in other cohort studies (Huang C et al., 2020; Wang D et al., 2020). Even in hospitalized groups, fever was not always evident on presentation. Fever was recorded in virtually all of the patients in one research study, but only around 20% of them had a low-grade fever of less than $100.4^{\circ}\text{F}/38^{\circ}\text{C}$ (Huang C et al., 2020). Fever (defined as an axillary temperature exceeding $99.5^{\circ}\text{F}/37.5^{\circ}\text{C}$) was present in only 44 percent of the 1099 Wuhan patients and other parts of China; however, it was detected in 89 percent of the time in patients during hospitalization (Guan WJ et al., 2020). Only 31% of COVID-19 patients hospitalized in New York had a temperature above $100.4^{\circ}\text{F}/38^{\circ}\text{C}$ at presentation, according to a study of over 5000 patients (Richardson S et al., 2020).

Smell and taste problems (such as anosmia and dysgeusia) have been reported more commonly in some studies. The pooled prevalence estimates for smell and taste anomalies in a meta-analysis of observational studies were 52 and 44 percent (Tong JY et al., 2020).

In an Italian study of 202 outpatients with mild COVID-19 symptoms, 64 percent reported changes in smell or taste, with 24 percent reporting very severe changes; smell or taste changes were reported as the only symptom by 3 percent of the patients (Spinato G et al., 2020). The majority of subjective smell and taste abnormalities associated with COVID-19 did not appear to be permanent; for instance, in a four-week follow-up assessment of 202 COVID-19 patients in Italy, 89 percent of those who experienced smell or taste changes reported resolution or improvement (Boscolo-Rizzo P et al., 2020).

Gastrointestinal symptoms (e.g., nausea and diarrhea) were reported by certain patients (Huang C et al., 2020; Wang D et al. 2020), despite the fact that they were not reported in the majority of cases. In a systematic evaluation of studies, the pooled prevalence of gastrointestinal symptoms in individuals with confirmed COVID-19 was 18 percent, with diarrhea, nausea/vomiting, and abdominal pain reported in 13, 10, and 9%, respectively (Cheung KS et al., 2020).

Conjunctivitis was also reported (Colavita F et al., 2020). Falls, general health decline, and delirium had been reported in elderly patients, particularly those over 80 years of age and those with underlying neurocognitive deficits (Annweiler C et al., 2021).

2.1.3.3 Asymptomatic Infections

Infections that cause no symptoms have also been well documented (Oran DP, Topol EJ., 2020). According to one study, 33 percent of patients infected with SARS-CoV-2 never showed symptoms (Oran DP, Topol EJ., 2021). This estimate was based on four large population-based cross-sectional surveys, in which the median proportion of people who had no symptoms at the time of a positive test was 46 percent (**Range:** 43 to 77 percent). Depending on which specific symptoms were analyzed, the concept of "asymptomatic" differed between studies (Wang Y et al., 2020; Hu Z et al., 2020). Some people who were asymptomatic at the time of diagnosis acquired symptoms afterward (i.e., they were actually pre-symptomatic). Following the initial positive RT-PCR test, the symptoms appeared in a median of four days (**Range:** 3 to 7 days) (Sakurai A et al., 2020).

2.1.4 Symptomatic Infections

2.1.4.1 Acute course and complications

Infection symptoms can range from minor to life-threatening, as previously discussed. Over the course of a week, some patients with mild symptoms may show progress (Cohen PA et al., 2020). However, in 138 Wuhan patients hospitalized for pneumonia caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), five days following the onset of the symptoms (Wang D et al., 2020). In another research study, dyspnea appeared at a median of eight days (Huang C et al., 2020).

Generally speaking, COVID-19 has been linked to a number of problems, including:

A. Respiratory failure

Acute respiratory distress syndrome (ARDS) is the most common consequence in individuals with advanced illness, and can appear as soon as dyspnea begins. In the above-mentioned trial of 138 patients, 20% had ARDS within eight days of the onset of symptoms, and 12.3% required mechanical breathing (Wang D et al., 2020). Mechanical ventilation was required by 12 to 24 percent of the hospitalized patients in large trials conducted in the United States (Petrilli CM et al., 2020; Richardson S et al., 2020).

B. Cardiac and cardiovascular complications

Arrhythmias, myocardial damage, cardiac failure, and shock have been reported as complications (Wang D et al., 2020; Chen T et al., 2020; Rentz M et al., 2020).

C. Thromboembolic complications

Venous thromboembolism (VTE), which includes a widespread deep vein thrombosis (DVT) and pulmonary embolism (PE), is common in very unwell COVID-19 patients, especially in the intensive care unit (ICU), where rates between 10 and 40% (Ilaloglu S et al., 2020) have been reported. Acute stroke (even in individuals younger than 50 years old without risk factors) and limb ischemia have also been documented, as a result of arterial thrombotic events (Zhang Y et al., 2020).

D. Neurologic complications

COVID-19 encephalopathy is a common consequence, especially among critically sick patients; for instance, encephalopathy was identified in one-third of hospitalized patients. Strokes, movement problems, motor and sensory impairments, ataxia, and seizures occur in a smaller percentage of people (Liotta EM et al., 2020).

E. Inflammatory complications

With persistent fevers, elevated inflammatory markers (e.g., D-dimer, ferritin), and elevated proinflammatory cytokines, some patients with severe COVID-19 have laboratory evidence of an exuberant inflammatory response; these laboratory abnormalities have been linked to critical and fatal illnesses (Huang C et al. 2020; Mehta P et al., 2020).

There may be further inflammatory consequences including auto-antibody-mediated symptoms. For instance, the Guillain-Barré syndrome can develop 5 to 10 days after the onset of symptoms (Toscano G et al., 2020). In children with COVID-19, a multisystem inflammatory syndrome with clinical characteristics comparable to the Kawasaki illness and toxic shock syndrome has been identified. This illness is characterized by substantially increased inflammatory markers and multiorgan dysfunction (particularly cardiac dysfunction) (Morris SB et al., 2020).

F. Secondary infections

In general, secondary infections do not appear to be a common COVID-19 consequence. The reported rate of bacterial or fungal coinfections was 8% (in 62 of 806 cases) in a review of nine studies, mostly from China (Kubin CJ et al., 2021). These were primarily respiratory infections and bacteremia. Presumptive invasive aspergillosis has been reported in immunocompetent individuals with COVID-19 ARDS, while the prevalence of this complication is unknown (Koehler P et al., 2020). In a retrospective study from 16 health care centers in India between September and December 2020, there were 187 cases of Mucormycosis among approximately 12,000 patients hospitalized with COVID-19 (prevalence 0.27 percent overall, and 1.6 percent among ICU patients); the majority of the cases involved the rhino-orbital region (Patel A et al., 2021).

2.1.4.2 Recovery and long-term sequelae

The time it takes to recover from COVID-19 is very variable, depending on age, pre-existing comorbidities, and the severity of the sickness. Individuals with a slight infection should recover quickly (e.g., within two weeks); however, many people with severe disease will take longer to recover (e.g., two to three months). Fatigue, dyspnea, chest pain, cough, and cognitive impairments are the most prevalent lasting symptoms. Findings also point to the possibility of long-term respiratory

impairment (Van den Borst B et al., 2020) and cardiac complications (Rajpal S et al., 2021).

Some COVID-19 survivors have SARS-CoV-2 NAATs that are permanently or recurrently positive. Although recurrent infection or reinfection cannot be ruled out entirely in these circumstances, data suggests that it is improbable.

2.1.4.3 Laboratory findings

Lymphopenia, elevated aminotransaminase levels, elevated lactate dehydrogenase levels, elevated inflammatory markers (e.g., ferritin, C-reactive protein, and erythrocyte sedimentation rate), and abnormalities in coagulation tests are all common laboratory findings in COVID-19 hospitalized patients (Wang D et al., 2020). Even though the overall white blood cell count can vary, lymphopenia is a prevalent condition (Huang C et al., 2020; Chen N et al., 2020; Wang D et al., 2020). Many patients with pneumonia have normal serum procalcitonin levels when they are admitted; however, those who require ICU care are more likely to have increased levels (Huang C et al., 2020; Chen N et al., 2020; Wang D et al., 2020). Several laboratory findings have been linked to critical illness or fatality, including high D-dimer levels and more severe lymphopenia (Chen N et al., 2020).

2.1.4.4 Imaging findings

A. Chest radiographs

In early or mild illness, chest radiographs may be normal. In a retrospective study of 64 COVID-19 patients in Hong Kong, 20% did not have any abnormalities on chest radiographs at any stage during their illness (Wong HYF et al., 2020). Consolidation and ground-glass opacities were common abnormal radiograph findings, with distributions in the bilateral, peripheral, and lower lung zones; lung involvement increased over the course of the disease, with a peak in severity at 10 to 12 days following the symptom onset. The occurrence of spontaneous pneumothorax has also been reported; however, it is uncommon (Miró Ò et al., 2021).

B. Chest CT

Although chest computed tomography (CT) is more sensitive than chest radiography, and some chest CT results may be COVID-19-specific, no one finding can entirely rule in or rule out COVID-19. The American College of Radiology (ACR) in the United States advises against utilizing chest CT for COVID-19 screening or diagnosis (ACR Recommendations, 2020).

The most common finding on chest CT in COVID-19 patients is ground-glass opacification with or without consolidative abnormalities, which is consistent with viral pneumonia (Ojha V et al., 2020). The following anomalies were found in a systematic analysis of studies that analyzed the chest CT findings of over 2700 patients with COVID-19 (Bao C et al., 2020):

- Ground-glass opacifications – 83 percent;
- Ground-glass opacifications with mixed consolidation – 58 percent;
- Adjacent pleural thickening – 52 percent;
- Interlobular septal thickening – 48 percent;
- Air bronchograms – 46 percent.

A crazy-paving pattern (ground-glass opacifications with superimposed septal thickening), bronchiectasis, pleural effusion, pericardial effusion and lymphadenopathy, were among the less prevalent observations. COVID-19 chest CT abnormalities are usually bilateral,

have a peripheral distribution, and affect the lower lobes. These results are typical in COVID-19, but they are not specific to it, and they are seen often in other viral types of pneumonias. Chest CT may be normal shortly after the onset of symptoms, similar to chest radiography, with abnormalities more likely to develop over the course of the disease (Pan F et al., 2020).

C. Lung ultrasound

When other imaging resources are not readily available, point-of-care lung ultrasonography has been described as a way to assess lung involvement in patients with probable COVID-19. Thickening, discontinuation, and interruption of the pleural line; discrete, multifocal, or confluent B lines visible under the pleura; patchy, strip, and nodular consolidations; and air bronchogram signs in the consolidations, have all been seen on lung ultrasound in patients with documented COVID-19 (Abrams ER et al., 2020).

2.1.5 Spectrum of severity and mortality rates

2.1.5.1 Spectrum of infection severity

The severity of symptomatic infection varies from moderate to critical, with the majority of infections being mild (Chan J-F et al., 2020; Bajema KL et al., 2020; Yang X et al., 2020).

According to a report by the Chinese Center for Disease Control and Prevention, which provided an estimate of disease severity based on 44,500 confirmed infections (Wu Z, McGoogan JM, 2020):

- 81 percent of people had a minor illness (no or mild pneumonia);
- 14% of people had severe illness (dyspnea, hypoxia, or over 50 percent lung involvement on imaging within 24 to 48 hours);
- 5% of people had a critical illness (such as respiratory failure, shock, or multiorgan dysfunction);
- The overall case mortality rate was 2.3 percent; no deaths in noncritical patients were documented.

Similarly, 14 percent of the 1.3 million cases reported by the US Centers for Disease Control and Prevention (CDC) through May 2020 required hospitalization, 2% were admitted to the intensive care unit (ICU), and 5% died (Stokes EK et al., 2020). The chance of developing a serious disease differed, depending on age and underlying comorbidities.

2.1.5.2 Mortality rates of COVID-19 infection

The case fatality rate solely reflects the mortality rate among instances that have been documented. Because many severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections are asymptomatic and many mild infections go undiagnosed, the infection mortality rate is much lower, with estimates ranging from 0.15 to 1% in some studies, with significant heterogeneity by location and risk group (Centers for Disease Control and Prevention, 28 July 2020; Ioannidis JPA, 2021).

The infection mortality rate was estimated to rise dramatically by age (0.002 percent at age 10, 0.01 percent at age 25, 0.4 percent at age 55, 1.4 percent at age 65, 4.6 percent at age 75, 15 percent at age 85, and over 25 percent at age 90), according to a systematic review and meta-analysis of 27 studies from resource-rich settings that evaluated the total number of community infections through seroprevalence surveys or comprehensive tracing programs up to September 2020 (Levin AT et al., 2020).

The majority of the geographic variation in the reported infection fatality rates appear to be due to age-related variances. Death rates, for example, were greater in areas with a higher median population age).

2.1.5.3 Mortality rates among hospitalized patients

Hospitalized patients are at a significant risk of developing serious or deadly illnesses. In a study of 2,741 hospitalized COVID-19 patients, 665 individuals (24 percent) died or were discharged to hospice (Petrilli CM et al., 2020). By the end of the study, 60 percent of 647 patients, who had invasive mechanical ventilation, died; 13 percent were still ventilated; and 16 percent had been discharged.

COVID-19 has been linked to a higher rate of in-hospital mortality than influenza. (Cates J et al., 2020; Verma AA et al., 2021). Patients with COVID-19 were found to be five times more likely to die during their stay than patients with influenza (21 percent versus 3.8 percent) (Cates J et al., 2020).

In a retrospective assessment of a national surveillance database in England, which included over 21,000 critical care patients with COVID-19, in-hospital mortality rates were reported to have been decreased over the course of the pandemic; ICU survival improved from 58 percent in late March 2020 to 80 percent in June 2020 (Dennis JM et al., 2021).

In resource-constrained situations, in-hospital mortality rates may be greater than previously reported. In one study from ten African countries, the in-hospital 30-day death rate, following critical care admission, was 48 percent (ACCCOS Investigators., 2021).

2.1.5.4 Excess deaths during the pandemic

Neither the case mortality rate nor the infection mortality rate is sufficient to account for the entire pandemic burden. Other factors, like delayed treatment, overwhelmed healthcare systems, and social determinants of health, contributed to the pandemic's excess mortality (Woolf SH et al., 2021; Islam N et al., 2021).

2.1.6 Risk factors for severe illness

Severe sickness can strike healthy people of any age, but it is more common in persons over the age of 65 years. Severe illness has also been linked to specific demographic characteristics and test abnormalities. In the sections that follow, these are examined in further depth. Based on epidemiologic, clinical, and laboratory data, several prediction techniques have been presented to identify patients who are more likely to experience severe illnesses.

2.1.6.1 Advanced age

SARS-CoV-2 infection can affect people of all ages, but it is most frequent in middle-aged and older adults; older adults are more likely to develop severe disease. In multiple cohorts of hospitalized patients with confirmed COVID-19, the median age ranged from 49 to 56 years (Huang C et al. 2020; Chen N et al., 2020; Wang D et al., 2020). According to a report by the Chinese Center for Disease Control and Prevention, which comprised around 44,500 confirmed infections, 87 percent of patients were between the ages of 30 and 79 years (Wu Z and McGoogan JM, 2020). Similarly, in a modeling study based on data from mainland China, the hospitalization rate for COVID-19 rose with age, with a 1% incidence for those between 20 and 29 years, a 4% rate for those between 50 and 59 years, and an 18% rate for those over 80 years (Verity R et al., 2020).

Older age is also linked to a higher risk of death (Wu Z and McGoogan JM, 2020; Richardson S et al., 2020; Williamson EJ et al. 2020). According to research by the Chinese Center for Disease Control and

Prevention, case fatality rates for people aged 70 to 79 years and 80 years or over were 8 and 15%, respectively, compared to 2.3 percent for the overall cohort (Wu Z et al., 2020). According to a study from the United Kingdom, the risk of death among people aged 80 and over was 20 times higher than that of people aged 50 to 59 years (Williamson EJ et al. 2020).

In a study of 2,449 patients diagnosed with COVID-19 in the United States, between 12 February and 16 March 2020, it was shown that those aged 45 years and over accounted for 67 percent of the cases, with 80 percent of fatalities concerning those aged 65 years and over. In a comprehensive health care database analysis, persons aged 18 to 34 years accounted for just 5% of adults hospitalized with COVID-19, with a death rate of 2.7 percent; morbid obesity, hypertension, and male gender were all linked to mortality in that age range (Cunningham JW et al., 2020).

2.1.6.2 Comorbidities

The following comorbidities have been linked to severe illness and mortality (Wu Z, McGoogan JM, 2020; Petrilli CM et al., 2020; Williamson EJ et al., 2020; Cunningham JW et al., 2020):

- Cardiovascular disease;
- Diabetes mellitus;
- Chronic obstructive pulmonary disease and other lung diseases;
- Cancer (particularly, hematologic malignancies, lung cancer, and metastatic disease) (Dai M. et al., 2020);
- Chronic kidney disease;
- Solid organ or hematopoietic stem cell transplantation;
- Obesity (Lighter J et al., 2020; Kompaniyets L et al., 2021);
- Smoking (Lowe KE et al., 2021).

In an Italian study of 355 COVID-19 patients who later died, the average number of pre-existing comorbidities was 2.7, with only three patients showing no underlying disease (Onder G et al., 2020).

2.1.6.3 Socioeconomic factors and gender

Certain demographic characteristics have also been linked to more serious sicknesses. In different cohorts around the world, males have accounted for a disproportionately high number of critical cases and deaths (Petrilli CM et al., 2020; Richardson S et al. 2020; Onder G et al., 2020).

In the United States and the United Kingdom, black, Hispanic, and South Asian people account for a disproportionately high number of COVID-19 infections and deaths, which is likely linked to underlying inequities in social determinants of health. Some studies (Kabarriti R et al., 2020; Muñoz-Price LS et al., 2020) that adjusted for comorbidities and socioeconomic status revealed no link between African-American or Hispanic ethnicity and poor COVID-19 results in hospitalized patients.

2.1.6.4 Laboratory abnormalities

Unfavorable outcomes have also been linked to specific laboratory characteristics.

These include (Wu C et al., 2020; Del Valle DM et al., 2020):

- Lymphopenia
- Thrombocytopenia
- Elevated liver enzymes
- Elevated lactate dehydrogenase (LDH)

- Elevated inflammatory markers (e.g., C-reactive protein [CRP], ferritin) and inflammatory cytokines (i.e., interleukin 6 [IL-6] and tumor necrosis factor [TNF]-alpha)
- Elevated D-dimer (>1 mcg/mL)
- Elevated prothrombin time (PT)
- Elevated troponin
- Elevated creatine phosphokinase (CPK)
- Acute kidney injury

In observational studies, deficiencies in several micronutrients, particularly vitamin D (Munshi R et al., 2021), have been linked to more severe illnesses.

2.1.6.5 Viral factors

Although other studies have identified no link between respiratory viral RNA levels and illness severity (Yilmaz A et al., 2021), patients with severe disease have been reported to have higher viral RNA levels in respiratory specimens than those with milder disease (Liu Y et al., 2020). The presence of viral RNA in the blood has been linked to serious illness, such as organ damage (e.g., lung, heart, kidney), coagulopathy, and mortality (Severe Covid-19 GWAS Group et al., 2020).

2.1.6.6 Genetic factors

Host genetic factors are also being studied to see whether they have any links to severe disease. One genome-wide association research, for example, discovered a link between polymorphisms in the ABO blood group genes and COVID-19 respiratory failure (type A associated with a higher risk) (Ray JG et al., 2020).

3. COVID-19 IN OLDER ADULTS

3.1 What is unique about COVID-19 and older adults?

COVID-19 is more likely to make older people quite unwell. When elderly people with COVID-19 become severely sick, they may require hospitalization, intensive care, or a ventilator to assist them to breathe, or they may even die. People in their 50s are at a higher risk, as are those in their 60s, 70s, and 80s. People aged 85 and over face the greatest danger.

COVID-19 poses a high danger to elderly patients due to physiologic changes associated with age, impaired immune function, and multimorbidity. Elderly people with respiratory viruses sometimes exhibit atypically, which can make diagnosis more difficult. In people over 70 years old, the median time from symptom onset to mortality is 11.5 days, compared to 14 days in younger people (Sohrabi C et al., 2020; Wang D et al., 2019).

According to a recent World Health Organization research, COVID-19 patients over the age of 80 years in China had a case fatality rate of 21.9 percent, while patients of all ages with no underlying chronic diseases had a fatality rate of only 1.4 percent (WHO-China Joint Mission, 2020). It should be remembered that concerns like insufficient ED or ICU care, as well as a lack of resources, can have a negative impact on mortality, and that age is just one of many such factors.

The very high danger of this virus in elderly patients is shown by new mortality statistics from Italy (Wang D et al., 2019). In Italy, where 23% of the population is over 65 years, 89 percent of COVID-19 deaths concerned people over 70 years of age (31 percent were people between 70 and 79 years, and 58 percent were people over 80 years) (Stancati, 2020).

3.2 What is fever in older adults?

Should we screen for disease in elderly people using only a temperature of 100 degrees Fahrenheit? Fever is frequently used in COVID-19 symptom checks as a significant marker of disease. Fever is the most prevalent symptom, according to Chinese data, with 83 percent of 99 in-patients with a mean age of 55 (15 percent over 70) having fever (Chen N et al., 2020). Fever, on the other hand, may not be a sensitive enough indicator in elderly patients, as it is commonly dulled or absent even in the presence of a serious infection (High KP et al., 2009). In the absence of particular data from the growing COVID-19 outbreak, the sensitivity of fever in elderly patients is informed by influenza, a respiratory virus that causes high mortality in elderly patients. Only 32% of patients over 60 years old with documented influenza had triage temperatures above 100 degrees Fahrenheit, according to one ED research (Lam P-P et al., 2016).

For elderly patients, the Infectious Disease Society of America proposes changing the definition of fever to:

- a single oral temperature over 100° F, or
- 2 oral repeated temperatures over 99° F, or
- an increase in temperature of 2° F over the baseline temperature (Norman DC, 2000).

3.3 The aging immune system

One of the greatest predictors of whether a patient would develop mild or severe COVID-19 symptoms is the ability of managing viral load (Liu Y, 2020). The immune system must accomplish four major activities in order to successfully suppress and remove SARSCoV-2: (1) recognize, (2) alert, (3) destroy, and (4) clear. In elderly patients, each of these processes is known to be malfunctioning and more diverse (Fulop T, 2018; Franceschi C, 2017).

However, it is unclear which tasks are most important for COVID-19 advancement in elderly patients (Shen-Orr SS, 2013). The immune system undergoes two key alterations as we age. One is immunosenescence, a slow loss of immunological function that impairs pathogen identification, alert signaling, and clearance. This is not to be confused with cellular senescence, an aging-related condition in which old or defective cells stop reproducing and become epigenetically locked into a pro-inflammatory state, secreting cytokines and chemokines. The other common immune system that changes with age is inflammaging, a chronic increase in systemic inflammation caused by a hyperactive but inadequate warning system (Franceschi C, 2000). Immunosenescence and inflammaging are important drivers of the increased mortality rates in older patients, according to a plethora of fresh evidence documenting the pathology and molecular changes in COVID-19 patients. Both the innate and adaptive immune systems are affected by immunosenescence. Innate immunosenescence is marked by inadequate pathogen detection and activation of macrophages, as well as a decrease in natural killer (NK) cell cytotoxicity, whereas adaptive immunosenescence is marked by thymic atrophy and the formation of anergic memory cells. Pathogenic, genetic, and lifestyle factors that impact the epigenetic status of cells and the variety of immune cells are likely to be the cause of these age-related changes in both cases.

3.3.1 The aging innate immune system

The body's initial line of defense against coronaviruses is the innate immune system. Sentinel cells, such as macrophages and dendritic cells, use single-pass membrane-spanning receptors termed Toll-like receptors (TLRs) produced on their cell surfaces to recognize structurally conserved viral proteins. In innate immune cells, defects in TLR activity have been shown to increase the severity of pneumonia

in mice, particularly in the context of aging and chronic inflammation (Hinojosa E, 2009).

AMs (alveolar macrophages) are mononuclear phagocytes that patrol the lungs for dust, allergens, and pathogen remnants. AMs produce type I interferons when their TLRs detect an invader, which draw immune cells to the infection site and present antigens to lymphocytes (Li G, 2020; Shi Y, 2020). Although the number of AMs increases with age, their ability to switch between pro- and anti-inflammatory states is considerably diminished, as seen by a modest cytokine response upon TLR activation [fig2].

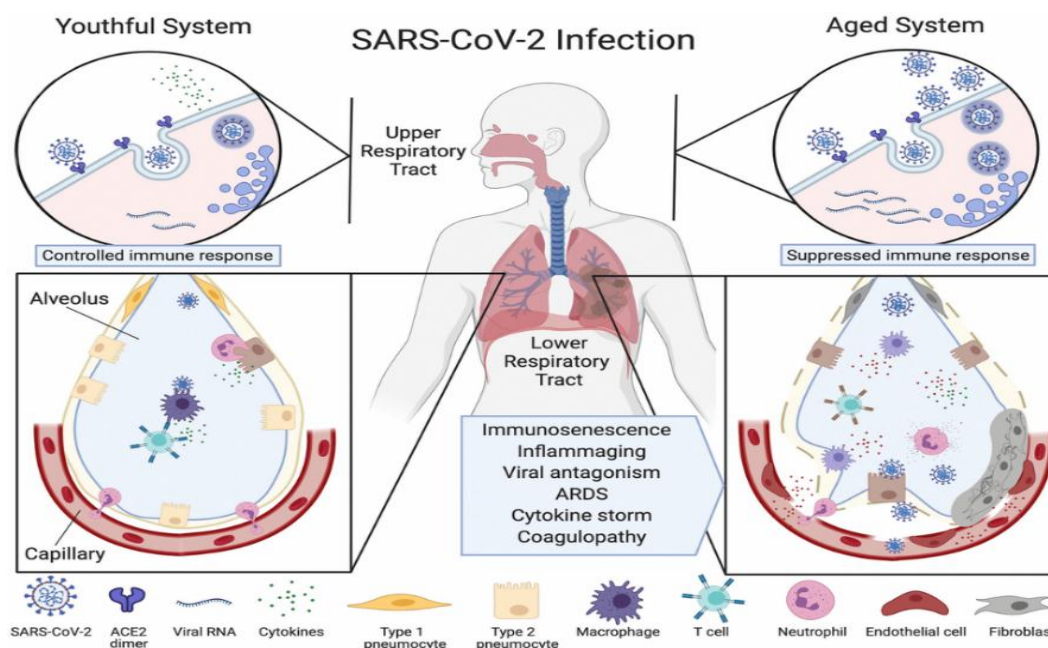


Figure 2: Ineffective clearance of SARS-CoV-2 infection

COVID-19 is likely accelerated in its early phases by the failure of AMs in older people to recognize viral particles and convert to a pro-inflammatory state, whereas in its mature stages, AMs are thought to be responsible for the excessive lung damage. In a recent study comparing the immune cell composition of bronchoalveolar lavage fluid from moderate and severe COVID-19 patients, researchers discovered that macrophages in severe cases were phenotypically more proinflammatory, expressing higher levels of C-C Motif chemokine receptor type 1 (CCR1) and C-X-C Motif Chemokine Receptor type 2 (CXCR2), which recruit other innate immune cells, compared to macrophages from moderate COVID-19 cases that expressed more T-cell attracting chemokines (Liao M et al., 2020).

Long-term monocyte activation has been linked to severe lung injury in rhesus monkeys, and increased numbers of pulmonary neutrophils and macrophages have been linked to the development of ARDS and greater lung damage in instances of SARS (induced by SARS-CoV-1).

Part of the reason for this could be a decrease in neutrophil activity, as these cells lose their ability to travel to infection sites and kill infected cells as they age. COVID-19 severity is unlikely to be caused by NK cells, a key component of innate immunity with potent cytotoxic action. Their numbers remain rather steady with age, and they were not required for proper viral clearance in a mouse model of SARS (Glass WG, 2004). More extensive investigations of COVID19 patient autopsy tissue will be required to determine which of these cell types play the most damaging effects.

Mucins, protective glycoproteins found in mucosal barriers throughout the body, also alter in production and diversity with age, though their involvement in immunization against coronaviruses in humans is unknown.

3.3.2 *The aging adaptive immune system*

The adaptive immune system's immunosenescence is another factor that may influence whether a patient develops severe COVID-19. The thymus, which is located right above the heart and is the site of T cell formation and maturation of early thymic progenitors from the bone marrow, is one of the earliest tissues to age. The thymus shrinks by 40% by the age of 65 (Palmer DB, 2013), which coincides with the activation of the inflammasome component NLRP3 and Caspase-1, a pro-apoptotic protease (Majumdar S, 2018; Youm YH, 2012). The thymic microenvironment is deteriorated by the accumulation of intrathymic adipocytes, which further lowers thymic cellularity.

Thymic atrophy also leads to a decrease in naive T cells and an increase in memory lymphocytes, impairing immunosurveillance and exhausting B cells, cytotoxic T cells, and helper T cells (Ongrádi J, 2010).

Other common aging impacts on the adaptive immune system include a decrease in the creation of new naive T cells, a smaller TCR repertoire, T cell metabolic inefficiency, and lower T cell activation (Ron-Harel N, 2018; Salam N, 2013). CD8⁺ T cell clonal populations expand with age, restricting their variety, whereas CD4⁺ T cells retain a wide range of TCRs but suffer activation deficits (Salam N, 2013). Surprisingly, one study discovered that supercentenarians – people above the age of 110 years – contain an uncommon population of cytotoxic CD4⁺ T cells whose activation does not wane with age and can fulfill effector duties normally performed by CD8⁺ T cells (Hashimoto K, 2019). This T cell activity could explain why some elderly patients, even those over the age of 100, can survive COVID-19.

Not only does the quantity of T cells decrease with age, but so does their repertoire. Low T cell levels are becoming more common in those over 60, a condition known as lymphopenia (Diao B et al., 2020). Lymphoma in COVID19 patients is unlikely to be caused by direct SARS-CoV-2 infection (Zhou P et al., 2020), as it is in HIV patients because T cells express relatively low amounts of ACE2. One possible cause of T cell deficiency is immune system depletion caused by repeated viral exposures over a lifetime (Diao B et al., 2020; Zheng HY, 2020; Huang C et al., 2020). This theory is based on a number of studies that looked at the morbidity and mortality of adults over 60 who had been infected with the human cytomegalovirus for a long time (CMV).

