C-reactive protein level and lipid profile among SARS-CoV-2 recovered patients in Baghdad / Iraq

Madha Mohammed Sheet Saleh^{*1} and Abdulrazzak Jabbar Al-Shawi² ⁽¹⁾ Al-Rafidain University College, Baghdad/ Iraq. Correspondence author G-mail : <u>madhamohammedsheet@gmail.com</u> ⁽²⁾ Al-Yarmok University College, Diyala / Iraq.

Abstract

Serum markers in post-discharged SARS-CoV-2 patients and their relationship with disease severity among recovered patients are poorly described and, in many occasions, might be related to residual effects of the disease. To evaluate the C-reactive protein positivity and the lipid profile after 2-7 months of recovery in SARS-CoV-2 patients. The study also pointed out the frequency of clinical manifestations during the illness course. A total of 27 COVID-19 recovered patients (13 males and 14 females) with an age range of 21-40 year (mean 27.2) were participated in this study. Variable frequency of symptoms as high as fatigue (96.3%), neurological symptoms (92.6%) and as low as pneumonia (7.4%) were reported. 37% of the participants were CRP positive at the discharge time with no gender significant variations. A positive correlation between fever and certain lipid parameters was noticed. The lipid profile was almost returned to its baseline except for HDL which was lower than the normal level with significant differences. CRP positivity in about third of the participants is almost an unexplainable phenomenon and could be due to a low-grade residual COVID-19 inflammatory reaction or a coincidence of other non-COVID-19 infection. The HDL below normal levels may refer to a prolonged lipid-metabolism dysfunction in spite of the 2-7 months after patient's recovery. The frequency of clinical manifestations was significantly higher in females concerning chest pain, depression, hair loss, joint pain, and CRP positivity.

Keywords: SARS-CoV-2; CRP; lipid profile; recovery; symptoms frequency.

مستوى البروتين الفعال سي ونسق الدهون ضمن المتشافين من الاصابة بفايروس كورونا في بغداد/ العراق أ.م.د. مضاء محمد شيت صالح¹ وَ أ.م.د.عبد الرزاق جبار الشاوي²

الخلاصة

لم تدرس علاقة المعلمات المصلية في المرضى المتعافين من اصابة فايروس كورونا مع شدة المرض بشكل كبير الى الان وقد تعتبر من التاثير ات طويلة المدى للمرض. لتقييم ايجابية البروتين الفعال سي ومستويات الدهون بعد 2-7 شهور من شفاء المصابين بفايروس كورونا وتكرارية الاعراض المختلفة التي ظهرت علي المرضى اثناء دورة المرض. 27 من مرضى كورونا المتعافين

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(13 ذكر و14 انثى) وبمدى عمري ما بين 21 الى 40 سنة (معدل 27.2 سنة) قد اشركوا في هذه الدراسة. سجلت اعراض مختلفة كان اعلاها هو الاجهاد (96.3%) والاعراض العصبية (92.6%) وادناها ذات الرئة (7.4%). كان نسبة الموجبين لاختبار البروتين الفعال سي 37% في وقت مغادرة المستشفى وبدون فرق معنوي مابين الجنسين. سجلت الدراسة علاقة مباشرة ما بين وجود عرض المعمل وبعض مؤشرات الدهون حيث ان معظم مستويات الدهون عادت الى معدلاتها فيما عدا الدهون عالية الكثافة كانت ادنى من الحمى وبعض مؤشرات الدهون حيث ان معظم مستويات الدهون عادت الى معدلاتها فيما عدا الدهون عالية الكثافة كانت ادنى من معدلاتها الطبيعية وبفارق معنوي. اكثر من ثلث المتعافين من مرض كورونا كانوا موجبين للبروتين الفعال سي وبعد شفائهم باشهر معدلاتها الطبيعية وبفارق معنوي. اكثر من ثلث المتعافين من مرض كورونا كانوا موجبين للبروتين الفعال سي وبعد شفائهم باشهر هي ظاهرة صعبة التفسير وقد تكون من بقايا الالتهابات التي زامنت فترة المرض او قد تكون لاصابات اخرى صاحبت الاصابة بي ظاهرة صعبة التفسير وقد تكون من بقايا الالتهابات التي زامنت فترة المرض او قد تكون لاصابات الحرى صاحبت الاصابة معنوروس كورونا كانوا موجبين للبروتين الفعال سي وبعد شفائهم باشهر بي ظاهرة صعبة التفسير وقد تكون من بقايا الالتهابات التي زامنت فترة المرض او قد تكون لاصابات اخرى صاحبت الاصابة بي بلاروس كورونا ولا تزال اثارها باقية. بقاء مستوى الدهون عالية الكثافة منخفضا بعد فترة طويلة من الشفاء قد يكون دلالة على بفايروس كورونا ولا تزال اثارها باقية. بقاء مستوى الدهون عالية الكثافة منخفضا بعد فترة طويلة من الشفاء قد يكون دلالة على اختلال وظيفي في التمثيل الغذائي للدهون بسبب المرض. واخيرا فان النتائج قد بينت ان الاعراض بصورة عامة كانت اعلى وبفارق معنوي ما بين الاناث وخاصة الام الصدر الاكتئاب فقدان الشعر الام المناص واليوتين التفاعي سي.

