ORIGINAL ARTICLE

# Occupational Risk Assessment of COVID-19 Exposure: A Case Study in a Bank Setting

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## Abstract

**Background:** The rise of COVID-19 in the 21st century has posed challenges for national and international communities. Meanwhile, people who work in high-risk jobs in terms of biological exposure, such as banks, are more likely to be exposed to coronavirus. This study aimed to investigate the risk of probability and clinical severity of COVID-19 infection among employees of one of the bank branches in Shiraz, Iran.

**Methods:** In this study, the risk of infection to Covid-19 among the desired bank branch employees was assessed using the Covid-age index. The related information was gathered through observation and face-to-face interviews using workplace risk assessment for exposure to SARS-COV-2 virus guidelines. Moreover, the International Labor Organization risk assessment standard was used to quantify the individuals' risks.

**Results:** The average COVID-19 risk score among studied employees was 4.6, categorized as low. Moreover, the employees' mean age and Covid-age index were 44.7±3.65 and 47.6±4.52, respectively. The severity of the clinical picture was evaluated as mild to moderate (levels 1 and 2). Moreover, the risk of disease was considered 2 for all employees, considering the work environment.

**Conclusion:** The results of this study showed that the Covid-age index could effectively evaluate and quantify the risk of exposure to COVID-19. Bank personnel is exposed to the biological risk of COVID-19. People with the underlying disease are at higher risk of COVID-19 consequences.

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**Keywords:** Bank setting, COVID-19, Covid-age, Risk assessment exposure

## Introduction

The World Health Organization recognized COVID-19 on March 11, 2019 as a disease that could potentially create many challenges for health professionals and technicians.[1] The COVID-19 pandemic has so far seriously damaged the public health of millions and even caused many deaths in various communities.[2] As the global COVID-19 epidemic progresses, many factors about the dynamics of the disease and its risk factors remain unknown. In the meantime, a better understanding of the clinical factors affecting the severity of COVID-19 can improve the management of this disease throughout the healthcare system. To control the spread of this virus, prevent its possible consequences, and reduce the workload of healthcare personnel, the international community has adopted different regulations such as social distancing, closing cities, canceling appointments, and so on.[3,4]

Despite the global community's exposure to infectious diseases similar to COVID-19, such as Ebola and SARS, weaknesses in health, treatment, and social systems still indicate a lack of adequate resilience.[5] Meanwhile, with the spread of the COVID-19 pandemic worldwide, many factors about the dynamics of the disease and its risk factors remain ambiguous.

Understanding the clinical factors affecting disease severity can improve disease management throughout the healthcare system. This issue can be challenging due to the rapid spread of the disease and the lack of accurate patient information.[6] This disease is associated with cases such as 1- Rapid spread, 2- More vulnerability of the old with lower levels of body immunity system, and 3- Different recovery rates.[7] Accordingly, identifying and assessing the risk of exposure to COVID-19 can prevent potentially irreversible consequences or reduce their severity.

COVID-19 is not a disease with a specific orientation, so it is expected to affect healthy people and people with underlying diseases. But studies show that people with underlying diseases make up most of the patients who require intensive care when infected with the virus.[8] Meanwhile, the mortality rate of people with heart disease is about 10.5 times higher than healthy groups.[9, 10] Similar studies have shown that COVID-19 is riskier for groups with lung disease, diabetes, and obesity.[11] Furthermore, diseases such as obesity and diabetes are responsible for 42% and 34% of patients with COVID-19 infections requiring hospitalization.[12] Therefore, assessing the probability and severity of COVID-19 by considering individuals' health parameters can effectively reduce the mortality rate of individuals.

Because of the various natural and environmental conditions of different workplaces and the individual characteristics of employees such as gender, weight, and underlying diseases, the risk of COVID-19 is not the same in all occupations. Moreover, a similar risk may have different effects on people's health. Therefore, concerning the COVID-19 pandemic, it can be concluded that people with weight problems, high blood pressure, kidney disease, and etc., in the case of coronavirus, may experience irreversible consequences and even death. Assessing the risk of exposure to COVID-19 in workplaces and individually for each person is a basic precondition for determining any precautionary actions and activities. This study aimed to evaluate the risk of exposure to coronavirus and its possible consequences among administrative staff in a bank setting because of the frequent exposure of the bank staff to various clients.

## Methods

Four bank branches from north, south, east, and west of Shiraz, were randomly selected to participate in the present study. Finally, the study was conducted among people willing to participate.

