



Effect of obesity on immune response against covid-19

Article information

Article history:

Received May 26, 2021

Accepted July 25, 2021

Available online September 12, 2021

DOI: [10.33899/mjn.2021.169026](https://doi.org/10.33899/mjn.2021.169026) ©2020, College of Nursing, University of Mosul.

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https://mjn.mosuljournals.com/article_169026.html

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Abstract

Background and Aim: In Wuhan, Hubei Province, China, a new coronavirus, now known as SARS-CoV-2, produced a series of acute atypical respiratory diseases in December 2019. A number of studies have investigated for risk factors in attempt to provide prevention and treatment options for the general public. Obesity, along with other comorbidities such diabetes, hypertension, coronary artery disease, and heart failure, has been recognized as a risk factor for catastrophic outcomes in patients with COVID-19 infection. Thus, the present study aimed to determine the association between the incidence of COVID-19 infection and BMI according to the demographic data.

Materials and Methods: This cross-sectional was conducted in the Iraq-Erbil city between 15th October 2020 to 5th of February 2021. Inclusion criteria were participants that tested positive for SARS-CoV-2. The patients classified according to their weight into 6 classes. The semi-quantitative analysis of IgG and IgM anti-SARS-CoV-2 antibodies was carried out for 200 enrolled participants by ELISA and also vitamin and ferritin level measured for the patients.

Results: The incidence of COVID-19 infection was higher among male by 4% than female. The highest percentage of COVID19 infection reported among the age group of (30-39) years old. The prevalence of the mentioned infection was higher among class 1 obesity group. A total of 200 IgG and IgM tests revealed that the underweight and class 3 obese patients had the highest percentage of positive cases in IgG testing by (100 %) while the obese patient class 1 reported highest percentage of positive IgM cases (47.36 percent). Furthermore, the highest number of underweight people (100%) had vitamin D3 deficiency among patients and the highest percentage of iron deficiency anemia was among class 3 obese patients (25%).

Conclusions: The present study concluded gender balance in COVID19 incidence. The infection of COVID-19 was found in all age groups. However, middle age group appears to be more susceptible. The highest IgG and IgM reported among obese patients. The highest number of underweight people had vitamin D3 deficiency. In contrast, the highest percentage of iron deficiency anemia was reported in class 3 obese patients

Keywords: Age, Body Mass Index, COVID-19, Gender, Vitamin D.

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Introduction

Coronavirus disease 2019 (COVID-19) is a global pandemic caused by the coronavirus 2 that causes severe acute respiratory syndrome (SARS-CoV-2) (1). A better understanding of the SARS-CoV-2 virus behavior has become an urgent need as the pandemic caused continues to plague the world adding more and more victims (2). A number of studies have investigated for risk factors in attempt to provide prevention and treatment options for the general public.

It has been observed by the earliest chines investigations that age could influence prognosis

(3, 4). However, with the spread of COVID-19 to Western Europe and North America, some new factors have been identified as risk factors and poor result predictors (2). The main reasons that obesity has emerged as a marker of adverse clinical evolution due to the fact that western European and North American countries have a high prevalence of obesity (5) and during the 2009 influenza A (H1N1) pandemic, obese patients were at a higher risk of hospitalization, complications, and mortality (6). Obesity may be a substantial risk factor in COVID-19, much as it is in influenza (1).

Obesity is defined by the World Health Organization (WHO) as a Body Mass Index(BMI) of 30% or higher, and overweight is defined as a BMI of 25 or higher (7). Obesity is an epidemic globally, causing more than 2.8 million deaths per year worldwide in 2019 (1). Obesity, along with other comorbidities such diabetes, hypertension, coronary artery disease, and heart failure, has been recognized as a risk factor for

Table (1): The incidence of COVID-19 and its relationship with gender

Gender	Number	Percentage
Female	96	48%
Male	104	52%
Total	200	100%

catastrophic outcomes in hospitalized patients with Covid-19 (8,9, 10,11). However, no investigations have been reported to determine obesity and its relationship with the prevalence of SARS-CoV-2 in Iraq. Thus, the present study aimed to characterize the relationship between obesity and incidence of SARS-CoV-2 according to the demographic data in Erbil city/Iraq.

Materials and Methods

This cross-sectional study conducted in the Iraq-Erbil city between 15th October 2020 to 5th February 2021. The sample was drawn from different laboratories. The overall 200 participants enrolled in the study. In English, Arabic, and Kurdish, a multicomponent, self-administered questionnaire was created using Google Forms. Inclusion criteria were participants that tested positive for SARS-CoV-2 while suspected patients were excluded. BMI of the patients obtained by diving the weigh in KG on the height square in Meter The blood samples were collected and the serum stored at -20°C prior to the application (12). The semi-quantitative analysis of IgG and IgM anti-SARS-CoV-2 antibodies was carried out by the NovaLisa SARS-CoV-2 (COVID- 19) IgG and IgM test (NovaTec Immundiagnostica GmbH, Dietzenbach, Germany).

Results

Sex differences in COVID-19 epidemiology The result of the present study showed that of total 200 infected COVID-19 cases, the incidence rate was 48% and 52% for female and male, respectively as shown in Table (1).

Susceptible ages COVID19 infection
It is clear from Table (2) that the highest percentage of COVID19 infection was among the age group (30-39) years which was 63

(32%) while the lowest percentage of the infection was among age group (10-19) which was 4 (2%).

