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Abstract

Background: Nearly all nations have been affected by the worldwide spread of the COVID- 19 pandemic. A case fatality rate greater than 1%, and limited effect of antiviral therapy, the mainstay of pandemic management, still persist.

Objective: The aim of the present study was to evaluate the prevalence of neuromuscular manifestations among Helwan School of Medicine population post COVID-19 infection and vaccines.

Patients and methods: This cross-sectional analytical design included

1502 adults (students and employees, Faculty of Medicine, Helwan University Hospital, Egypt). They were divided into 3 groups: group (A) recovered individuals from COVID-19 infection (not vaccinated); group (B) vaccinated individuals (did not catch COVID-19); and group (C) previously infected with COVID-19 and vaccinated individuals.

Results: There was significant difference between COVID-19 Infected cases, COVID-19 vaccinated and COVID-19 Infected and vaccinated as regarding manifestation, duration of manifestation, treatment, hospital admission, age, gender, CBC, CRP, Ferritin, D-dimer and LDH. Total Fatigue score was statistically significantly higher in 1st year students. There were significant differences between different types of vaccines regarding fatigue Categories.

Conclusion: The persistent neuromuscular symptoms are challenging because the estimated prevalence of these symptoms remains high even after recovery. Although the believed molecular mechanisms behind pathophysiology have yet to be addressed, this work adds to our understanding of the long-term effects of COVID-19 in recovered patients. Our study suggested that COVID-19 vaccines may be a protective factor.

Keywords: Post COVID-19 Pandemic; Neuromuscular Manifestations; vaccines

INTRODUCTION

The greatest health threat in this decade was undoubtedly the COVID-19 pandemic, which has been created by the SARSCoV-2 virus [1]. As the temporal extent of the pandemic continues and the population of individuals who have achieved recovery expands, a significant number of researchers have begun inquiring about the potential long-term modifications induced by the COVID-19 virus. Certain individuals have reported enduring

symptoms such as dyspnea, tiredness, cough, chest discomfort, myalgia, and arthralgia. Additional symptoms that have been documented encompass depression, cognitive impairments, headaches, and palpitations among individuals whose first stage of the illness was characterized as mild [2].

The neurological symptoms associated with COVID-19 span a spectrum of severity, encompassing minor signs such as headache, dizziness, and loss of smell (anosmia), as well as more serious conditions including Guillain–Barré syndrome (GBS), encephalopathy, encephalitis, acute disseminated encephalomyelitis, and stroke [3]. Patients may exhibit symptoms such as gradual ascending flaccid quadriparesis, areflexia, and cranial nerve palsies, leading to a diagnosis of acute motor axonal neuropathy (AMAN) variant of GBS [4]. The muscular manifestations observed in individuals with COVID-19 exhibit a range of symptoms, including myalgia (characterized by muscle aches and pain), myositis, and rhabdomyolysis. The prevalence of these manifestations has been shown to range from 11% to 50% [5]. The pathogenesis of muscle involvement in COVID-19 has been the subject of investigation. The findings indicated that the impact of SARS-CoV-2 on skeletal muscle can be attributed to two main factors: direct invasion of the muscle tissue through angiotensin-converting enzyme receptors, and immune-mediated processes involving cytokine storming, which leads to the generation and buildup of inflammatory cytokines in the skeletal muscles [6].

Therefore, this study aimed to assess the prevalence of neuromuscular manifestations among Helwan School of Medicine population post COVID -19 infection and vaccines.

PATIENTS AND METHODS

This cross-sectional analytical design included 1502 adults (male and female). They included students, employees and doctors in Faculty of

Medicine, Helwan University Hospital, Egypt during the period from June 2022 to June 2023. The studied individuals were divided into 3 groups:

(I) **Recovered patients from COVID-19 infection.** Diagnosed as COVID-19 according to the New COVID-19 Pneumonia Prevention and Control Program (5th edition) by meeting 1 or both criteria of chest CT symptoms and (RT-PCR), published by the WHO interim guidance.

(II) **Vaccinated individuals.**

(III) **Previously infected with COVID-19 and vaccinated individuals**

Inclusion criteria:

Adults (age more than 18 years old) with positive PCR for COVID-19 or Positive rapid antigen test.

Administration of COVID-19 vaccine (for Group II & III).