In this study, the authors used the Workplace Risk Assessment in the Case of Exposure to SARS CoV-2 Virus published by the Macedonian occupational safety and health association (MOSHA).[13] This guideline explains the risk assessment framework of the workplace in the case of exposure to the COVID-19 using an interrelated causal process. The steps of the study were as follows:

### *Demographic Characteristics of the Participants*

The authors collected demographic characteristics of the target working staff, including age, gender, height, weight, job title, duration of contact with people, frequency of contact with people, and amount of social distance as well as information about the history of underlying diseases (such as asthma, chronic respiratory diseases, diabetes, heart failure, cerebrovascular disease, chronic kidney disease, non-hematologic cancer, liver disease, etc.) by questionnaire and interview with bank personnel.

### *Assessment of the Probability of Exposure to SARS COV-2 Virus at the Workplace*

The probability of workers' exposure to SARS CoV-2 virus at their respective workplaces was assessed based on the "type and characteristics of the work process", "physical contact with patients, clients, associates, and other persons that are suspected to be positive to COVID-19 at a distance that is shorter than 1" and "the duration and frequency of such contacts". Then, the probability of the exposure assessment includes four levels: Very High, High, Moderate/ average, and Low exposure (Table 1).

### *Assessment of the Medical/Clinical Vulnerability*

In this section, the severity of the consequences arising from the potential exposure to SARS CoV-2 virus was evaluated based on the following parameters:

- Very severe clinical image with a high probability of a fatal outcome
- Severe clinical image with a high probability of hospitalization and permanent (irreversible) consequences affecting one's health situation
- Moderately severe clinical image without any

**Table 1:** Categorization of the probability of exposure to SARS COV-2 virus*

| Definition | Level | Score |
|---|---|---|
| There is a very high exposure potential to a confirmed or a suspected source of COVID-19** in the course of specific medical procedures, post-mortem or laboratory examinations. | Very high infection Probability (IPS-4) | 4 |
| The necessity of having frequent and close contact with patients exposed to a known or suspected source of COVID-19 | High infection Probability (IPS-3) | 3 |
| The necessity of having frequent and close contact with persons that may be infected with COVID-19 but have not yet been confirmed and/or exposed to suspected cases. | Average infection Probability (IPS-2) | 2 |
| No necessity to have contact with confirmed and/or suspected cases of COVID-19 | Low infection Probability (IPS-1) | 1 |

*Severe acute respiratory syndrome coronavirus 2; **Coronavirus disease 2019

consequences affecting one's health situation
- Mild clinical image and/or asymptomatic cases

The Covid-age index has been used in the current study since it is a useful tool for assessing the severity of vulnerability or the likelihood of death after COVID-19 infection. This vulnerability assessment is mainly based on the underlying diseases of the individuals (the presence of other ailments not related to COVID-19). Covid-age was calculated by adding years specified for any given medical risk factor to the actual (biological) age (Table 2). For example, a healthy woman and man, aged 40, have a Covid-age of 35 and 40 years, respectively. A woman and man aged 45, BMI 35 with severe asthma have a Covid-age of (45+5+5+3)=58, and (45+5+3)=53 years, respectively.

In this case, the 45-year-old man in the example above is estimated to have the same medical/clinical vulnerability as a man aged 53 years. In contrast, the woman from the example above, with similar age and clinical state to the man (weight and presence of asthma), has a medical/clinical vulnerability of a woman aged 48 years. It implies that her risk of fatality and development for a severe COVID-19 clinical image is lower.

Tables 3 and 4, respectively, present the possibility of developing a clinical image showing the severity and