CMV reemergence cycles were linked to extensive immune system remodeling, including significant exhaustion of CD8⁺ T cells, which was found to be a better predictor of all-cause death than chronological age.

T cell depletion is caused by a combination of infections and lifestyle factors, and not just CMV (Aiello A, 2019; Bartlett DB, 2012). Telomere shortening in viral-specific memory CD8⁺ T lymphocytes, which produces cellular senescence, a state of cell cycle arrest and hyper inflammation that precludes growth upon re-infection, is a primary cause of immunological fatigue at the chromosomal level. The fact that bronchoalveolar CD8⁺ T cells appear to have limited expansion potential (Liao M et al., 2020) and that peripheral blood T cells exhibit high amounts of the immune-exhaustion marker PD-1 in the most severe COVID-19 cases, lend credence to this notion (Diao B et al., 2020).

B lymphocytes, which make antibodies in response to coronavirus antigens (Li G, 2020), are similarly less diverse and sensitive as people get older. While the total number of B cells does not decrease with age, memory B cells increase and naive B cells decrease, perhaps leading to a loss of B cell repertoire

diversity, though this has yet to be fully established in people. Changes in IgG glycosylation patterns, on the other hand, have been demonstrated to be closely linked to age and inflammation, and to predict the onset of age-related diseases. IgG N-glycans appear to be the most predictive of biological aging, although more research into B-cell internal and extrinsic glycosylation control in aging is needed.

3.3.3 *The Deficiency and Potential Roles of Vitamin D for the Immune System in elderly patients*

The immunological function is inextricably linked to one's dietary state. Vitamin D is one important nutrient that has attracted a lot of attention. The current SARS-CoV-2 pandemic has heightened concerns regarding vitamin D insufficiency as a risk factor and vitamin D supplementation as a nutritional assistance in the treatment of respiratory tract illnesses (RTIs).

About half of all elderly people have a vitamin D deficit, which lowers the efficacy of both adaptive and innate immune responses and raises the risk of infection due to a lack of sun exposure and decreased vitamin D production. Vitamin D levels in elderlies are linked to immune characteristics such as the CD4+/CD8+ ratio and reduced levels of pro-inflammatory cytokines after stimulation (Meehan M, 2014; Sundaram ME, 2012). Although not all studies have found a benefit of vitamin D supplementation on the likelihood or duration of lower respiratory infections, a number of studies have shown its effectiveness, particularly in those who have an antibody shortage or are more susceptible to respiratory tract infections (Bergman P, 2015; Arihiro S et al., 2019).

Vitamin D treatment averted roughly 20% of acute respiratory infections, according to a recent meta-analysis of 25 randomized, placebo-controlled trials. As a result, some health professionals have suggested vitamin D supplementation for elderly people in general, as well as aged-care residents and critically-ill patients, as a method for increasing COVID19 survival rates.

The following examples illustrate crucial scientific information:

1. Both observational and interventional studies imply that vitamin D deficiency increases the incidence of RTIs and influenza in general (Beard JA, 2011). RTIs are more likely to occur in those who do not have enough vitamin D in their bloodstream.
2. Research suggests that supplementing with vitamin D can lessen the incidence of influenza (Grant WB et al., 2020) and other RTIs (Esposito S, 2015).
3. The vitamin D receptor (VDR) is found in respiratory epithelial cells, B and T lymphocytes, and other immune cells (such as monocytes, macrophages, and dendritic cells) (Sassi F, 2018). The VDR in these immune cells regulates antimicrobial molecule expression, which is important for infection management through modulating the innate and adaptive immune systems (Sassi F, 2018; Prietl B, 2013).
4. The involvement of vitamin D and VDR in lowering the inflammatory response by inhibiting the synthesis of pro-inflammatory cytokines, such IL-1, IL-1, and tumor necrosis factor- α (Ebadi M, 2020), which contribute to the severity of infection, are of special relevance (e.g. pneumonia). The presence of 1-hydroxylase (CYP27B1), an enzyme that converts 25(OH)D to 1.25(OH)D and is largely found in the kidney, in respiratory epithelium and immune cells, adds to the evidence that vitamin D plays a role in protecting against respiratory pathogen invasion.
5. Twenty-eight clinical trials to evaluate vitamin D and COVID-19 have been formally registered as of September 2, 2020 (WHO Trial Registry Network, 2020). Despite the fact that randomized clinical trials have yet to validate the significance of vitamin D in lowering the risk and severity of COVID-19, numerous researches have demonstrated its effectiveness.

6. Vitamin D supplementation may minimize the risk of COVID-19 or severe COVID-19, according to (Grant WB, 2020; Baggerly CA, 2020).

While vaccines and other particular methods may be used to prevent and cure COVID-19, a well-functioning immune system is a requirement for overall health and aids in the protection of the human body against invading microorganisms. Given the prevalence of vitamin D deficiency in diverse locations and populations, vitamin D consumption and circulation levels should not fall below the levels suggested by health care authorities and professional organizations. This may be especially critical among elderly people.

3.4 Preexisting medical conditions

The COVID-19 virus can infect people of all ages. The COVID-19 virus can infect both older and younger people. People over the age of 65 years, as well as those with pre-existing medical issues including asthma, diabetes, and heart disease, tend to be more susceptible to the virus. Cancer, chronic kidney disease, chronic obstructive pulmonary disease (COPD), immunocompromised state, obesity, serious heart conditions, Type 2 diabetes mellitus, cerebrovascular disease, hypertension, and neurologic conditions, are all common among elderly people, according to CDC (US CDC, 2019).

If the severity of COVID-19 is determined by chest imaging for lung damage, D-dimer levels (Yao Y et al., 2020; Yu B et al., 2020), for coagulation status, virus loading and shedding duration for virus replication and clearance, and cytokine levels for cytokine storm, it is possible that most of these preexisting medical conditions are unrelated to the COVID-19 severity. Instead, as demonstrated in COVID-19 patients with COPD, cerebrovascular disease, cardiovascular disease, hypertension, and neurologic disorders, COVID-19 may aggravate these conditions. COVID-19 lung inflammation has the potential to degrade the remaining lung tissue and/or function in COPD patients; however, more research is needed to see if this can boost SARS-CoV-2 replication or speed up COVID-19 development.

Similarly, SARS-CoV2 can damage blood vessel endothelial and cause blood coagulation, which can exacerbate cerebrovascular and cardiovascular disorders. Cerebrovascular and cardiovascular illnesses, on the other hand, do not always promote virus multiplication or virus-induced tissue damage. Patients with diabetes who have hyperglycemia are more prone to bacterial infections, which can exacerbate the disease of COVID-19 patients. When glycemia is adequately controlled, however, the patients' susceptibility to bacterial infection is not increased, and COVID-19 may not be influenced by the diabetes status.

COVID-19 patients were shown to have a high prevalence of hypertension (Huang C et al., 2020; Richardson S et al., 2020), which could be due to increased ACE2 expression induced by the binding of SARS-CoV-2 spike protein to ACE2, or by other mechanisms (Bunyavanich S, 2020; Wang Z et al., 2018). The overexpression of ACE-2 may activate angiotensin, which raises blood pressure further. Fever, a frequent sign of viral infection, could potentially be linked to elevated blood pressure in COVID-19 patients. Intriguingly, it was discovered that giving ACE inhibitors to hypertensive patients could reduce the severity of COVID-19 (Kanwal A, 2020; Bean D et al., 2020).

3.5 Features of COVID-19 infection in elderly patients

Fortunately, the majority of COVID-19 cases are minor, with just a small percentage (about 14%) requiring hospitalization and oxygen support, and 5% requiring only admission to an intensive care unit (China CDC, 2020). Multiorgan failure is the leading cause of death in severe COVID-19 patients, followed by acute respiratory distress syndrome (ARDS), sepsis, and septic shock (Yang X et al., 2020).

Because elderly patients often have atypical clinical presentations, diagnosing and managing them will be difficult, with a high incidence of delayed diagnosis or misinterpretation, especially in cases of cognitive impairment, as well as a higher risk of infection spreading during COVID-19 outbreaks and a high mortality rate (Xue Za Zhi, 2020).

A number of studies have found that the most obvious symptoms at admission for COVID-19 infection in elderly patients were fever, cough, dyspnea and fatigue, which are common with any viral infection. Dyspnea was clearly the most commonly acquired symptom in patients who died (Verity R et al., 2019).

3.5.1 Atypical COVID 19 Presentations in Frail Older Adults

Despite the respiratory disease, typical COVID-19 symptoms such as fever, cough, and dyspnea may be missing in elderly patients (Jung YJ, 2017). Fever was present in only 20-30% of geriatric patients with infection (Jung YJ, 2017). Delirium, falls, widespread weakness, malaise, and functional deterioration are examples of atypical COVID-19 symptoms (Jung YJ, 2017). Conjunctivitis, anorexia, increased sputum production, dizziness, headache, rhinorrhea, chest discomfort, hemoptysis, diarrhea, nausea/vomiting, abdominal pain, nasal congestion, and anosmia are among the other symptoms (Dadamo H, 2020).

In elderly patients, tachypnea, delirium, unexplained tachycardia, or a decrease in blood pressure may be the presenting clinical symptoms (Dadamo H, 2020; Jarrett PG, 1995). Atypical presentation can be caused by a variety of factors, including physiologic changes with age, comorbidities, and the difficulty to provide an accurate history (Malone ML, 2020). Atypical presentation is more likely as people are older, frailer, and have more comorbidities (Jung YJ, 2017). Mild symptoms in elderly patients may be exaggerated in comparison to the severity of their illness (Jung YJ, 2017).

3.6 Outcome of COVID-19 infection in Elderly patients

Over 70% of the 339 COVID-19 infected patients, aged 60 years and over, were found to have a severe illness, a rapid rate of progression, and a high case fatality rate (19 percent). A symptom such as dyspnea, the presence of numerous comorbidities, such as cardiovascular disease and chronic obstructive pulmonary disease (COPD), or complications, such as acute respiratory distress syndrome (ARDS), were all linked to poor outcomes in elderly patients. Unfortunately, only a small percentage of elderly patients with ARDS, who were mechanically ventilated, did survive (Wu Z, 2020).

According to a retrospective examination of 82 COVID-19 deaths in Wuhan, China, more than half of the patients who died were over 60 years of age, accounting for 80.5 percent of all deaths, with a median age of 72.5 years. Males had a higher fatality rate (65.9 percent). Comorbidity was found in the majority of patients who died (76.8%), including hypertension in 56.1 percent, heart disease in 20.7 percent, diabetes in 18.3 percent, cerebrovascular illness in 12.2 percent, and cancer in 7.3 percent (Bicheng Z et al., 2020). As a result of the significant frequency of malnutrition in elderly patients and its impact on the immune system, nutritional evaluation and management should be given a top priority in determining the risk of infection, the course of the disease, and the outcome of the disease in elderly patients (Lipsitch M, 2020).

3.6.1 Morbidity and mortality in elderly patients due to COVID-19

COVID-19 epidemic has affected people of all ages. However, as compared to other age groups, it appears to have a higher influence on the health of elderly patients. According to an initial study from China and data from Italy, elderly patients had a higher probability of developing COVID-19 severe illness.

All COVID-19 cases reported through 11 February 2020 were evaluated by the China Center for Disease Control (CDC), which contained the records of 72,314 patients. According to the CDC findings, the severity of COVID-19 infection was shown to be higher in those aged 60 years and over. In populations aged 60 to 69 years, 70 to 79 years, and 80 years and over, the case fatality rate was 3.6 percent, 8 percent, and 14.8 percent, respectively. Similarly, an Italian study found that over 84 percent of the 7,587 people who died as a result of the disease were over 70 years of age.

During this time period, a good number of elderly patients were unable to receive competent care due to the fact that they were ranked lower on the priority list than their young counterparts, based on criteria that maximized the benefits in terms of the number of lives saved and the number of life-years saved. COVID-19 mortality was highest in elderly people aged 85 years and over (10 percent to 27 percent), followed by those aged 65–84 years (3 percent to 11 percent), and those aged 55–64 years (3 percent to 11 percent).

Those aged 20–54 years, on the other hand, had a mortality rate of less than 1%, with no deaths among teenagers. However, research has revealed that the severity of the disease is unevenly distributed among countries around the world. In many undeveloped countries, for instance, the severity and fatality rates were low. Despite having a large number of infected people, India had a lower fatality rate than in other parts of the world.

4. MATERIALS AND METHODS

4.1 Study population

A total of 100 patients with COVID-19 symptoms, who were admitted into hospitals between 15 January 2020 and 18 May 2021, were regarded in this study. The reason for the small size is that many hospitals refused to give us access to private information. Further, the country's economic and political status at the time of the study posed additional challenges, particularly with respect to transportation and the scarcity of gasoline. The ongoing power outage in Lebanon posed an additional problem, especially with respect to internet connection.

4.2 Statistical analysis

The Statistical Package for Social Sciences (SPSS version 25) was used for data entry and analysis. All statistical tests were performed on a two-sided basis with a significance level of 5%.

5. RESULTS

Data were analyzed using SPSS version 25. The study population consisted of 100 patients who were split 50-50, see Figure 3, between two hospitals, namely: Labib Medical Center (LMC), Sidon - Lebanon, and Governmental Hospital (JGH), Jezzine - Lebanon.

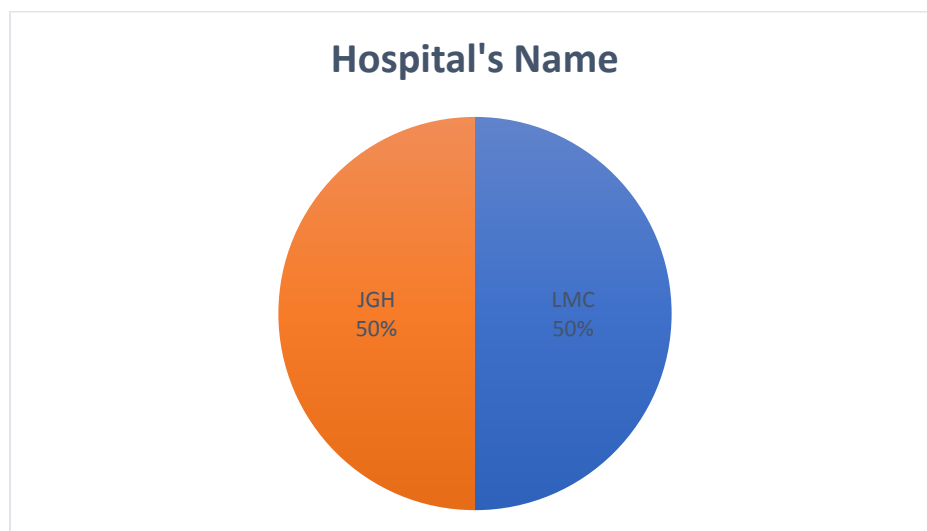


Figure 3: Distribution of patients at JGH and LMC

5.1 Demographic Characteristics

The patients were split into 65 males (65%) and 35 females (35%), see Figure 4.

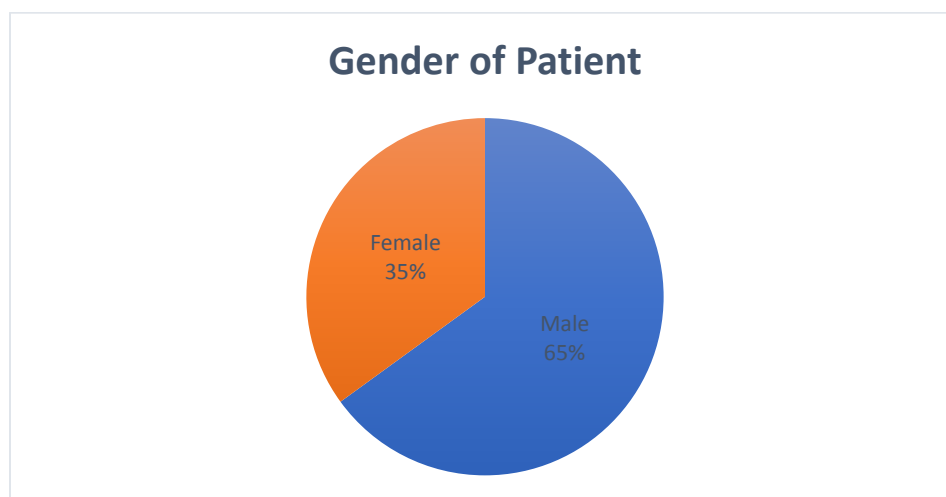


Figure 4: Distribution of patients according to gender

The median age of patients was 61.6 years; the mean age was 61.6 ± 15.3 years. Patients were split 50/50, between elderly patients (65 years and over) and young/adult patients (under 65 years of age). Figure 5 shows the distribution of patients as a function of age.

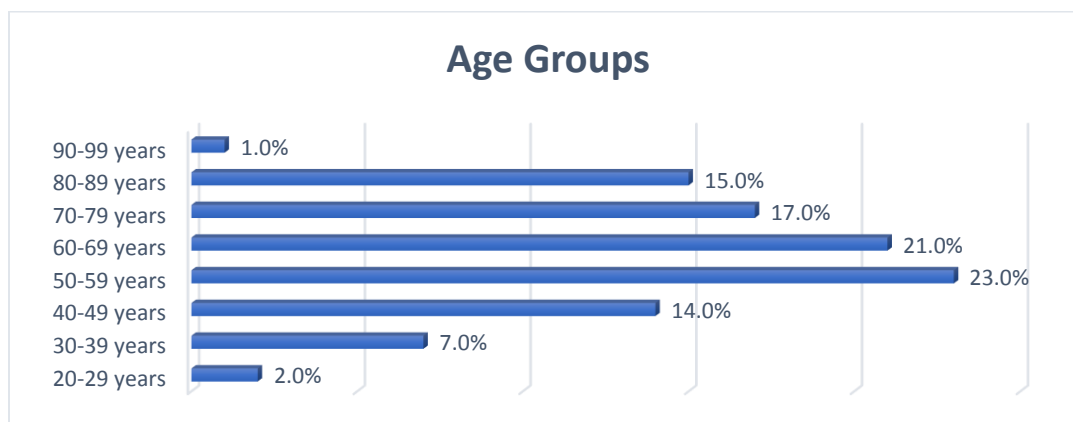


Figure 5: Distribution of patients according to age

Young/adults (under 65 years of age) consisted of 30 males (60 percent) and 20 females (40 percent), with no statistically significant relationship between gender and age ($p = 0.295$), see Table 1. Elderly patients (65 years and over) consisted of 35 males (70 percent) and 15 females (30 percent). Body Mass Index (BMI) differed significantly by age group ($p = 0.002$), with 14 percent of elderly patients being underweight compared to 2% of young/adult patients; 24 percent of the young/adult patients were overweight compared to 2% of elderly patients.

Table 1: Demographic characteristics according to age

		Age		Total	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)	(N = 100)	
Gender	Male	30	35	65	0.295 ^a
		60.0%	70.0%	65.0%	
	Female	20	15	35	
		40.0%	30.0%	35.0%	

Table 1 (cont.): Demographic characteristics according to age

Body Mass Index	Underweight	1	7	8	0.002^a
		2.0%	14.0%	8.0%	
	Normal weight	11	7	18	
		22.0%	14.0%	18.0%	
	Overweight	12	1	13	
		24.0%	2.0%	13.0%	
	Obese	4	10	14	
		8.0%	20.0%	14.0%	
	Unknown	22	25	47	
		44.0%	50.0%	47.0%	

a) Chi-square test; Significance level set at 5%

5.2 Blood Type

Table 2 shows that there was no statistically significant relationship between age and blood type of the patients under study ($p = 0.337$). Out of the 100 patients under study, 25% had blood type A, 8% had blood type B, 11% had blood type AB, 10% had blood type O, and 46% were not tested.

Table 2: Blood type of patients according to age

		Age		Total	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)	(N = 100)	
Blood type	A	11	14	25	0.337 ^a
		22.0%	28.0%	25.0%	
	B	3	5	8	
		6.0%	10.0%	8.0%	
	AB	5	6	11	
		10.0%	12.0%	11.0%	
	O	8	2	10	
		16.0%	4.0%	10.0%	

Table 2 (cont.): Blood type of patients according to age

Unknown	23	23	46
	46.0%	46.0%	46.0%

a) Chi-square test; Significance level set at 5%

5.3 Symptoms

Prior to PCR, 94 percent of young/adult patients and 92 percent of elderly patients showed symptoms, with no statistically significant difference between the age groups ($p = 0.603$), see Table 3. The duration of the symptoms prior to PCR varied by age group ($p = 0.003$). Adult patients had a 16 percent incidence rate of symptoms 3 days ahead of PCR, while elderlies revealed a 28 percent occurrence rate. In young/adult patients, 78 percent of the symptoms appeared within 3 to 6 days of PCR, while in the elderly patients, 42 percent of the symptoms appeared within 3 to 6 days of PCR. Young/adults had a 4 percent occurrence rate of symptoms within 7 to 10 days following PCR, whereas the elderly patients exhibited an 18 percent incidence rate.

Table 3: Symptomatic onset prior to PCR according to age

		Age		Total (N = 100)	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)		
Symptomatic before PCR	No	3	3	6	0.603 ^a
		6.0%	6.0%	6.0%	
	Yes	47	46	93	
		94.0%	92.0%	93.0%	
	Unknown	0	1	1	
		0.0%	2.0%	1.0%	
Symptom duration before PCR	Less than 3	8	14	22	0.003 ^a
		16.0%	28.0%	22.0%	
	3-6 days	39	21	60	
		78.0%	42.0%	60.0%	
	7-10 days	2	9	11	
		4.0%	18.0%	11.0%	
	11-14 days	1	2	3	
		2.0%	4.0%	3.0%	

Table 3 (cont.): Symptomatic onset prior to PCR according to age

	More than 14 days	0 0.0%	4 8.0%	4 4.0%	
Symptoms onset before PCR in days	Mean (SD)	3.94 (2.22)	6.20 (7.86)	5.07 (5.86)	0.703 ^b
	Min - Max	0 - 12	0 - 41	0 - 41	
	Median [IQR]	4 [3-5]	3.5 [2-7]	4 [3-6]	

a) Chi-square test; b) Mann-Whitney U test; Significance level set at 5%

Table 4 reveals that young/adult patients had a hyperthermia rate of 56 percent whereas the elderly patients showed a rate of 20 percent, with sub-febrile temperature of 20 percent in young/adult patients and 34 percent in elderly patients; there was a statistically significant difference between the two groups ($p = 0.002$). With respect to chills, adult patients revealed a chill rate of 68 percent compared to 24 percent in elderly patients; the difference between the two groups was statistically significant ($p < 0.001$). Chest pain was reported by 24% of the study participants, with no statistically significant difference between the age groups ($p = 0.640$). Headaches were reported by 59 percent of the study participants with no statistically significant difference between the age groups ($p = 0.555$). Cardiac arrhythmia was found in 24% of the study participants, with no statistically significant difference between the age groups ($p = 0.160$).

Table 4: General symptoms according to age

		Age		Total (N = 100)	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)		
Body temperature	No fever	12	21	33	0.002 ^a
		24.0%	42.0%	33.0%	
	Sub febrile temp	10	17	27	
		20.0%	34.0%	27.0%	
	Hyperthermia	28	10	38	
		56.0%	20.0%	38.0%	
	Alternation between hyper and hypothermia	0	2	2	
		0.0%	4.0%	2.0%	

Table 4 (cont.): General symptoms according to age

Chills	No	15	36	51	< 0.001 ^a
		30.0%	72.0%	51.0%	
	Yes	34	12	46	
		68.0%	24.0%	46.0%	
	Unknown	1	2	3	
		2.0%	4.0%	3.0%	
Chest pain	No	37	39	76	0.640 ^a
		74.0%	78.0%	76.0%	
	Yes	13	11	24	
		26.0%	22.0%	24.0%	
	Unknown	1	2	3	
		2.0%	4.0%	3.0%	
Headache	No	17	21	38	0.555 ^a
		34.0%	42.0%	38.0%	
	Yes	32	27	59	
		64.0%	54.0%	59.0%	
	Unknown	1	2	3	
		2.0%	4.0%	3.0%	
Cardiac arrhythmia	No	41	35	76	0.160 ^a
		82.0%	70.0%	76.0%	
	Yes	9	15	24	
		18.0%	30.0%	24.0%	
	Unknown	1	2	3	
		2.0%	4.0%	3.0%	

a) Chi-square test; Significance level set at 5%

Table 5 shows that cough rates varied by age group, with 90 percent concerning young/adult patients compared to 70 percent of elderly patients; the difference between the two groups was statistically significant ($p = 0.044$). Sputum was found in 13% of the study participants, with no statistically significant difference between the two groups ($p = 0.231$). Dyspnea was found in 89 percent of the study participants, with no statistically significant difference between the two groups ($p = 0.259$).

Table 5: Respiratory symptoms of patients according to age

		Age		Total	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)	(N = 100)	
Cough	No	4	12	16	0.044^a
		8.0%	24.0%	16.0%	
	Yes	45	35	80	
		90.0%	70.0%	80.0%	
	Unknown	1	3	4	
		2.0%	6.0%	4.0%	
Sputum	No	44	38	82	0.231 ^a
		88.0%	76.0%	82.0%	
	Yes	5	8	13	
		10.0%	16.0%	13.0%	
	Unknown	1	4	5	
		2.0%	8.0%	5.0%	
Dyspnea	No	7	3	10	0.259 ^a
		14.0%	6.0%	10.0%	
	Yes	43	46	89	
		86.0%	92.0%	89.0%	
	Unknown	0	1	1	
		0.0%	2.0%	1.0%	

a) Chi-square test; Significance level set at 5%

Table 6 reveals that elderly patients had lower oxygen saturation than young/adult patients, with a statistically significant difference between the two age groups ($p = 0.035$). Among young/adult patients, 28% had Spo2 above 94%, 46% had Spo2 between 90 and 94%, 18% had Spo2 between 80 and 89%, and 8% had Spo2 below 79%. Among the elderly patients, 12 percent had Spo2 above 94%, 46% had Spo2 between 90 and 94%, 12% had Spo2 between 80 and 89%, and 30% had Spo2 below 79%.

Table 6: Oxygen saturation of patients according to age

		Age		Total	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)	(N = 100)	
Oxygen saturation of patient	Spo2 below 70%	1	6	7	0.035^a
		2.0%	12.0%	7.0%	
	Spo2 between 70 and 79%	3	9	12	
		6.0%	18.0%	12.0%	
	Spo2 between 80 and 89%	9	6	15	
		18.0%	12.0%	15.0%	
	Spo2 between 90 and 94%	23	23	46	
		46.0%	46.0%	46.0%	
	Spo2 above 94%	14	6	20	
		28.0%	12.0%	20.0%	

a) Chi-square test; Significance level set at 5%

Table 7 shows that rhinorrhea was found in 10% of the study participants, with no statistically significant difference between the two age groups ($p = 0.182$). Conjunctivitis was found in 19% of the study participants, with no statistically significant difference between the two age groups ($p = 0.176$). Sore throats varied by age category, with 58 percent concerning young/adult patients and 10% concerning elderly patients, with a statistically significant difference between the two age groups ($p < 0.001$). Loss of taste or smell varied by age group, with 58 percent concerning young/adult patients and only 6% concerning elderly persons, with a statistically significant difference between the two age groups ($p < 0.001$).

Table 7: ORL symptoms of patients according to age

		Age		Total	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)	(N = 100)	
Rhinorrhea	No	44	43	87	0.182 ^a
		88.0%	86.0%	87.0%	
	Yes	6	4	10	
		12.0%	8.0%	10.0%	

Table 7 (cont.): ORL symptoms of patients according to age

Unknown		0	3	3	
		0.0%	6.0%	3.0%	
Conjunctivitis	No	39	39	78	0.176 ^a
		78.0%	78.0%	78.0%	
	Yes	11	8	19	
		22.0%	16.0%	19.0%	
	Unknown	0	3	3	
		0.0%	6.0%	3.0%	
Sore throat	No	19	41	60	< 0.001 ^a
		38.0%	82.0%	60.0%	
	Yes	29	5	34	
		58.0%	10.0%	34.0%	
	Unknown	2	4	6	
		4.0%	8.0%	6.0%	
Loss of Taste or smell	No	20	43	63	< 0.001 ^a
		40.0%	86.0%	63.0%	
	Yes	27	3	30	
		54.0%	6.0%	30.0%	
	Unknown	3	4	7	
		6.0%	8.0%	7.0%	

a) Chi-square test; Significance level set at 5%

Table 8 reveals that diarrhea was more common in young/adult patients (44 percent) than in children (24 percent), with a statistically significant difference between the two age groups ($p = 0.035$). Young/adult patients (40%) were more likely than elderly patients (16%) to experience nausea and vomiting, with a statistically significant difference between the two age groups ($p = 0.035$). Abdominal pain was more prevalent in young/adult patients (40%) than in elderly patients (24%), with no statistically significant difference between the two age groups ($p = 0.086$).

Table 8: GI symptoms of patients according to age

		Age		Total	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)	(N = 100)	
Diarrhea	No	28	38	66	0.035^a
		56.0%	76.0%	66.0%	
	Yes	22	12	34	
		44.0%	24.0%	34.0%	
Nausea and vomiting	No	30	42	72	0.008^a
		60.0%	84.0%	72.0%	
	Yes	20	8	28	
		40.0%	16.0%	28.0%	
Abdominal pain	No	30	38	68	0.086 ^a
		60.0%	76.0%	68.0%	
	Yes	20	12	32	
		40.0%	24.0%	32.0%	

a) Chi-square test; Significance level set at 5%

Table 9 shows that a whopping 84 percent of the study participants reported fatigue and general weakness, with no statistically significant difference between the age groups ($p = 0.275$). Joint discomfort was reported by 30% of the study participants, with no statistically significant difference between the age groups ($p = 0.563$). Muscle pain was reported by 48 percent of the study participants, with no statistically significant difference between the age groups ($p = 0.230$).