Exclusion criteria:

Subject known with any neuromuscular manifestations and or complication such as uncontrolled DM, thyroid disease, cerebrovascular diseases, malignancy, chronic kidney disease, joint-muscle-connective tissue diseases for example (RA, SLE, antiphospholipid syndrome, psoriatic arthritis, systemic sclerosis, polymyositis, and dermatomyositis).

Ethical Consideration:

The study received permission from the Scientific and Ethical Committee at Helwan University. The researchers acquired written informed consent from all subjects involved in the study. The research conducted adhered to the ethical guidelines outlined in The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving human participants.

Procedures:

The questionnaire included personal data (Age, Gender, Occupation, phone number), COVID-19 infection data (previous COVID-19 infection, time of infection of COVID-19; and confirmation of Covid 19 infection using PCR, rapid antigen test and CT. Duration of symptoms, symptoms self-relieved or needed medication, treatment received, need to admission to hospital, and need to ventilation. Laboratory work up if applicable: CBC, CRP, D dimer, S. Ferritin, and LDH.

Vaccine information:

Type of vaccine used were AstraZeneca, Sinopharm, Johnson, Pfizer, and Sinovac.

Symptoms after administration of vaccine, Duration of symptoms, symptoms self-relieved or needed medication.

Fatigue Assessment scale:

The study utilized the Fatigue Assessment Scale (FAS), a self-report scale consisting of 10 items designed to assess symptoms associated with chronic fatigue. The Fatigue Assessment Scale (FAS) adopts a unidimensional approach in conceptualizing fatigue and does not employ a factor-based measurement framework. Nevertheless, for the purpose of comprehensively assessing fatigue, the scale incorporates an evaluation of both physical and mental symptoms.

The comprehensive score spans from 10 to 50, with a greater number signifying a heightened level of weariness. The calculation of a normative percentile for the total score is derived from a sample of adults, serving as an indicator of the respondent's performance relative to a standard pattern of responses observed among adults. The present study provides a depiction of the exhaustion encountered, with the total score serving as an indicator. A score below 22 signifies fatigue levels within the range of "normal" or healthy. Scores falling between 22 and 34 indicate the presence of mild-to-moderate fatigue. On the other hand, a score of 35 or more suggests the presence of

severe fatigue [7].

There exist two subordinate scales.

Mental exhaustion, as quantified by the summation of items 3, 6, 7, 8, and 9, serves as an indicator of the cognitive consequences of weariness experienced by the individual. These consequences may manifest as diminished motivation, difficulties in initiating tasks, and impaired cognitive functioning. Physical weariness, as indicated by the combined scores of items 1, 2, 4, 5, and 10, serves as a metric for assessing the tangible manifestations of fatigue experienced by the individual, such as physical exhaustion and diminished energy levels.

Outcome measures:

1- **General outcome:** To study the prevalence of neuromuscular manifestations among the studied groups in (Helwan School of Medicine population post COVID -19 infection and vaccines.

2- **Specific outcomes:**

(a) Prevalence of neuromuscular manifestations among Helwan University School of Medicine population post COVID-19 affection.

(b) Prevalence of neuromuscular manifestations among Helwan University School of Medicine population post COVID-19 after administration of different types of COVID-19 vaccines.

(c) Prevalence of neuromuscular manifestations among Helwan University School of Medicine population post COVID-19 infection and vaccine administration.

Statistical analysis:

The data that was obtained was organized and examined using the SPSS software (SPSS; SPSS Inc., 28 Chicago, Illinois, USA). Mean ± standard deviation (SD), mean difference (MD), and 95% confidence interval (CI) were used to display continuous

variables, when applicable. Categorical variables were reported as numbers and percentages. The Chi-square ($\chi 2$) test was employed to assess categorical data, whereas the Fisher exact test was used when the predicted frequency was less than five. For the comparison of continuous variables, the t-test was utilized. A p-value that is less than 0.05 is generally regarded as being statistically significant.

