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The Effect Of Ferritin Concentration As A Result Of Iron Deficiency and Its Effect On Corona Patients

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Summary: *Ferritin is considered a protein that contains iron and includes two types of subunits: ferritin light chain (FTL) and ferritin heavy chain (FTH), which increases when inflammation increases, especially in the heart and kidneys, and helps in converting ferrous iron into iron. The light subunit is present in the liver and spleen and has a role in storing iron (1). Coronavirus (COVID-19) caused by the new coronavirus SARS-CoV-2 is a disease It is new to humanity, as it is accompanied by symptoms during the disease, including blood abnormalities, with activation of the immune system and phagocytic monocytes, and damage to the lungs. In our study, we showed that ferritin is an indicator of the severity of the disease and mortality (2). Acute respiratory syndrome (Coronavirus), which causes pneumonia and damages the heart, liver, and kidneys, is caused by the appearance of acute inflammatory cytokines that lead to death (3). A cytokine is a small protein that transmits messages to help stimulate the body's immune response, and its rise causes increased inflammation, and these Cytokines secreted by macrophages (TNF-α, IL-10, IL-6) where there is high inflammation in the plasma. An indicator of the progress and severity of the disease (3).*

Keywords*: Ferritin, Covid-19 , Corona virus, immune, Iron*

1. INTRODUCTION:

The immune system represents the first line of defense against viruses, which prevents their reproduction and enables them to overcome the body's cells. Viruses such as the Corona virus can affect the function of the immune system, representing a defect in the response to viruses and macrophages, and given the lack of an effective vaccine or medicine against the Corona virus, therefore, after strengthening the system. The immune system, as well as strengthening the host response, and genetic mutations have an effective effect in stopping viruses, including the Corona virus (4,5).

When the ferritin concentration is within the range (30-400) micrograms/liter(6), and for patients who do not suffer from a severe disease, and when the ferritin excess is more than 400 micrograms/liter, the ferritin concentration is more than 800 micrograms/liter, and the ferritin concentration is more than 800 micrograms/liter. Ferritin is actively secreted at the site of injury(7). It is possible that ferritin has other functions, including the role of an iron storage protein. It is preferable to replace the patient's blood serum with another blood serum (8).

The elderly and those who suffer from chronic or concomitant diseases are more susceptible to death when infected with the Coronavirus, and even young people who have any of the chronic diseases may be at risk of death if they develop complications such as cardiomyopathy as well as clotting within the blood vessels (9,10).

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2. INSTRUMENTS AND METHODS

MINI VIDAS manufactured by BIOMERIEUX SPA-ITALY, MINI VIDAS manufactured by BIOMERIEUX SPA-ITALY, the measurement process was carried out at a temperature of 25 °C, and the blood serum was mixed with a buffer solution and placed in a cassette or strip designated for measuring ferritin, after placing a code or identification chip in the device to measure ferritin.

Iron:

The innate immune response controls iron metabolism(11). Iron deficiency reduces the immune ability to limit viral infections(12). Iron works to regulate cytokine production, either directly or through hepcidin. It has been noted that anemia that results from iron deficiency increases when the infection affects Viral effects on the immune system, as iron oxide nanoparticles exert strong antiviral activity(13)

By changing the transcription of RNA and redox enzymes, they inactivate influenza viruses and enhance protection against them (4,14).

Hepcidin is the main regulator of iron, in addition to cytokines such as IL-1, which increase the synthesis of the iron protein (ferritin), and excess iron also reduces

It also leads to diseases, and it is important to maintain iron at an acceptable level as a result of iron metabolism (15,16)

3. RESULTS:

During the months in which the Corona virus appeared, until July 2020, our study was on patients hospitalized in Al-Amal Hospital, of which 250 patients were diagnosed, and approximately of them died later, as they showed positive for the SARS-COV-2 virus detection test. The total average age was 58,704, and they were admitted to a room. Emergency, intensive care, and long-term admission halls. The most common symptoms were cough, fever, respiratory tract infection, loss of taste, and in advanced cases, diarrhea, abdominal pain, and low oxygen levels.

Tests were conducted on them upon admission to the hospital, and the results were that of those with a ferritin level greater than 1000 mg/L, 75% of them had severe pneumonia, 65% suffered from high blood pressure, 45% suffered from high blood sugar, 64% suffered from shortness of breath, and 80% suffered from high blood pressure. They suffer from fever, and the focus here in our study was on ferritin concentration, knowing that the patients had tests for diabetes and liver and kidney functions.