Table 9: Musculoskeletal symptoms of patients according to age

		Age		Total	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)	(N = 100)	
Fatigue and general weakness	No	6	10	16	0.275 ^a
		12.0%	20.0%	16.0%	

Table 9 (cont.): Musculoskeletal symptoms of patients according to age

Joint pain	Yes	44	40	84	0.563 ^a
		88.0%	80.0%	84.0%	
	No	35	34	69	
		70.0%	68.0%	69.0%	
	Yes	14	16	30	
		28.0%	32.0%	30.0%	
	Unknown	1	0	1	
		2.0%	0.0%	1.0%	
Muscle pain	No	23	29	52	0.230 ^a
		46.0%	58.0%	52.0%	
	Yes	27	21	48	
		54.0%	42.0%	48.0%	

a) Chi-square test; b) Fisher Exact test; Significance level set at 5%

Table 10 reveals that the rate of falling-down symptoms was larger in elderly patients (28%) than in young/adult patients (6%), with a statistically significant difference between the two age groups ($p = 0.006$). The rate of delirium symptoms was higher in elderly patients (20%) than in young/adult patients (4%), with a statistically significant difference between the two age groups ($p = 0.028$). Elderly patients (48%) had a lower level of consciousness than young/adult patients (14%), with a statistically significant difference between the two groups ($p < 0.001$).

Table 10: Geriatric symptoms of patients according to age

		Age		Total	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)	(N = 100)	
Fall down	No	47	36	83	0.006^b
		94.0%	72.0%	83.0%	
	Yes	3	14	17	
		6.0%	28.0%	17.0%	
Delirium	No	48	40	88	0.028^b
		96.0%	80.0%	88.0%	

Table 10 (cont.): Geriatric symptoms of patients according to age

Decrease level of consciousness	Yes	2	10	12	< 0.001^a
		4.0%	20.0%	12.0%	
	No	43	26	69	
		86.0%	52.0%	69.0%	
	Yes	7	24	31	
		14.0%	48.0%	31.0%	

a) Chi-square test; b) Fisher Exact test; Significance level set at 5%

5.4 Medical History

In terms of medical conditions, elderly patients (86 percent) exhibited more problems than young/adults (62 percent), with a statistically significant difference between the two groups ($p = 0.006$). Cardiac issues were more common in elderly patients (54%) than in young/adult patients (20%), with a statistically significant difference between the two groups ($p < 0.001$). Congestive heart failure was found to be more common in elderly patients (30%) than in young/adult patients (10%), with a statistically significant difference between the two groups ($p = 0.012$). Coronary artery disease was found to be more common in elderly patients (40%) than in young/adult patients (18%), with a statistically significant difference between the two groups ($p = 0.015$).

Lung disease was found in 13% of the patients under participants, with no statistically significant difference between the groups ($p = 0.766$). Only 5 the elderly patients (10%) and 6 of the young/adult patients (12%) had chronic obstructive pulmonary disease. Hypertension was found to be more common in elderly patients (74%) than in young/adult patients (28%), with a statistically significant difference between the two groups ($p < 0.001$). Diabetes were prevalent in elderly patients (54 percent) than in young/adult patients (28 percent), with a statistically significant difference between the two groups ($p = 0.008$).

A number of medical issues, such as obesity, cancer, renal illness, sleep apnea, etc., are listed in Table 11.

Table 11: Medical history of patients according to age

		Age		Total (N = 100)	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)		
Health problem	No	19	7	26	0.006^a
		38.0%	14.0%	26.0%	
	Yes	31	43	74	
		62.0%	86.0%	74.0%	

Table 11 (cont.): Medical history of patients according to age

Cardiac problem	No	40	23	63	< 0.001 ^a
		80.0%	46.0%	63.0%	
	Yes	10	27	37	
		20.0%	54.0%	37.0%	
Congestive heart failure	No	45	35	80	0.012 ^a
		90.0%	70.0%	80.0%	
	Yes	5	15	20	
		10.0%	30.0%	20.0%	
Coronary artery disease	No	41	30	71	0.015 ^a
		82.0%	60.0%	71.0%	
	Yes	9	20	29	
		18.0%	40.0%	29.0%	
Lung disease	No	43	44	87	0.766 ^a
		86.0%	88.0%	87.0%	
	Yes	7	6	13	
		14.0%	12.0%	13.0%	
Sleep apnea	No	43	45	88	0.394 ^a
		86.0%	90.0%	88.0%	
	Yes	0	1	1	
		0.0%	2.0%	1.0%	
	Unknown	7	4	11	
		14.0%	8.0%	11.0%	
Chronic obstructive pulmonary disease	No	50	45	95	0.056 ^b
		100.0%	90.0%	95.0%	
	Yes	0	5	5	
		0.0%	10.0%	5.0%	

Table 11 (cont.): Medical history of patients according to age

Asthma	No	44	50	94	0.027^b
		88.0%	100.0%	94.0%	
	Yes	6	0	6	
		12.0%	0.0%	6.0%	
Hypertension	No	36	13	49	<0.001^a
		72.0%	26.0%	49.0%	
	Yes	14	37	51	
		28.0%	74.0%	51.0%	
Diabetes	No	36	23	59	0.008^a
		72.0%	46.0%	59.0%	
	Yes	14	27	41	
		28.0%	54.0%	41.0%	
Liver disease	No	48	49	97	1.000 ^b
		96.0%	98.0%	97.0%	
	Yes	2	1	3	
		4.0%	2.0%	3.0%	
Immunosuppressed	No	49	50	99	1.000 ^b
		98.0%	100.0%	99.0%	
	Yes	1	0	1	
		2.0%	0.0%	1.0%	
Obesity	No	25	31	56	0.124 ^a
		50.0%	62.0%	56.0%	
	Yes	7	10	17	
		14.0%	20.0%	17.0%	
	Unknown	18	9	27	
		36.0%	18.0%	27.0%	

Table 11 (cont.): Medical history of patients according to age

Cancer	No	46	47	93	0.695 ^b
		92.0%	94.0%	93.0%	
	Yes	4	3	7	
		8.0%	6.0%	7.0%	
Renal disease	No	46	43	89	0.338 ^b
		92.0%	86.0%	89.0%	
	Yes	4	7	11	
		8.0%	14.0%	11.0%	
Other comorbidities	Arrhythmias	0	2	2	
	Gastric ulcer	5	6	11	
	Carotid stenosis	0	1	1	
	BPH	1	4	5	
	Osteoporosis	0	1	1	
	Valvopathy and epilepsy	0	1	1	
	Rheumatism	0	1	1	
	Alzheimer	0	1	1	
	Thyroid disease	1	1	2	
	Epilepsy	1	0	1	
	Anemia	2	0	2	

a) Chi-square test; b) Fisher Exact test; Significance level set at 5%

5.5 Comorbidities

Seven (7%) of the 100 patients under study were on dialysis, with no statistically significant difference between young/adult patients (3%) and elderly patients (4%) ($p = 1.000$). With a statistically significant difference ($p = 0.040$), 19 (19%) of the 100 patients under study were treated with psychoactive medicine, which was split between 5 (10%) young/adults and 14 (28%) elderly patients. Further, with a statistically significant difference ($p < 0.001$), 66 (66%) of the 100 patients under study had poor eyesight, entailing 20 (40%) young/adult patients and 46 (92%) elderly patients. In addition, with a statistically significant difference ($p < 0.001$), 28 (28%) of the 100 patients under study had severe hearing loss, involving 4 (8%) young/adult patients and 24 (48%) elderly patients. Eight elderly patients (16%) required facility-based long-term care services, including assisted living, nursing homes.

Further comorbidities (cerebrovascular accident or stroke, Parkinson disease, smoking, and drinking) are presented in Table 12.

Table 12: Comorbidities of patients according to age

		Age		Total	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)	(N = 100)	
Dialysis	No	47	46	93	1.000 ^b
		94.0%	92.0%	93.0%	
	Yes	3	4	7	
		6.0%	8.0%	7.0%	
Living in nursing home or assisted living	No	50	42	92	0.006^b
		100.0%	84.0%	92.0%	
	Yes	0	8	8	
		0.0%	16.0%	8.0%	
Psychoactive medication	No	45	36	81	0.040^b
		90.0%	72.0%	81.0%	
	Yes	5	14	19	
		10.0%	28.0%	19.0%	
Impaired vision	No	30	4	34	<0.001^a
		60.0%	8.0%	34.0%	
	Yes	20	46	66	
		40.0%	92.0%	66.0%	
Impaired hearing	No	46	26	72	<0.001^b
		92.0%	52.0%	72.0%	
	Yes	4	24	28	
		8.0%	48.0%	28.0%	

Table 12: Comorbidities of patients according to age

Cerebrovascular accident or stroke	No	49	44	93	0.112 ^b
		98.0%	88.0%	93.0%	
	Yes	1	6	7	
		2.0%	12.0%	7.0%	
Parkinson disease	No	50	46	96	0.117 ^b
		100.0%	92.0%	96.0%	
	Yes	0	4	4	
		0.0%	8.0%	4.0%	
Current smoker	No	30	35	65	0.144 ^a
		60.0%	70.0%	65.0%	
	Yes	20	13	33	
		40.0%	26.0%	33.0%	
	Unknown	0	2	2	
		0.0%	4.0%	2.0%	
Alcoholic	No	43	44	87	0.044^a
		86.0%	88.0%	87.0%	
	Yes	6	1	7	
		12.0%	2.0%	7.0%	
	Unknown	1	5	6	
		2.0%	10.0%	6.0%	

a) Chi-square test; b) Fisher Exact test; Significance level set at 5%

5.6 Reason for Admission

Table 13 provides a summary of the reasons for admission. Dyspnea (31%), fever (9%), and fever plus dyspnea (16 percent) were the top three causes for admission.

Table 13: Reasons for admission according to age

	Age				Total	
	Less than 65 years (N = 50)		Equal and above than 65 years (N = 50)		(N = 100)	
Dyspnea	13	26.0%	18	36.0%	31	31.0%
Fever	5	10.0%	4	8.0%	9	9.0%
Both fever and dyspnea	11	22.0%	5	10.0%	16	16.0%
Arrhythmia	1	2.0%	2	4.0%	3	3.0%
Arrhythmia and dyspnea	1	2.0%	1	2.0%	2	2.0%
Hyperglycemia	1	2.0%	0	0.0%	1	1.0%
Diarrhea	4	8.0%	0	0.0%	4	4.0%
Decrease level of consciousness	0	0.0%	6	12.0%	6	6.0%
Left side weakness	1	2.0%	2	4.0%	3	3.0%
General weakness	3	6.0%	0	0.0%	3	3.0%
Respiratory arrest	2	4.0%	2	4.0%	4	4.0%
GI bleeding	0	0.0%	1	2.0%	1	1.0%
Cardiac arrest	0	0.0%	1	2.0%	1	1.0%
Chest pain	2	4.0%	2	4.0%	4	4.0%
Hip fracture	0	0.0%	1	2.0%	1	1.0%
Both dyspnea and general weakness	4	8.0%	4	8.0%	8	8.0%
Cough	0	0.0%	1	2.0%	1	1.0%
Fall down	1	2.0%	0	0.0%	1	1.0%
DVT	1	2.0%	0	0.0%	1	1.0%

5.7 Hospitalization

The average number of days spent at the hospital was 9 ± 5.6 days for the elderly patients, compared to 7.8 ± 6 days for the young/adult patients, with no statistically significant difference between the age groups ($p = 0.067$). Acute respiratory distress was prevalent in 50% of the elderly patients, compared to 24% of the young/adult patients ($p = 0.007$). Pneumonia was prevalent in 100% of the elderly patients ($p < 0.001$), compared to 78% of the young/adult patients. Mechanical ventilation (MV) was applied by 34% of the elderly patients and 20% of the young/adult patients ($p = 0.115$), with an average duration

of 3.1 days by the elderly patients and 1.6 days by the young/adult patients ($p = 0.106$). Forty-two percent of the elderly patients and 22 percent of the young/adult patients ($p = 0.032$) required CPAP (see table 14).

Table 14: Hospitalization-related characteristics according to age

		Age		Total	p-value
		Less than 65 years	Equal and above than 65 years		
Days of hospitalization	Mean (SD)	7.82 (6.05)	9.00 (5.58)	8.41 (5.82)	0.067 ^b
	Min - Max	0 - 32	0 - 30	0 - 32	
	Median [IQR]	6 [4 – 8.5]	8.5 [5-11]	7 [5 – 10]	
Acute respiratory distress during hospitalization	No	38	25	63	0.007^a
		76.0%	50.0%	63.0%	
	Yes	12	25	37	
		24.0%	50.0%	37.0%	
Pneumonia	No	11	0	11	<0.001^c
		22.0%	0.0%	11.0%	
	Yes	39	50	89	
		78.0%	100.0%	89.0%	
Patient under mechanical ventilator	No	40	33	73	0.115 ^a
		80.0%	66.0%	73.0%	
	Yes	10	17	27	
		20.0%	34.0%	27.0%	
Days on mechanical ventilator	Mean (SD)	1.64 (5.01)	3.06 (6.17)	2.35 (5.63)	0.106 ^b
	Min - Max	0 - 32	0 - 30	0 - 32	
Extubation	No	9	17	26	0.127 ^a
		18.0%	34.0%	26.0%	
	Yes	1	0	1	
		2.0%	0.0%	1.0%	

Table 14 (cont.): Hospitalization-related characteristics according to age

		Unknown	40	33	73	0.032^a
			80.0%	66.0%	73.0%	
Need of CPAP	No		39	29	68	
			78.0%	58.0%	68.0%	
	Yes		11	21	32	
			22.0%	42.0%	32.0%	

a) Chi-square test; b) Mann-Whitney U test; c) Fisher exact test; Significance level set at 5%

5.8 Laboratory Results

Seventy-five percent (75%) of the 100 patients under study had lymphopenia, which was evenly divided between 36 (72%) young/adults and 39 (78%) elderly patients, with no statistically significant difference between the two groups ($p = 0.488$). In addition, 48 (48%) of the 100 patients under study showed Leukopenia, with no statistically significant difference between the groups ($p = 0.230$), including 27 (54%) young/adults and 21 (42%) elderly patients. Thrombopenia was found in 27 (27%) of the 100 patients under study, with 17 (34%) young/adults and 10 (20%) elderly patients, with no statistically significant difference between the groups ($p = 0.115$). D-dimer levels were found to be abnormally high in 60% of the elderly patients and 40% of the young/adult patients ($p = 0.0132$). Troponin levels were high in 50% of the elderly patients and 24% of the young/adult patients ($p = 0.020$). CRP levels were high in 96% of the elderly patients and 94% of the young/adult patients ($p = 0.310$) (see Table 15).

Table 15: Laboratory findings in function the age group

		Age		Total	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)	(N = 100)	
Lymphopenia	No	11	14	25	0.488 ^a
		22.0%	28.0%	25.0%	
	Yes	39	36	75	
		78.0%	72.0%	75.0%	
Leukopenia	No	23	29	52	0.230 ^a
		46.0%	58.0%	52.0%	
	Yes	27	21	48	
		54.0%	42.0%	48.0%	

Table 15 (cont.): Laboratory findings in function the age group

Thrombopenia	No	40	33	73	0.115 ^a
		80.0%	66.0%	73.0%	
	Yes	10	17	27	
		20.0%	34.0%	27.0%	
D-dimer	Elevated	20	30	50	0.132 ^a
		40.0%	60.0%	50.0%	
	Normal	14	10	24	
		28.0%	20.0%	24.0%	
	Not tested	16	10	26	
		32.0%	20.0%	26.0%	
Troponin test	Elevated	12	25	37	0.020 ^a
		24.0%	50.0%	37.0%	
	Normal	13	11	24	
		26.0%	22.0%	24.0%	
	Not tested	25	14	39	
		50.0%	28.0%	39.0%	
CRP test	Elevated	47	48	95	0.310 ^a
		94.0%	96.0%	95.0%	
	Normal	2	0	2	
		4.0%	0.0%	2.0%	
	Not tested	1	2	3	
		2.0%	4.0%	3.0%	

a) Chi-square test; Significance level set at 5%

5.9 Status at Discharge and Survival

Fifty-seven (or 57%) of the 100 patients under study were discharged without disability, including 36 (72%) young/adult patients and 21 (42%) elderly patients ($p = 0.002$). The death rate in the studied population was 30%, with 40% for the elderly patients and 20% for the young/adult patients ($p = 0.029$). On release, 6 percent of the 100 patients under study showed decreased cognitive function, 16 percent revealed decreased physical function, and 4 percent were transferred to a long-term facility.

Table 16: Status at Discharge and Survival according to age

		Age		Total	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)	(N = 100)	
Discharged without impairment	No	14	29	43	0.002^a
		28.0%	58.0%	43.0%	
	Yes	36	21	57	
		72.0%	42.0%	57.0%	
Death	No	40	30	70	0.029^a
		80.0%	60.0%	70.0%	
	Yes	10	20	30	
		20.0%	40.0%	30.0%	
Decrease cognitive function on discharge	No	49	45	94	0.092 ^b
		98.0%	90.0%	94.0%	
	Yes	1	5	6	
		2.0%	10.0%	6.0%	
Decrease physical function on discharge	No	46	38	84	0.054 ^b
		92.0%	76.0%	84.0%	
	Yes	4	12	16	
		8.0%	24.0%	16.0%	
Transferred to long term facility	No	49	47	96	0.617 ^b
		98.0%	94.0%	96.0%	
	Yes	1	3	4	
		2.0%	6.0%	4.0%	

a) Chi-square test; b) Fisher exact test; Significance level set at 5%

Cardiac arrest (16%), multi-organ failure (9%), respiratory arrest (19%), secondary infection (4%), and DIC were the leading causes of death (2 percent). The causes of mortality did not differ by age group ($p > 0.05$). (table 17).

Table 17: Death reasons according to age

		Age		Total	p-value
		Less than 65 years (N = 50)	Equal and above than 65 years (N = 50)	(N = 100)	
Death from cardiac arrest	No	45	39	84	0.171 ^a
		90.0%	78.0%	84.0%	
	Yes	5	11	16	
		10.0%	22.0%	16.0%	
Death from multi- organ failure	No	46	45	91	1.000 ^b
		92.0%	90.0%	91.0%	
	Yes	4	5	9	
		8.0%	10.0%	9.0%	
Death from respiratory arrest	No	44	37	81	0.125 ^a
		88.0%	74.0%	81.0%	
	Yes	6	13	19	
		12.0%	26.0%	19.0%	
Death from secondary infection	No	49	47	96	0.617 ^b
		98.0%	94.0%	96.0%	
	Yes	1	3	4	
		2.0%	6.0%	4.0%	
Death from DIC	No	50	48	98	0.495 ^b
		100.0%	96.0%	98.0%	
	Yes	0	2	2	
		0.0%	4.0%	2.0%	

a) Chi-square test; b) Fisher exact test; Significance level set at 5%

6. DISCUSSION

Coronavirus disease 2019 (COVID-19) severity and outcome are largely determined by a patient's age. Elderly people over the age of 65 account for 80% of all hospitalizations and have a 23-fold higher risk of death than those under the age of 65. The world's aging population, particularly in light of the recent

SARS CoV 2 pandemic, necessitates a deeper understanding of the challenges that may arise in the 65 and over age range.

In this study, 100 patients who were confirmed to have SARS-CoV-2 infection and were hospitalized at two hospitals: Labib Medical Center, Sidon - Lebanon, and Jezzine Governmental Hospital, Jezzine - Lebanon, were observed; fifty of the patients were over 65 years of age and 50 were under 65 years of age. Seventy percent of the elderly patients were male and 30% were female. With respect to the under 65 years age group, sixty percent were young/adult male patients and 40% were young/adult female patients.

According to this study, elderly patients exhibited a greater rate of chronic medical illness (86%) compared to 62 percent for young/adult patients; this result agrees well with that of previous research that determined that the frequency of comorbidities is higher in elderly patients than in young/adult patients (Xue Za Zhi, 2020). This study has revealed that the proportion of elderly patients with cardiovascular disease (54%), diabetes (54%) and hypertension (74%), was higher than that found in young/adult patients (28 percent, 28 percent and 20 percent, respectively). Congestive heart failure was found to be more common in elderly patients (30%) than in young/adult patients (10%); coronary artery disease was found to be more common in elderly patients (40%) than in young/adult patients (18 percent).

On admission, according to this study, the most prevalent symptoms in elderly patients were dyspnea, exhaustion, and general weakness, whereas the most common symptoms in young/adult patients were fever, cough, and fatigue. This shows that when infected with SARS-CoV-2, some elderly patients may not experience the same symptoms as young/adult patients, such as fever or cough. Due to a low basal temperature, disturbance in thermal homeostasis caused by aging, and the frequent use of drugs like aspirin, fever in elderly patients with bacterial or viral illness may be muted or perhaps absent. The difference between the aged groups lung structure, such as muscle atrophy, could well explain why elderly patients have worse airway clearance (Yao TT, 2020), lung reserve (Zuo MZ et al., 2020), and defensive barrier function (Xu J et al., 2020).

COVID-19 abnormal symptoms in elderly patients include falls, delirium, disorientation, dizziness, and unusual weariness. In this study, the rate of fall down symptoms was higher in elderly patients (28%) than in young/adult patients (6%); the rate of delirium symptoms was higher in elderly patients (20%) than in young/adult patients (4 percent). This suggests that atypical COVID-19 presentations should be considered during screening and testing of patients who are considered high risk due to age (Wang D et al., 2020).

Furthermore, when compared to young/adult patients, the incidence of severe or critically severe illnesses were higher in elderly patients. When persistent medical diseases, the probability of unusual symptoms, and the high incidence of severe sickness are factored in, senior patients require far more care and nursing during the COVID-19 pandemic.

Lymphopenia was a prevalent anomaly in elderly patients and young/adult SARS-CoV-2 patients, affecting 72 percent of elderly patients and 78 percent of young/adult patients. In this respect, studies have revealed that with beta coronavirus infections, severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV), depressed lymphocytes were a common observation (Zumla A, 2016; Wong RS et al., 2003).

Other laboratory abnormalities, such as an elevated D-dimer, an elevated troponin level, and a high level of CRP, were more common in elderly COVID-19 patients than in young/adult patients. D-Dimer is a fibrinolysis specific marker that has been used to screen patients for venous thromboembolism, but it also promotes inflammation and may predict a bad sepsis prognosis (Mikuła T et al., 2018; Gris JC,

2011). In this study, 60 percent of elderly patients had an elevated D-dimer level, compared to 40% in young/adult patients. During hospitalization, however, no participants were diagnosed with venous thromboembolism, suggesting that the high D-dimer was more likely connected with inflammation in the SARS-CoV-2 infection.

CRP has a critical function in innate immunity to pathogens (Slaats J, 2016). The number of elderly patients with high CRP levels was 96 percent, while the percentage of young/adult patients with elevated CRP levels was 94 percent, revealing the severity of the inflammatory process following SARS-CoV-2 infection. SARS-CoV-2 infection appears to have the potential to cause systemic damage to a patient's body. In this respect, it is critical to use laboratory testing to track organ function and the inflammatory response, especially in elderly COVID-19 patients.

When laboratory data were compared between young/adult and elderly patients, troponin levels were found to be increased by 50% in elderly patients, compared to just 24% in young/adult patients, indicating that the involvement of high sensitivity troponin in SARS-CoV-2 is critical; an increase in troponin could be linked to clinical disorders other than heart disease, such as pulmonary embolism, renal failure, or endothelial cell involvement in general (Varga Z, 2020).

According to this study, the mean hospitalization for elderly patients was 9 ± 5.6 days, compared to 7.8 ± 6 days for young/adult patients. Acute respiratory distress during hospitalization was seen in 50% of elderly patients, compared to 24% in young/adult patients. Pneumonia was found in 100% of elderly patients, compared to 78% in young/adult patients. COVID-19 patients over 65 years of age had a higher risk of respiratory failure and required more treatment time than COVID-19 patients under 65 years of age, indicating that elderly COVID-19 patients had considerably more severe disease and a poorer response to treatments than younger COVID-19 patients. This outcome coincides well with that of previous studies (Zhou F et al., 2020; Wang W, 2020).

When compared to young/adult patients, elderly patients received more invasive mechanical ventilation and CPAP/BIPAP. Mechanical ventilation (MV) was used by 34% of the elderly patients, with a mean duration of 3.1 days, and by 20% of the young/adult patients, with a mean duration of 1.6 days. Forty-two percent of elderly patients and 22 percent of young/adult patients required CPAP.

In terms of short-term outcomes, this study revealed that the overall death rate was 30%, with 40 percent for the elderly patients and 20 percent for the young/adult patients. The most common causes of death were respiratory arrest (19%), cardiac arrest (16%), multi-organ failure (9%), secondary infection (4%) and DIC (2%). The impact of age on mortality risk was found to be significant; patients between the ages of 75 and 84 years and those 85 years and above had 200 times and 630 times higher average death rates, respectively, than those between the ages of 18 to 29 years (CDC, 2020).

7. CONCLUSION

Lung infections are the most common symptom of the novel coronavirus. The stress on the heart is increased by lung infections. Multi-system illness characteristics that coexist in elderly people result in difficult and complex diseases. Other systemic complications, such as gastrointestinal bleeding, renal failure, disseminated intravascular coagulation (DIC) or deep vein thrombosis, delirium, and secondary infections, should be avoided because elderly patients are prone to multi-system organ dysfunction and even failure.

SARS-host CoV-2's receptor is found in a variety of human organs, including lungs, heart, neurological system, and skeletal muscles, which may explain why SARS-CoV-2 can cause harm to various organs. When compared to young and adult patients, elderly individuals are more likely to have substantial pulmonary and extrapulmonary organ damage, as well as a greater mortality rate. This could be owing

to the fact that elderly people have more comorbidities and are malnourished. The mortality of elderly COVID-19 patients is linked to age, ARDS, acute cardiac damage, and heart failure. Given the higher severity and lethality of COVID-19 in elderly patients, physicians should actively monitor and avoid any organ damage in order to improve their survival and reduce their mortality rate. According to this study, elderly Covid-19 patients who were hospitalized had more chronic comorbidities, less symptomatology (cough and fever), but more severe respiratory symptoms and cardiac enzyme abnormalities than the younger and adult patients.

Finally, with SARS-CoV-2 infection, elderly patients are more likely to have a severe or critically severe illness. When compared to the young/adult population, they may have uncommon symptoms and various organ problems, as well as a rapid and unexpected clinical deterioration. During hospitalization, elderly patients have greater complications than young/adult patients; with timely and appropriate care, they can have comparable favorable results to young/adult patients. In conclusion, careful nursing, observation, and systemic treatment are critical to elderly patients.

REFERENCES

- Abrams ER, Rose G, Fields JM, Esener D (2020). Point-of-Care Ultrasound in the Evaluation of COVID-19. *J Emerg Med*; 59:403
- ACR Recommendations for the use of Chest Radiography and Computed Tomography (CT) for Suspected COVID-19 Infection <https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Recommendations-for-Chest-Radiography-and-CT-for-Suspected-COVID19-Infection> (Accessed on 1 April 2020).
- African COVID-19 Critical Care Outcomes Study (ACCCOS) Investigators. (2021). Patient care and clinical outcomes for patients with COVID-19 infection admitted to African high-care or intensive care units (ACCCOS): a multicentre, prospective, observational cohort study. *Lancet*; 397:1885.
- Aiello A, Farzaneh F, Candore G, Caruso C, Davinelli S, Gambino CM, Ligotti ME, Zareian N, Accardi G. (2019). Immunosenescence and its hallmarks: how to oppose aging strategically? a review of potential options for therapeutic intervention. *Front Immunol.*; 10:2247
- Annweiler C, Sacco G, Salles N, et al. (2021). National French Survey of Coronavirus Disease (COVID-19) Symptoms in People Aged 70 and Over. *Clin Infect Dis*; 72:490.
- Arihiro S, Nakashima A, Matsuoka M, Suto S, Uchiyama K, Kato T, Mitobe J, Komoike N, Itagaki M, Miyakawa Y, Koido S, Hokari A, Saruta M, et al. (2019). Randomized trial of vitamin D supplementation to prevent seasonal influenza and upper respiratory infection in patients with inflammatory bowel disease. *Inflamm Bowel Dis.*; 25:1088–95. <https://doi.org/10.1093>
- Bajema KL, Oster AM, McGovern OL, et al. (2020). Persons Evaluated for 2019 Novel Coronavirus - United States, January 2020. *MMWR Morb Mortal Wkly Rep* 2020; 69:166.
- Bao C, Liu X, Zhang H, et al. (2020). Coronavirus Disease 2019 (COVID-19) CT Findings: A Systematic Review and Meta-analysis. *J Am Coll Radiol*; 17:701.
- Bartlett DB, Firth CM, Phillips AC, Moss P, Baylis D, Syddall H, Sayer AA, Cooper C, Lord JM. (2012). The age-related increase in low-grade systemic inflammation (inflammaging) is not driven by cytomegalovirus infection. *Aging Cell.*; 11:912–15.
- Bean D, Kraljevic Z, Searle T, Bendayan R, Pickles A, Folarin A, et al. (2020). Treatment with ACE-inhibitors is associated with less severe disease with SARS-Covid-19 infection in a multi-site UK acute Hospital Trust. *medRxiv*.
- Beard JA, Bearden A, Striker R. (2011). Vitamin D and the anti-viral state Jeremy A. *J Clin Virol.*; 50: 194-200.
- Bergman P, Norlin AC, Hansen S, Björkhem-Bergman L. (2015). Vitamin D supplementation to patients with frequent respiratory tract infections: a post hoc analysis of a randomized and placebo-controlled trial. *BMC Res Notes.*; 8:391

- Bicheng Zhang, Xiaoyang Zhou, Yanru Qiu, Fan Feng, Jia Feng, et al. (2020) Clinical characteristics of 82 death cases with COVID-19. *Med*
- Boscolo-Rizzo P, Borsetto D, Fabbris C, et al. (2020). Evolution of Altered Sense of Smell or Taste in Patients with Mildly Symptomatic COVID-19. *JAMA Otolaryngol Head Neck Surg*; 146:729.
- Bunyavanich S, Do A, Vicencio A. (2020). Nasal gene expression of angiotensin-converting enzyme 2 in children and adults. *JAMA.*; 323: 2427-2429.
- Cates J, Lucero-Obusan C, Dahl RM, et al. (2020). Risk for In-Hospital Complications Associated with COVID-19 and Influenza - Veterans Health Administration, United States, October 1, 2018-May 31, 2020. *MMWR Morb Mortal Wkly Rep*; 69:1528.
- CDC COVID-19 Response Team. (2020). Severe Outcomes Among Patients with Coronavirus Disease 2019 (COVID-19) - United States, February 12-March 16, 2020. *MMWR Morb Mortal Wkly Rep*; 69:343.
- CDC (2020). COVID-19 hospitalization and death by age. Centers for Disease Control and Prevention. <https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-byage.htm>
- Centers for Disease Control and Prevention. (July 28, 2020). COVID-19 Pandemic Planning Scenarios. <https://www.cdc.gov/coronavirus/2019-ncov/hcp/planning-scenarios.html>.
- Chan J-F, Yuan S, Kok K-H, To K-K, Chu H, Yang J, et al. (2020). A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster *Lancet*, 395, pp. 514-523
- Chen N, Zhou M, Dong X, et al. (2020). Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet*; 395:507.
- Chen N, Zhou M, Dong X, et al. (2020). Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *The Lancet* ;395(10223):507-513.
- Chen T, Wu D, Chen H, et al. (2020). Clinical characteristics of 113 deceased patients with coronavirus disease 2019: retrospective study. *BMJ*; 368:m1091.
- Cheung KS, Hung IFN, Chan PPY, et al. (2020). Gastrointestinal Manifestations of SARS-CoV-2 Infection and Virus Load in Fecal Samples from a Hong Kong Cohort: Systematic Review and Meta-analysis. *Gastroenterology*; 159:81.
- China CDC, 2020. Vital surveillances: The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19)-China. *China CDC Weekly* 2: 113-122.
- Cohen PA, Hall LE, John JN, Rapoport AB. (2020). The Early Natural History of SARS-CoV-2 Infection: Clinical Observations from an Urban, Ambulatory COVID-19 Clinic. *Mayo Clin Proc*; 95:1124.
- Colavita F, Lapa D, Carletti F, et al. (2020). SARS-CoV-2 Isolation from Ocular Secretions of a Patient with COVID-19 in Italy with Prolonged Viral RNA Detection. *Ann Intern Med* 2020; 173:242.
- Coronaviridae Study Group of the International Committee on Taxonomy of V (2020). The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2 *Nat Microbiol*, 5, pp. 536-544
- Cunningham JW, Vaduganathan M, Claggett BL, et al. (2020). Clinical Outcomes in Young US Adults Hospitalized with COVID-19. *JAMA Intern Med*.
- Dadamo H, Yoshikawa T, Ouslander JG. (2020). Coronavirus Disease 2019 in geriatrics and long-term care: The ABCDs of COVID-19. *J Am Geriatr Soc.* doi: 10.1111/jgs.16445.
- Dai M, Liu D, Liu M, et al. (2020). Patients with Cancer Appear More Vulnerable to SARS-CoV-2: A Multicenter Study during the COVID-19 Outbreak. *Cancer Discov*; 10:783.
- Del Valle DM, Kim-Schulze S, Huang HH, et al. (2020). An inflammatory cytokine signature predicts COVID-19 severity and survival. *Nat Med* 2020; 26:1636.
- Dennis JM, McGovern AP, Vollmer SJ, Mateen BA. (2021). Improving Survival of Critical Care Patients with Coronavirus Disease 2019 in England: A National Cohort Study, March to June 2020. *Crit Care Med*; 49:209.