**Table 2:** COVID-19 clinical vulnerability risk factors and their corresponding equivalence of added years of age

| Risk factor | Relative risk | Equivalence of added years of age |
|---|---|---|
| Female sex | 0.6 | -5 |
| Body mass index (BMI) (Kg/m2) | | |
| 25-29.9 | | 1 |
| 30-34.9 | 1.3 | 3 |
| 35-39.9 | 1.6 | 5 |
| ≥40 | 2.4 | 9 |
| Asthma | | |
| Mild (no oral corticosteroids in the past year) | 1.1 | 1 |
| Severe (used oral corticosteroids in the past year) | 1.4 | 3 |
| Diabetes | | |
| Type 1 | | |
| HbA1c* ≤58 mmol/mol in past year | 2.0 | 7 |
| HbA1c > 58 mmol/mol in past year | 2.7 | 10 |
| HbA1c unknown | 3.3 | 12 |
| Type 2 | | |
| HbA1c ≤ 58 mmol/mol in past year | 1.5 | 4 |
| HbA1c > 58 mmol/mol in past year | 2.0 | 7 |
| HbA1c unknown | 2.3 | 8 |
| Heart failure | 2.2 | 8 |
| Chronic heart disease | 1.3 | 3 |
| Cerebrovascular disease | 2.2 | 8 |
| Chronic respiratory disease (without asthma) | 1.9 | 6 |
| Chronic kidney disease | | |
| Estimated GFR** 30-60 mL/min | 1.5 | 4 |
| Estimated GFR < 30-60 mL/min | 3.0 | 11 |
| History of dialysis and end-of-stage renal disease | 3.7 | 13 |
| Non-hematological cancer | | |
| Diagnosed <1 year ago | 1.7 | 5 |
| Diagnosed 1-4.9 years ago | 1.2 | 2 |
| Diagnosed ≥5 years ago | 1 | 0 |
| Hematological malignancy | | |
| Diagnosed <1 year ago | 2.8 | 10 |
| Diagnosed 1-4.9 years ago | 2.5 | 9 |
| Diagnosed ≥5 years ago | 1.6 | 5 |
| Liver disease | 1.8 | 6 |
| Chronic neurological disease other than stroke or dementia*** | 2.6 | 9 |
| Organ transplant | 3.6 | 12 |
| Spleen diseases**** | 1.4 | 3 |
| Rheumatoid/ lupus/ psoriasis | 1.2 | 2 |
| Other immunosuppressive conditions ***** | 1.8 | 6 |

*Hemoglobin A1c; **GFR<60mL/min/1.73m2, during the latest examination of serum creatinine. ***Chronic neurological disease other than stroke or dementia includes motor neuron disease, myasthenia gravis, multiple sclerosis, Parkinson's disease, cerebral palsy, quadriplegia, hemiplegia, and progressive cerebellar disease. ****Spleen diseases include splenectomy, or spleen dysfunction (e.g. from sickle cell disease). *****Other immunosuppressive condition includes HIV, conditions inducing permanent immunodeficiency (ever diagnosed), aplastic anemia, and temporary immunodeficiency recorded within the past year.

**Table 3:** The probability of developing a clinical image with different severity and occurrence of fatality

| Covid-age | The severity of the clinical image/ consequences | Definition |
|---|---|---|
| >85 | Very severe with a high probability of fatality (T-1) | Very high probability of developing a very severe clinical form of the disease and/or fatality |
| 70-85 | Severe, with a high probability of hospital treatment (T-2) | High probability of developing a severe form of the disease, a high probability of hospitalization, and the development of irreversible health consequences |
| 50-69 | High (T-3) | Lower probability of developing a severe clinical form of the disease |
| <50 | Low (T-4) | Very low probability of developing a severe clinical form of the disease |

**Table 4:** Relative risks of mortality from Covid-19 and estimated case fatality rates per 1000 infected persons

| Covid-age* | Estimated relative risk to that at age 47 years (healthy males) | Estimated case-fatality rate per 1000 in cases of Covid-19 infection |
|---|---|---|
| 20 | 0.1 | 0.1 |
| 25 | 0.1 | 0.2 |
| 30 | 0.2 | 0.3 |
| 35 | 0.3 | 0.6 |
| 40 | 0.5 | 1.0 |
| 45 | 0.8 | 1.6 |
| 47 | 1.0 | 2.0 |
| 50 | 1.4 | 2.7 |
| 52 | 1.7 | 3.3 |
| 54 | 2.1 | 4.1 |
| 56 | 2.5 | 5.1 |
| 58 | 3.1 | 6.2 |
| 60 | 3.8 | 7.6 |
| 62 | 4.7 | 9.4 |
| 64 | 5.8 | 11.5 |
| 66 | 7.1 | 14.1 |
| 68 | 8.7 | 17.4 |
| 70 | 10.7 | 21.3 |
| 72 | 13.1 | 26.2 |
| 74 | 16.1 | 32.2 |
| 76 | 19.8 | 39.6 |
| 78 | 24.3 | 48.6 |
| 80 | 29.9 | 59.7 |

* Coronavirus disease-age

**Table 5:** The risk matrix for risk assessment of COVID-19

| Probability of infection occurrence (index points) | The severity of the consequences of clinical/medical vulnerability | | | |
|---|---|---|---|---|
| | Low (asymptomatic and/or mild clinical image) | Moderate (moderately severe clinical image) | High (severe clinical image) | Very high (potential fatal outcome) |
| Little probable | 2 | 3 | 4 | 5 |
| Moderately probable | 4 | 6 | 8 | 10 |
| Probable | 6 | 9 | 12 | 15 |
| Very probable | 8-12 | 12-15 | 16-20 | >20 |

occurrence of mortality and the relative risks of COVID-19 mortality and the estimated case mortality per 1000 infected individuals. Even if there is no practical knowledge about assessing the overall likelihood of fatal disease outcomes, hospital treatment, and the varying severity of clinical manifestations of COVID-19, Table 4 estimates the potential relative risk of fatal disease outcomes and mortality per 1000 infected people with the disease according to Covid-age.