Factors affecting Coronavirus patients:

Age and some accompanying diseases, such as diabetes(17), high blood pressure(18), and respiratory diseases, and there are no extensive studies linking the extent of the impact of the accompanying diseases on the extent to which the body tolerates infection and exceeds the stage of danger in the presence of these accompanying diseases. Infection with the Corona virus, in addition to the accompanying diseases, may contribute to death, according to clinical studies Clinical data on liver and kidney function(19,20), other concomitant diseases, age, and ferritin level can determine the extent to which a person overcomes the disease and recovers from it or not (21).

Effects of iron deficiency:

For mothers, iron deficiency during pregnancy causes low birth weight for the child, and there are diseases such as autism, schizophrenia, and abnormal brain structure during moderate and severe iron deficiency (22).

Oxygen delivery, electron transfer, and enzymatic activity are functions of iron, and its deficiency affects the growth of the fetus and its weight loss during birth.
The possibility that the babies are premature (22).

However, iron supplements that are used to treat IDA have very little benefit, so medications taken intravenously can be replaced.

Anemia, according to the definition of the World Health Organization (WHO), is moderate iron deficiency (70-100) g/L, while the level (20-30) g/L is considered a severe level.

Iron balance is important for the host's immune defense and inflammatory responses, as iron excess and deficiency both cause disruption to cells and organs of the human body, as it causes low blood iron (SI) and restriction of hemoglobin and causes anemia, while iron excess and its accumulation inside cells, especially phagocytic cells, leads to damage. Cells and tissues produce reactive oxygen species (ROS) stimulated by iron, and iron fibrosis may occur, which is non-programmed cell death (23).

Hepcidin is a regulator of iron stability and balance, as it controls the absorption of dietary iron and the release of iron from macrophages, where its concentration increases during infections, leading to hypoferremia. Most people infected with Covid-19 have a low level of hemoglobin (24,25).

Ferroptosis is linked to the metabolism of iron, fats, and amino acids, and various comorbidities such as severe lung, liver, kidney, and diabetes are involved in the development of the disease (26).

Iron is regulated through a series of iron-regulating proteins (IRPs), where the iron present outside the cell enters the cell through transferrin TF and its receptors, and then Fe2+ can produce lipid peroxides via Fenton or the iron-containing lipoxygenase enzyme (25).

Studies have shown that most SARS-COV-2 patients with diabetes have the highest levels of ferritin (27), and treatment for patients has also been linked taking into account age, sex, genetic factors, and comorbidities such as heart disease, respiratory system, diabetes, cancer, and kidney disease, where deaths are high (28).

The study included about 250 patients who were hospitalized during the year 2023, of whom 75 patients died, or 30%. The reason is that the virus lost its momentum during this period and is no longer as effective as in the year 2021, which are as follows:

1. Category from 10-22. This category consists of 4 individuals, 3 of whom had high ferritin levels and later died.
2. Category 22-30. This category has 10 individuals, two of whom have high ferritin levels.
3. Category 30-40. This category numbered 15 individuals, 4 of whom had a ferritin level greater than 1200. They later died.
4. The group of 40-50, numbering 38 individuals, where 7 individuals had a high ferritin level of more than 1200.
5. The group of 50-60 years old, numbering 72 individuals, where 19 individuals had an elevated ferritin level of more than 1200.
6. The group of 60-70 years and its number is 44 individuals, where 20 individuals have a high ferritin level of more than 1200.
7. The group of 70-80 and its number is 46 individuals, where 19 individuals have a high ferritin level of more than 1200.
8. The 80-90 category, which has a small number of 7 individuals, is due to the fact that the percentage of those who reach this age is small.