Introduction

Corona virus which is known later as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first detected in China in December 2019. Since then, more than 500 million of people globally have been infected, and over 6 million of people have died due the infection with this virus. Serum markers profile in post-discharged SARS-CoV-2 patients and their correlation with the severity of the disease and clinical features are poorly described and, in many occasions, they were not back to their pre infection levels and might be potentially considered as residual effects of the disease [1]. Although such alterations are usually reported in severe and critically ill patients, however they could also be occurred in mild infection of people who did not hospitalize. It has not illustrated yet if the risk of developing long lasting effects of SARS-CoV-2 would be influenced by gender, age, ethnicity, underlying health conditions, viral dose, or progression of SARS- CoV-2 [2]. C-reactive protein is an inflammatory marker that elevated in most SARS-CoV-2 patients and was correlated with severity of illness [3]. C-reactive protein level of >100 mg/L was reported to be associated with higher possibility of ICU admissions and 30-day mortality [4]. The prognostic value of CRP has not been tested yet in SARS-CoV-2 hospitalized or discharged patients. Many evidences suggested that patients with severe SARS-CoV-2 will display dysregulated lipid metabolism. Low lipid levels is mostly correlated with dysfunctions in the cardiovascular, immune, and respiratory systems, accompanied with high levels of inflammatory and proinflammatory cytokines. In addition, low lipid profile is etiologically associated with higher chances of coagulation complications, heart dysfunction, and higher platelet activity [5]. HDL-C with levels was postulated as a risk factor for many infections. In SARS-CoV-2, LDL-C, HDL-C and triglyceride (TG) low levels were said to be associated with disease severity, with an effect of these lipids in immune mechanisms [6].

This study aim is to evaluate C-reactive protein and lipid profile in SARS-CoV-2 patients 2-7 months post-recovery. Additionally, to investigate the most frequent clinical manifestation during the disease course of these recovered patients. Coronavirus is an ssRNA enveloped virus that named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on 2020, by the World Health Organization [7]. The outer envelope comprised three proteins: membrane protein (M), spike protein (S), and envelope protein (E) [8].

It can transmit by air in close areas. The infection can come from both symptomatic and asymptomatic people. Other routes for viral transmission are indirect contact transmission, fecal-oral and urine contamination. Infected women in late pregnancy almost are not able to transmit the coronavirus to infant. This contradicted with some other studies that postulated a vertical transmission of the virus [9]. Flue like clinical manifestations can be demonstrated with some strains of SARS-CoV-2 which may develop into acute respiratory distress (ARDS), accompanied with fever, dyspnea, cough, pneumonia and possibly death [10]. C-reactive protein is an inflammatory biomarker that rise and fall rapidly during acute illness [11]. CRP elevation begins in few hours after an acute inflammatory insult and can reach its maxima at 48 hours [12]. By resolving the inflammatory reaction and subsiding of cellular damage it falls rapidly, making it a very good marker for monitoring disease reactivity [13]. During the course of SARS-CoV-2, the CRP molecules are produced by the interaction of the virus with angiotensin II converting enzyme [14] which are not only pointing out an acute inflammation but also provide an accurate expectation about the prognosis and severity of the disease [15]. Accordingly, high levels of CRP in the early SARS-CoV-2 infection mostly associated with lung destruction and disease severity [14]. A negative proportion between CRP levels and partial oxygen pressure to fraction of inspired oxygen ratio (PaO2/FiO2) had been proposed [16].