*Risk Level Determination*

After determining the level of infection probability (Table 1) and clinical image severity (Table 3), the risk of COVID-19 exposure was calculated by the following equation.[14] Finally, the risk probability number (RPN) was calculated by the risk matrix (Table 5). This matrix has been adapted from the international labor organization (ILO) customized for COVID-19.[14]

Risk=Possibility of infection occurrence×Severity of the expected clinical image

## Results

The participants evaluated in this study included ten men working as cashier and bank branch manager.

**Table 6:** Descriptive findings of the study

| Employee No | Age | Risk code | Probability of infection (Table 1) | The relative risk of death (per 100 people) (Table 4) | Clinical image severity (Table 3) | Covid-age* (Table 2) |
|---|---|---|---|---|---|---|
| Employee 1 | 40 | 4 | 2 | 1 | 1 | 41 |
| Employee 2 | 44 | 6 | 2 | 2.7 | 2 | 50 |
| Employee 3 | 47 | 4 | 2 | 2 | 1 | 48 |
| Employee 4 | 41 | 4 | 2 | 2 | 1 | 48 |
| Employee 5 | 47 | 4 | 2 | 2 | 1 | 48 |
| Employee 6 | 46 | 4 | 2 | 2 | 1 | 48 |
| Employee 7 | 50 | 6 | 2 | 5 | 2 | 56 |
| Employee 8 | 40 | 4 | 2 | 1 | 1 | 40 |
| Employee 9 | 43 | 4 | 2 | 2 | 1 | 47 |
| Employee 10 | 49 | 6 | 2 | 2.7 | 2 | 50 |
| Average | 44.7±3.65 | 4.6±0.96 | 2 | 2.24±1.12 | 1.3±0.48 | 47.6±4.52 |

*Coronavirus disease-age

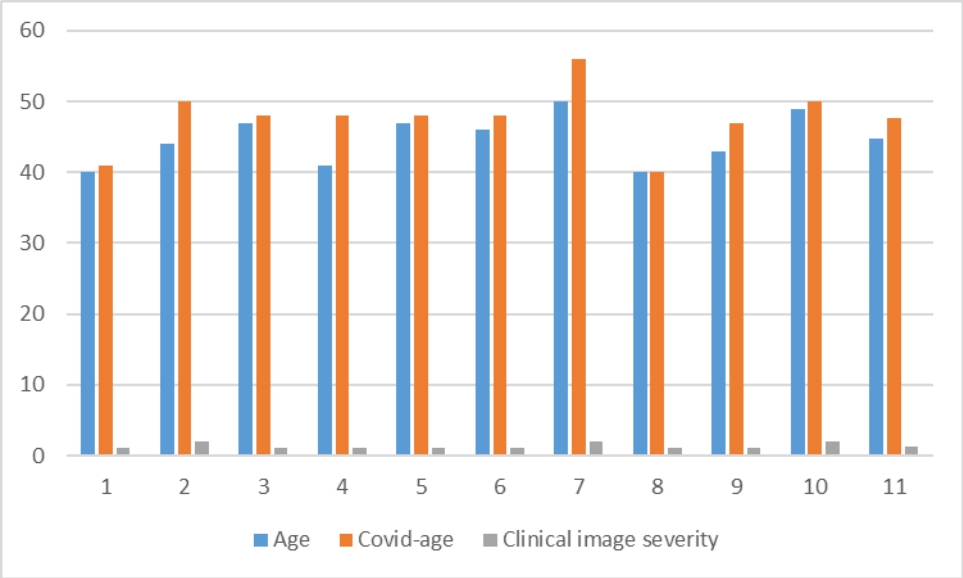


**Figure 1:** The results of biological age, Covid-age, and clinical severity of COVID-19 among the employees of the studied bank setting.

The age range of participants has been between 40 and 60 years. Their health status includes five healthy people and five people with underlying diseases. Table 6 shows that the severity of the clinical picture is low to moderate (levels 1 and 2).