- Diao B, Wang C, Tan Y, Chen X, Liu Y, Ning L, Chen L, Li M, Liu Y, Wang G, Yuan Z, Feng Z, Zhang Y, et al. (2020). Reduction and functional exhaustion of T cells in patients with coronavirus disease 2019 (COVID-19). *Front Immunol.*; 11:827.
- Ebadi M, Montano-Loza AJ. (2020). Perspective: improving vitamin D status in the management of COVID-19. *Eur J Clin Nutr.*; 74: 856-859.
- Esposito S, Lelii M. (2015). Vitamin D and respiratory tract infections in childhood. *BMC Infect Dis.*; 15: 487.
- Franceschi C, Bonafè M, Valensin S, Olivieri F, De Luca M, Ottaviani E, De Benedictis G. (2000). Inflammaging. An evolutionary perspective on immunosenescence. *Ann N Y Acad Sci.*; 908:244–54
- Franceschi C, Salvioli S, Garagnani P, de Eguileor M, Monti D, Capri M. (2017). Immunobiography and the heterogeneity of immune responses in elderly persons: a focus on inflammaging and trained immunity
- Fulop T, Larbi A, Dupuis G, Le Page A, Frost EH, Cohen AA, Witkowski JM, Franceschi C. (2018).
- Glass WG, Subbarao K, Murphy B, Murphy PM. (2004). Mechanisms of host defense following severe acute respiratory syndrome-coronavirus (SARS-CoV) pulmonary infection of mice. *J Immunol.*
- Grant WB, Baggerly CA, Bhattoa HP. (2020). Nursing home residents could reduce risk of COVID-19 by supplementing with vitamin D3. *BMJ.*; 369.
- Grant WB, Lahore H, McDonnell SL, Baggerly CA, French CB, Aliano JL, et al. (2020). Evidence that Vitamin D Supplementation Could Reduce Risk of Influenza and COVID-19 Infections and Deaths. *Nutrients.*; 12: 988
- Grant WB, Lahore H, McDonnell SL, et al. (2020). Evidence that Vitamin D Supplementation Could Reduce Risk of Influenza and COVID19 Infections and Deaths. *Nutrients*; 12: 988.
- Gris JC, Bouvier S, Cochery-Nouvellon E, Faillie JL, Lissalde-Lavigne G, Lefrant JY. (2011). Fibrin-related markers in patients with septic shock: individual comparison of D-dimers and fibrin monomers impacts on prognosis. *Thromb Haemost.*
- Guan WJ, Ni ZY, Hu Y, et al. (2020). Clinical Characteristics of Coronavirus Disease 2019 in China. *N Engl J Med*; 382:1708.
- Hashimoto K, Kouno T, Ikawa T, Hayatsu N, Miyajima Y, Yabukami H, Terooatea T, Sasaki T, Suzuki T, Valentine M, Pascarella G, Okazaki Y, Suzuki H, et al. (2019). Single-cell transcriptomics reveals expansion of cytotoxic CD4 T cells in supercentenarians. *Proc Natl Acad Sci USA.*; 116:24242–51
- High KP, Bradley SF, Gravenstein S, et al. (2009). Clinical practice guideline for the evaluation of fever and infection in older adult residents of long-term care facilities: update by the Infectious Diseases Society of America. *Clinical Infectious Diseases* ;48(2):149-171
- Hinojosa E, Boyd AR, Orihuela CJ. (2009). Age-associated inflammation and toll-like receptor dysfunction prime the lungs for pneumococcal pneumonia. *J Infect Dis.*; 200:546–54
- Hu Z, Song C, Xu C, et al. (2020). Clinical characteristics of 24 asymptomatic infections with COVID-19 screened among close contacts in Nanjing, China. *Sci China Life Sci* 2020; 63:706.
- Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China *Lancet*, 395, pp. 497-506
- Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet.*; 395: 497-506.
- Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z, Yu T, Xia J, et al. (2020). Clinical features of patients infected with 2019 novel coronavirus in wuhan, China. *Lancet.*; 395:497–506.
- Ilaloglu S, Aphinyanaphongs Y, Jones S, et al. (2020). Thrombosis in Hospitalized Patients with COVID-19 in a New York City Health System. *JAMA*; 324:799.
- Ioannidis JPA. (2021). Reconciling estimates of global spread and infection fatality rates of COVID-19: An overview of systematic evaluations. *Eur J Clin Invest*; 51: e13554.

- Islam N, Shkolnikov VM, Acosta RJ, et al. (2021). Excess deaths associated with covid-19 pandemic in 2020: age and sex disaggregated time series analysis in 29 high income countries. *BMJ*; 373: n1137.
- Italy (2020). With Aging Population, Has World's Highest Daily Deaths from Virus, Wall Street Journal available at <https://www.wsj.com/articles/italy-with-elderly-personspopulation-has-worlds-highest-death-rate-from-virus11583785086>
- Jarrett PG, Rockwood K, Carver D, Stolee P, Cosway S. (1995). Illness presentation in elderly persons. *Arch Intern Med.*;155(10):1060-4.
- Jiang F, Deng L, Zhang L, Cai Y, Cheung CW, Xia Z (2020). Review of the clinical characteristics of coronavirus disease 2019 (COVID-19). *J Gen Intern Med.*, 35(5):1545–9.
- Johnson N-P, Mueller J (2002). Updating the accounts: global mortality of the 1918-1920 "Spanish" influenza pandemic *Bull Hist Med*, 76, pp. 105-115
- Jung, YJ, Yoon JL, Kim HS, Lee AY, Kim MY, Cho JJ. (2017). Atypical clinical presentation of geriatric syndrome in elderly persons with pneumonia or coronary artery disease. *Ann of Geri Med and Res.*;21(4):158-63.
- Kabarriti R, Brodin NP, Maron MI, et al. (2020). Association of Race and Ethnicity with Comorbidities and Survival Among Patients with COVID-19 at an Urban Medical Center in New York. *JAMA Netw Open*; 3: e2019795.
- Kain T, Fowler R (2019). Preparing intensive care for the next pandemic *influenza Crit Care*, 23, p. 337
- Kanwal A, Agarwala A, Martin LW, Handberg EM, Yang E. (2020). COVID-19 and Hypertension: What We Know and Don't Know.
- Koehler P, Cornely OA, Böttiger BW, et al. (2020). COVID-19 associated pulmonary aspergillosis. *Mycoses*; 63:528.
- Kompaniyets L, Goodman AB, Belay B, et al. (2021). Body Mass Index and Risk for COVID-19-Related Hospitalization, Intensive Care Unit Admission, Invasive Mechanical Ventilation, and Death - United States, March-December 2020. *MMWR Morb Mortal Wkly Rep*; 70:355.
- Kubin CJ, McConville TH, Dietz D, et al. (2021). Characterization of Bacterial and Fungal Infections in Hospitalized Patients with Coronavirus Disease 2019 and Factors Associated with Health Care-Associated Infections. *Open Forum Infect Dis*; 8: ofab201.
- Lam P-P, Coleman BL, Green K, et al. (2016). Predictors of influenza among older adults in the ED. *BMC infectious diseases* ;16(1):615
- Levin AT, Hanage WP, Owusu-Boaitey N, et al. (2020). Assessing the age specificity of infection fatality rates for COVID-19: systematic review, meta-analysis, and public policy implications. *Eur J Epidemiol*; 35:1123.
- Li G, Fan Y, Lai Y, Han T, Li Z, Zhou P, Pan P, Wang W, Hu D, Liu X, Zhang Q, Wu J. (2020). Coronavirus infections and immune responses. *J Med Virol.*; 92:424–32.
- Li J-Y, You Z, et al. (2020, February 20). The epidemic of 2019-novel-coronavirus (2019-nCoV) pneumonia and insights for emerging infectious diseases in the future. *Microbes and Infection Journal*, Elsevier.
- Liao M, Liu Y, Yuan J, Wen Y, Xu G, Zhao J, Cheng L, Li J, Wang X, Wang F, Liu L, Amit I, Zhang S, et al. (2020). Single-cell landscape of bronchoalveolar immune cells in patients with COVID-19. *Nature medicine*.
- Lighter J, Phillips M, Hochman S, et al. (2020). Obesity in Patients Younger Than 60 Years Is a Risk Factor for COVID-19 Hospital Admission. *Clin Infect Dis*; 71:896.
- Liotta EM, Batra A, Clark JR, et al. (2020). Frequent neurologic manifestations and encephalopathy-associated morbidity in Covid-19 patients. *Ann Clin Transl Neurol*; 7:2221.
- Lipsitch M, Swerdlow DL, Finelli L (2020). Defining the epidemiology of covid-19-studies needed. *N Engl J Med* 382: 1194-1196.
- Liu Y, Yan LM, Wan L, et al. (2020). Viral dynamics in mild and severe cases of COVID-19. *Lancet Infect Dis*; 20:656.

- Liu Y, Yan LM, Wan L, Xiang TX, Le A, Liu JM, Peiris M, Poon LLM, Zhang W. (2020). Viral dynamics in mild and severe cases of COVID-19. *Lancet Infect Dis*.
- Lowe KE, Zein J, Hatipoglu U, Attaway A. (2021). Association of Smoking and Cumulative Pack-Year Exposure with COVID-19 Outcomes in the Cleveland Clinic COVID-19 Registry. *JAMA Intern Med*; 181:709.
- Majumdar S, Nandi D. (2018). Thymic atrophy: experimental studies and therapeutic interventions. *Scand J Immunol.*; 87:4–14.
- Malone ML, Hogan TM, Perry A, Biese K, Bonner A, Pagel P, Unroe KT. (2020). COVID-19 in older adults - Key points for emergency department providers. *J of Geri Emerg Med.*;1(4):1-11
- Meehan M, Penckofer S. (2014). The role of vitamin D in the aging adult. *J Aging Gerontol.*; 2:60–71.
- Mehta P, McAuley DF, Brown M, et al. (2020). COVID-19: consider cytokine storm syndromes and immunosuppression. *Lancet*; 395:1033.
- Mikuła T, Sapuła M, Jabłońska J, Kozłowska J, Stańczak W, Krankowska D, et al. (2018). Significance of heparin-binding protein and D-dimers in the early diagnosis of spontaneous bacterial peritonitis. *Mediators Inflamm*.
- Miró Ò, Llorens P, Jiménez S, et al. (2021). Frequency, Risk Factors, Clinical Characteristics, and Outcomes of Spontaneous Pneumothorax in Patients with Coronavirus Disease 2019: A Case-Control, Emergency Medicine-Based Multicenter Study. *Chest*; 159:1241.
- Morris SB, Schwartz NG, Patel P, et al. (2020). Case Series of Multisystem Inflammatory Syndrome in Adults Associated with SARS-CoV-2 Infection - United Kingdom and United States, March-August 2020. *MMWR Morb Mortal Wkly Rep*; 69:1450.
- Muñoz-Price LS, Nattinger AB, Rivera F, et al. (2020). Racial Disparities in Incidence and Outcomes Among Patients with COVID-19. *JAMA Netw Open* 2020; 3: e2021892.
- Munshi R, Hussein MH, Toraih EA, et al. (2021). Vitamin D insufficiency as a potential culprit in critical COVID-19 patients. *J Med Virol* 2021; 93:733.
- Norman DC. (2000). Fever in elderly persons. *Clinical Infectious Diseases*;31(1):148-151.
- Ojha V, Mani A, Pandey NN, et al. (2020). CT in coronavirus disease 2019 (COVID-19): a systematic review of chest CT findings in 4410 adult patients. *Eur Radiol*; 30:6129.
- Onder G, Rezza G, Brusaferro S. (2020). Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy. *JAMA*; 323:1775.
- Ongrádi J, Kövesdi V. (2010). Factors that may impact on immunosenescence: an appraisal. *Immun Ageing.* ; 7:7.
- Oran DP, Topol EJ. (2020). Prevalence of Asymptomatic SARS-CoV-2 Infection: A Narrative Review. *Ann Intern Med*; 173:362.
- Oran DP, Topol EJ. (2021). The Proportion of SARS-CoV-2 Infections That Are Asymptomatic: A Systematic Review. *Ann Intern Med*; 174:655.
- Palmer DB. (2013). The effect of age on thymic function. *Front Immunol.*; 4:316
- Pan F, Ye T, Sun P, et al. (2020). Time Course of Lung Changes at Chest CT during Recovery from Coronavirus Disease 2019 (COVID-19). *Radiology*; 295:715.
- Patel A, Agarwal R, Rudramurthy SM, et al. (2021). Multicenter Epidemiologic Study of Coronavirus Disease-Associated Mucormycosis, India. *Emerg Infect Dis*.
- Petrilli CM, Jones SA, Yang J, et al. (2020). Factors associated with hospital admission and critical illness among 5279 people with coronavirus disease 2019 in New York City: prospective cohort study. *BMJ*; 369:m1966.
- Priehl B, Treiber G, Pieber TR, Amrein K. (2013). Vitamin D and Immune Function. *Nutrients.*; 5: 2502-2521.

- Rajpal S, Tong MS, Borchers J, et al. (2021). Cardiovascular Magnetic Resonance Findings in Competitive Athletes Recovering from COVID-19 Infection. *JAMA Cardiol*; 6:116.
- Ray JG, Schull MJ, Vermeulen MJ, Park AL. (2020). Association Between ABO and Rh Blood Groups and SARS-CoV-2 Infection or Severe COVID-19 Illness: A Population-Based Cohort Study. *Ann Intern Med*; 174:308.
- Rentz M, Yim E, Klaff L, et al. (2020). Characteristics and Outcomes of 21 Critically Ill Patients with COVID-19 in Washington State. *JAMA*; 323:1612.
- Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19) (2020), available at <https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf>020. doi:10.1001/jama. 1585
- Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, et al. (2020). Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City Area. *JAMA*.; 323: 2052-2059
- Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, et al. (2020). Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City Area. *JAMA*.; 323: 2052-2059.
- Richardson S, Hirsch JS, Narasimhan M, et al. (2020). Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized with COVID-19 in the New York City Area. *JAMA*; 323:2052.
- Ron-Harel N, Notarangelo G, Ghergurovich JM, Paulo JA, Sage PT, Santos D, Satterstrom FK, Gygi SP, Rabinowitz JD, Sharpe AH, Haigis MC. (2018). Defective respiration and one-carbon metabolism contribute to impaired naïve T cell activation in aged mice. *Proc Natl Acad Sci USA*. ; 115:13347–52
- Sakurai A, Sasaki T, Kato S, et al. (2020). Natural History of Asymptomatic SARS-CoV-2 Infection. *N Engl J Med*; 383:885.
- Salam N, Rane S, Das R, Faulkner M, Gund R, Kandpal U, Lewis V, Mattoo H, Prabhu S, Ranganathan V, Durdik J, George A, Rath S, Bal V. (2013). T cell ageing: effects of age on development, survival & function. *Indian J Med Res.*; 138:595–608.
- Sassi F, Tamone C, D'Amelio P. (2018). Vitamin D: Nutrient, Hormone, and Immunomodulator. *Nutrients*.; 10: 1656.
- Severe Covid-19 GWAS Group, Ellinghaus D, Degenhardt F, et al. (2020). Genomewide Association Study of Severe Covid-19 with Respiratory Failure. *N Engl J Med*; 383:1522.
- Shen-Orr SS, Furman D. (2013). Variability in the immune system: of vaccine responses and immune states. *Curr Opin Immunol*; 25:542–47
- Shi Y, Wang Y, Shao C, Huang J, Gan J, Huang X, Bucci E, Piacentini M, Ippolito G, Melino G. (2020). COVID-19 infection: the perspectives on immune responses. *Cell Death Differ.*; 27:1451–54.
- Simonsen L, Clarke M-J, Schonberger L-B, Arden N-H, Cox N-J, Fukuda K (1998). Pandemic versus epidemic influenza mortality: a pattern of changing age distribution. *J Infect Dis*, 178, pp. 53-60
- Slaats J, Ten Oever J, van de Veerdonk FL, Netea MG. (2016). IL-1 β /IL-6/CRP and IL-18/ferritin: distinct inflammatory programs in infections. *PLoS Pathog.* (12):e1005973.
- Sohrabi C, Alsafi Z, O'Neill N, et al. (2020), World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19), *International Journal of Surgery*; 76:71-76.
- Spinato G, Fabbris C, Polesel J, et al. (2020). Alterations in Smell or Taste in Mildly Symptomatic Outpatients with SARS-CoV-2 Infection. *JAMA*; 323:2089.
- Stokes EK, Zambrano LD, Anderson KN, et al. (2020). Coronavirus Disease 2019 Case Surveillance - United States, January 22-May 30. *MMWR Morb Mortal Wkly Rep* 2020; 69:759.
- Struyf T, Deeks JJ, Dinnes J, et al. (2020). Signs and symptoms to determine if a patient presenting in primary care or hospital outpatient settings has COVID-19 disease. *Cochrane Database Syst Rev*; 7:CD013665.
- Sundaram ME, Coleman LA. (2012). Vitamin D and influenza. *Adv Nutr.*; 3:517–25.

- Tong JY, Wong A, Zhu D, et al. (2020). The Prevalence of Olfactory and Gustatory Dysfunction in COVID-19 Patients: A Systematic Review and Meta-analysis. *Otolaryngol Head Neck Surg*; 163:3.
- Toscano G, Palmerini F, Ravaglia S, et al. (2020). Guillain-Barré Syndrome Associated with SARS-CoV-2. *N Engl J Med*; 382:2574.
- US CDC. (2019). Coronavirus disease 2019 (COVID 19). People with Certain Medical Conditions.
- van den Borst B, Peters JB, Brink M, et al. (2020). Comprehensive health assessment three months after recovery from acute COVID-19. *Clin Infect Dis*.
- Varga Z, Flammer AJ, Steiger P, Haberecker M, Andermatt R, Zinkernagel AS, Mehra MR, Schuepbach RA, Ruschitzka F, Moch H. (2020). Endothelial cell infection and endotheliitis in COVID-19.; 395: 1417-1418
- Verity R, Okell LC, Dorigatti I, et al. (2020). Estimates of the severity of coronavirus disease 2019: a model-based analysis. *Lancet Infect Dis*; 20:669.
- Verity R, Okell LC, Dorigatti I, Winskill P, Whittaker C, et al. (2020) Estimates of the severity of coronavirus disease 2019: A model-based analysis. *Lancet Infect Dis* 20: 669-677
- Verma AA, Hora T, Jung HY, et al. (2021). Characteristics and outcomes of hospital admissions for COVID-19 and influenza in the Toronto area. *CMAJ*; 193: E410.
- Viboud C, Simonsen L, Fuentes R, Flores J, Miller M-A, Chowell G (2016). Global mortality impact of the 1957-1959 influenza pandemic. *J Infect Dis*, 213, pp. 738-745
- Wang D, Hu B, Hu C, et al. (2019). Clinical Characteristics of 138 Hospitalized Patients with Novel Coronavirus–Infected Pneumonia in Wuhan, China. *JAMA*. Published online February.
- Wang D, Hu B, Hu C, et al. (2020). Clinical Characteristics of 138 Hospitalized Patients with 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. *JAMA*; 323:1061
- Wang D, Hu B, Hu C, et al. (2020). Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected Pneumonia in Wuhan, China *JAMA*. ;323(11):1061–1069. doi:10.1001/jama.1585
- Wang W, Tang J, Wei F. (2020). Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China. *J Med Virol*; 92: 441–447.
- Wang Y, Liu Y, Liu L, et al. (2020). Clinical Outcomes in 55 Patients with Severe Acute Respiratory Syndrome Coronavirus 2 Who Were Asymptomatic at Hospital Admission in Shenzhen, China. *J Infect Dis*; 221:1770.
- Wang Z, Chen Z, Zhang L, Wang X, Hao G, Zhang Z, et al. (2018). Status of hypertension in China: results from the China Hypertension Survey, *Circulation*.; 137: 2344-2356.
- WHO Trial Registry Network (2020). <https://clinicaltrials.gov/ct2/results?cond=COVID-19+vitamin+D>
- Williamson EJ, Walker AJ, Bhaskaran K, et al. (2020). Factors associated with COVID-19-related death using OpenSAFELY. *Nature*; 584:430.
- Wong HYF, Lam HYS, Fong AH, et al. (2020). Frequency and Distribution of Chest Radiographic Findings in Patients Positive for COVID-19. *Radiology*; 296: E72.
- Wong RS, Wu A, To KF, Lee N, Lam CW, Wong CK, et al. (2003). Hematological manifestations in patients with severe acute respiratory syndrome: retrospective analysis. *BMJ*.;326(7403):1358–62.
- Woolf SH, Chapman DA, Sabo RT, Zimmerman EB. (2021). Excess Deaths from COVID-19 and Other Causes in the US, March 1, 2020, to January 2, 2021. *JAMA*.
- Wu C, Chen X, Cai Y, et al. (2020). Risk Factors Associated with Acute Respiratory Distress Syndrome and Death in Patients with Coronavirus Disease 2019 Pneumonia in Wuhan, China. *JAMA Intern Med* 2020; 180:934.
- Wu F, Zhao S, Yu B, Chen Y-M, Wang W, Song Z-G, et al. (2020). A new coronavirus associated with human respiratory disease in China *Nature*, 579 (2020), pp. 265-269
- Wu Z, McGoogan JM (2020). Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: Summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *JAMA*.

- Wu Z, McGoogan JM. (2020). Characteristics of and Important Lessons from the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases from the Chinese Center for Disease Control and Prevention. *JAMA*; 323:1239.
- Xu J, Zhao S, Teng T, Abdalla AE, Zhu W, Xie L, et al. (2020). Systematic comparison of two animal-to-human transmitted human coronaviruses: SARS-CoV-2 and SARS-CoV. *Viruses*. <https://doi.org/10.3390/v12020244>. pii: E244.
- Xue Za Zhi (2020). Epidemiology Working Group for NCIP Epidemic Response, Chinese Center for Disease Control and Prevention. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases
- Yang X, Yu Y, Xu J, et al. (2020). Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. *Lancet Respir Med*; 8:475.
- Yang X, Yu Y, Xu J, Shu H, Xia J, et al. (2020) Clinical course and outcomes of critically ill patients with SARSCoV-2 pneumonia in Wuhan, China: A single-centered, retrospective, observational study. *Lancet Respir Med* 8: 475-481.
- Yao TT, Qian JD, Zhu WY, Wang Y, Wang GQ. (2020). A systematic review of lopinavir therapy for SARS coronavirus and MERS coronavirus possible reference for coronavirus disease-19 treatment option. *J Med Virol* <https://doi.org/10.1002/jmv.25729>.
- Yao Y, Cao J, Wang Q, Shi Q, Liu K, Luo Z, et al. (2020). D-dimer as a biomarker for disease severity and mortality in COVID-19 patients: a case control study. *J Intensive Care.*; 8: 49.
- Yilmaz A, Marklund E, Andersson M, et al. (2021). Upper Respiratory Tract Levels of Severe Acute Respiratory Syndrome Coronavirus 2 RNA and Duration of Viral RNA Shedding Do Not Differ Between Patients with Mild and Severe/Critical Coronavirus Disease 2019. *J Infect Dis.* ; 223:15.
- Youm YH, Kanneganti TD, Vandanmagsar B, Zhu X, Ravussin A, Adijiang A, Owen JS, Thomas MJ, Francis J, Parks JS, Dixit VD. (2012). The Nlrp3 inflammasome promotes age-related thymic demise and immunosenescence. *Cell Rep.* ; 1:56–68.
- Yu B, Li X, Chen J, Ouyang M, Zhang H, et al. (2020). Evaluation of variation in D-dimer levels among COVID-19 and bacterial pneumonia: a retrospective analysis. *J Thromb Thrombolysis.*; 1-10.
- Zayet S, Kadiane-Oussou NJ, Lepiller Q, et al. (2020). Clinical features of COVID-19 and influenza: a comparative study on Nord Franche-Comte cluster. *Microbes Infect*; 22:481.
- Zhang Y, Xiao M, Zhang S, et al. (2020). Coagulopathy and Antiphospholipid Antibodies in Patients with Covid-19. *N Engl J Med*; 382: e38.
- Zheng HY, Zhang M, Yang CX, Zhang N, Wang XC, Yang XP, Dong XQ, Zheng YT. (2020). Elevated exhaustion levels and reduced functional diversity of T cells in peripheral blood may predict severe progression in COVID-19 patients. *Cell Mol Immunol.*; 17:541–43.
- Zhonghua Liu Xing Bing Xue Za Zhi (2020). The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. 41: 145-151.
- Zhou F, Yu T, Du R, et al. (2020). Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study.; 395: 1054–1062.
- Zhou P, Yang XL, Wang XG, Hu B, Zhang L, Zhang W, Si HR, Zhu Y, Li B, Huang CL, Chen HD, Chen J, Luo Y, et al. (2020). A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature.*; 579:270–73.
- Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. (2020). A novel coronavirus from patients with pneumonia in China, 2019 *N Engl J Med*, 382 (2020), pp. 727-733
- Zumla A, Chan JF, Azhar EI, Hui DS, Yuen KY. (2016). Coronaviruses – drug discovery and therapeutic options. *Nat Rev Drug Discov.* (5):327–47.
- Zuo MZ, Huang YG, Ma WH, Xue ZG, Zhang JQ, Gong YH, et al. (2020). Expert recommendations for tracheal intubation in critically ill patients with noval coronavirus disease 2019. <https://doi.org/10.24920/003724>

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The ATV – UTV Stress and Strain Survey: A Pilot Study

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KEYWORDS

ATV
UTV
Stress
Strain

ABSTRACT

All-terrain vehicles (ATVs) and utility terrain vehicles (UTV or side-by-sides) are used in many industries for their versatility. The agriculture sector is a frequent user, giving operators the ability to access lands that would otherwise be inaccessible other than by foot or horseback. Operating ATVs and UTVs have been associated with injuries and fatalities due to rollovers, collisions, and loss of control (LOC) events. Experts have reported that ATV hazards are due to vehicle design, reduced safety features, high center of gravity, and a short wheelbase that compromise overall vehicle stability. The Montana Weed Control Association (MWCA) is a statewide organization where members frequently use both vehicles on the job. Investigators developed a pilot study to identify stress and strains that may influence a riders' ability to control and safely operate their ATV or UTV. A 20-question online survey was completed by 54 MWCA members for a 30% response rate. Researchers found that upper extremities and the back were common areas of fatigue. ATV riders reported more fatigue in the legs compared to UTV drivers. The legs were another common site for pain, followed by the buttock and thighs. One-half of UTV drivers reported no pain. Of those subjects reporting vehicle related pain, 35% reported the head and neck were the most common areas. This pilot study provides essential subjective reporting of stress and strain that can be followed up with future research to measure and evaluate stress and strain associated with ATV and UTV use.

1. INTRODUCTION AND BACKGROUND

The ATV Safety Institute (ASI) estimated that more than 11 million Off-Highway Vehicles (OHVs) were used by 35 million Americans for both recreation (78%) and work (22%) (ASI, 2018). The most popular OHVs are ATVs and UTVs. While these vehicles are used by many people and fulfill multiple purposes, they are not without risk (Neves et al., 2018). The Consumer Product Safety Commission (CPSC) reported that there were 2,258 total deaths involving OHVs between the years 2015-2017 and more than 15,000 deaths since 1982 (2020). In addition to the loss of life, there are an estimated 400,000 injuries per year with approximately 100,000 who seek medical care at emergency room departments in hospitals across the United States (US) (CPSC, 2020). The

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accidents and deaths of agricultural ATV-related accidents have been fairly well studied (Fawcett et al., 2016; Gilkey, 2019; Neves et al., 2018).