The relationship between SARS-CoV-2 and the lipid profile was abundantly studied. Recently it had been reported that hypolipidemia in hospitalized SARS-CoV-2 patients is common [17]. The association between lipid profile and the disease severity in SARS-CoV-2 patients had been elucidated [18]. New evidence pointed out that Covid 19 may have a direct impact on slowing down lipid-metabolism by interfering with related proteins and pathways, leading to dyslipidemia [19].

Other study proposed that low lipid profile during the course of SARS-CoV-2 infection may associate with liver damage caused by the infection itself [18]. In most viral infections, the integrity of the viral envelops and their fusion to the host cell membrane, as well as viral replication, is highly dependable on lipid contents [20].

Subjects & Methods

Subjects: Twenty-seven SARS-CoV-2 recovered patients were included in this study. The participants were mostly college students from Baghdad of both genders including 13 males and 14 females with age rage 21-40 years.

Samples preparation: About 5 ml of blood samples were drawn in gel tubes and centrifuged after an hour at 5000 rpm for 5 min to separate the serum from blood clot. The separated sera were frozen at -20 °C till they were used.CRP estimation: The CRP kit was from *LORNE Laboratories (LTD), UK, expired date (8/2022).* The test principle is latex agglutination. Anti-CRP coated latex particles are mixed with a patient's serum to develop a visible agglutination reaction within 3 minutes if the CRP is positive in serum. Triglycerides estimation, cholesterol estimation and HDL cholesterol estimation kits (from Biosystems S.A, Spain) are all spectrophotometric techniques were used in this study. For VLDL cholesterol calculation the following formula was used:

Triglycerides

VLDL Cholesterol = ------

5

For LDL cholesterol calculation the following formula was used:

LDL -c = Total Cholesterol - (HDL-c + VLDL-c)

Results

This study measured two important parameters: the CRP and the lipid profile in 27 persons who had been recovered from SARS-CoV-2 recently. Table 1 show the demographical distribution of recovered patients with SARS-CoV-2.

Parameter	Number	Age range (average)	P-value		
Total participants	27	21-40 (27.2)			
Males	13	21-40 (28.5)	NC		
Females	14	21-40 (26)	IND		

Table	(1): Demog	raphical distr	ibution of 1	recovered pa	atients with	SARS-CoV-2.
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NS= not-significant

The normal reference values for the lipid profile and the CRP are shown in Table 2.

Table (2): Normal reference values for lipid profile and CRP.

Parameter			Normal value			
Total cholesterol*			<200-40 mg/dl			
		Male	>60 mg/dl= desirable			
HDL-cholesterol**			<40 mg/dl= at risk			
		Fomolo	>60 mg/dl= desirable			
		remaie	<50 mg/dl= at risk			
Triglyceride			<150 mg / dl			
VLDL			< 30 mg / dl			
LDL***	N	Normal	< 40-130 mg/dl			
	Very low		<40 mg/dl			
CRP (mg/dl)	Positive		>or = 6			
	Negative		<6			

*https://www.sciencedirect.com. Hypocholesterolemia an overview. Science Direct Topics (Hypocholesterolemia is 50-125 mg/dl). ** © 1998-2021 Mayo Foundation for Medical Education and Research (MFMER), Nov, 10, 2020. HDL cholesterol: how to boost your good cholesterol. ***© 1998-2021 Mayo Foundation for Medical Education and Research (MFMER), Nov, 25, 2020. Cholesterol level: can it be too low?

Table 3 shows the total frequency of clinical symptoms in SARS-CoV-2 recovered patients and a gender comparison in symptom frequency.