Given that Covid-age is directly related to the actual age of individuals, the health status of individuals also significantly impacts the calculation of Covid-age and the intensity of the clinical image. Figure 1 compares the biological and Covid age and the clinical severity of COVID-19 among studied employees. Generally, the data indicate that employees' vulnerability level and disease risk in the workplace are low.

## Discussion

Risk assessment is considered an important step in reducing disaster risk and increasing risk-related knowledge to eliminate or control it. In addition, the initial mortality risk assessment for patients with COVID-19 disease allows physicians to triage patients and prioritize the resources and capabilities of healthcare systems for individuals.[6] Accurate criteria for measuring the risk factors of COVID-19 disease can increase public confidence.[15] So health risk assessment tools have been developed to assess individual risk for specific diseases.[5]

Each COVID-19 risk assessment tool has its specific capabilities and assesses people's vulnerability in case of infection with COVID-19 by considering various risk factors. In the present study, the applied risk assessment technique considers age, gender, and underlying diseases as the most influential factors determining the consequences of infection by COVID-19. Moreover, this technique provides a quantitative measure of the vulnerability of people.[13] Objective risk stratification (ORS), as another type of health risk assessment tool, considers age, sex at birth, ethnicity, and underlying disease as the contributing factors to severe consequences of infection by COVID-19.[16] The major shortage of this technique is its limitation to healthcare workers. However, the applied technique in the present study is more generalized and can be used in different workplaces. The study was conducted in banks, post centers, and hospitals setting, indicating a medium to high risk of getting an infection with COVID-19,

which is in line with the results of the present study.[17] Disease probability, severity (consequence), and level of health belief are the three components considered in the study (rapid risk analysis technique). Gender, age, and underlying disease seem to be more necessary for risk assessment in exposure to COVID-19 that are not considered in the previous study.

Age could be considered a substantial factor affecting the severity of COVID-19 consequences. This finding means that older people are more vulnerable to COVID-19. Another study, consistent with the current study results, assessed the severity of COVID-19 disease and indicated that age is one of the major risk factors for exacerbating the disease consequences.[18] Another study investigated the age-dependent effects in the transmission and control of COVID-19 epidemics. The study revealed the susceptibility to infection in individuals under 20 years is approximately half of those over 20 years. Moreover, the clinical symptoms existed in 21% of infections in 10- to 19-year-olds, rising to 69% in those over 70 years.[19]

In addition to age, having a history of underlying diseases such as high blood pressure and diabetes can double the severity or consequences of COVID-19.[20] One of the advantages of the technique used in this study is the evaluation of having the underlying disease as an influential factor in increasing the severity of COVID-19 consequences. The results of this study showed that employees with the underlying disease have a higher risk of vulnerability than those without the underlying disease to COVID-19. One study cited high blood pressure as one of the leading underlying diseases in adults in India. It was cited as one of the leading causes of death in people with coronary heart disease.[21] Other studies have cited respiratory problems as the main cause of increased COVID-19 mortality.[22] Another study, consistent with current study, showed an increase in COVID-19 mortality in people with cardiovascular disease, high blood pressure, diabetes, chronic lung disease, and cancer, which is consistent with the results of this study.[23]

Gender is another factor that can increase the severity of the COVID-19 consequences. One study found that men were more vulnerable to COVID-19 disease than women.[5] Of course, evidence indicating the reason for this difference is not yet available. Despite considering gender as a factor influencing the severity of disease consequences in the applied technique, it was impossible to compare the severity of the COVID-19 disease between men and women due to the lack of female employees in the studied bank branches. The aggravating and increasing effects of two variables, age, and gender, on COVID-19 mortality rate were reported in another study.[23] It seems that several behavioral habits, such as smoking, also increase the risk of death in people with COVID-19.[24]

The most important limitation of this study was the small number of employees investigated, which may affect the estimation of the exposure probability, affecting the generalizability of the results to all bank employees. Certainly, it is worth noting that the number of individuals examined for the severity of the outcome component is not a representative sample, as it is affected by age and physiological factors.

## Conclusion

The results of this study indicated that workplace risk assessment based on the calculation of the Covid-age index is an efficient and appropriate technique for screening the Covid-19 risks among employees, especially those with underlying diseases. While this technique carefully examines individuals' clinical conditions, the accuracy of this technique is insufficient to assess workplace risk, so a supplementary technique should be used. In addition to underlying diseases, the applied technique evaluated age and gender for risk assessment; this can be considered the main advantage of this technique.

As the score of the workplace under study was less than 7, indicating a low or partial level of risk, it is recommended to proceed with the work process. Also, the increment of safeguards is recommended.

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