In the US, ATV related fatalities make up less than one-percent of all occupational fatalities (Helmkamp, Marsh and Aiken, 2011). However, the expanding use and popularity of ATVs in agriculture and other industries have led to a 300% increase in occupational related fatalities between 1992 and 2007 (Helmkamp, Marsh and Aiken, 2011). It was estimated that 65% of all ATV worker-related fatalities occurred in the agricultural sector (Helmkamp et al., 2012). In a review of workers' compensation claims in Montana from 2007 through 2012, it was found that the agricultural sector comprised of 59% of all claims with another business 15 sectors reporting claims as well (Lagerstrom et al., 2015). The accidents and injuries related to OHVs are not limited to the US. For example, in New Zealand, Quadbike (ATV)-related fatalities accounted for between 8% to 19% of all work-related fatalities (Shulruf & Balemi, 2010). Liddle et al. (2020) reported that approximately 1,500 Australian ATV users visit emergency rooms each year due to accidents and resulting injuries with approximately 10 – 15 deaths. In Sweden, investigators reported a threefold increase in the number of fatalities when comparing time intervals from 2003-2007 to 2013-2017 (Edlund et al., 2020).

Known risk factors for LOC events and/or accidents included going too fast, terrain slope (going up, down, or across hills), turning too sharp, carrying a passenger, and riding or driving on paved roads (Gilkey, 2019; Gilkey and Brazile, 2021). Despite these known risk factors, there has been little research carried out to identify and/or measure physical and/or mental stresses associated with operating ATVs and UTVs that could play a role in LOC events. Investigators have looked at ATV related whole-body vibration (WBV) and mechanical shock associated with back pain (Essien et al., 2016). Another study investigated body pain associated with ATV use by looking at New Zealand farmers (Milosavljevic et al., 2010). Researchers found lower back pain was the most common complaint being reported by 67% of the farm ATV riders. Neck pain was the second most common pain affecting 42% of users followed by upper back pain afflicting 25%. Study subjects reported persistent pain up to 12 months after the farmers' lambing season (Milosavljevic et al., 2010). It should be noted, 95% of the ATV and UTV accidents in Australia and New Zealand involved older working populations, whereas in the US, the majority of accidents occur among younger populations (Carman et al. 2010; Goldcamp et al., 2006; Moroney et al., 2003). We believe that further investigation is needed to evaluate stresses and strains among user populations with varied capabilities that may play a role in LOCs and accidents.

A literature review looking at ATV use in agriculture concluded that minimal research has been done to explore riders' interactive risk associated with ATVs and LOC events (Neves et al., 2018). Previous research focused on evaluating risk factors of LOC events, accidents, injuries, and fatalities. The leading cause of fatality during a LOC event has been not wearing a helmet (Lagerstrom et al., 2016). This pilot study was developed to identify rider perceived stress and strain associated with ATV and/or UTV use among a group of frequent OHV users in Montana.

The pilot study aims were to 1) identify and characterize ATV and UTV users within MWCA, 2) identify and distinguish basic patterns among this group of agricultural workers, and 3) identify and describe physical and/or mental stresses and strains associated with vehicle use. The primary study hypothesis was that parameters of stress and strain would not vary by gender, age, or vehicle type. To accomplish this, the investigators partnered with MWCA. The MWCA is an organization that serves all 56 count of the state and primarily uses ATVs and UTVs for herbicide application. The MWCA consists of more than 700 members distributed across seven regions of Montana serving all 56 counties.

2. METHODS

A 20-question anonymous survey was developed to investigate perceptions of stress and strain among MWCA ATV and UTV users. The survey was approved by the Institutional Review Board (IRB) at the university. Nine of the questions were structured as statements with respondents reporting their perceived levels of agreement using a Likert scale; 1 = highly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = highly agree (Likert, 1932). Descriptive questions comprised of seven items looking at gender, age, vehicle type, average hours operated in a week, vehicle modifications, seasons, and terrain type. Health and mental stresses were investigated using four questions in the form of statements, how they would rate their general health, ability to easily evaluate the landscape, reaction time, and balance control. Stress and strain responses were investigated using questions about fatigue and pain associated with specific body parts and/or activities. Researchers entered the survey in to the online data collection tool Qualtrics. The MWCA distributed the survey link through email and by phone to primary supervisors throughout the state. Raw data were downloaded in Microsoft Excel, aggregated, and moved to Minitab Statistical Package 20.4 for analysis. Descriptive statistics and frequencies were generated using Minitab. Associations between variables were investigated using non-parametric Chi-square statistical test and general linear model (GLM).

3. RESULTS

The pilot study survey resulted in 54 responses over a one-month period. While there were 54 responses not every respondent answered every question. The link connected respondents to the Qualtrics site for survey completion. The survey did not reach the 700+ members of MWCA and only went to 181 members for a 30% response rate. Spraying weeds accounted for 85% of tasks in which respondents participated using the ATV and/or UTV (Table 1). Ninety-four percent of the participants were classified into the 46 to 65-year age group. Males comprised 65% of respondents and most users operated both types of vehicles (Table 1). ATV and UTV users reported that the majority of their vehicle operations required that they ride or drive on off-road brush or dirt and gravel surfaces 78% and 80% respectively (Table 1).

There was a considerable agreement with most questions asked with an overall mean score of 3.9 (Table 2). Only one question had a low mean score of 2.0 pertaining to wearing a helmet (Table 2). The survey participants agreed or highly agreed that they could survey the landscape while traveling (mean score 4.4), maintained their balance (mean score 4.4), had enough strength to maintain control of their vehicle (mean score 4.5), and were able to shift their weight when making turns (mean score 4.5) (Table 2).

The overall mean scores for pain and fatigue associated with both ATV and UTV were 3.3 and 3.5 respectively (Table 3). Fatigue wasn't felt on an average day by 65% riders whereas, approximately 30% reported experiencing some fatigue and 35.3% reported pain (Table 3).

Table 1 – ATV and UTV Rider Characteristics and Use Patterns

Variable	Characteristics	Frequency (n)	Percent
Gender	Male	34	65%
	Female	18	35%
Age (yrs)	18 - 24	2	4%
	25 - 35	7	13%
	36 - 45	9	17%
	46 - 55	13	24%
	56 - 65	20	37%
	More than 65	3	6%
What do you normally ride ATV or UTV (side-by-side or ROV) or Both?	ATV	13	25%
	UTV (side-by-side or ROV)	15	29%
	Both	24	46%
On average, how many hours do you ride in a week?	<=10	30	59%
	11 to 20	6	12%
	21 to 30	8	16%
	31+	7	14%
Has your vehicle been modified for any of these tasks?	Spraying weeds	46	85%
	Building/maintaining fence	9	17%
	Plow/blade snow	10	19%
	Irrigation work	8	15%
	Moving animals	5	9%
Surfaces the you normally travel	Paved road	19	35%
	Dirt/gravel road	43	80%
	Brush off-road	42	78%
	Hill 30-45 % Grade	30	56%
What seasons do you use your ATV/UTV? select all that apply	Spring	50	93%
	Summer	51	94%
	Fall	45	83%
	Winter	23	43%

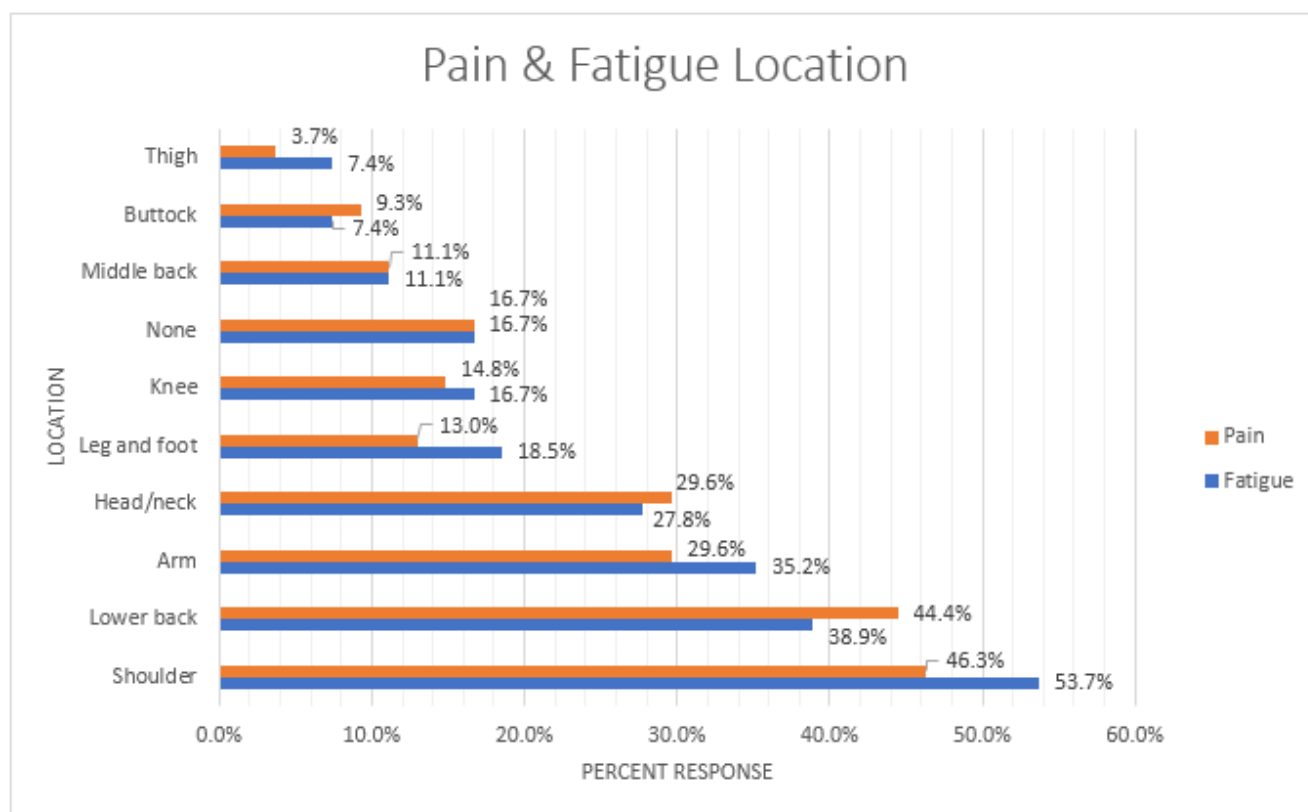
Table 2 – Mean Scores for Select Questions

Statements	N	Mean Score	95% CI
I always wear a helmet when riding?	53	2.0	1.62 - 2.42
How would you rate your general health?	54	4.3	4.09 - 4.43
How would you rate your reaction time?	53	4.1	3.94 - 4.32
I easily evaluate the landscape on which I am traveling across?	51	4.4	4.12 - 4.66
I easily maintain my balance?	53	4.4	4.11 - 4.61
When mounting or dismounting my UTV/ATV, I rarely find it fatiguing?	52	3.8	3.42 - 4.23
I always have enough strength to maintain control of my vehicle?	52	4.5	4.23 - 4.74
I never have numbness/tingling in my hands or fingers after riding?	51	3.5	3.12 - 3.98
When making turns, I find it easy to shift my weight?	53	4.5	4.32 - 4.73

Table 3 –Fatigue and Pain on Average Day

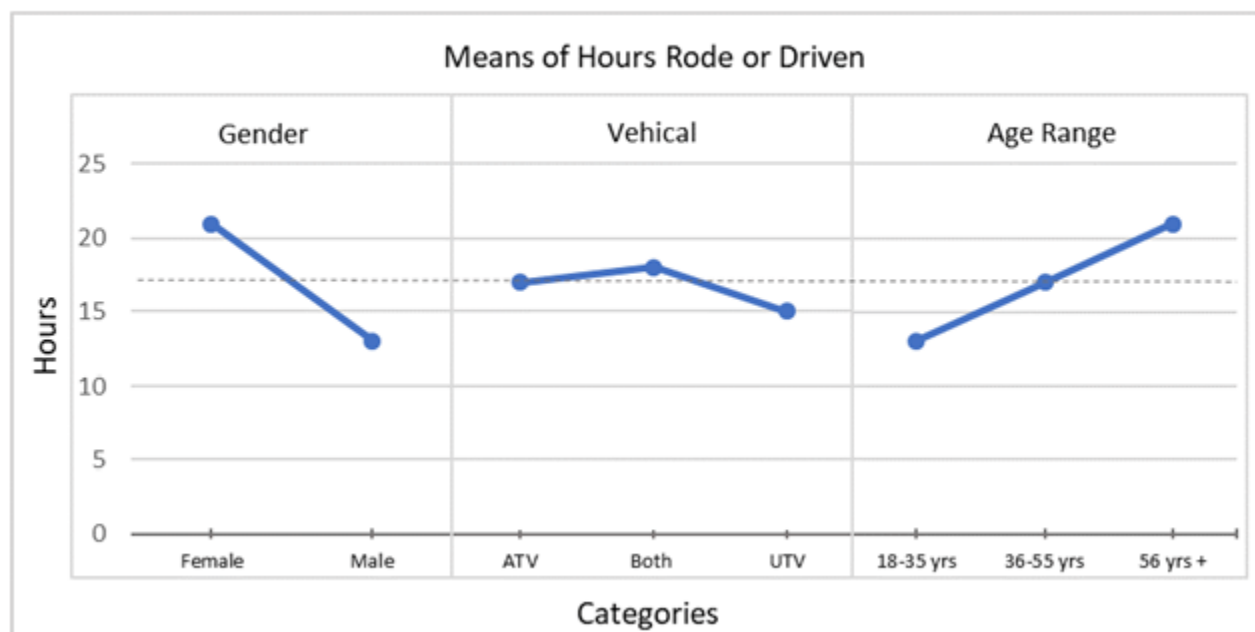
Strongly Disagree	Somewhat Disagree	Neither agree nor Disagree	Somewhat Agree	Strongly Agree
When riding on an average day I feel NO fatigue?				
5	10	3	24	10
9.6%	19.2%	5.8%	46.2%	19.2%
Mean: 3.5			95% CI 2.19 - 4.74	
When riding on an average day I feel NO pain?				
5	13	5	16	12
9.8%	25.5%	9.8%	31.4%	23.5%
Mean: 3.3			95% CI 1.98 - 4.70	

Pain and fatigue were similar for shoulder and lower back, 43% and 47% respectively, and they were the most reported specific body areas were affected (Figure 1). The differences reported between operators' pain and fatigue were seen in legs, feet, arms, lower back, and shoulders at 5.5%, 5.6%, 5.5%, and 7.4% respectively (Figure 1).

Figure 1 – Pain and Fatigue Location

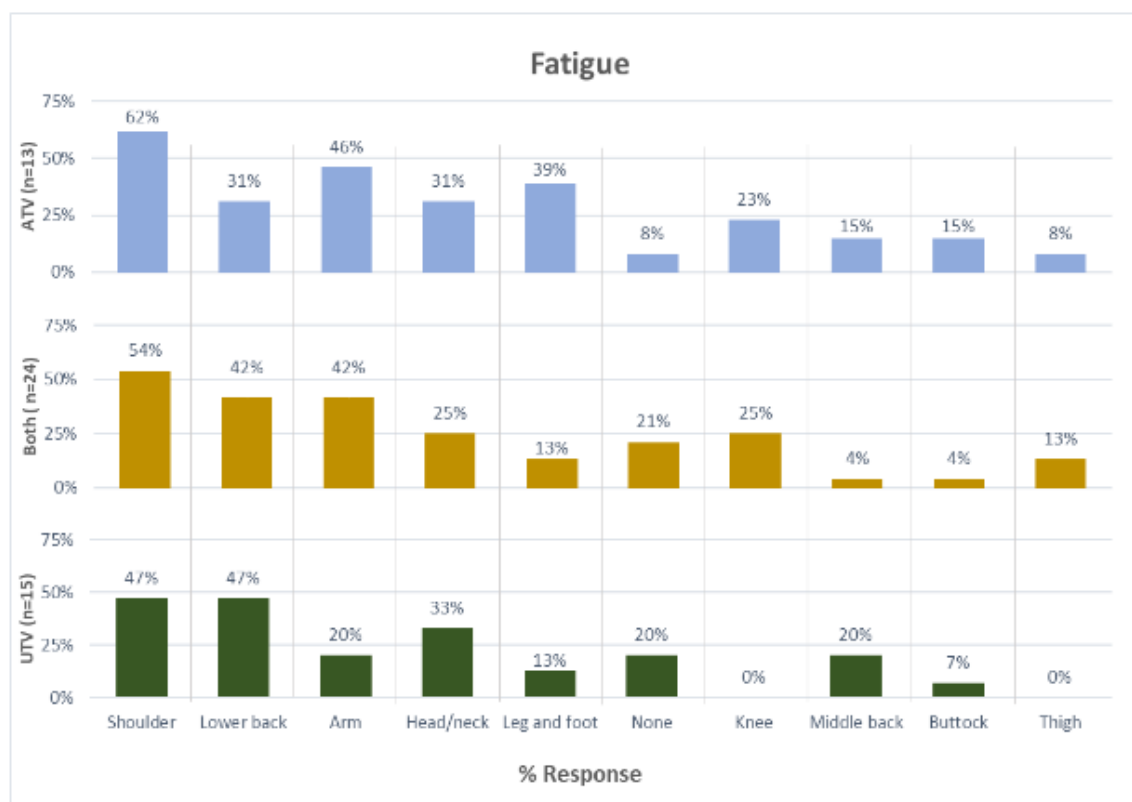
The mean hours of vehicle operation for females were 21.0 hours whereas males were 12.7 hours (Figure 2) however, 59% reported less than 10 hours per week vehicle use (Table 1). As the participants increased in age, their hours of vehicle use also increased to a maximum of 20.5 hours (Figure 2).

Figure 2 – Hours of Operation by Vehical Type, Gender, and Age



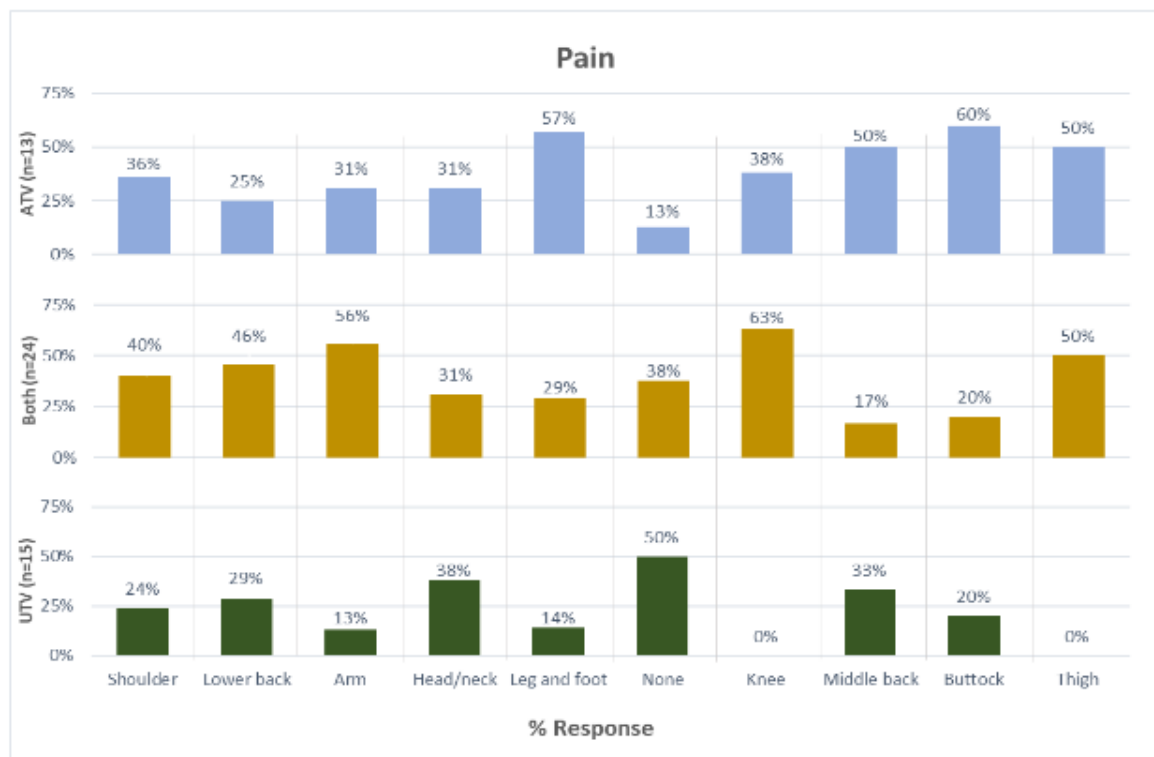
The areas of the body most frequently reported to experience fatigue were in the shoulder and lower back for both vehicles (Figure 3). Fatigue patterns overall seem to be similar for both ATVs and UTVs. Use of the ATVs had the highest upper extremity fatigues in the shoulder and arm 62% and 46% respectively compared to UTVs (Figure 3). UTV drivers reported no knee fatigue yet nearly a quarter of ATV riders did report fatigue in the knees.

Figure 3 – Fatigue by Specific Body Location and Vehicle Type



The pain by location was quite different compared to the fatigue (Figure 3 vs Figure 4). ATV riders reported the most frequent pain in the legs, feet, and buttocks (Figure 4). UTV riders appear to experience less pain overall with none reported in knees and thighs (figure 4). UTV drivers reported a slightly higher frequency of neck pain than ATV riders 38% and 33% respectively (Figure 4). Half of the UTV users reported no pain in contrast to 87% of ATV users reporting wide distribution of pain (figure 4).

Figure 4 - Pain by Specific Body Location and Vehicle Type



4. DISCUSSION

This pilot study yielded insight into perceived stresses and strains associated with operating both ATVs and UTVs. The primary study hypothesis was that parameters of stress and strain would not vary by gender, age, or vehicle type. We reject that hypothesis because there was variability in reported fatigue and pain patterns. Associations of genders, age and vehicle type were to pain and fatigue were not statistically significant ($p\text{-value} > 0.05$) however, descriptive analysis clearly showed a higher frequency of pain among ATV users in comparison to UTV users (Figure 4). ATV operation appears to have greater stress and strain associated with use. ATV operators reported a similar pattern of fatigue but more pain. The ATV riders reported pain affecting all areas identified (Figure 4). A proposed explainer theory suggests ATVs are more physically demanding to operate compared to UTVs. ATVs are uniquely designed with a straddle seat, motorcycle-like handlebars, hand controls, and low inflation tires whereas, UTVs are designed more like the automobile with a bucket seat, steering wheel, foot controls, and roll-cage for added safety (Gilkey, 2019). The UTV is generally heavier, wider, and lower to the ground resulting in a lower center of gravity, increased stability, and safety (Gilkey, 2019). The interactive risk associated with ATVs requires that riders exert more effort, stand frequently, and shift their weight to maintain control of the vehicle especially when turning, riding up, down, or across hills. The ATV is smaller, designed for one person, and inherently less stable because of its narrower wheelbase and higher center of gravity (Gilkey, 2019).

The MWCA is a unique agriculture organization with members that use ATVs and UTVs frequently, more so in the spring, summer, and fall. Spraying weeds using ATVs or UTVs in Montana and/or elsewhere consists of modifying the vehicle to hold fluid-filled tanks to carry herbicide. The operator rides along roadways and property lines spraying herbicides. The added tanks when filled with liquid raise the ATVs or UTVs center of gravity thus requiring more strength and body movement to control the vehicle. The higher stress and strain are concerning when a fatal outcome from a LOC and crash is 3.9 times higher on an ATV carrying a liquid load such as a herbicide tank (Shulruf & Balemi, 2010).

The relationship between the number of reported fatigue locations and the vehicle type or gender were evaluated using a Chi-square and GLM. The results of this evaluation resulted in p-values greater than 0.05, statistically insignificant. The relationship between the number of reported pain locations and the vehicle/gender using the same GLM resulted in a similar p-value > 0.05. The low number of responses resulted in a poor goodness of fit in the model. Even though statistically, there were no significant relationships seen between fatigue or pain and vehicle operated or gender, there were higher frequencies of responses related to fatigue and pain in certain body locations (Figures 3 and 4). Figure 3 shows about half of the respondents indicated shoulders and lower back were the most common area of complaint for both ATV and UTV operation, this was consistent with prior investigation (Milosavljevic et al., 2010). These findings suggest that future research is warranted looking at how a tank-equipped vehicle affects the arm and back muscle activation. It is also noted from personal experience riding ATVs and spraying weeds, stress is greater on the upper extremity because one arm must hold the spray wand with one hand and driving with the opposite hand. The net effect is greater fatigue and pain from sustained static loading.

The age distribution was consistent with the group of MWCA personnel that were regional supervisors who completed the survey. There were very few young people, 4% < 24 years and only 3% that reported being older than 65 years that completed the survey. A study was completed in Australia that revealed that the number of fatal incidents on ATVs increases with age but decreases after age 65 (Fragar et al., 2007). This was also shown in the CPSC report where the age group 55+ had about double the off-highway fatalities in contrast to the 16-24 age group (2020). The LOC hazards of operating ATVs are strongly correlated with human behavior because of the interactive risk associated with vehicle control. Training on vehicle operation and risk control is offered by the ASI and Recreational Off-Highway Vehicle Association (ROHVA) and strongly suggested for those with careers requiring ATV and/or UTV use on the job (ASI, 2021; ROHVA, 2021; Shulruf & Balemi, 2010).

5. CONCLUSION

It appears that there is a relationship between ATV and/or UTV use and perceived stress and strain in the arms and lower back and other areas of the body. This pilot study focused on identifying regions of the body experiencing stress and strains. Multiple regions of the body were identified with differences between vehicle types. The results of this pilot study provide a basis for further research investigating, measuring, and evaluating the stresses in the arm, legs, and back when performing specific tasks such as spraying weeds. The trends in use of ATVs and UTVs in occupational settings will likely increase as more industries find applications for the units. The hope is further research may lead to a deeper understanding of human behavior and interactive risk so that prevention strategies can be developed and implemented driving down the numbers of LOC events and resulting injuries and fatalities.

REFERENCES

- ATV Safety Institute (ASI). (2018). Industry background. Retrieved from <https://atvsafety.org/wp-content/uploads/2018/03/ASI-ATV-Tips-Guide-2018.pdf>.
- ATV Safety Institute (ASI). (2021). Hands on ATV training courses. <https://atvsafety.org/atv-ridercourse/>.
- Carman, A. B., Gillespie, S., Jones, K., Mackay, J., Wallis, G., & Milosavljevic, S. (2010). All-terrain vehicle loss of control events in agriculture: Contribution of Pitch, roll and Velocity. *Ergonomics*, 53(1), 18–29. <https://doi.org/10.1080/00140130903380919>
- Edlund, B., Lindroos, O., & Nordfjell, T. (2020). The effect of rollover protection systems and trailers on quad bike stability. *International Journal of Forest Engineering*, 31(2), 95-105.
- Essien, S. K., Bath, B., Koehncke, N., Trask, C., & Saskatchewan Farm Injury Cohort Study Team. (2016). Association between farm machinery operation and low back disorder in farmers: a retrospective cohort study. *Journal of occupational and environmental medicine*, 58(6), e212-e217
- Fawcett, V., Tsang, B., Taheri, A., Belton, K., & Widder, S. (2016). A review on All Terrain Vehicle Safety. *Safety*, 2(2), 15. <https://doi.org/10.3390/safety2020015>
- Fragar, L., Pollock, K., Morton, C., 2007. ATV Injury on Australian Farms: The Facts—2007 (No. 07/149). University of Sydney, Sydney, Australia.
- Gilkey, D. (2019). ROV safety: epidemiology, risks, hazards, interventions and trends. *World Safety Journal*, ISSN 1015-5589 Vol. XXVIII No.3, 8-12.
- Gilkey, D. and Brazile, B. (2021). Snowmobile and All Terrain Safety. In: Vickerman, Roger (Eds.) *International Encyclopedia of Transportation*. Vol 2, pp. 77-84. UK: Elsevier Ltd.
- Helmkamp, J., Biddle, E., Marsh, S., Campbell, C. (2012). The economics burden of All-Terrain vehicle related adult deaths in the U.S. workplace, 2003-2006. *Journal of Agricultural Safety and Health*, 18(3): 233-243. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4625379/>.
- Helmkamp, J., Marsh, S. and Aiken. (2011). Occupational all-terrain vehicle deaths among workers 18 years and older in the United States, 1992 – 2007. *Journal of Agriculture Safety and Health*, 17(2), 147-155.
- Lagerstrom, E., Gilkey, D., Elenbaas, D., Rosecrance, J. (2015). ATV-related injuries in Montana 2005-2012. Special Issue - All-Terrain (ATVs, Quad Bikes) and Off-Highway (ROVs, UTVs, SSVs, LSVs, LUVs, MUVs, XUVs) *Safety*, 1(1), 59-70; doi:10.3390/safety1010059.
- Lagerstrom, E., Gilkey, D., Magzamen, S., Stallones, L., and Rosecrance, J. (2016). Understanding risk factor patterns in ATV fatalities: A recursive partitioning approach. *Journal of Safety Research*, 59, 23-31.
- Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology*, 22 140, 55. (https://legacy.voteview.com/pdf/Likert_1932.pdf)
- Milosavljevic, S., Bergman, F., Rehn, B., & Carman, A. B. (2010). All-terrain vehicle use in agriculture: Exposure to whole body vibration and mechanical shock. *Applied Ergonomics*, 41(4), 530–535. <https://doi.org/10.1016/j.apergo.2009.11.002>
- Neves, H., Brazile, W., & Gilkey, D. P. (2018). ATVs and agriculture: A review of the literature. *Acta Sci Agric*, 2, 178-194.
- Recreational Off-Highway Vehicle Association (ROHVA). (2021). ROV basic driver course. <https://rohva.org/learn-to-drive/>.
- Shulruf, B., & Balemi, A. (2010). Risk and preventive factors for fatalities in all-terrain vehicle accidents in New Zealand. *Accident Analysis & Prevention*, 42(2), 612–618. <https://doi.org/10.1016/j.aap.2009.10.007>
- Topping, J. (2020). (rep.). 2020 Report of Deaths and Injuries Involving Off-Highway Vehicles with More than Two Wheels (pp. 3–5). Bethesda, MD: U.S. Consumer Product Safety Commission.