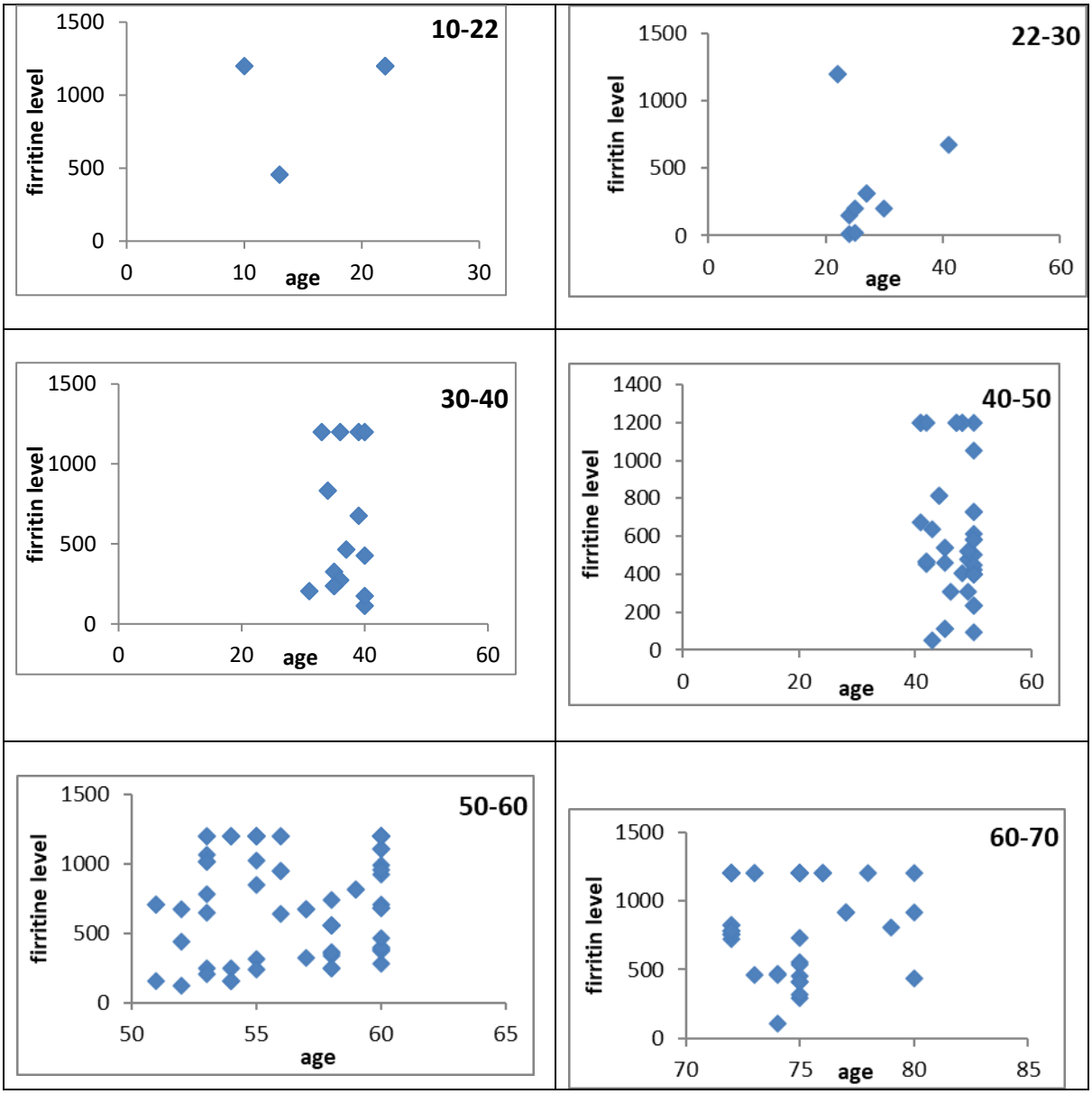
Table (1) shows data for a sample of 250 people infected with Coronavirus and the concentration of ferritin in blood serum for the year 2023.

Seq.	sex	age	firritin	Seq.	sex	age	firritin	Seq.	sex	age	firritin
1	M	81	204	36	M	41	>1200	71	W	48	408
2	W	41	676	37	M	40	427	72	W	65	91
3	M	39	>1200	38	M	39	676	73	W	40	113
4	M	55	315	39	M	70	>1200	74	W	65	356