		Total n=27		Males n=13		Female n=14	
IS	Positive		Positive		Positive		value
		%	N⁰	%	N⁰	%	
Cough	18	66.7	9	69	9	64	NS
Chest pain	12	44.5	5	38.5	7	50	S
Pneumonia	2	7.4	1	7.7	1	7.1	NS
Dyspnea	12	44.5	6	46.2	6	42.9	NS
GIT		74.1	10	76.9	10	71.4	NS
lepression	19	70.4	7	53.8	12	85.7	S
neadache)	25	92.6	12	92.3	13	92.9	NS
veak memory	18	66.7	6	46.2	12	85.7	S
	22	81.5	11	84.6	11	78.6	NS
nd taste	20	74.1	10	76.9	10	71.4	NS
Fatigue		96.3	13	100	13	92.9	NS
Cannulated during illness		44.5	7	53.8	5	35.7	S
Hospitalized during illness			3	23.1	2	14.3	S
pling time	10	37.0	4	30.8	6	43	S
	S Cough Chest pain Pneumonia Dyspnea epression neadache) weak memory nd taste ng illness ng illness pling time	STotaPosN№Cough18Chest pain12Pneumonia2Dyspnea1220epression19neadache)25weak memory1822nd taste2026ng illness5pling time10	Total n=27 Positive № % Cough 18 66.7 Chest pain 12 44.5 Pneumonia 2 7.4 Dyspnea 12 44.5 20 74.1 epression 19 70.4 neadache) 25 92.6 veak memory 18 66.7 12 81.5 15 nd taste 20 74.1 26 96.3 12 ng illness 5 18.5 pling time 10 37.0	Total n=27 Male Positive Pos N₀ % № % № Cough 18 66.7 9 6 Chest pain 12 44.5 5 Pneumonia 2 7.4 1 Dyspnea 12 44.5 6 20 74.1 10 equation of the second	Total n=27Males n=13PositivePositive№%№%Cough1866.7969Chest pain1244.5538.5Pneumonia27.417.7Dyspnea1244.5646.22074.11076.9epression1970.4753.8neadache)2592.61292.3veak memory1866.7646.22281.51184.6nd taste2074.11076.92696.31310010ng illness1244.5753.8ng illness518.5323.1pling time1037.0430.8	Total n=27Males n=13FemalePositivePositivePositiveN№%N№%№Cough1866.79699Chest pain1244.5538.57Pneumonia27.417.71Dyspnea1244.5646.262074.11076.910epression1970.4753.812neadache)2592.61292.313veak memory1866.7646.2122281.51184.611nd taste2074.11076.9102696.31310013ng illness1244.5753.85ng illness518.5323.12pling time1037.0430.86	Total n=27 Males n=13 Female n=14 No No No No Positive Positive No No No No No No No No Cough 18 66.7 9 69 9 64 Chest pain 12 44.5 5 38.5 7 50 Pneumonia 2 7.4 1 7.7 1 7.1 Dyspnea 12 44.5 6 46.2 6 42.9 20 74.1 10 76.9 10 71.4 epression 19 70.4 7 53.8 12 85.7 eadache) 25 92.6 12 92.3 13 92.9 weak memory 18 66.7 6 46.2 12 85.7 22 81.5 11 84.6 11 78.6 nd taste 20 74.1 10 76.9 10 71.4 26 96.3 13 100 <

 Table (3): Frequency of clinical symptoms in SARS-CoV-2 recovered patients.

 $NS = not \ significant \ (p > 0.05), \ S = \ Significant \ (p < 0.05)$

Table 4 shows the symptoms of COVID-19 recovered patients as they rearranged from the highest (fatigue 26%) to the lowest (pneumonia 2%) frequency.

Servertoring	Frequ	ency (n=27)
Symptoms	N⁰	%
Fatigue	26	96.3
Neurological symptoms as headache	25	92.6
Fever	22	81.5
GIT	20	74.1
Loss of smell and taste	20	74.1
Psychological as depression	19	70.4
Others (hair loss, Joint pain, weak	18	66.7
Cough	18	66.7
Cannulated during illness	12	44.5
Chest pain	12	44.5
Dyspnea	12	44.5
CRP result at blood sampling time	11	40.7
Hospitalized during illness	5	18.5
Pneumonia	2	7.4

 Table (4): Frequency of clinical symptoms in SARS-CoV-2 recovered patients.