World Safety Journal

A peer-reviewed journal,
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Journal Homepage:
<https://worldsafety.org/wso-world-safety-journal/>



Behavioral Economics of Safety Culture Management in Companies

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KEYWORDS

Behavior
Safety
Culture
BBS
Management
Companies
Economics
India

ABSTRACT

Most businesses are more concerned with making money and increasing profits than with ensuring the safety of their workers. Why do business leaders and employers refuse to invest in safety culture, as though they are unconcerned or unresponsive to risky work practices that result in disasters, incidents, family pain, and long-term consequences? They are probably unaware that the benefits of implementing safety in any company, large or small, far outweigh the financial benefits of not doing so.

1. INTRODUCTION

Profits should not be made at the expense of the health and safety of employees. Paul O'Neill saw that safety is an opportunity to boost profit and productivity while lowering medical and compensation costs and improving the bottom line (Berthold, 2016). Reduced lost employee hours, hospital costs, sick leave, pollution costs, property damages, and insurance premiums are all benefits of a safe work environment, all of which lead to higher productivity (Ekenedo, 2013).

Over the years, it has been debated whether willful violations of systems rules and procedures can be explained by system designers and managers failing to follow some behavioral economics propositions: firstly, unclear rules; secondly, delayed or ambiguous feedback; and thirdly, conflicts between high and low-level safety commitments (Battmann and Klumb, 1993).

Organizational safety culture management is heavily influenced by behavioral economics. The theoretical underpinning of safety culture is that it represents how people think and behave in connection to safety; it is a proactive method for enhancing occupational safety by focusing on the company's safety systems and its people's safe behaviors. The term "safety culture" has several definitions (Vu & De Cieri, 2014). Employee perceptions, attitudes toward organizational safety goals, everyday safe behavior, and the company's safety mechanisms to support safe behavior are all represented in the existing safety culture, according to the American Petroleum Institute (2015). (Cooper, 2018).

According to the Journal of Accounting and Economics, U.S. company executives, under market pressure to fulfill profitability expectations, may put workers' health and safety at risk in order to please investors (Smith, 2017). More than forty standards dealing with occupational safety and health have been adopted by the ILO, providing tools for governments, businesses, and workers to set procedures

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that ensure optimal workplace safety. However, the reality for millions of workers is quite different (ILO, 2021). Behavioral economics can help us discover solutions to regulate or ethically influence organizational biases and cognitive limitations, in order to help create company value (Deloitte, 2021). According to the ILO (2021b), health and safety management is an essential part of running a company to ensure that dangers and risks cannot harm employees.

This study examined the role of behavioral economics in safety management in order to create more lucrative judgments by analyzing potential concerns with at-risk behavior perception.

2. LITERATURE REVIEW

The economic benefits of health and safety management are enormous, with a return of 2.2 Euros for every Euro invested in OSH (Tanya, 2021). According to recent studies, it is behavioral economics 'money' that provides the solution, as well as actionable insights for employers and governments as they bargain between safety management and profits (Jaggi, 2021). Behavioral science insights can help firms better understand how they make financial decisions related to health, safety, and the environment (HSE). As a result, behavioral economics is critical to a company's long-term safety culture implementation (Dash, 2020).

Behavioral economics refers to the economic decision-making processes of individuals and institutions (Academy 4SC, 2021). Safety culture is about the values, beliefs, norms, practices, competencies and behaviors of an organization in relation to HSE. (Drummond and Pietikainen, 2021). International studies on the return on investment in prevention show that every unit invested in safety and health generates a potential benefit of more than two units of positive economic effects. The improvement of safety and health protection in the company does not necessarily mean an increase in expenditure (DGUV, 2021).

The Covid-19 situation underlines the importance of the balance between economy and health, taking into account the interactions between safety and microeconomics, in order to support this type of decision-making in the sense of a cost-benefit analysis and profitability analysis in safety culture management (Chao et al., 2021). The Covid-19 pandemic has shown how important occupational safety and health protection are for protecting the health of employees, for the smooth functioning of our societies, and for economic and social action. The European Commission renews its commitment to update health and safety at work by adopting the EU Strategic Framework for Health and Safety at Work 2021-2027; it set out the measures needed to improve the health and safety of workers over the next few years (European Commission, 2021).

3. RESEARCH METHODOLOGY

Research has shown that the behavioral economics of safety culture management is a relevant, critical and important concern for companies. With that in mind, it was a good idea to examine various findings from field workers, especially during the Covid-19 pandemic when economic security issues were a real concern. Both primary data (interviews, discussions) and secondary data (incident and accident rates) were collected. Interviews based on open-ended questions and personal in-depth discussions with 309 HSE, medical, educational, management and psychiatric professionals were conducted over a time period of two months (from June to July 2021) using remote data collection techniques from various locations and organizations in India. The non-random convenience, as well as snowball sampling techniques, were used to collect the relevant data. The participants were selected from the researcher's contact list and invited via WhatsApp and email to take part in the online survey.

4. DATA COLLECTION AND ANALYSIS

A key element of this research was data collection, which was carried out by means of controlled interviews and questionnaire surveys. A total of 500 people participated in this study, 309 of whom completed a field-of-action survey with the researcher. These research participants had introduced a behavioral safety culture in their workplaces. The research participants involved CEOs, directors, managers, department heads and security professionals from public and private industrial sectors, including chemicals, construction, gas, energy and steel.

Roughly 84% of the study participants said that they did not support a zero-harm policy. Almost 90% of the study participants felt that the main reasons why Indian companies are unwilling to spend on safety are: ignorance, cost, wrong regulation, abuse of regulation, and the reluctance of workers. The study participants noted that behavior and safety are positively correlated, and that when doing root-cause analysis, the underlying cause of safety implementation is people's behavior. The study participants (about 78%) also noted that increased involvement in safety awareness reflects a good safety culture.

The greatest challenge in the implementation of the behavioral safety culture program is the involvement of all employees, including contract employees, which is only possible when the fear of making punctual corrections to endangered behavior at the workplace has been removed from the minds. In other words, the approval of every employee is paramount to a successful implementation. This can be demonstrated by department heads and other senior leadership teams through visible actions that strengthen safe behavior and reduce risk behavior (Cooper, 2020). Employees should be encouraged to report any risky behavior openly and without fear, using the 'no-fault, no mistake, no name's method with the main objective of correcting behavior on the ground in order to reduce the risk of accidents or incidents, as suggested by 86% of the study participants.

The principle of positive safety culture management ensures that companies generate sustainable profits. Eight-eight percent of the study participants believed that a strong safety culture ensured that everyone is empowered, responsible for safety, and pursues safety on a daily basis by making punctual corrections of unsafe behavior without fear, with the primary goal of Zero Harm for everyone. The study participants feel that when an employee is valued, heard and really cared for, his or her attitude towards the company becomes different in a positive way. This, consequently, forces management to create an environment in which employees feel comfortable when they encounter safety risks or risky behavior (Michie, 2020).

The study participants (89%) also noted that organizations that do implement a behavioral safety approach ensure that no one is being harmed. However, they noted that establishing a safety culture is not only associated with a change in behavior, but also with a change in the mindset. The economics of implementing a behavioral safety culture in companies was noted by 82% of the study participants who indicated that unsafe practice leads to disaster and that every disaster, like road accidents, railway accidents, fire accidents, etc., is beyond an economic evaluation;

Generally speaking, the study participants felt that Indian companies do not appear to be aware that spending on safety is an investment and not an expense!

5. CONCLUSIONS

During the past 15 months, the world has witnessed the direct and indirect effects of a pandemic that took the lives of millions of people around the world and left millions at risk with its devastating and

painful effects. Due to the lack of awareness among urban and suburban communities, the spread of the pandemic had been uncontrollable! This could have been avoided, or the extent of the harm reduced if people had behaved responsibly by following various Covid-19 appropriate behaviors to limit the deadly effects (Nature Human Behavior, 2020).

By all means, a strong safety culture begins with the visible commitment of management and highly committed and capable employees at all levels. This would lead to satisfied stakeholders through reduced costs, increased reliability, reduced maintenance and better product quality, as well as benefits through motivated employees and satisfied customers; this could have direct consequences on business sustainability and profitability.

Eighty-one percent of the study participants stated that the behavioral safety culture was an instrument with which risks from occupational health and safety, as well as process safety, can be successfully limited. This behavioral science approach is currently being used successfully in numerous companies around the world (Geller, 2001).

There is a need to expand the behavioral safety culture program to include employee families and other key stakeholders in society, especially children and adolescents. This could only be achieved through the intervention of educational institutions and public forums that raise awareness of a behavioral safety culture in order to make it a way of life! Occupational health and safety management (OSH) can and should be viewed in monetary terms as part of a business system (Eastern Kentucky University, 2021). Annual safety reviews are critical to continued development; these are often not actively addressed by managers. What is important is that changing the hierarchy of safety controls at the sites is very important; this is also not so strongly emphasized by HODs. Most importantly, every employee plays 5 minutes of safety time every day, which is set as the SOP, an important role in developing a good safety culture. Performance reviews must be used as part of the safety culture to maintain a safe work environment (Hestbak, 2019).

The development of an interdependent safety culture is on the agenda for future-oriented companies in order to ensure long-term sustainability. The best way to identify company culture is by how its employees behave outside of the workplace. A common vision of the people of a zero-harm future would be the foundation of a safety culture that is reflected in safety beliefs, values, attitudes and daily behavior. It is important to motivate and motivate employees to pursue the behaviors that contribute to a strong HSE culture (Scace, 2018).

6. SCOPE OF FUTURE RESEARCH

It is important to remember that poor occupational health and safety costs money. Good occupational safety is good for business (EU-OSHA, 2021). The industry longs for social well-being. Safety is the core value in the industries of developed nations. The benchmarking of the safety statistics of all industrial nations has changed dramatically. Environmental standards are also implemented as disciplinary benchmarks. Due to the spread of the Covid-19 pandemic, occupational safety standards have been drastically improved. But, safety goes far beyond that! It still starves for benchmarking excellence. The number one cause of any injury caused by an incident is behavior. This also has a cascading effect on environmental health (Chao et al., 2021). Understanding changes in working conditions and deciding on company practices for safety, health and wellbeing would be critical (Glorian et al., 2021). Anticipate, prepare and invest now in resilient occupational safety and health systems (ILO, 2021a). Understanding the biggest risks in the workplace is the first step to better protecting employees and the bottom line (Liberty Mutual Insurance, 2021).

REFERENCES

- Academy 4SC (2021). Introduction to Behavioural Economics: Acting Irrationally. Retrieved on 26 July 2021 from <https://academy4sc.org/video/introduction-to-behavioural-economics-acting-irrationally/>
- Alcumus eCompliance (2021). 8 Steps to Building a Successful Behavior Based Safety Program. Retrieved on 12 August 2021 from <https://www.ecompliance.com/blog/behavior-based-safety-success/>
- American Petroleum Institute (2015). Pipeline safety management systems standard (ANSI/API RP 1173).
- Battmann, Wolfgang & Klumb, Petra. (1993). Behavioural economics and compliance with safety regulations. *Safety Science*. 16. 35-46. 10.1016/0925-7535(93)90005-X.
- Berthold, Janice (2016, Nov 04). Profits Should Not Come at the Cost of Workplace Safety. Retrieved on 15 August 2021 from <https://www.industryweek.com/operations/safety/article/21992214/profits-should-not-come-at-the-cost-of-workplace-safety>
- Cooper, D. (2020). Faces of EHS: Talks Behavioral Safety and Managing COVID-19. Retrieved on 14 August 2021 from <https://ehsdailyadvisor.blr.com/2020/03/faces-of-ehs-dominic-cooper-talks-behavioral-psychology-and-managing-covid-19/>
- Cooper, M.D. (2018). The Safety Culture Construct: Theory and Practice. In: Gilbert C., Journé B., Laroche H., Bieder C. (eds) *Safety Cultures, Safety Models*. Springer Briefs in Applied Sciences and Technology. Springer, Cham. https://doi.org/10.1007/978-3-319-95129-4_5
- Dash, Sanket Sunand (2020, December 20). Behavioural Economics: A New Driver of Strategic HRM. *NHRD Network Journal*, Volume: 14 issue: 2, 206-215. <https://doi.org/10.1177/2631454120977240>
- Deloitte (2021). Behavioural economics and management. Retrieved on 29 July 2021 from <https://www2.deloitte.com/us/en/insights/focus/behavioural-economics.html>
- DGUV (2021). About Vision Zero. Retrieved on 29 July 2021 from <https://www.vz-rsi.in/about>
- Drummond, James, and Pietikainen Anna (2021). How behavioural science can promote safety culture. Retrieved on 27 July 2021 from <https://apolitical.co/solution-articles/en/how-behavioural-science-can-promote-safety-culture>.
- Eastern Kentucky University (2021). The Economic Aspect of Health and Safety. Retrieved on 30 July 2021 from <https://safetymanagement.eku.edu/blog/the-economic-aspect-of-health-and-safety/>
- Ekenedo, Golda (2013). Framework for developing and sustaining safety culture in a developing economy. *European Journal of Applied Sciences*. 1. 28 -37.
- European Commission (2021). Occupational safety and health in a changing world of work. Retrieved on 11 August 2021 from https://ec.europa.eu/commission/presscorner/detail/en/ip_21_3170
- EU-OSHA (2021). Good OSH is good for business. Retrieved on 15 August 2021 from <https://osha.europa.eu/en/themes/good-osh-is-good-for-business>
- Geller E. Scott (2001). Behavior-based safety in industry: Realizing the large-scale potential of psychology to promote human welfare. *Applied & Preventive Psychology* 10:87-105 (2001). DOI: 10.1017.S0962184902010028
- Glorian Sorensen, Jack T. Dennerlein, Susan E. Peters, Erika L. Sabbath, Erin L. Kelly, & Gregory R. Wagner (2021). The future of research on work, safety, health and wellbeing: A guiding conceptual framework, *Social Science & Medicine*, Volume 269.

- Jaggi, Gautam (2021, Mar 23). How behavioural economics can enable a safe return to work. Retrieved on 28 July 2021 from https://www.ey.com/en_in/megatrends/how-behavioural-economics-can-enable-a-safe-return-to-work
- Johnson, Sara (2021, July, 26). Global economic growth depends increasingly on Covid19 vaccination progress. Retrieved on 29 July 2021 from <https://ihsmarkit.com/research-analysis/global-economic-growth-depends-Covid19-vaccine.html>
- Hestbak, Brad (2019 September 11). How can performance reviews be used as part of safety culture and maintaining a safe work environment? Retrieved on 30 July 2021 from <https://www.safeopedia.com/how-can-performance-reviews-be-used-as-part-of-safety-culture-and-maintaining-a-safe-work-environment/7/8088>
- ILO (2021). International Labour Standards on Occupational Safety and Health. Retrieved on 28 July 2021 from <https://www.ilo.org/global/standards/subjects-covered-by-international-labour-standards/occupational-safety-and-health/lang--en/index.htm>
- ILO (2021a). World Day for Safety and Health at Work 2021. Retrieved on 11 August 2021 from <https://www.ilo.org/global/topics/safety-and-health-at-work/events-training/events-meetings/safeday2021/lang--en/index.htm>
- ILO (2021b). How can occupational safety and health be managed? Retrieved on 14 August 2021 from <https://www.ilo.org/global/topics/labour-administration-inspection/resources-library/publications/guide-for-labour-inspectors/how-can-osh-be-managed/lang--en/index.htm>
- Liberty Mutual Insurance (2021, July 21). 2021 Liberty Mutual Insurance Workplace Safety Index Helps Companies Better Protect Employees and Control Costs as the Economy Continues to Reopen. Retrieved on 15 August 2021 from <https://www.libertymutualgroup.com/about-lm/news/articles/2021-liberty-mutual-insurance-workplace-safety-index-helps-companies-better-protect-employees-and-control-costs-economy-continues-reopen>
- Michie, S. (2020). Behavioural strategies for reducing covid-19 transmission in the general population. Retrieved on 14 August 2021 from <https://blogs.bmj.com/bmj/2020/03/03/behavioural-strategies-for-reducing-covid-19-transmission-in-the-general-population/>
- OSHA (2021). Business Case for Safety and Health. Retrieved on 14 August 2021 from <https://www.osha.gov/businesscase>
- Scace, Emily (2018, Sep 17). Safety Culture 2018: Seven Life Lessons from E. Scott Geller. Retrieved on 31 July 2021 from <https://ehsdailyadvisor.blr.com/2018/09/safety-culture-2018-seven-life-lessons-from-e-scott-geller/>
- Smith, Sandy (2017, May, 16). Are Injuries Still the ‘Cost of Doing Business’ at Some Companies? <https://www.ehstoday.com/safety/article/21919024/are-injuries-still-the-cost-of-doing-business-at-some-companies>
- Tanya (2021). Economic benefits of health and safety management. Retrieved on 11 August 2021 from <https://www.ecoonline.com/blog/economic-benefits-health-safety-management>
- Vu, T., & De Cieri, H. (2014). Safety culture and safety climate definitions suitable for a regulator: A systematic literature review (Research report 0414-060-R2C). Monash University.



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Individuals, Organizations, and the Economy: All Suffer When Workplace Hazards Are Ignored!

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KEYWORDS

Workplace accidents
Lebanon
Middle East

ABSTRACT

Work accounts for one-third of one's adult life. If the state of the place of work is unfavorable – regardless of where, when, how large, or what kind – negative health consequences are certain to occur. When it comes to health and safety in the Middle East (ME), it is worth mentioning that the ME Safety Statistics have shown significant changes in safety rules over the last decade. However, considerable work still needs to be done; this will be true for regions all over the world until all workplaces are accident-free. In this paper, the occupational health and safety (OHS) in Lebanon — a small country in the Middle East, with an area of 10,452 km², a population of 4 million and nearly 2 million refugees from neighboring ME countries, and a service-oriented economy — is examined. The study aims to outline the magnitude of the problem and identify areas for potential research and interventions.

1. INTRODUCTION

Globally, work-related accidents or diseases claim the lives of 6,300 individuals every day, or more than 2.3 million deaths every year, 340 million injured every year, and 160 million who suffer from work-related illnesses. The International Labor Organization's (ILO) projections for the years to come are only expected to climb with time, demonstrating both the poor health conditions that the world's working population is experiencing and the lack of concern for changing those conditions. The human cost of daily adversity is enormous, and the annual economic cost of poor occupational safety and health policies in some countries, like Lebanon, is estimated to be 4% of the Gross Domestic Product (GDP). Given the prevalence of numerous threats that contribute to poor worker health, Lebanon is eerily similar to the ordeals of other countries, particularly developing ones.

Most businesses in Lebanon do not adhere to legally mandated minimum safety and health standards, and employees who are injured at work do not dare to assert their rights for fear of losing their jobs. As a result, they are responsible for their own treatment in case of a workplace accident. Due to a lack of official labor protection mechanisms, whether through inspections by the Ministry of Labor or issuing decrees and decisions that emphasize the importance of workers' compensation, the legal provisions relating to workers' compensation for accidents that affect them remain merely ink on paper.

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When performing dangerous tasks with their bare hands, such as chopping wood and steel or dealing with poisonous chemicals, some workers may not wear any type of personal protection equipment. Many workers also retain bad posture throughout their tasks, increasing their chances of getting chronic back or neck discomfort for the remainder of their lives. They may work in a filthy but apparently safe environment, but they are actually surrounded by unknown and potentially carcinogenic substances and biological dangers.

Workers are not to blame for what looks to be carelessness. More than 80% of Lebanon's population presently lives in poverty as a result of a mix of bad political and economic conditions. Workers accept workplace dangers because they are too busy putting food on the table for themselves and their families. Because of this vicious cycle of poverty and poor health – as well as a lack of means to get out – workers are either unable to fully understand the impact of the state of their work on their health, or cannot afford to purchase protective gear, risking being fired if they raise their concerns with management, or go without a salary while pursuing jobs under safer conditions.

2. SOURCES OF THE PROBLEM

The problem stems from the overall management of the workplace health and safety. Policymakers in countries, such as Lebanon, frequently underestimate the need for safe and healthy workplace and, consequently, fail to incorporate Health, Safety and Environment (HSE) in the country's priority list. The lack of implementation of present government legislation, as well as the resources required by the Ministry of Labor to prosecute violators, are all hurdles to employee protection in Lebanon.

By addressing the issue of occupational hygiene, many of Lebanon's problems will certainly be relieved. With technological advancements and increased productivity, such measures could improve worker health and life expectancy, decrease the number of people who quit work early due to illness or injury, lower the social and health-care costs, maximize the worker's potential, and lead to more effective and efficient labor processes.

By all means, employers must be held responsible for workplace health and safety issues. Management should be required to set aside a specific budget for acquiring the necessary equipment to monitor and mitigate occupational dangers, and hire occupational hygienists. Occupational hygiene experts identify potential dangers in the workplace before they arise, assess the risk on human health, and, if all else fails, apply appropriate control measures with respect to physical, chemical and biological hazards. By eliminating workplace hazards, occupational hygienists can then focus on prevention rather than on therapy, which is the best option.

3. INTERNATIONAL LEGISLATION

The topic of workplace safety and compensation regarding work-related injuries have gained center stage in international laws. The International Labor Organization (ILO), for instance, has provided recommendations, and was engaged in treaties and international conventions to regulate this issue. In 1921, for instance, the ILO issued the 12th Convention on Compensation for Work Accidents in Agriculture: “Each Member of the International Labor Organization which ratifies this Convention undertakes to extend to all agricultural wage-earners its laws and regulations which provide for the compensation of workers for personal injury by accident arising out of or in the course of their employment.”

On the other hand, Agreement No. 25 of 1927, relating to health insurance for agricultural workers, mandated health insurance for agricultural workers, both manual and non-manual workers who work for agricultural companies, including trainees, with the possibility of exempting some specific groups, in addition to the exemption of those who are covered by an alternative health-care system. According to Article 21, paragraph 1, of Convention No. 184 on safety and health in agriculture, "Agricultural employees are covered by an insurance system or social security against sustained injuries, fatal and non-fatal, disability, and other health work-related risks, which provides them with protection that is equivalent to at least that provided to workers in other industries."

The first Article of the International Labor Organization's Convention No. 17 on Compensation for Accidents Act of 1925 stated: "Everyone pledges to." If a member state of the International Labor Organization ratifies this Convention, it guarantees that workers wounded in a workplace accident or their dependents will be compensated in a condition that is at least comparable to the parameters stated in this agreement." This agreement, however, "Persons who carry out incidental, unrelated work" are exempt from its rules. Have a job or an employer's project, workers in their homes, and family members The sole proprietor who lives in his own home and works for himself Non-manual workers whose earnings surpass a maximum specified by national laws or regulations" were likewise excluded from Article 3 of the Convention under Article 2, paragraph 2. Mariners, fishers, and others who benefit from a system with at least equal benefits. The advantages set forth in this agreement, as well as Article 4, do not apply to workers employed by farmers who are bound by their own agreements. Article 5 of this agreement specifies the persons who are entitled for compensation as a result of work-related accidents, namely the injured worker or the persons whom he supports in the event of permanent disability or death. Article 7 states obliges an additional payment in case the concerned injured person requires help from someone else. As regards Article 11 of the Convention, it provided freedom to countries to determine the appropriate compensation to the worker in the event that insurance companies or the employers were unable to do so.

Occupational diseases are defined in Convention No. 18 of 1925 with regard to compensation for workers in the event of occupational diseases, and amended by Convention No. 34 of 1934, which in turn was replaced by Convention No. 121 in 1964; its name was changed to Injury Work Benefits Agreement. This agreement restored the exceptions contained in Agreement No. 17. Article 6 states that cases that involve compensation for a work-related accident is illness, incapacity to perform work, loss of earning capacity, partially or wholly, loss of livelihood for the assigned categories of beneficiaries as a result of breadwinner's death. This agreement necessitated countries to compile a list of occupational diseases and work accidents that they consider to be work-related accidents, according to Articles 7 and 8. Article 9 stipulates that compensation includes medical care and sick pay cash benefits where the worker is unable to make money. This continues so long as the case necessitates it. Also, Convention No. 42 on compensation for workers in the event of occupational diseases, as amended by the aforementioned Convention No. 121, came into force in 1934.

With regard to Convention No. 24 of 1927 concerning Sickness Insurance for Workers in industry, so Industry, trade and domestic workers, Article 1 obliged the ratifying countries to set up a system of compulsory health insurance" for manual and non-manual workers who work in industrial and commercial establishments, including home and domestic workers, as per Article 2 paragraph 1 On the other hand, paragraph 2 of Article 2 allowed some exceptions in the provisions of this contract, as regards temporary work, casual work, workers whose wages exceed an amount determined by the applicable law, workers who do not receive cash wages, domestic workers whose work type deviates from that of other paid ordinary workers, workers whose age is specified is determined by applicable laws, and the employer's family members. Article 2 paragraph 3 of compulsory insurance also excluded persons who benefit from health insurance that corresponds to the benefits stated in this agreement.

In this context, Convention No. 37 on Insurance against employee disabilities in industrial and commercial enterprises, liberal professions, domestic workers in their homes and domestic servants have been implemented in Agreement No. 128 in the year 1967, the name of which has become an agreement on invalidity, old-age and survivors' benefits.

4. THE LEBANESE LAW

Work-related accidents in Lebanon are governed by the Emergency, Protection and Prevention Labor Law, Accidents de Travail, promulgated by Legislative Decree No. 136 dated 9/16/83, which is the legislation-in-force until the entry into effect of the provisions of the National Social Security Fund Law that are related to work emergencies and occupational diseases.

According to Article 1 of the law, the employer is responsible for the sudden injuries that are caused by an external factor and which is inflicted on the employee due to the implementation of a work contract or as a result of implementing the contract. According to Article 17, the employer shall bear all medical, surgical and medicinal expenses, including:

- Hospital expenses, in addition to the cost of installing, maintaining and renewing limb prosthetic machines and other medical and surgical instruments that are necessary for the treatment and recovery of the injured worker, regardless of the duration of the worker's absence from work as a result of the work-related accident. Article 12 of the law obligates employers to ensure that employees have reasonable plans available for compensation and medical treatment.

In order to apply the law, Article 1 requires the following:

- the injured person is a wage-earner under an employment contract as per Article 624, paragraph 1 of the Lebanese Code of Obligations and Contracts.
- the accident is of work-emergency type that is caused by an external and sudden factor that led to bodily harm.

A mental disorder is regarded as a bodily injury. A disease is not considered work-related if it occurs in an excessively slow manner whilst the employee is carrying out the work, such as slow poisoning from water that is placed at the disposal of the employee. On the other hand, rapid poisoning caused by a contaminated drink is regarded as an emergency that deserves compensation.

- the emergency was the result of employment implementation or because of it.

A work emergency refers to the accident that the employee is exposed to during the course of his work, going to or returning from work, provided that going to or returning from are done without stopping or deviating from the normal course for a reason that is independent of work.

- the damage that is being complained of was the result of work emergency; that it, there is a direct causal link between the two, where the injury or the resulting damage is the result of the emergency that is being complained of.

Article 31 of the law states that an emergency compensation work claim shall be filed within a period of one year from the date of the accident, or from the outcome of the investigation, or following the cessation of temporary compensation payment. This period is regarded as a waiver period that is not cut or stopped, as is the case with the passage of time when the worker's right to claim compensation is no longer applicable.

As for the amount of compensation, the law distinguishes between injury that leads to total or partial disability. Compensation depends on the age of the beneficiary and the manner of death. Article 3 specifies the compensation accrued to a wage earner who sustains a total disability, and whose wage does not exceed the official minimum wage, as follows:

- 800 days of his average wage, if he is under 35 years of age;
- 700 days of his average wage, if he is over 35 years of age and under 50 years of age;
- 600 days of his average wage, if he is over 50 years of age.

In the event that the wage exceeds the official minimum wage, then the employee is entitled to receive, in addition to the above-mentioned compensations, a quarter of the compensation for the portion of wages that exceeds the minimum wage and up to double this limit, or one-eighth (1/8), of the compensation for the portion that exceeds about twice the official minimum wage.

In the event of partial disability, Article 4 of the decree states that an injured person has the right to receive compensation that is commensurate with the loss of the earning ability. This compensation shall reflect the case of whether the disability is permanent. If the damage is listed in the appendix attached to the work emergency law, then the injured employee shall receive a compensation that is equal to the percentage specified in the appendix. However, if the disability is not mentioned in the appendix, then the Labor Arbitration Council shall decide the compensation amount, taking into account the injured person's experience and work competence.

Article 5 states that an injured person has the right, from the very first day following the accident, for compensation of up to nine months, which is equal to $\frac{3}{4}$ th of the last daily wage; this wage is divided by six if the wage is weekly, by twelve if the wage is every 15 days, and by twenty-five if the wage is monthly. The daily compensation shall be made at the place and time where the wages normally take place; the time period between two consecutive payments shall not exceed fifteen days.

The employer shall also bear responsibility for all medical treatment expenses, regardless of the treatment period and cost. The employer is obligated to secure insurance contracts with insurance companies to guarantee compensation and treatment, according to Article 12 of the Work Emergency Law.

In the event of death, Article 6 of the Labor Emergency Law states the following: if the deceased employee's wages do not exceed the official minimum wage, his heirs shall receive a maximum compensation for 500-day wages; in case the wages do not exceed the minimum wage, then the heirs of the employee will be entitled to only one-fourth of the compensation related to the portion of wages that exceeds the official minimum wage and up to twice that limit, as well as $\frac{1}{8}$ th of the compensation that exceeds twice the official minimum wage. Article 10 prohibits the heirs of a foreign employee from compensation if they were found outside of Lebanon during the accident, with the exception of nationals of countries which grant Lebanese citizens the same rights as their own citizens.

In addition to the aforementioned compensation, the employer shall bear the burial expenses up to twice the official minimum wage. It should be noted in this context that compensation for death under this law does not belong to the legal heirs but to the rightful holders specified in the special law issued on 2/8/1974, which concerns the appointment of the rightful holders to receive compensation for dismissal from service.

5. HEALTH WORKERS' SAFETY NEGLECTED DURING COVID-19

Lebanese authorities have shown a callous disregard for the protection of healthcare workers at the front lines of the Covid-19 pandemic. The country has had an alarming surge of cases that is threatening to overwhelm the healthcare system.

Government institutions, including the Health Ministry, National Social Security Fund, and security agencies such as the military and Internal Security Forces, owe private and public hospitals large sums of money. Their failure to meet their financial obligations severely restricts hospitals' ability to maintain sufficient staffing levels and protect staff from infection. The authorities have also failed to stop violent attacks against healthcare workers. The pandemic has had a significant mental and emotional toll on the workers.

Lebanon's economic crisis predates the pandemic. The national currency has lost more than 80 percent of its value in the past year. Poverty rates have doubled, unemployment has skyrocketed, and inflation exceeded 500 percent.