5	W	83	60	40	W	62	655	75	M	73	>1200
6	M	60	>1200	41	W	51	153	76	W	57	320
7	M	56	>1200	42	M	62	>1200	77	M	50	402
8	M	72	>1200	43	W	36	273	78	M	60	989
9	M	49	476	44	W	43	50	79	W	58	250
10	W	30	204	45	M	74	112	80	M	58	558
11	M	75	551	46	W	50	237	81	W	60	>1200
12	M	70	423	47	M	24	150	82	M	55	846
13	W	75	>1200	48	W	70	397	83	W	60	370
14	W	68	429	49	M	53	>1200	84	M	58	250
15	W	60	281	50	M	33	>1200	85	M	58	554
16	W	58	341	51	M	34	832	86	W	60	>1200
17	M	70	832	52	M	50	>1200	87	W	54	250
18	M	37	464	53	W	85	>1200	88	M	62	>1200
19	M	35	326	54	W	56	>1200	89	M	24	15
20	W	56	636	55	W	60	>1200	90	M	54	>1200
21	M	70	1091	56	W	13	455	91	M	76	>1200
22	W	65	560	57	W	65	1001	92	W	52	670
23	W	50	501	58	W	10	>1200	93	M	85	850
24	M	52	437	59	M	36	>1200	94	W	54	>1200
25	M	50	1054	60	M	70	>1200	95	W	70	830
26	M	70	886	61	M	45	461	96	W	72	>1200
27	M	61	947	62	W	60	918	97	M	61	>1200
28	M	50	425	63	W	73	>1200	98	M	90	1972
29	W	50	96	64	W	53	243	99	M	35	238
30	W	31	205	65	W	50	236	100	W	45	115
31	W	53	1061	66	W	75	455	101	W	65	854
32	W	79	804	67	W	82	355	102	W	77	916
33	M	69	921	68	W	70	94	103	W	50	731
34	W	68	>1200	69	W	63	41	104	W	22	>1200
35	M	41	>1200	70	W	75	292	105	M	62	>1200
106	W	58	551	141	W	53	1014	176	M	70	>1200
107	M	49	305	142	W	75	>1200	177	M	42	>1200
108	W	72	783	143	W	64	713	178	M	43	636

109	W	65	638	144	W	75	410	179	M	52	118
110	M	78	>1200	145	W	60	377	180	M	55	242
111	M	75	734	146	M	55	>1200	181	W	55	1019
112	M	72	721	147	W	70	478	182	M	60	705
113	W	67	>1200	148	W	73	463	183	M	82	>1200
114	M	76	>1200	149	M	58	367	184	W	60	391
115	W	57	670	150	W	70	980	185	W	70	>1200
116	M	85	830	151	W	63	906	186	M	61	945
117	W	90	976	152	W	75	322	187	W	50	396
118	W	75	>1200	153	W	50	614	188	W	63	774
119	M	45	541	154	M	50	402	189	W	70	464
120	M	70	>1200	155	W	80	438	190	M	49	518
121	W	75	>1200	156	M	55	>1200	191	W	42	454
122	W	27	316	157	W	53	207	192	W	70	366
123	W	74	468	158	M	60	>1200	193	W	65	519
124	M	72	>1200	159	W	53	779	194	M	25	197
125	W	72	755	160	W	46	310	195	M	60	1104
126	M	42	465	161	M	65	>1200	196	M	60	681
127	M	44	816	162	M	50	447	197	W	56	949
128	W	48	>1200	163	M	61	>1200	198	W	55	>1200
129	M	63	967	164	W	60	957	199	W	54	157
130	W	51	706	165	W	80	916	200	W	72	827
131	W	47	>1200	166	M	80	>1200	201	M	53	>1200
132	M	50	581	167	W	65	741	202	W	60	>1200
133	M	59	811	168	M	75	537	203	W	53	1014
134	M	60	1104	169	W	53	648	204	W	75	>1200
135	M	60	681	170	W	40	>1200	205	W	64	713
136	W	56	947	171	M	40	175	206	W	75	410
137	W	55	>1200	172	W	58	740	207	W	60	397
138	W	54	157	173	M	70	>1200	208	M	60	>1200
139	W	72	827	174	M	55	>1200	209	M	65	722
140	W	60	>1200	175	M	65	1120	210	W	70	478
211	W	60	463	225	M	74	458	238	M	72	>1200
212	W	25	19.3	226	M	72	>1200	239	M	35	238

213	W	58	357	227	M	72	755	240	W	45	115
214	M	70	980	228	W	42	465	241	W	65	854
215	M	76	>1200	229	M	44	816	242	W	77	916
216	W	57	670	230	W	48	>1200	243	W	50	731
217	M	85	830	231	M	63	967	244	W	22	>1200
218	W	90	976	232	M	51	705	245	W	58	551
219	M	75	>1200	233	W	47	>1200	246	W	72	783
220	M	62	>1200	234	M	50	581	247	W	65	638
221	M	45	541	235	M	59	811	248	W	67	586
222	M	70	>1200	236	W	62	>1200	249	M	72	>1200
223	W	75	>1200	237	M	54	>1200	250	M	75	721