Table 5 shows the lipid profile in SARS-CoV-2 recovered patients according to their date of first negative PCR result after illness. The lipid profile values were compared with the normal reference values to extract the statistical significance between the two values. The only significant difference was noticed with HLD-c in which the values were lower than normal in all groups.

Table (5): Lipid profile of SARS-CoV-2 recovered patients according to their date of first negative

 PCR results after illness.

	Date of -ve PCR results after recovery								
Parameter	Aug-Dec. 2020 n=4	Jan-2021 n=4	Feb-2021 n=4	Mar- 2021 n=2	April- 2021 n=10	Total	p- value		
	Average (range)								
Tot.	142.5	172.5	125	135	131	137.6	NC		
Cholesterol	(125-161)	(80-240)	(87-159)	(130-140)	(97-163)	(80-240)	IND		
	43.3	44.3	50	34.5	46.5	45.6	NC		
HDL-C	(30.8-57.2)	(32-55)	(30-69)	(34-35)	(35-67)	(30-69)	IND.		
Triglycorido	85	112.5	108	92.5	142	116.7	NC		
Trigiyceriue	(63.6-98)	(40-160)	(59-183)	(90-95)	(77-255)	(40-255)	IND.		
VI DI	17.0	22.5	21.7	18.5	28.4	23.5	G		
VLDL	(12.7-19.5)	(8-32)	(12-37)	(18-19)	(16-51)	(8-51)	3		
IDI	86.8	105.8	50.1	134	56.1	72.2	NC		
LDL	(58-111.5)	(40-155)	(23-92)	(86-182)	(21-99)	(21-182)	TND		

NS= not significant (p>0.05), S= Significant (p<0.05) (the statistical differences of the above values was extracted in comparison with the normal values of lipid profile demonstrated in Table 2)

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Table 6 compares the lipid profile values between males and females. The results demonstrate no significant differences (p>0.05) in all lipid profile values. In the same table the lipid values of 3 parameters (total cholesterol, HDL and LHL) were compared within each gender, between genders and in total number of participants. Concerning the HDL, most of the participants of both genders were below normal level with highly significant differences (p<0.01).

Lipid parameters			Males n=13	Females n=14	Total n=27	p-value	
al cholesterol Mo/d1		Average (rang	e)	132.3	142.3	137.6	NS
				(86.8-170)	(80-240)	(80-240)	
	_	Normal=<200-126		9 (69.2%)	9 (64.3%)	18 (66.7%)	
	1g/d	Hyper= 200 or	N⁰	0 (0%)	2 (14.3%)	2 (7.4%)	
tal c	Z	more	(%)				
To		Hypo= 125 or less	_	4 (30.8%)	3 (21.4%)	7 (25.9%)	
		p-value		NS	S	S	
		Average (rang	e)	42.2	48.8	45.6	NS
HDL-cholesterol mg/dl			(30.2-66.6)	(32-69)	(30-69)		
		Normal>60		0 (0%)	2 (14.3%)	2 (7.4%)	
	/dl	Borderline:		6 (46.2%)	3 (21.4%)	9 (33.3%)	
	mg	male: 60-40	№ (%)				
		Below normal:		7 (53.8)	9 (64.3)	16 (59.3%)	
H		male: <40					
p-value		HS	HS	HS			
		Triglyceride		110.0	122.8	116.7	NS
				63.6-207.2	(40-255)	(40-255)	
		VLDL		22.0	24.6	23.5	NS
				(13.1-41.4)	(8-51)	(8-51)	
		Average (rang	e)	76.0	68.7	72.2	NS
				(21.5-182)	(22.6-155)	(21-182)	
lb/		Normal (<130-40)		10 (76.9%)	11 (78.6%)	21 (77.8%)	
, mg/		Hyper (>130)	N⁰	0 (0%)	0 (0%)	0 (0%)	
IDI		Нуро (<40)	(%)	3 (23.1%)	3 (21.4%)	6 (22.2%)	
		p-value	1	NS	NS	NS	

Table (6): Lipid profile in SARS-CoV-2 recovered patients according to genders.