The economic crisis has had a devastating impact on the healthcare sector. Medicines and medical supplies, most of which are imported, are in short supply. The value of nurses' and doctors' salaries has declined rapidly, triggering a mass exodus. The pandemic then placed an additional strain on a healthcare sector already in crisis. Hospitals' capacities have been stretched, their costs have risen, and yet the government is not disbursing the funds it owes them.

Under the International Covenant on Economic, Social, and Cultural Rights, which Lebanon has ratified, Lebanon is obligated to minimize the risk of occupational accidents and diseases, including by ensuring workers have health information and adequate protective clothing and equipment. This means providing healthcare workers and others involved in the COVID-19 response with appropriate training in infection control and with appropriate protective gear. In the context of the right to life where a lack of adequate PPE creates a foreseeable life-threatening situation, failure to provide adequate PPE to health workers exposed to Covid-19 may violate states' obligations to protect life.

Lebanon has had an exponential increase in Covid-19 cases and related deaths since October. Multiple full or partial lockdowns have been poorly enforced and have not stemmed the rise of Covid-10 cases, in large part due to the lack of an emergency social safety net that would enable working people to stay at home. Critics have accused the government of not having a cohesive, long-term strategy to deal with the pandemic.

The Lebanese authorities have also failed to address the economic crisis that has endangered people's basic rights. The World Bank said that the "deliberate lack of effective policy action by authorities has subjected the economy to an arduous and prolonged depression." The World Bank said that this lack of action is likely to cause Lebanon's economic crisis to be "deeper and longer than most economic crises."

5.1 Overworked and Underpaid

The Covid-19 pandemic has placed additional strains on a healthcare system already in crisis due to the government's failure to address the economic crisis and pay hospitals their dues. Various public sector entities, including the Health Ministry, National Social Security Fund, Internal Security Forces, and the army cover some medical costs for their personnel or residents covered under certain health insurance schemes, but the government has not disbursed a large share of those payments to hospitals.

The hospitals' precarious economic situation forced many to lay off significant numbers of staff in 2019, making them ill-prepared to face the Covid-19 pandemic. On top of that, the delay in paying doctors and nurses, the 80 percent decline in the value of healthcare workers' real income, and the lack of faith in the government's ability to address the multiple crises Lebanon is facing, have prompted an exodus from Lebanon of doctors and nurses – many of whom were among the most qualified.

Private and public hospitals have adopted cost-saving measures that have negatively affected their staff. Some have slashed salaries or forced staff to work half time. Others have started treating overtime hours as regular hours, instead of paying time and a half for overtime, as Lebanese labor law stipulates. Still, others have switched from paying their staff in US dollars to Lebanese pounds either at the official exchange rate or at a slightly higher rate that is considerably less than half the unofficial market rate.

5.2 Lack of Personal Protective Equipment

The failure of the government to pay hospitals their dues has made it difficult for the latter to purchase adequate supplies of personal protective equipment, prices for which have increased drastically due to the national currency's depreciation.

In this respect, the World Health Organization (WHO) has issued interim guidance on Covid-19 concerning the rights, roles, and responsibilities of healthcare workers. Employers and managers should provide workers with infection prevention and control masks, gloves, goggles, gowns, hand sanitizer, soap and water, and cleaning supplies in sufficient quantity such that workers will not have to incur their own expenses. Workers have the right to remove themselves from a situation that they have reasonable justification to believe presents an imminent and serious danger to their life or health, and to be protected from any resulting retaliation.

Further, the World Health Organization has indicated that medical masks should be worn by all healthcare workers interacting with Covid-19 patients and that respirator masks should be worn by those conducting aerosol-generating procedures. The Centers for Disease Control and Prevention stated that regular face masks do “not provide the wearer with a reliable level of protection from inhaling smaller airborne particles and [are] not considered respiratory protection,” and recommends that health workers wear respirators where possible.

5.3 Attacks on Healthcare Workers

During the pandemic, some healthcare workers have become targets of violent attacks by patients and their families, especially as hospitals were no longer able to admit new patients. Some estimates indicate that there is at least one serious attack on a doctor every month, amid “judicial laxity” in holding the attackers – often people with “political backing” – accountable.

5.4 Mental Health Toll

The pandemic, its unrelenting spread across the country, and the failure by the government to adequately respond to the pandemic and support healthcare workers, has taken a mental and emotional toll.

6. CONCLUSION AND RECOMMENDATIONS

In Lebanon, most companies do not meet the minimum statutory health and safety requirements, and workers who are exposed to work accidents do not dare assert their rights for fear of losing their jobs; therefore, they bear the cost of their own treatment as a result of a work-related accident, which normally should be borne by the employer.

Given the lack of formal Occupational Safety and Health (OSH) mechanisms, either through multi-level inspections by the Department of Labor or through the adoption of ordinances and decisions that emphasize the importance of worker protection, compensation simply remains ink on paper. It is necessary that the social rights of people are at the forefront of government priorities and do not change with changing governments and ministers. By all means, being aware of a workplace safety will reduce health difficulties for employees and save the Lebanese government millions of dollars in healthcare costs. The constant maintenance of health and illness prevention affects not only the workers but also the company as a whole, as well as the whole country.

We must ensure that factory managers, supervisors, and employees have basic awareness of OSH, both in terms of practicalities and rights, at the workplace level. Although the focus will always be on prevention, all employees must be aware of what to do in the event of an accident or emergency. In recent years, numerous stakeholders have conducted a significant amount of safety training. The decrease in the number of workplace fires and accompanying fatalities, for instance, demonstrates the success of these measures and the potential lives and livelihoods saved.

Workers must be assisted in better understanding their workplace safety rights, such as the right to use personal protective equipment when appropriate, the right to quit hazardous employment, and the right to seek assistance from the labor inspectorate, among other things. Employers, too, have an important role to play and must be well aware of their responsibilities. They should make workplace safety a high priority. Money spent on safety is an investment that will benefit not only the workers but also the company.

Establishing safety committees at companies with more than 50 employees must be a top priority. Safety committees can play a vital role in bringing worker and employer representatives together. They will serve as a conduit for worker participation in enhancing workplace safety, necessitating the provision of free and equitable opportunities for workers to select their own safety committee representatives. Furthermore, the question of worker safety and worker rights are inextricably linked. Workers who are empowered and aware play a critical role in ensuring workplace safety. In this regard, trade unions play a critical role, and they must be permitted to form and operate freely across all industries. Workers and their organizations must be empowered so that they can become active participants.

REFERENCES

- Brasseur JR (24 December 2021). Lebanon: From Switzerland of the Middle East to modern-day dystopia. Middle East Eye.
- Croner-i Limited (17 March 2021). Employment Law in Lebanon: In-depth. London, United Kingdom.
- Diab S. (13 May 2020). Ignoring work hazards is bad for people, businesses & Lebanon's economy. Beirut Today, Lebanon.
- Fayad R., Nuwayhid I., Tamim H., Kassak K., and Khogali M. (2003). Cost of work-related injuries in insured workplaces in Lebanon. Bulletin of the World Health Organization, 81 (7).

Hubbard B. (10 October 2021). Collapse: Inside Lebanon's Worst Economic Meltdown in More Than a Century. The New York Times, USA

Morcos P. (2015). Compensation for work accidents: Lebanese Law and International Legislation. The Human and Health Magazine, Vol. 31, Lebanon.

In the following annex, background information on employment law in Lebanon is provided.

Annex: Employment Law in Lebanon

The Ministry of Labor: Responsibilities

Labour inspections are the responsibility of the Department of Labour Inspection, Prevention and Safety (DLIPS) under the Labour Relations Authority of the Ministry of Labour.

The National Social Security Fund (NSSF) carries out inspection services to verify social security contributions.

Law that covers organisation and functional composition:

- Lebanese Labour Law of 1946 and its amendments, in particular 1962
- Decree No. 3273 of 26 June 2000 on labour inspection
- Decree No. 112 of 12 June 1959 regarding status of public officials
- Order No. 161/1 of 18 February 1999 concerning the re-evaluation of transport indemnities
- Decree No. 128/ 2 of 17 February 2001 relating to the elaboration of inspection programmes.

Lebanese Labour Law is applicable to all employees and employers except for domestic and agricultural workers, enterprises limited to family members and public servants.

The Department of Labour Inspection, Prevention and Safety supervises the implementation of all laws, regulations, decrees and rules pertaining to the terms and conditions of employment, and the protection of workers in the workplace, including the provisions of international Labour Conventions approvals. Labour inspectors ensure the supervision of compliance with regulations in relation to conditions of employment and protection of workers including occupational health and safety. In addition, they monitor whether the trade unions and occupational associations comply with relevant laws, monitor compliance with protection and safety measures in family enterprises and the work of private employment agencies.

Under their functions they also investigate collective labour disputes. They are also involved in conciliation and the control of work permits for foreign workers.

Among the labour inspectors, some of them are generic who oversee inspecting conditions and others are occupational health and safety inspectors.

The Department of Labour Inspection, Prevention and Safety is the central authority of labour inspection, but from the legal and practical points of view, all labour inspection activities are decentralised in the provinces. The Department of Labour Inspection, Prevention and Safety acts as a regional department in charge of labour inspection activities within the capital and the other regional departments independent of it.

The inspection activities in the country do not follow any clear policy or strategy and there is an absence of collaboration among the different concerned institutions. The regional inspection activities are not under the supervision or control of a central authority of labour inspection. Inspection visits are

carried out according to an annual labour inspection programme, and monthly work report with results on labour inspection activities have to be prepared. However, the labour inspection activities are not planned at the national level.

There is no co-ordination between the National Social Security Fund and the Ministry of Labour.

The objectives of the Ministry of Labour are to reform the labour law to comply with the international standards and conventions, including the provisions related to labour inspection and to expand the labour and occupational safety and health inspection and services to ensure the compliance of the enterprises in the private sector with the labour legislations.

Recruitment and Selection

Methods and practices

The recruitment and selection process are subject to regulations, requirements for work permits in the case of non-Lebanese nationals. There are only relatively limited, general rules related to discrimination (see Discrimination) and Data Protection (see Data Protection). Recruitment and selection methods and practices are not specifically regulated or prohibited. All employees must provide evidence about their criminal records and pass a medical examination.

Discrimination

The Labour Law prohibits any discrimination that prejudices equal opportunity employment and equal access to jobs, though without specifying any particular grounds (sex, race, age, etc) on which such discrimination is unlawful (see Prohibition of Discrimination). The only specific rules on discrimination in recruitment apply to people with “special needs”. A Ministerial Decree stipulates that employers must not discriminate against such individuals in recruitment and selection. Job advertisements must not indicate any intention to discriminate against applicants with special needs. Employers must consider using a variety of channels to advertise vacancies and to receive job applications in order to include people with special needs. They must also consider adapting their selection procedures to give applicants with special needs the opportunity to demonstrate their capacities (i.e. giving them more time in interviews).

Probationary periods

There are two types of employees under the Lebanese labour law:

- the first includes all professional workers who hold office jobs; this includes everyone from administrative employees to senior managers
- the second category is comprised of manual labourers.

When employees are first hired, they are placed on a three-month probation period. After the trial period, the employer must pay at least the minimum wage which is 675.000 LBP per month.

During a probationary period, the employer and/or the employee may terminate the employment contract without having to give notice (see Notice Periods). The same employee may not serve more than one probationary period with the same employer nor can be renewed.

If the employee successfully completes the probationary period, it must be considered as part of the employee's period of continuous service with the employer.

During the probationary period, the employee is not entitled to benefit from any type of leave — even sick leave. If they want to take any leave, it will be considered as unpaid leave.

In case the employee takes service as a trainee, the employee as well as the employer shall be entitled to terminate the work contract without any prior notice or indemnity in the course of the three months following signing on.

Work permits and residency

A permit from the Ministry of Labour is required for foreigners to work in Lebanon. The Lebanese law entitles foreign workers, who are in possession of a work permit from the Ministry of Labour, to enjoy full social rights.

Free visas and temporary residence valid for a period of six months are granted on border departments and centres according to the following.

1. For Arab investors, businessmen and their family members who are visiting Lebanon for the first time for the purpose of investment, and that after presenting an official document from the appropriate authorities proving their professional occupation in addition to a recommendation letter from the same authorities in favour of granting the visa.
2. For Arab investors, businessmen and their family members holding a letter from the Investment Development Authority of Lebanon (IDAL) in favour of granting the visa.
3. For Arab investors, businessmen, traders and their family members pursuant to an invitation from a Lebanese businessman according to the following.

The inviting party presents an application to the General Directorate of General Security that should include:

- a written commitment to bring over the concerned party on the applicant's responsibility
 - a photocopy of his commercial record
 - a passport's photocopy of the invited person with an official document issued by the competent authorities certifying his professional occupation.
4. Investors and businessmen mentioned in articles 1–3 above, possessing a temporary residence for a period of six months and who have already launched investment projects in Lebanon, can present a request to the General Directorate of General Security to obtain a yearly or a permanent residence, valid for three years and renewable.
 5. For the citizens of the countries who have not granted immediate visas at the airport, their cases will be treated according to:
 - bankers, directors/general managers and employers after presenting a document that certifies their positions
 - people from Lebanese origin provided they present a proof
 - touristic delegations of minimum eight persons pursuant to an application presented by an authorised tourist company in Lebanon along with a departure commitment by that company.

Employment Contract

General principles

An employee may be employed only on the basis of an employment contract signed by both the employer and the employee. The employer must give the employee a copy of the signed written contract.

An employment contract is defined by the Labour Law as an agreement with a fixed or indefinite term concluded between an employer and an employee, whereby the latter commits to working for, and under the management and supervision of, the former in return for a wage that the employer is

committed to paying. An employee is defined as a person who works for, and under the management and supervision of, an employer in return for a wage of any kind (the definition includes employees).

The following are the Labour Law's main provisions on employment contracts.

- Employment contracts (and other employment-related documentation and instructions) must be in Arabic. If another language is also used, the Arabic text prevails in the event of any dispute.
- Employment contracts must in principle be in writing and in duplicate, with copies retained by the employee and the employer; if there is no written contract, any legal means of evidence may be used to prove that a contract exists and what its terms and conditions are.

Any employment contract that is not in writing is deemed to have an indefinite term.

All employment contracts must state:

- the names of the employer and employee
- the starting date of employment
- if the employment is not intended to be indefinite, its expected duration or, if it is a fixed term, the date when it is to end
- the job title or a brief description of the work
- the place of work
- the wages
- any terms and conditions relating to hours or days of work
- the notice period for termination.

Types of contract

An “employer” is defined as any person, natural or juridical, who is an industrial, trading, or agricultural enterprise employs an employee in some capacity to perform services for remuneration of any kind.

An “employee” is any man or woman who works in the service of another party for consideration of a wage or salary in an employer's premises, in accordance with an individual or group contract, written or oral.

It is forbidden to set adolescents, who have not yet completed their eighteenth year of age, to work more than six hours a day, with a break of at least one hour if the daily working period exceeds four consecutive hours.

An employment contract is defined as a contract of service or apprenticeship, whether oral or in writing, plus any permitted amendment or replacement thereof as agreed between the employer and employee. The written contract is to be written in Arabic; it may be, however, translated into a foreign language if the foreign employer does not know Arabic.

Employment contracts may have an indefinite or fixed term.

Based on the Labour Law, the maximum duration of a fixed-term contract is one year, automatically renewed.

Though this is not specifically regulated by the Labour Law, employment contracts can be for full-time or part-time work. No special rules generally apply to part-time contracts. The employee must sign special standard-format part-time employment contracts, using an official template, with the original and additional employers. The original employer is responsible for the employee's statutory benefits — notably annual leave (see Annual Leave).

General

Employers have general duties to:

- ensure, as far as is reasonably practicable, their employees' health, safety and welfare at work
- provide and maintain a workplace that is free of harassment, safe and without risks to employees' health.

Employees have duties to:

- perform their employment duties with reasonable diligence and care
- obey the employer's orders to the extent that these are consistent with the employee's employment duties and will not expose them to danger, and that carrying them out will not contravene any applicable regulation or legislation
- comply with the employer's health and safety instructions
- take reasonable care of any of the employer's property that is in the employee's possession or control or is accessed or used by the employee
- not compete with the employer's business
- not disclose to any third party any of the employer's confidential information, unless such disclosure is compelled by a competent court or applicable law (this obligation continues to apply indefinitely after employment ends).

Pay and Benefits

General pay principles

The payment of wages is an essential element of the employment contract. Wages are set by the employment contract. The Labour Law regulates matters such as payment of and deductions from wages. It defines the “wage” as whatever is given an employee in return for their service by virtue of an employment contract, whether in cash or in kind, a yearly, monthly, weekly, daily, hourly or piece basis. “Basic Salary” is defined as the wage stipulated in the employment contract, exclusive of any allowances.

An “allowance” is any allowance payable to an employee pursuant to an employment contract, including any housing, travel, education, social and entertainment allowances. An “additional payment” is any bonus, commission or other payment made by the employer that is discretionary, non-recurring or expressly agreed not to form part of the employee's wage or allowance. The employee's remuneration is the sum of the wage and any additional payments.

Payment of wages

The Labour Law stipulates:

- employees whose pay is calculated on an annual or a monthly wage must be paid at least once per month
- if any employee is paid on a monthly basis, the employer must not, without the employee's written agreement, change the basis of payment to weekly, daily, or hourly
- the wage or salary shall be paid in full during the delivery holiday of a pregnant employee
- an employee who has availed themselves of the ten-week delivery holiday, with full pay, has the right to receive the wage or salary for the period of the ordinary annual holiday, which may be obtained during the same year, in compliance with article 39 of the Code of Labour.

Transportation

Every employee receives 8000 LBP for every working day summing up to be 208,000 LBP per month. When the employee is on leave, s(he) will not benefit from the transportation.

Deductions

The Labour Law permits only the following deductions from wages:

- the social security contributions and income tax contributions (see NSSF Health Benefits)
- disciplinary fines imposed on the employee (see Disciplinary Matters)
- the repayment of debts to a third party, based on a court ruling; normally, the sums deducted for this reason must not exceed a quarter of the employee's wages but if there are numerous debts or debtors, up to half the wages may be deducted
- sums to pay for the repair or replacement of tools, machines, products or materials that have been lost, damaged or destroyed because the employee was at fault or breached the employer's instructions; the sums deducted for this reason must not exceed five days' wages per month.

National Social Security Fund

The National Social Security Fund (NSSF) provides employees with insurance coverage for sickness and maternity care. It also covers family allowances, end-of-service pension and work-related accidents and diseases. Any employee or labourer in any sector is eligible to enrol in the program. Employers are required to register all employees working for local and international firms with the NSSF. Foreign employees with a valid work permit and residence permits are entitled to join the NSSF, provided their home country offers equivalent or better programs to Lebanese residents employed there. Foreign Nationals are not entitled to end-of-service benefits.

Contributions

Employers must cover their employees' medical, family allowance and end-of-service indemnities contributions as follows:

- 6% of the salary toward family allowances (with a ceiling of 1,500,000 LL from the salary)
- 7% of the salary for health indemnity fund (with a ceiling of 1,500,000 LL from the salary)
- 8.5% of the salary for end-of-service fund (without any ceiling).

The employee contributes by 2% for health coverage with a monthly ceiling of LBP 30,000.

End of service

At the age of 60, an employee can ask for early retirement and end-of service compensation (paid only once) provided 20 years of service has been completed. Noting that the retirement age is 64, employees no longer benefit from the NSSF. An employee can continue working after 64 if the company's by-law allows it, but employees will no longer benefit from the end of service. The end-of-service indemnity will allow the employee to receive a month's wage equivalent to the last salary for every year worked.

Family and education allowances

Employees are entitled to family and education allowances, attached to the husband's rather than wife's salary, except if the female employee is a widow or sole provider.

A married employee registered with NSSF receives a spouse allowance of LBP 60,000 and an additional LBP 33,000 for every child (maximum 5 children); this amount is paid by the NSSF through the employers.

The transport allowance for every day they attend work is free of tax, and is not subject to NSSF contribution.

Schooling allowance

Schooling allowance, with a ceiling of LBP 1,500,000, is calculated on the basis of a lump sum, attending school or university.

This allowance does not form part of the NSSF employer contributions but is accounted for as operational expenses, and it is free of tax.

Employees of whatever category have children attending schools on a regular basis, be they private or public, or universities, will be granted yearly scholarships for each and every one of their children (males and females), and up to five children only, according to the following terms:

- amount of allowance:
 - LBP 300,000 for students in public schools
 - LBP 750,000 for students in private schools or universities
 - LBP 450,000 for students enrolled in the Lebanese university
- the allowance will be granted for every child who is three years of age directly before the beginning of the academic year, and does not exceed 25 years of age
- a female employee will not be granted such allowances, unless she has legal custody over the children and is cashing family allowances for them, or if the husband does not have the right, by virtue of the law, to obtain schooling allowances for their children; in addition, the female employee cashes the allowances difference in case the husband cashes a scholarship less than the amount stipulated in the Collective Labour Agreement.

NSSF health benefits

Once an employee is registered, the NSSF covers the employee and dependents in maternity, sickness, and work-related accidents.

The employee is liable for:

- 10% of all hospitalisation costs
- 20% of medication and examination expenses.

Exceptions are made for pre-maternity and post-maternity examinations, which the NSSF pays in full.

Compliance

The law requires all companies to contribute to the NSSF Fund. Companies with less than 10 employees have to submit reports and pay contributions every three months. Larger enterprises that contain more than 10 employees must submit their reports and settle their contributions on a monthly basis.

Evading the payments will impose penalties on the employer. Late payment penalties are calculated on a basis of 1 per thousand for each day of late payment of the contribution amount.

Minimum wages

The minimum wage is 675,000 LBP. The basic salary should be fully enrolled in the National Social Security Fund (NSSF) and Ministry of Finance.

Working Time, Rest and Holidays

Working hours and days

An employer may demand a maximum of 48 regular hours per week from an employee regardless of age or gender. This applies to all business except agriculture. Under special circumstances, employers

can add extra hours to an employee's regular shift, but this requires a permit from the Ministry of Labour and that:

- the Social Affairs service is informed within 24 hours of the intervening case and of the time necessary to perform the work
- the wage or salary for the overtime provided by the wage-earner or salary-earner is 50% higher than the rate of normal hours.

Any hours that exceed the statutory limits for normal working time are considered to be overtime.

A normal working day should be eight hours, and in some cases up to 12 hours, knowing that employees should be given nine consecutive hours of rest between each working day.

All employees are to be granted a weekly rest which must not be under 36 unbroken hours.

Rest breaks and rest periods

The employer is to select the day of this rest generally on Sundays or distribute it among the employees in sympathy with the requirements of the work especially in the operations departments.

Breaks do not count as working hours. Special rules on breaks apply to factories and workshops where work is carried out in successive shifts around the clock, and operations that require uninterrupted work for technical and economic reasons.

Whenever the duration of work exceeds six non-stop hours for men and five non-stop hours for women, the employer is required to allow these employees in the middle of the day, a rest-time which is not to be under one hour.

Annual leave

Employees are entitled (under the Labour Law) to paid annual leave after they have completed one year's service with an employer.

During the first year of service, they have no entitlement until they complete one year's service. Leave must generally be taken in the year when the employee accrues the entitlement.

The employer may determine when the employee takes annual leave.

During annual leave, the employer must pay the employee their basic wage and any housing allowance that forms part of their remuneration.

The employer is forbidden from dismissing an employee or giving them notice of dismissal during annual leave.

Employees who have completed one year of employment are entitled to an annual leave according to their period of employment with full pay:

- 15 days from 1 (completed year) till 5 years of employment
- 17 days from 5 till 10 years of employment
- 19 days from 10 till 15 years of employment
- 21 days for more than 15 years of employment.

The employer may choose the date of these leaves in sympathy with the requirements of service. The employer may not dismiss the wage-earner or salary-earner nor serve him with dismissal notice while his leave is in progress.

Bereavement leave

- Employees are granted a paid leave up to two days in the event of the death of a first level relative (father, mother, spouse, child, grandchild, sister, brother, grandfather or grandmother) with full pay.
- Employees are granted a paid leave up to 1 day in the event of the death of a 2nd level relative (uncle, aunt, cousin, niece, nephew, brother-in-law, sister-in-law, father-in-law, or mother-in-law).
- Proof document (obituary paper) should be provided to the HR department when the employee resumes work.

Marriage leave

Employees are granted a one-week paid leave for their marriage, and this is *only* for “one time” during their employment with the company.

Public holidays

Employees are entitled to a paid day off on official public holidays.

An employer may require an employee to work on a public holiday, if circumstances make this necessary. In such cases, the employer must grant the employee a day off on another day and pay their normal rate.

Fitr Feast	Varies according to Calendar
Adha Feast	Varies according to Calendar
Islamic New Year	Varies according to Calendar
Independence Day	22 November
New Year Day	1 January
Ashoura	Varies according to Calendar
Christmas	25 December
Prophet's Birthday	Varies according to Calendar
Easter Sunday	Varies according to Gregorian and West Calendar
Orthodox Easter	Varies according to Gregorian and West Calendar
Labour Day	1 May
Resistance and Liberation Day	25 May
Assumption Day	15 August

Parenthood and Work-life Balance

Maternity leave

- Pregnant employees are entitled to a paid maternity leave of absence for 10 consecutive weeks; this period will include the days before and after delivery date.
- The employee who has availed themselves of the ten-week delivery holiday, with full pay, has the right to receive the wage or salary for the period of ordinary annual holiday, which may be obtained during the same year, in compliance with article 39 of the Code of Labour.

An employer must not dismiss (or give notice of dismissal to) an employee who is pregnant or on maternity leave or send any warning. Any such dismissal will be deemed to be “arbitrary” and the employee may claim compensation (see Arbitrary Dismissal).

Paternity leave

Employees are entitled to a paid leave up to three days when they give birth. Every company reserves the right to grant this leave.

Sick leave

If the employee is afflicted with a disease other than the diseases of their trade or labour accidents covered by Decree-Law No. 25/ ET of 4 May 1943, they shall be entitled to sick leave if they have completed three months' service with their employer after the completion of any probationary period as follows:

- half a month with full pay and half a month with half pay for the wage-earner or salary-earner who had three months' service or more up to two years' service
- one month with full pay and one month with half pay for the wage-earner or salary-earner who has had more than two years' service and up to four years' service
- one month and a half with full pay and one month and a half with half pay for the employees who have had more than four years' service up to six years' service
- two months with full pay and two months with half pay for the employees who have had more than six years' service up to ten years' service
- two months and a half with full pay and two months and a half with half pay for the employees who have had more than ten years' service.

The employee must notify the employer of the sickness absence as soon as reasonably practicable on the first day of absence and at least once every three days during the absence.

Sick leaves shall be granted on the evidence of a medical report covering the entire period of absence either of the employees' attending doctor, or the doctor of the organisation. The employer is entitled to have the certificate produced by the employees checked by a medical examiner.

These sick leaves may be renewed in the course of the year as many times as is necessary until the maximum time limits listed above. If these leaves exceed one month, the employer is entitled to reduce the annual leave up to eight days.

The employer may not dismiss the employee nor serve on him a dismissal notice while he is on sick leave.

If an employee on sick leave works for another employer during the leave, the main employer is entitled to dismiss the employee and withhold payment for the leave.

Equality and Discrimination

Prohibition of discrimination

The Labour Law prohibits any discrimination that prejudices equal opportunity employment, equal access to jobs, equal continuity of employment or equal enjoyment of rights, and bans discrimination between employees with the same work duties. This general prohibition does not specify any particular grounds on which discrimination is unlawful (i.e. sex, race or age).

The employer may not discriminate between working men and women with regard to:

- type of work
- amount of wage or salary
- employment
- promotion
- professional qualifications
- apparel.

Employees' obligations and rights

Employers have general duties to:

- ensure, as far as is reasonably practicable, their employees' health, safety and welfare at work
- provide and maintain a workplace that is without risks to employees' health and safety.

They must, as far as is reasonably practicable:

- ensure adequate systems are in place that minimise risks to health relating to fire hazards and the use, handling, storage and transport of dangerous articles and substances
- provide information, instruction, training and supervision to employees, in English or, if necessary, another language understood by the employees, to ensure their health and safety at work
- inform each employee in writing at the time of recruitment of the dangers, if any, connected with the employment and of the protective measures the employee must take
- provide and maintain adequate and safe access to, and from, the workplace
- provide any other facilities or meet any other requirements as prescribed in OHS rules/regulations.

Termination of Employment

Termination by the employer

The employer may terminate by giving a required notice and giving a severance pay and may also dismiss an employee without notice on certain misconduct-related grounds.

However, if the employer dismisses an employee with notice for “arbitrary” reasons, the employee may claim compensation.

The employer and the employee shall each have a right to terminate at any time the work contract of unspecified duration concluded between them.

However, in case of misuse or abuse of this right, the aggrieved party shall be entitled to claim indemnity assessed in conformity with the following bases.

- In case termination comes from the employer, indemnity shall be assessed in accordance with the:
 - nature of the job
 - employee's age
 - employee's service period
 - employee's family status
 - employee's health condition
 - scope of the prejudice and the extent of misuse of that right

On condition that indemnity as awarded by the Court shall be neither less than the wages of two months nor higher than the wages of 12 months over and above those indemnities reverting to the employee due to the fact of the dismissal.

- In case termination comes from the employee on grounds other than those authorised by the law, and if it should be proved that has caused prejudice or embarrassment to the employer, indemnity for damages shall be valued at the equivalent of between one and four months' wages depending on the case, over and above the indemnity.

The party who should deem that the termination is the outcome of misuse or abuse of right, shall have to institute proceedings to this result before the Conciliation Board within a time limit of one month dating from the notification of termination with all modes of evidence.

The Conciliation Board shall adjudicate within a maximum time limit of three months.

The party who should breach the provisions of the preceding paragraph shall be liable to pay to the other party an indemnity equal to the amount of wages of the time limit of notice set by law.