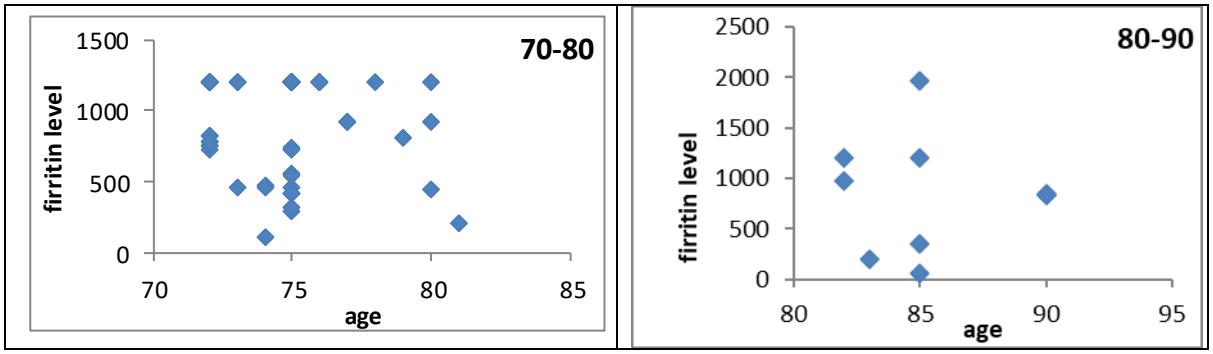
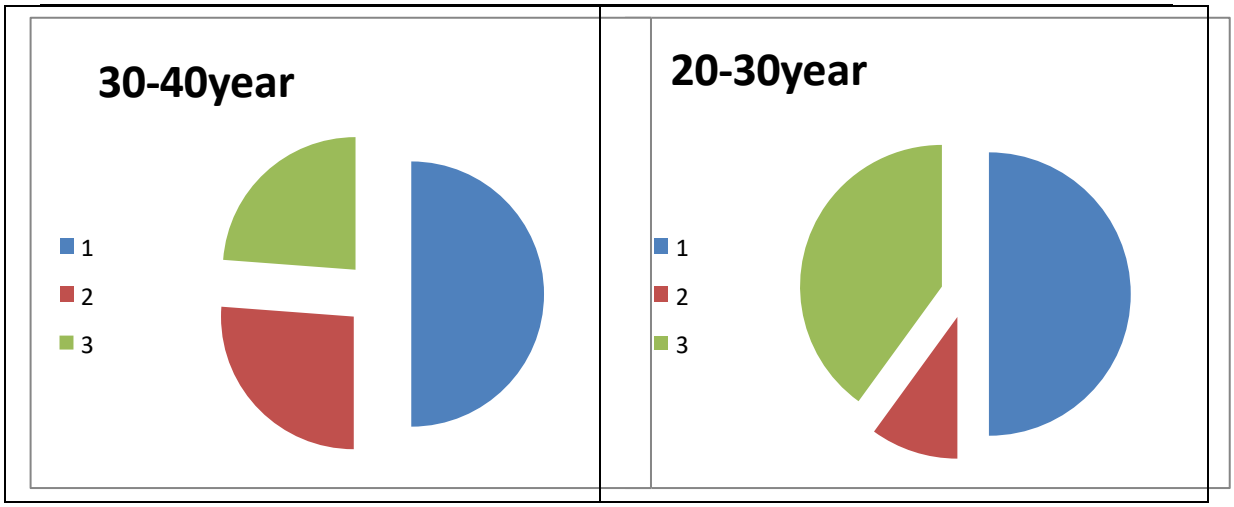


Figure (1) shows ferritin concentration and age for eight age groups of people infected with Corona for the year 2023.

Table (2) shows the data of a sample of 790 people hospitalized with Coronavirus and the concentration of ferritin in blood serum for the year 2020. There are 9 target categories and the infection rates in each category, as well as the infection rate for both sexes and the eventual recovery and death rates.