The correlations between fever, in one hand and gender, CRP results and lipid profile on the other are illustrated in Table 7. It is clear that fever exists in the majority of males (84.6%) and females (78.6%) with significant values (p < 0.05). Concerning the CRP, there was no correlation with fever for all groups. For lipid profile, no correlation was noticed between the total cholesterol, HDL-c, and LDL and the fever. For triglyceride and VLDL there was a significant correlation among the recovered patients who were with no fever during their illness.

Donomoton		Feve	er +ve	Feve	er -ve	a sualas o	
Paran	ieter	N⁰	%	N⁰	%	p-value	
Male n=13		11	84.6	2	25.4	S	
Female	n=14	11	78.6	3	21.4	S	
Total	n=27	22	81.5	5	28.5	S	
CDD	Positive		9		1	NS	
UNI	Negative	13		4		IND	
Total cholesterol: average		137.7		136.5		NG	
(ran	(range)		(80-240)		144.6)	IND	
Normal= <	200 mg/dl	× ,		``````````````````````````````````````			
HDL-choleste	rol: average	44.6		50.2		NS	
Normal >	(range) Normal >60 mg/dl		(30.2-69)		66.6)		
Triglyceride: av	Triglyceride: average (range)		107.0		59.0	S	
Normal <150 mg / dl		(40-182.5)		(88-	-255)		
VLDL: average (range)		2	21.4		1.7	S	
Normal < 30 mg / dl		(8-3	(8-36.5)		3-51)	ى د	
LDL: avera	ige (range)	7	6.3	54	4.5	NS	
Normal < 1	l 30 mg/dl	(22.6-182)		(21.5-77.4)		СИL	

Table (7): correlations between fever, gender, CRP, and lipid profile in SARS-CoV-2 recovered patients.

Discussion

The gender distribution results of this study were in coordination with a WHO report in which a preliminary analysis of 1, 434, 793 case of coronavirus shows a relatively equal distribution of infections between women and men (47 % females and 51 % males, respectively) with some variations across age groups [21]. Concerning the age, table 8 summarizes the number of cases, hospitalization and number of deaths in USA according to their age groups using the age (5-17 years) as a reference group comparison [22]. The table clearly illustrates that the severity of the illness and the mortality rate are positively correlated. No age randomization for patients in the current study as most of the participants were university students with age range in majority of 21-27 years (66.7%) and 28-40 years (33.3 %) for the rest of participants. The percent of hospitalization in younger group was 5.6% compared to 44.4% in older group with a significant difference (p < 0.05).

Table (8): SARS-CoV-2 age correlation with number of cases, number of hospitalizations and number of deaths in the USA.

Nisk for COVID-17 Infection, Hospitalization, and Death Dy Age Group										
Rate compared	0-4	5-17	18-29	30-39	40-49	50-64	65-74	75-84	85+	
to 5-17 years	years	years old	years							
old ¹	old		old							
Cases ²	< 1x	Reference group	2x	2x	2x	2x	1x	1x	2x	
Hospitalization ³	2x	Reference group	бх	10x	15x	25x	40x	65x	95x	
Death ⁴	1x	Reference group	10	45x	130x	440x	1300x	3200x	8700x	

Risk for COVID-19 Infection, Hospitalization, and Death By Age Group

Symptoms of SARS-CoV-2 are multi-organ and not confined to respiratory system due to the vigorous immune reactions leading variable effects and death [23]. In this study depression and other psychological symptoms, hair loss, joint pain, weak memory and positivity of CRP were significantly higher among females whereas cannulation and hospitalization were significantly higher among males. For other frequency of symptoms, no significant differences between genders were exist. Liu *et al.*, 2020 [24] and Frederiksen, *et al.*, 2020 [25] reported similar results. To explain the gender-dependent variation in symptoms only speculations are available. More specifically, females are more susceptible to infections (mostly microbial) because of a higher natural immunity than males [26]. In addition, it has been well-documented that the estrogen hormone is a potent stimulator of the immune response, in particular by increasing the activity and clonal expansion of T- cells [27]. Initially, mortality rate is higher among males than females indicating a gender-related severity of the diseases as it is reported in a study in the Tongji Hospital in Wuhan, China which found that SARS-CoV-2 deaths, were 27 % in females and 73 % in male [28].