Summary dismissal

An employer is entitled to dismiss an employee without notice if the employee:

- claims a false identity or nationality, or submits false certificates or documents
- is undergoing a probationary period (see Probationary Periods)
- commits an error that results in major material losses to the employer; however, the employer is required to inform in writing the Social Affairs Service of this violation within three days of the organisation of the fact
- has been convicted of an act or rendered himself guilty of a deliberate negligence with intent to cause material damage to the employer's prejudice
- fails to perform their main duties in accordance with the employment contract and does not remedy such a failure despite written warnings of the matter; repeated warnings which have been served to the employee in writing three times in the course of a single offence will lead to lawful termination
- reveals any business secrets related to the company where the employee is employed
- is found during working hours to be in a state of drunkenness or under the influence of narcotics
- has been sentenced to a year's imprisonment or more for a crime they have committed or if they have been guilty of an offence on the premises of their work and during work hours
- has been condemned for facts or acts designated and sanctioned by article 344 of the Penal Code
- assaults the employer, a manager or another employee in the course of work
- is absent without valid cause for more than seven consecutive days, or more than 15 non-consecutive days in one year; the employer must give the employee written warning of the number of days during which the employee was absent, otherwise, the case will be considered groundless
- commits an unprovoked assault on the employer on the premises.

On the other hand, the employee is entitled to leave work before the date provided for in the contract and without prior notice if the employer:

- has deceived the employee as to the conditions of work at the time when the contract was concluded; but the employee loses his right from such argument if thirty days have passed since his starting date
- does not honour his obligations towards the employee in conformity with the requirements of the Labour Law
- commits a misdemeanour offence on the person of the employee or on a member of his family
- is guilty of assault on the employee's person.

External factors

The employer shall be entitled to terminate all or part of his organisation's work contracts in the event of force majeure or of compelling economic or technical circumstances, such as reduction of the size of the organisation.

The employer shall be required to notify the Ministry of Labour and Social Affairs of any intent to terminate those contracts one month prior to the execution and shall equally be required to consult the Ministry of Labour on the scheduling of laying off the employees, taking into consideration employees' seniority in the organisation, their specialisation, their age, their family and social status, and finally the means deemed necessary for their re-hiring.

Employees laid off due to an external factor as stated above, shall have the benefit, within one year of their discharge, of priority for being re-hired in the organisation from which they were laid off if work is resumed normally.

Equally benefiting from the dismissal indemnity, the woman employee who is bound to leave service due to marriage on condition that she serves advance notice, is served to the employer within the notice period and that the employee has been employed for more than one year. The indemnity is payable only when marriage has been established.

Retirement

The employee of 60 years of age or who has 25 years' service in the same organisation may, on request, be dismissed and benefit from the dismissal indemnity.

This same employee also has the right to continue to work until the age of 64 years; at this age, the employee's subjection to the provisions of the Code of Labour, and therefore to the rules regarding dismissal indemnity, shall end, unless the organisation where the employee works or the group work contract allows work beyond the age of 64 years.

If an employee requests the payment of indemnity at the age of 60 or after 25 years' service in the same organisation, they shall have no right to a new dismissal indemnity in case they stay in employment until the age of 64.

Final settlement

The pay to be taken for the assessment of indemnities referred to is the last one paid before dismissal for the dismissal advance notice.

Pay is understood to be the basic remuneration calculated at the time and encashed by the employee as well as the allowances and commissions added to the basic pay.

If pay was calculated in whole or in part on the basis of commission, account shall be taken of the average sum actually encashed by the employee during the twelve-month period before dismissal.

Arbitrary dismissal

If an employer dismisses with notice an employee on an indefinite-term contract, this is considered "arbitrary" if the cause of termination is not "related to the work". It is specifically arbitrary to dismiss an employee for filing a serious complaint against the employer with the public authorities, or bringing a valid claim against the employer, or to dismiss a pregnant employee.

"Arbitrary" is not otherwise defined by the Labour Law or other statutes. In practice, dismissals generally tend to be found not to be arbitrary if related to misconduct, poor performance, redundancy or business reasons, and if the employer has followed appropriate and fair procedures, i.e. the constitutional disciplinary procedure (see Disciplinary Matters) in the case of a disciplinary dismissal.

One or several Arbitration Boards shall be set up in each Governorate to have jurisdiction on disputes taking place between the employer and employee regarding matters, specifically terminations.

This Board shall be composed of:

- a judge, of the 11th grade or above:
 - to be appointed by Decree on the proposal of the Minister of Justice
 - after the approval of the Higher Council of the Bench
- an employer's representative and a worker's representative:
- to be appointed by Decree on the proposal of the Minister of Labour and Social Affairs.

Another two deputy members will be appointed, one representing the employer and the other representing the employees, in case of absence or excuse, by decree on the proposal of the Minister of Labour and Social Affairs.

The acting representatives of employers and employees must meet the following conditions:

- have a Lebanese nationality
- are 20 years of age
- have suffered no conviction for dishonourable offences or crimes
- have carried on their profession for at least five years.

The arbitration Board deals with:

- disputes arising from the assessment of the minimum pay
- disputes arising from labour accidents covered by Legislative Decree No. 25 of 4 May 1943
- disputes arising from dismissal, negligence of work, and fines.

Such disputes are exempted from juridical fees; as with Court expenses, these are borne by the losing party.

Resignation

An employee may terminate an indefinite-term employment contract at any time by giving the employer the required notice, or payment in lieu (see Notice Periods). An employee is entitled to resign without notice if the employer breaches its legal or contractual obligations towards the employee, or if the employer or its legal representative assaults the employee; in such cases, the employee can seek compensation, as for arbitrary dismissal (see Arbitrary Dismissal).

Notice periods

Notice periods must be given in writing.

During a notice period, the employee must be paid their full wages and must continue to carry out their job, unless the employer does not require this.

The employer or employee may pay the other party in lieu of all or part of the notice period, at the employee's normal wage rate.

The employer and the employee shall each be required to advise the other of intent to terminate the contract as follows:

- one month in advance in the case of the employment duration being more than three months and less than three years
- two months in advance in the case of the employment duration being more than three years and less than six years
- three months in advance in the case of the employment duration being more than six years and less than twelve years
- four months in advance in the case of the employment duration being more than twelve years.

The dismissal notice period may not be served on:

- the expecting mother
- the woman on delivery holiday
- any employee on ordinary holiday or on sick leave.

However, the employer is not obliged by these restrictions if the employee has found employment elsewhere in the course of the said holiday.

If the employer fails to comply with the rules regarding the dismissal notice, he shall have to pay the employee the wage or salary for the days comprised in the time limit of the notice, or those for the days during which the dismissal notice may not be served.

Prior notice shall be affected in writing and shall be notified to the interested party; the latter shall be entitled to require clarification of the causes on which termination is grounded if such causes are not indicated in the text of the notice.

Other forms of termination

The employer and employee can terminate the employment contract at any time by mutual consent, as long as the employee's consent is expressed in writing.

The employment contract terminates on the employee's death or medically certified total disability. If the employer is an individual, the employment contract does not automatically terminate on their death, unless the contract relates to the employer's person.

End-of-service

Employees who have at least one year's service (excluding any days of unpaid absence) are in many circumstances entitled under the Labour Law to a statutory "End-of-Service Gratuity/ Indemnity" on termination of employment.

- The gratuity is neither calculated as less than wages of two months nor higher than the wages of twelve months over and above those indemnities reverting to the employee due to the fact of the dismissal.
- The wages on which the gratuity is calculated exclude all bonuses and allowances, overtime pay and payments in kind.
- The gratuity included the notice period (see Notice Periods).
- The gratuity included the annual leaves entitled to the dismissed employee.

Where the employer dismisses an eligible employee, they are entitled to a statutory end-of-service gratuity except in the case of summary dismissal on valid grounds (see Summary Dismissal).

In case termination comes from the employee on grounds other than those authorised by the law, and if it should be proved that has caused prejudice or embarrassment to the employer, indemnity for damages shall be valued at the equivalent of between one and four months' wages depending on the case, over and above the indemnity.

Challenging dismissals

If an employee believes that they have been arbitrarily dismissed (see Arbitrary Dismissal), summarily dismissed without justification (see Summary Dismissal), or dismissed without the due notice or procedure, they may make a complaint to the Ministry of Labour, which will seek to broker an amicable settlement. If this is unsuccessful, the Ministry may authorise the employee to bring a case in the labour courts.

If the court finds that an employee has been arbitrarily dismissed or without justification, it may order the employer to pay compensation to the employee. The court bases the compensation on the type of work, the extent of damages incurred to the employee, the duration of employment and the work conditions.

Disciplinary matters

The Labour Law permits the employer to impose the following disciplinary sanctions.

- Verbal Warning and Written Warnings
 - Written warnings which have been served to the employee three times during a single offence will lead to lawful termination.
 - Every warning should be submitted to the Ministry of Labour within a three-day time frame after the employer and the employee sign on it. The employee reserves the right to sign or not to sign. In the case of no signature, the employer can write “the employee has been served and abstained to sign”
 - The warnings must be submitted, signed and stamped at the Ministry of Labour.
 - A copy will be given to the employer to be saved in the employee's personal file.
- Fines due to negligence of work or any misconduct or misuse, which may be set as a specific amount; the fine for a single disciplinary offence must not exceed three days' pay and the sums deducted from pay in respect of fines must not exceed five days' wages per month.

Fines are no longer applicable if fifteen days have passed on the violation or misconduct of the employee. The fines' details shall be saved in the employee's file and the payroll:

- the name of the employee
- the nature of his offence
- the date
- the importance of the penalty.

An employer may make deductions from an employee's wages to pay for the repair or replacement of tools, machines, products or materials that have been lost, damaged or destroyed because the employee was at fault or breached the employer's instructions. If it does so, it must not impose a disciplinary sanction for the same fault or breach.

However, in no case can the sums withheld exceed in a single month the amount of five days' pay.

- Dismissal with a full end-of-service gratuity
- Dismissal with no end-of-service gratuity; this is permitted only in the circumstances where summary dismissal is valid (see Summary Dismissal).

An employer must not impose a disciplinary sanction on an employee unless it has notified them in writing of the charges, heard and investigated the employee's defense, and recorded the matter (and the sanction imposed) in their personal file.

An employer must not impose more than one disciplinary sanction for the same offence.

Data protection

Data privacy is protected in a general manner by the Penal Code, which makes it a criminal offence to use or disclose individuals' personal data without their consent. Under the Civil Code, an individual whose rights are breached in this way may bring a court case seeking compensation/damages and/or an order to end the infringement. There is no specific legislation on data protection in the employment context but the Penal Code's provisions indicate that employers can collect and use personal data only with the consent of the employee or job applicant concerned.

Record keeping, rules and regulations

Employers that employ at least five employees must (under the Labour Law) keep a file for each employee, stating their name, occupation, age, nationality, address, marital status, date of employment, wages (and any adjustments to them), any disciplinary sanctions penalties imposed, and occupational injuries and diseases sustained, and the date of and reasons for termination of employment. The file must include a leave card, recording annual leave, sick leave and other leave taken.

Employers that employ at least 15 employees must keep at every workplace:

- a payroll record stating for all employees the date employment started and ended, the days worked, the amount of daily, weekly or monthly wages paid, fringe benefits and any piecework or commission payments
- a record of all occupational injuries and diseases sustained
- “basic work regulations”, approved by the public labour authorities and displayed prominently, stating the daily working hours, the weekly rest period, public holidays, and the measures and precautions taken for the prevention of occupational injuries and fire hazards
- disciplinary rules, approved by the public labour authorities and displayed prominently, stating the applicable disciplinary offences and sanctions (see Disciplinary Matters).

ONE FINAL WORD!***Lebanon: From Switzerland of the Middle East to modern-day dystopia!***

After years of delusory economic policies enforced by a corrupt elite, Lebanon is experiencing a painful awakening. The coffers of a nation long renowned as the Switzerland of the Middle East are empty, the underbelly of its banking system - delivering artificial interest rates - exposed, and the Lebanese people given a full reality check, two years into the Lebanese economic catastrophe.

The economy's rapid deterioration has shattered Lebanese society, plunging sections of the working class, middle class, poor, and well-off into poverty and toppling a financial system described as a nationally supervised Ponzi scheme.

Following the civil war in Lebanon from 1975 to 1990, successive governments implemented financial engineering policies in an attempt to reclaim Lebanon's former reputation as the Middle East's Switzerland, a distinction owed more to the banking secrecy of its financial institutions than to its mountains.

This utopian linkage has given rise to a very real dystopia today: the myth of the Lebanese economic miracle, culminating in the monetary curse of the central bank governor, Riad Salameh, a man formerly referred to as a "financial genius." The illusion has worn off, and with the onset of the country's worst-ever socioeconomic crisis - including the civil war years - it is evident that Lebanon's central bank governor has stepped over to the dark side.

The once Middle Eastern stronghold is now nothing more than a piggy bank with a padlock for those who didn't get their cash under their mattress in time. The country has become a vast theatre, where depositors and bankers are engaged in a strange and cruel conflict.

Why Lebanon's internal collapse seems unstoppable

Savers are being shut out of dollar accounts or told that the monies they may access are worth less in this bizarre circumstance. "This is not a dollar," the Lebanese may well reason, for not only are withdrawals limited, but greenbacks in the country of cedars are instantaneously changed into multi-colored piles of worthless Lebanese pounds. In other words, a clutch of Monopoly money in a game where only the depositors go to jail - sentenced for daring to try to undermine the system one October evening in 2019.

Growing unlawful financial practices and bank closures in the aftermath of the popular uprising in October 2019 may have accelerated the Lebanese crisis, but danger had been festering for some time. International investments had already dried up, and the cash looted for years by a corrupt elite lubricating the Lebanese financial system had already sailed to more pleasant shores - offshore tax havens, as some would call them.

While the country devolves into inexorable bankruptcy, the usual suspects sit pretty and unconcerned, mutually absolving themselves of any wrongdoing and clinging to the reins of power of a non-existent state - even if it means sacrificing Lebanon's entire population in the name of political survival. When you strike a bargain with the devil, though, you have to live with the consequences!

Legends and dystopias are the stuff of fiction, and trusting them too much might lead to delusional behavior. Truth is stranger than fiction, as the shocking degradation of Lebanon over the last two years has demonstrated. The tale of Lebanon could begin as follows: Once upon a time, there was a country renowned as the Middle East's Switzerland. And, to be honest, that's where the story ends.

Lebanon as we previously knew it, the Middle East's Switzerland, with Beirut as the Middle East's Paris, is no longer! I never imagined I'd live to see the end of Lebanon, but that's exactly what we're seeing right now! Since 2019, the currency has lost over 90% of its value; 78 percent of the population is estimated to be poor; severe fuel and diesel shortages exist; society is on the verge of collapsing; the population is physically, psychologically, and emotionally exhausted, and life has been reduced to the necessities of survival.

Sitting down to work is nearly impossible because my laptop's battery only lasts for so long. In my community, government-supplied energy is only accessible for 2 to 3 hours per day, and private community generators only run for maximum 10 hours before shutting down at midnight until morning. As a result, I'm behind on every deadline, and I've sent a lot of sorry emails. I'm not sure what I'm supposed to say at this point. "My nation is falling"!

Nowadays, Lebanese people who do not want to risk attempting the perilous Mediterranean crossing are swarming in government offices to get visas for any potential destination. They're looking beyond the water, where the blaze of green, the green light of promise - and the dollar - beckons.

Because the almighty greenback is the ticket out of Lebanon, Lebanese people carefully stash their dollars (at home) while waiting for the big departure. The dollar, Lebanon's lifeline, is traded on the underground market at a rate that is changing the country's society. Simply ask, "What currency are you paid in?" to distinguish the former rich from the new poor!

In the end, many Lebanese have chosen to say their final goodbyes, creeping to the airport like tortoises, their houses on their backs, after admirably sticking in for so long.

World Safety Organization (WSO)

The WSO was founded in 1975 in Manila, The Republic of the Philippines, as a result of a gathering of over 1,000 representatives of safety professionals from all continents at the First World Safety and Accident Prevention Congress. The WSO World Management Center was established in the United States of America in 1985 to be responsible for all WSO activities, the liaison with the United Nations, the co-operation with numerous Safety Councils, professional safety/environmental (and allied areas) organizations, WSO International Chapters/Offices, Member Corporations, companies, groups, societies, etc. The WSO is a non-profit, non-sectarian, non-political organization dedicated to: "Making Safety a Way of Life ... Worldwide."

World Safety Organization Activities

WSO publishes WSO Newsletters, World Safety Journal, and WSO Conference Proceedings.

WSO provides a network program linking various areas of professional expertise needed in today's international community.

WSO develops and accredits educational programs essential to national and international safety and establishes centers to support these programs.

WSO receives proposals from professional safety groups/societies for review and, if applicable, submits them to the United Nations for adoption.

WSO presents annual awards: The James K. Williams Award, Glenn E. Hudson International Award, J. Peter Cunliffe Transportation Award, Concerned Citizen, Concerned Company/Corporation, Concerned Organization, Educational Award, WSO Chapter/National Office of the Year, and Award for Achievement in Scientific Research and Development.

WSO provides recognition for safety publications, films, videos, and other training and media materials that meet the WSO required educational standards.

WSO establishes and supports divisions and committees to assist members in maintaining and updating their professional qualifications and expertise.

WSO has Chapters and National/International Offices located throughout the world, providing contact with local communities, educational institutions, and industrial entities.

WSO organizes and provides professional support for inter-national and national groups of experts on all continents who are available to provide expertise and immediate help in times of emergencies.

Benefits of Membership

WSO publishes the "WSO Consultants Directory" as a service to its Members and to the Professional Community. Only Certified Members may be listed.

WSO collects data on the professional skills, expertise, and experience of its Members in the WSO Expertise Bank for a reference when a request is received for professional expertise, skill, or experience.

WSO provides a network system to its Members whereby professional assistance may be requested by an individual, organization, state, or country on a personal basis. Members needing assistance may write to the WSO with a specific request, and the WSO, through its Membership and other professional resources, will try to link the requester with a person, organization, or other resource which may be of assistance.

WSO provides all Members with a Membership Certificate for display on their office wall and with a WSO Membership Identification Card. The WSO awards a Certificate of Honor Membership to the

corporations, companies, and other entities paying the WSO Membership and/or WSO Certification fees for their employees.

Members have access to WSO Newsletters and other member-ship publications of the WSO on the WSO website, and may request hard copies by contacting the WSO World Management Center. Subscription fees apply to certain publications.

Members are entitled to reduced fees at seminars, conferences, and classes given by the WSO. This includes local, regional, and international programs. When Continuing Education Units (CEUs) are applicable, an appropriate certificate is issued.

Members who attend conferences, seminars, and classes receive a Certificate of Attendance from the WSO. For individuals attending courses sponsored by the WSO, a Certificate of Completion is issued upon completion of each course.

Members receive special hotel rates when attending safety pro-grams, conferences, etc., sponsored by the WSO.

Membership

The World Safety Organization has members who are full time professionals, executives, directors, etc., working in the safety and accident prevention fields, including university professors, private consultants, expert witnesses, researchers, safety managers, directors of training, etc. They are employees of multinational corporations, local industries, private enterprises, governments, and educational institutions. Membership in the World Safety Organization is open to all individuals and entities involved in the safety and accident prevention field, regardless of race, color, creed, ideology, religion, social status, sex, or political beliefs.

Membership Categories

Associate Membership: Individuals connected with safety and accident prevention in their work or individuals interested in the safety field, including students, interested citizens, etc. **Affiliate Membership:** Safety, hazard, risk, loss, and accident prevention practitioners working as full time practitioners in the safety field. Only Affiliate Members are eligible for the WSO Certification and Registration Programs.

Institutional Membership: Organizations, corporations, agencies, and other entities directly or indirectly involved in safety activities and other related fields.

Sustaining/Corporate Member: Individuals, companies, corporations, organizations or other entities and selected groups, interested in the international effort to "Make Safety A Way of Life ... Worldwide."

The WSO Membership Application is included on the following pages and is also available on the WSO website: <https://worldsafety.org/quick-downloads/>

WSO – Application for Membership

- ☒ Application Fee \$20.00 USD
☐ Associate Membership \$65.00 USD
☐ Affiliate Membership \$90.00 USD
☐ Institutional Membership*) \$195.00 USD
☐ Corporate Membership*) \$1000.00 USD

*) In case of institution, agency, corporation, etc., please indicate name, title, and mailing address of the authorized representative.

(Please print or type.)

NAME (Last, First, Middle) <input type="checkbox"/> Mr. <input type="checkbox"/> Ms. <input type="checkbox"/> Mrs. <input type="checkbox"/> Dr. <input type="checkbox"/> Engr.	
BIRTHDATE:	
POSITION/TITLE:	
COMPANY NAME AND ADDRESS: <input type="checkbox"/> Preferred	
HOME ADDRESS: <input type="checkbox"/> Preferred	
BUSINESS PHONE:	FAX:
CELL PHONE:	HOME PHONE:
E-MAIL ADDRESS(ES):	
PROFESSIONAL MEMBERSHIP(S), DESIGNATION(S), LICENSE(S):	
EDUCATION (degree(s) held):	

REFERRAL

If you were referred by someone, please list his/her name(s), chapter, division, etc.:

WSO Member: _____
WSO Chapter: _____
WSO Division/Committee: _____
Other: _____

PLEASE specify your area of professional expertise. This information will be entered into the WSO "Bank of Professional Skills," which serves as a pool of information when a request for a consultant/information/expertise in a specific area of the profession is requested.

- ☐ Occupational Safety and Health (OS&H)
☐ Environmental Safety and Health (EH&S)
☐ Fire Safety/Science (FS&S)
☐ Safety/Loss Control Science (S&LC)
☐ Public Safety/Health (PS&H)
☐ Construction Safety (CS)
☐ Transportation Safety (TS)
☐ Industrial Hygiene (IH)
☐ Product Safety (PRO)
☐ Risk Management (RM)
☐ Hazardous (Toxic) Materials Management (HAZ)
☐ Nuclear Safety (NS)
☐ Aviation Safety (AS)
☐ Ergonomics (ERG)
☐ Petroleum (PS)
☐ Oil Wells (OW)
☐ Other: _____

PAYMENT OPTIONS

For secure Credit Card Payment, please visit the SHOP on WSO's website (<https://worldsafety.org/shop>) and select "WSO Membership Application Fee" to make your payment. You will receive an emailed invoice for the Membership Fee upon approval.

Check or Money Order payable to WSO may be mailed with application packet to: WSO-WMC, Attn: Membership Coordinator, PO Box 518, Warrensburg MO 64093 USA. International postal money orders or bank drafts with a U.S. routing number are acceptable for applicants outside the United States. For alternate payment arrangements, please contact WSO-WMC.

Annual dues hereafter will be billed and payable on the anniversary date of your membership. U.S. funds only.

By submitting this application, you are accepting that WSO will use the information provided to perform an independent verification of employer, credentials, etc.

Mail or email completed form, along with current résumé/CV:

WSO World Management Center

PO Box 518 | Warrensburg, Missouri 64093 USA

Phone 660-747-3132 | FAX 660-747-2647 | membership@worldsafety.org



Student Membership Application

WORLD SAFETY ORGANIZATION

Instructions | Complete all applicable fields and mail to WSO World Management Center, PO Box 518, Warrensburg, MO 64093 USA, email to membership@worldsafety.org, or fax to 1-660-747-2647. For assistance completing this application, please call 1-660-747-3132, or email questions to membership@worldsafety.org.

Membership Level | Choose One

☐ College/University Student Membership – FREE

You will receive all member benefits including subscriptions to WSO World Safety Journal and WSO NewsLetter, as well as access to WSO's Mentor Program.

☐ Middle/High School Student Membership – FREE

You will receive all member benefits including subscription to WSO World Safety Journal and WSO NewsLetter, excluding access to WSO's Mentor Program.

Last Name/Family Name

First Name/Given Name

Initial

☐ M ☐ F
(Gender)

Birthdate MM / DD / YYYY (Application must include exact birthdate with year to be processed.)

Current Street Address ☐ On Campus ☐ Off Campus (Attach separate sheet if you need more room for your address.)

City

State/Province

Country

Zip/Postal Code

Telephone Number (including area code)

☐ Landline ☐ Mobile
(Type)

Permanent Street Address

City

State/Province

Country

Zip/Postal Code

Telephone Number (including area code)

☐ Landline ☐ Mobile
(Type)

Send mail to: ☐ Current Address ☐ Permanent Address

Email Address(es)

COLLEGE/UNIVERSITY STUDENT

Category: ☐ Undergraduate ☐ Graduate/Post-Graduate

Degree(s) Sought/Obtained

Name of College/University

Campus

MIDDLE / HIGH SCHOOL STUDENT

☐ I am a Middle Schooler in: ☐ 6th Grade ☐ 7th Grade ☐ 8th Grade

☐ I am a High School: ☐ Freshman ☐ Sophomore ☐ Junior ☐ Senior

Name of School

Approximate Date of Graduation (MM / YYYY)

(For High School and College/University students, application must include approximate date of graduation to be processed.)

If you were referred by someone, please list name(s), chapter, division, etc.:

WSO Member: _____

WSO Chapter/National Office: _____

WSO Division/Committee: _____

Other: _____

What Interests You?

Please specify your area(s) of interest. These areas of interest will allow you to connect with others who share similar interests throughout the world.

- ☐ Occupational Safety and Health (OS&H)
- ☐ Environmental Safety and Health (EH&S)
- ☐ Fire Safety/Science (FS&S)
- ☐ Safety/Loss Control Science (S&LC)
- ☐ Public Safety/Health (PS&H)
- ☐ Construction Safety (CS)
- ☐ Transportation Safety (TS)
- ☐ Industrial Hygiene (IH)
- ☐ Product Safety (PRO)
- ☐ Risk Management (RM)
- ☐ Hazardous (Toxic) Materials Management (HAZ)
- ☐ Nuclear Safety (NS)
- ☐ Aviation Safety (AS)
- ☐ Ergonomics (ERG)
- ☐ Petroleum (PS)
- ☐ Oil Wells (OW)
- ☐ Other: _____

Required Signatures & Permissions

I subscribe to the above record and when approved will be governed by the Constitution and By-Laws of WSO and its Code of Ethics as I continue as a member. I furthermore agree to promote the objectives of the WSO wherever and whenever possible.

X

Applicant Signature

Date

FOR MID/HIGH SCHOOLERS ONLY: WSO subscribes to the Family Educational Rights and Privacy Act (FERPA) philosophy in protecting student privacy and information. WSO may disclose "directory" information such as a student's name, WSO Student Chapter affiliation, name of school, grade in school, etc., along with group or individual photos in WSO NewsLetters, NewsFlashes, eNews, on WSO website, and on WSO's social media accounts.

- ☐ My student has permission to participate as outlined above.
- ☐ My student has permission to participate with exclusions:

X

Parent/Guardian Signature (Mid/High Student)

Date

X

WSO Student Chapter Mentor Signature
(IF APPLICABLE)

Date

WSO – National Offices

WSO National Office for Algeria

c/o Institut des Sciences et de la Technologie (I.S.T.)
attn: Mr. Ferhat Mohia, Director
contact: ferhatmohia@yahoo.fr

WSO National Office for Australia

c/o Curtin University of Technology
attn: Dr. Janis Jansz, Director
contact: j.jansz@curtin.edu.au

WSO National Office for Austria

c/o Payesh System Mehr Engineering Company
attn: Dr. Majid Alizadeh, Director
contact: majidealizadeh@gmail.com

WSO National Office for Cameroon

c/o Cameroon Safety Services
attn: Mr. Clement B. Nyong, Director
contact: ny.clement@yahoo.com

WSO National Office for Canada

c/o Apex One Management Group
attn: Mr. Michael Brown, Director
contact: michael.brown@worldsafetycanada.ca |
mike@apexone.com
website: worldsafetycanada.ca

WSO National Office for Ghana

c/o Ghana National Fire Service
attn: Mr. Peter Oko Ahunarh, Director
contact: pahunarh23@gmail.com

WSO National Office for India

c/o Indian Society of Safety Engineers (I.S.S.E)
attn: Mr. T.Shankar, Director
contact: support@worldsafety.org.in

WSO National Office for Indonesia

c/o Prosafe Institute
attn: Mr. Soehatman Ramli, Director
contact: soehatmanramli@yahoo.com

WSO National Office for Iran

c/o Payesh System Mehr Engineering Company
attn: Mrs. Fatemeh Gilani, Director
contact: gilani@imsiran.ir

WSO National Office for Iraq

c/o NAYA Engineering Services & Training
attn: Dr. Eng. Khaldon Waled Suliman, Director
contact: naya_engineering_services@yahoo.com

WSO National Office for Lebanon

c/o Ministry of Transport
attn.: Dr. Elias M. Choueiri, Director
contact: elias.choueiri@gmail.com

WSO National Office for Myanmar

c/o Win Oshe Services Co., Ltd
attn.: Mr. Win Bo, Director
contact: winbo@osheservices.com

WSO National Office for Nigeria

c/o DanaRich Creative Concept, LTD
attn.: Mr. Soji Olalokun, WSO-RSD, Director
contact: info@worldsafety.org.ng
website: worldsafety.org.ng

WSO National Office for Pakistan

c/o Greenwich Training & Consulting
attn: Mr. Tayyeb Shah, Director
contact: doctimes@gmail.com

WSO International Office for Philippines

attn.: Engr Alfredo A. De La Rosa Jr., Director
contact: info@wsophil.org

WSO National Office for Saudi Arabia (KSA)

c/o The Academy of Sciences for Medical Education
attn: Mr. Rocky Binuya, Director
contact: info@aos-ksa.com | binuya.rocky@gmail.com
website: <https://aos-ksa.com/en>

WSO National Office for United Arab Emirates (UAE)

c/o Tatweer Industrial Inspection & Training Services LLC
attn: Miss Nazya Robin, Quality Manager & Director
contact: info@tiits.ae

WSO National Office for Vietnam

c/o Safety Training & Consulting Limited
attn: Mr. Binh Pham, WSO-CSI(ML), Director
contact: binh.pt@worldsafety.org.vn |
binh.pt@safety.edu.vn
website: worldsafety.org.vn

World Safety Organization Code of Ethics

*Members of the WSO,
by virtue of their acceptance of membership
into the WSO,
are bound to the following Code of Ethics
regarding their activities associated with the WSO:*



Members must be responsible for ethical and professional conduct in relationships with clients, employers, associates, and the public.



Members must be responsible for professional competence in performance of all their professional activities.



Members must be responsible for the protection of professional interest, reputation, and good name of any deserving WSO member or member of other professional organization involved in safety or associate disciplines.



Members must be dedicated to professional development of new members in the safety profession and associated disciplines.



Members must be responsible for their complete sincerity in professional service to the world.



Members must be responsible for continuing improvement and development of professional competencies in safety and associated disciplines.



Members must be responsible for their professional efforts to support the WSO motto:

“Making Safety a Way of Life...Worldwide.”



Published by the WSO National Office for Lebanon
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