Seq	Age group	total number	Percentage%	Sex		Final position			
				female	male	Dead	percentage %	healing	percentage %
1	10-20	5	0.6	4	1	1	20	4	80
2	20-30	21	2.6	11	10	11	52	10	48
3	30-40	41	5.17	20	21	17	41.5	24	58.5
4	40-50	115	14.5	50	65	42	36.5	73	63.5
5	50-60	163	20.6	73	90	62	38	101	62
6	60-70	170	21.5	76	94	68	40	102	60
7	70-80	180	22.7	69	111	100	55.5	80	44.5
8	80-90	73	9	38	35	42	57.5	31	42.5
9	90-100	24	3	10	14	14	58	10	42
total		792		352	440	357		435	



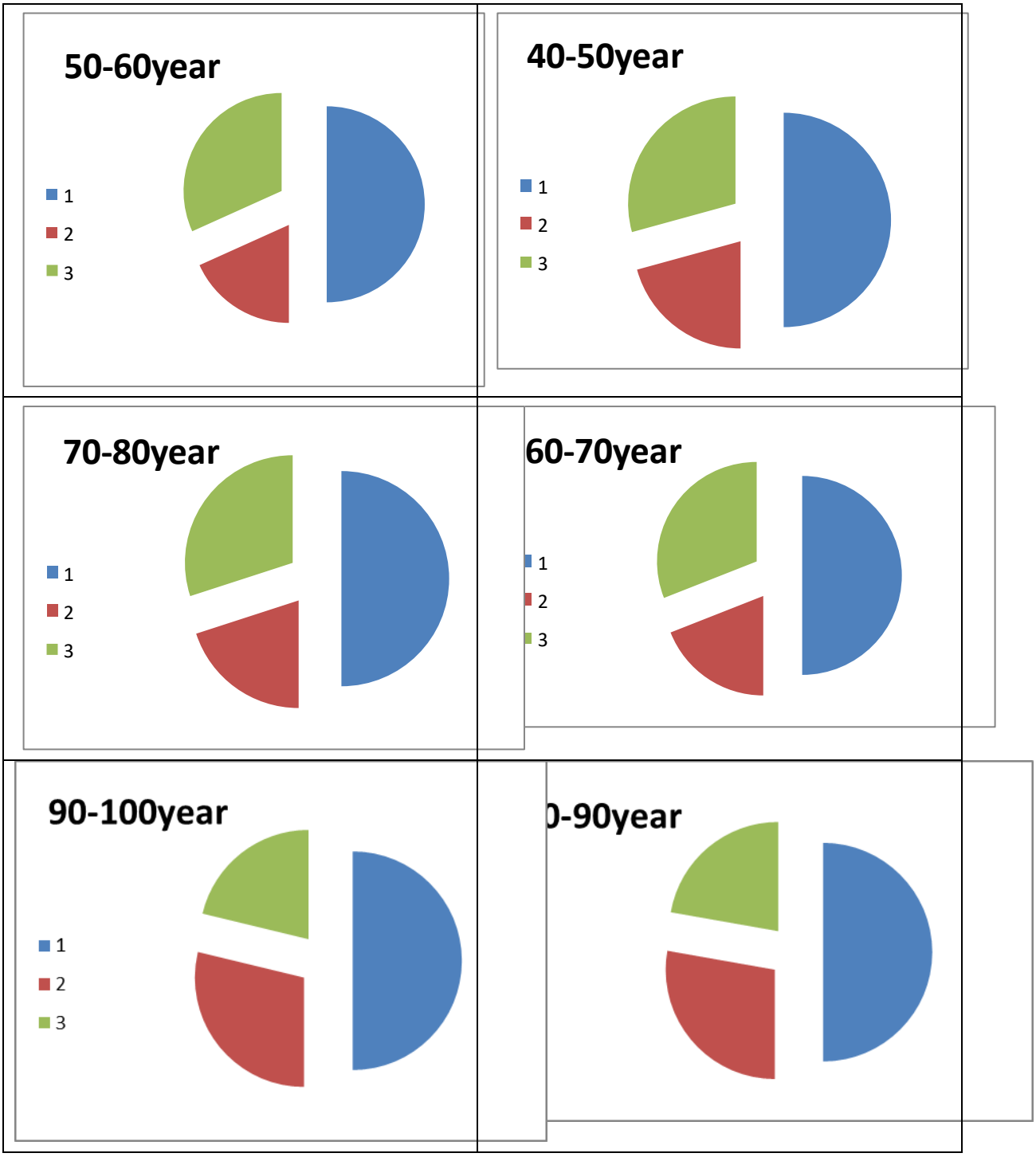


Figure (2) shows the percentages of those who survived the disease and the percentages of those who died of Corona patients for the year 2020,1:total,2:dead,3:healing