RESULTS

Table (1): Sociodemographic characteristics of all the study participants (n= 1502)

	n (%)
Age Categories	
❖ Less than 20 years	931 (62.0%)
❖ 20 – 45 years	537 (35.8%)
❖ More than 45 years	34 (2.2%)
Gender	
❖ Male	733 (48.8%)
❖ Female	769 (51.2%)
Category	
❖ Staff Member and Doctor	132 (8.7%)
❖ Employee	127 (8.3%)
❖ Student	1243 (83.0%)
Occupation	
❖ Staff Member and Doctor	132 (8.7%)
❖ Employee	127 (8.3%)
❖ First year student	510 (34.0%)
❖ Second year student	332 (22.1%)
❖ Third year student	163 (10.9%)
❖ Fourth year student	120 (8.0%)
❖ Fifth year student	80 (5.4%)
❖ Sixth year student	38 (2.6%)
COVID-19 Categories	

❖ Infected (group A)	61 (4.0%)
❖ Vaccinated (group B)	1043 (69.5%)
❖ Infected and vaccinated (group C)	398 (26.5%)

Table (2): COVID-19 affection among all the study participants (n= 1502)

	n (%)
COVID-19 Affection	
❖ No	1043 (69.4%)
❖ Yes	459 (30.06%)
Approved COVID-19 Affection	
❖ Not done	82 (18.0%)
❖ PCR	231 (50.3%)
❖ Rapid Antigen test	50 (10.9%)
❖ CT Chest	89 (19.3%)
❖ Others (laboratory)	7 (1.5%)

Table (3): COVID-19 vaccination among all the study participants (n= 1502)

	n (%)
COVID-19 vaccinated	
❖ No	61 (4.1%)
❖ Yes	1441 (95.9%)
Type of COVID-19 vaccination	
❖ AstraZeneca	381 (26.4%)

❖ Sinopharm	349 (24.2%)
❖ Sinovac	280 (19.4%)
❖ Pfizer	231 (16.0%)
❖ Johnson	128 (8.8%)
❖ Sputnik	75 (5.2%)
❖ Moderna	65 (4.5%)
Number of vaccine doses	
❖ First	1441 (95.9%)
❖ Second	1179 (83.7%)
❖ Third	156 (11.1%)

Table (4): Comparing the Clinical Data among the different COVID-19 groups (n=1502)

	Group A n=61	**Group B n=1043**	**Group C n=398**	***P value***
Manifestation				
❖ No	23(37.7%)	12 (1.2%)	8 (2.0%)	<0.001**[i]
❖ Yes	38 (62.3%)	1031 (98.8%)	390 (98.0%)	
Types of manifestation:				
❖ Fever	20 (32.8%)	253 (24.3%)	328 (82.4%)	<0.001**[i]
❖ Headache	16 (26.2%)	338 (32.4%)	344 (86.4%)	<0.001**[i]
❖ Fatigue	17 (27.9%)	250 (23.9%)	291 (73.1%)	<0.001**[i]

❖ Joint Pain	15 (24.6%)	251 (24.0%)	233 (58.5%)	<0.001**[i]
❖ Muscle pain	11 (18.0%)	100 (9.5 %)	203 (51.0%)	<0.001**[ii]
❖ Loss of smell and taste	11 (18%)	0 (0.0%)	67 (16.8%)	0.019*[ii]
❖ Cough	10 (16.4%)	2 (0.2%)	43 (10.8%)	0.004*[ii]
❖ Tingling and numbness	2 (3.2%)	3 (0.3%)	39 (9.7%)	0.039*[ii]
❖ Pain at site of injection	0 (0.0%)	278 (26.6%)	389 (97.7%)	<0.001**[ii]
❖ Dyspnea and other respiratory symptoms	2 (3.2%)	0 (0.0%)	21 (5.3%)	0.26 [ii]
Duration of manifestation				
❖ None	23 (37.7%)	12 (1.2%)	8 (2.0%)	<0.001**[ii]
❖ Hours	0 (0.0%)	512 (49.0%)	249 (62.6%)	
❖ Days	14 (23.0%)	510 (48.8%)	16 (4.0%)	
❖ Weeks	13 (21.3%)	9 (1.0%)	121 (30.4%)	
❖ Months	11(18.0%)	0 (0.0%)	4 (1.0%)	
Treatment				
❖ No	19 (31.2%)	1004 (96.3%)	76 (19.1%)	<0.001*[i]
❖ Yes	42 (68.8%)	39 (3.7%)	322 (80.9%)	
Hospital admission				
❖ No	60 (98.4%)	1043 (100%)	391 (96.2%)	<0.001*[ii]
❖ Yes	1 (1.6%)	0 (0.0 %)	7 (1.8%)	
Need for ventilation				
❖ No	61(100.0%)	1043 (100%)	397 (99.8%)	<0.001*[ii]
❖ Yes	0 (0.0%)	0 (0.0%)	1 (0.2%)	