Table (2): The incidence of COVID19 infections according different age groups.

Age	Number	Percentage
10—19	4	2%
20-29	34	17%
30-39	63	32%
40-49	38	19%
50-59	38	19%
60-69	17	9%
≥70	6	3%
Total	200	100%

Associations between BMI and COVID-19
As shown in table (3), the incidence of COVID19 infection was highest in class 1

obesity (86%) and lowest in underweight (0.5%) among 200 patients having a history of the infection.

Table (3): distribution of patients according to the BMI index

Group/BMI	Number	Percentage
Under weight	1	0.5
Normal	19	9.5
Over weight	70	35
Class 1 obesity	86	43
Class 2 obesity	20	10
Class 3 obesity	4	2
Total	200	100

Percentage of IgG and IgM status according BMI

A total of 200 IgG and IgM tests revealed that the underweight and class 3 obese patients had the highest percentage of positive cases in IgG testing (100 %), whereas patients with normal

weight had the lowest percentage of positive IgG (73.68 %). The obese patient class 1 reported highest percentage of positive IgM cases (47.36%), while the underweight patient class 1 had the lowest percentage of positive IgG cases by (0%).

Table (4): percentage of positive and negative of IgG and IgM

BMI type	IgG				IgM			
	Negative		Positive		Negative		Positive	
	<1 IU/ML	>=1 IU/ML						
	No.	%	No.	%	No.	%	No.	%
Under weight	0	0%	1	100%	1	100%	0	0%
Normal	5	26.3%	14	73.68%	10	52.63%	9	47.36%
Over weight	2	2.85%	68	97.14%	49	70%	21	30%
Class 1 obesity	6	6.97%	80	93.02%	64	74.41%	22	25.58%
Class 2 obesity	1	5%	19	95%	17	85%	3	15%
Class 3 obesity	0	0%	4	100%	3	75%	1	25%
Total	14	7%	186	93%	144	72%	56	28%

Vitamin D3 and iron deficiency anemia among COVID-19 patients according to their BMI
The findings revealed that the highest number of underweight people (100%) had vitamin D3 deficiency, while lower percentage was among

class 1 and class 2 obesity which was (25%). The group with the highest percentage of iron deficiency anemia was class 3 obesity (25%) and lower percentage was among underweight which was (0%).

Table (5): vitamin D3 deficiency and iron deficiency anemia among COVID-19 patients according to their BMI.

Diseases and Disorders	Under weight		Normal weight		Over weight		Class 1 obesity		Class 2 obesity		Class 3 obesity		Total	
	No.	Per.	No.	Per.	No.	Per.	No.	Per.	No.	Per.	No.	per.	No.	Per.
Vitamin D3 deficiency	1	100%	8	42.1%	18	25.71%	25	29.1%	5	25%	1	25%	58	29%
Iron deficiency anemia	0	0%	2	10.52%	3	4.28%	17	19.76%	4	20%	1	25%	28	14%

Discussion

According to early data from China, there is a gender disparity in the number of COVID-19 cases detected and the rate of case mortality (13), (14) and (15). However, only a few studies have looked at the gender imbalance in COVID19 incidence and disease progression, and a detailed analysis of the underlying factors is still absent (16) and (17). Due to the disease's global spread, the Global Health 50/50 research program gave an amazing overview of sex-disaggregated data from

nations around the world, clearly revealing identical numbers of cases in women and men, but a higher case fatality rate in men (18). The incidence rate of mentioned virus was higher in men than female in the present study which may be due to the level of angiotensin converting enzymes2(ACE 2) receptor. Some investigations have indicated that circulating levels of ACE2 are higher in healthy men as compared to women (19). Despite the fact that COVID-19 was found in all age groups, older individuals appear to be more susceptible to

infection, which may be due to the fact that higher ACE2 serum activity in older age reported than younger (19).

Obesity is a key risk factor for negative outcomes following SARS-CoV-2 infection (20). A most recent study on the relationship between severe COVID-19 and obesity found that obesity in patients with metabolic associated fatty liver disease increased the risk of severe COVID-19 illness (21). It's unclear how obesity affects the release of SARS-CoV-2-specific IgG. The findings demonstrate that in COVID-19 patients, blood levels of SARS-CoV-2 IgG antibodies are adversely correlated with BMI. This finding is in line with the fact that obesity is an inflammatory disorder linked to inflammation (22).

Several studies have established that vitamin D can reduce the risk of infections and deaths from COVID-19 through different mechanisms (23), (24) and (25) through modulating adaptive immunity (26), lowering the expression and production of IFN- and pro-inflammatory cytokines, therefore reducing the cytokine storm (27) and down-regulation of an Angiotensin-Converting Enzyme 2 (ACE2) (28).

Conclusions

The present study concluded the following points:

There was no relationship between gender and the incidence of COVID19 and the middle age group (30-39) appears to be more susceptible as the highest percentage of COVID19 infection was among the age group (30-39) years, there was adverse relation between positive IgG and IgM and obesity group among patients and The highest number of underweight people had vitamin D3 deficiency. In contrast, the highest percentage of iron deficiency anemia was reported in class 3 obesity.

Conflict of Interest

The authors have no conflicts of interest to declare.

Ethics

The corresponding author hereby confirms that ethics were considered for this research and that the article is original, and its contents are unpublished. The co-author has read and

approved the manuscript for submission.

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