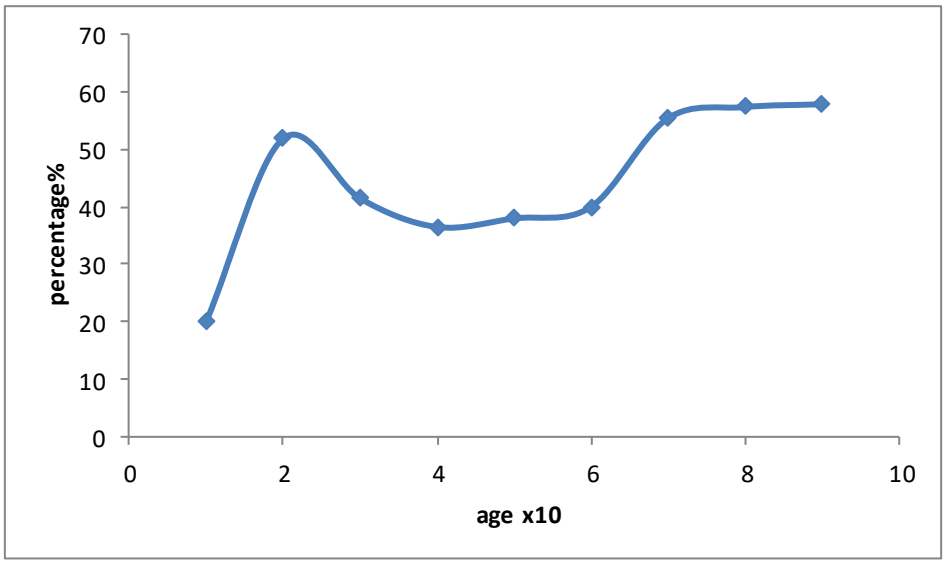


Figure (3) shows the relationship between age and death rates for Corona patients in the category under study for 792 patients hospitalized for the year 2021.

The second group that was studied entered the hospital in 2021 and numbered 792 patients, including 352 females and 440 males, and 357 of them died. 435 improved after entering the hospital.

We note that in the group that was studied, it was noted that the mortality rate is high and close to half, but it is not at the same rate for all age groups.

1. The group under 20 years old. We note that the percentage of deceased does not exceed 20%, and its percentage to the rest of the patients in other age groups is very small, 0.6%. This indicates that this group has high immune characteristics and does not contract the disease except rarely, as it indicates that people with This group has a lively and active body, young and active body cells, active in their defense against viruses, and the rate of infection with infected diseases is low or non-existent.
2. The category of 20-30. This category also shows a low rate of infection with Covid-19 disease, as the percentage does not exceed 2.6%, and this is attributed to the same reasons as the first category.
3. The 30-40 category: This category has 5% of the general population of those infected with the disease, which is a high percentage when compared to the percentages of the previous two categories. This is due to the fact that members of this young group may suffer from lung diseases due to smoking, as well as some chronic diseases such as diabetes, high blood pressure, kidney and liver diseases.

4. The 40-50 category has a high share of infection and also has a high percentage of those who did not overcome or overcome the disease and died. The reasons are due to the chronic diseases associated with the Corona virus disease.
5. Category 50-60. This category accounts for a fifth of the total infections, as well as the high death rate. The reasons are due to the chronic diseases or those associated with Corona disease.
6. Category 60-70. Here the percentage is higher than before, but the death rate is greater and reaches 40%. This indicates that the body has begun to weaken and the accompanying diseases are affecting it and reducing its immunity and resistance to the disease.
7. The 70-80 category, and here it has a larger share (considered large) among the target number, as well as the death rate exceeds half of 55.5. This indicates that age has a role in contracting or surviving the disease, and this category is considered the largest in number of ages in the middle of life (the elderly). That is, more than 70 years.
8. Category 80-90. This category has a smaller number of infected people than the previous three categories. The reason is that the percentage of centenarians who reach this age is low when compared with the rest of the categories.

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