However, studies with female predominance in severity and fatality also exist as that in a Korean study which showed that 37.7 % of deaths were males while 62.3% were females [29]. In the current study, no death ratio was calculated, but cannulation and hospitalizations instead were recorded which were higher among males compared to females. In this study the symptoms frequency from higher to lower were as it is shown in table 4 in which fatigue and neurological symptoms where the highest (96.3 % and 92.6 % respectively) whereas hospitalization during illness and pneumonia

(18.5 % and 7.4 % respectively) were the lowest. Another study reviled different order of clinical manifestation frequency [30] in which cough was the highest (51 %), followed by fever (41 %), myalgia (38 %) and headache (30 %), whereas loss of smell (16 %) loss of taste (15 %) were the with the lowest frequency.

The Government of Canada, 2020 [31] issued a guidance document about the most frequent SARS-CoV-2 symptoms in 18 of September 2020. The document listed the more frequent symptoms (fever 44-91 %, cough 57-74 %, shortness of breath 31–63 %, fatigue 31–70 %, loss of appetite 39-84%, and loss of smell and/or taste 54 - 88 %). On the other hand, muscle aches, chest pain, diarrhea, nausea/vomiting, and sore throat were the lowest frequent symptoms ranging from 5- 44 %.

This study reveals a normal mean value in most lipid profile parameters (Total cholesterol, Triglyceride, LDL and VLDL) except the HDL in which the values were below normal for all groups with significant differences (p < 0.05). In other study, significant reduced levels in LDL-C, HDL, TC, and TG during the SARS-CoV-2 illness were reported [20]. In acute SARS-CoV-2 infection, sever inflammatory reaction occur with significantly elevated cytokine levels known as cytokine storm which possibly has a role in HDL and LDL-C dysfunction. High levels of pro-inflammatory cytokines can lead to high consumption of albumin, ApoA1, HDL, TC, TG, LDL-C, along with decreased lymphocytes [32]. Sun and his colleagues (2020) [33], suggested that low apoA-1 and HDL-C levels could be a fine predictor for disease severity and mortality in SARS-CoV-2 patients.

In the current study most of patients showed decreased HDL-c levels of 15% or more below normal. This was probably due to medications or nutritional supplements taken during recovery course as well as the loss of appetite which may result in malnutrition and consequently low lipid levels. No significant differences (p>0.05) in all lipid profile values between genders was noticed in this study. For the total cholesterol, the majority of males were with normal level whereas (30.8 %) were with below normal value with but with no significant difference. For females the values were 64.3 %, 14.3 %, and 21.4% for the normal, hyper and hypo cholesterolaemia respectively with a significant difference. For the total cholesterol of the total participants, the difference was significant between the normal and abnormal values. Concerning the HDL values most of the participants of both genders were below normal level with highly significant differences (p<0.01). About the LDL, the majority of the participants were within normal value for both genders with no significant difference. Very similar results were found by Fan *et al.*, 2020 [17] concerning HDL, LDL and cholesterol. The acute inflammatory marker CRP had reported to be increased in SARS-CoV-2 patients and is associated with disease severity [33]. Tables 2 and 3 show the results of CRP among the SARS - CoV-2 recovered patients. The total positive CRP was 10 out of 27 representing 37 % of the total (30.8 % among males and 43 % among females). These results consider unusual in patients had been recovered 2-7 months ago and supposed to returned to their normal level of CRP. Indeed, no logic explanation for this phenomenon which possibly is one of the post-sequela of the SARS-CoV-2 infection as a low grade inflammation that could be resolved in the near future.

Other possible explanation for this phenomenon is the presence of current non- SARS-CoV-2 infection that raised the CRP level during the blood sampling of the study participants. Concerning the correlation between the CRP positivity and fever during the course of SARS- CoV-2 illness of these participants, no significant association was found between them. No association of fever with TC, LDL, HLD-c, TG and VLDL.

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