Table (5): Demographic and lab Data among different COVID-19 groups (n= 1502)

	Group A n=61	Group B n=1043	Group C n=398	*P value*
Age Categories				
❖ Less than 20 years	29 (47.5%)	721 (69.1%)	181 (45.5%)	
❖ 20 – 45 years	31 (50.8%)	303 (29.1%)	203 (51.0%)	<0.001**i
❖ More than 45 years	1 (1.7%)	19 (1.8%)	14 (3.5%)	
Gender				
❖ Male	34 (55.7%)	528 (50.6%)	171 (43.0%)	0.016*ii
❖ Female	27 (44.3%)	515 (49.4%)	227 (57.0%)	
CBC				
❖ Not done	49(80.3%)	1038 (99.5%)	319 (80.2%)	
❖ Low lymphocytes	1 (1.7%)	1 (0.1%)	11 (2.7%)	<0.001**i
❖ Low HB	10 (16.4%)	4 (0.4%)	63 (15.8%)	
❖ Low HB & lymphocytes	1(1.6%)	0 (0.0%)	5 (1.3%)	
CRP				
❖ Not done	51 (83.6%)	1039 (99.6%)	310 (77.9%)	
❖ Normal	2 (3.3%)	1 (0.1%)	12 (3.0%)	<0.001*i
❖ High	8 (13.1%)	3 (0.3%)	76 (19.1%)	
Serum Ferritin				
❖ Not done	58 (95.1%)	1040 (99.7%)	374 (94.0%)	
❖ Normal	1(1.7%)	3 (0.3%)	6 (1.5%)	0.003*i
❖ High	2 (3.2%)	0 (0.0%)	18 (4.5%)	
D Dimer				
❖ Not done	56 (91.8%)	1040 (99.7%)	346 (86.9%)	
❖ Normal	1 (1.7%)	3 (0.3%)	25 (6.3%)	<0.001*i
❖ High	4 (6.5%)	0 (0.0%)	27 (6.8%)	

LDL				
❖ Not done	56 (91.8%)	1042 (99.9%)	396 (99.4%)	
❖ Normal	0 (0.0%)	1 (0.1%)	1 (0.3%)	<0.001[*i]
❖ High	5 (8.2%)	0 (0.0%)	1 (0.3%)	

Table (6): Fatigue among all the study participants (n= 1502)

Total Fatigue Assessment score	
Median (IQR)	19 (16 – 25)
Min. – Max.	(10 – 48)
Fatigue Categories	
Healthy (<22)	904 (60.1%)
Mild to Moderate (22-34)	572 (38.0%)
Severe (>35)	26 (1.9%)

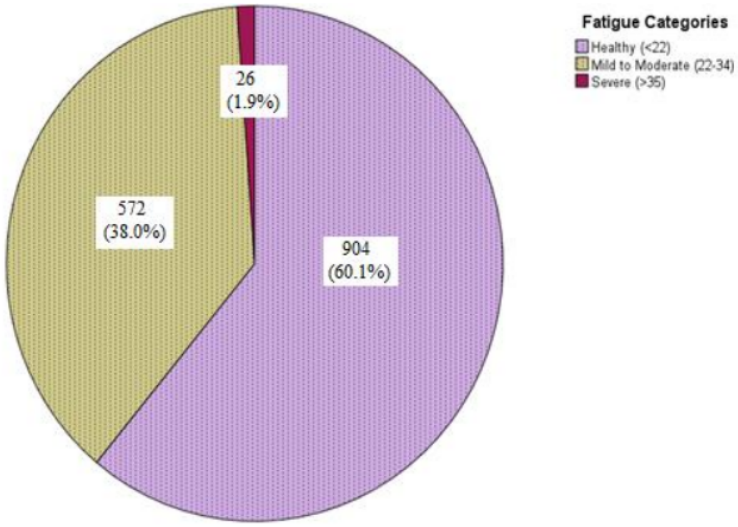

Fig (1): Pie Chart illustrates the distribution of fatigue severity among the study participants. تكرار

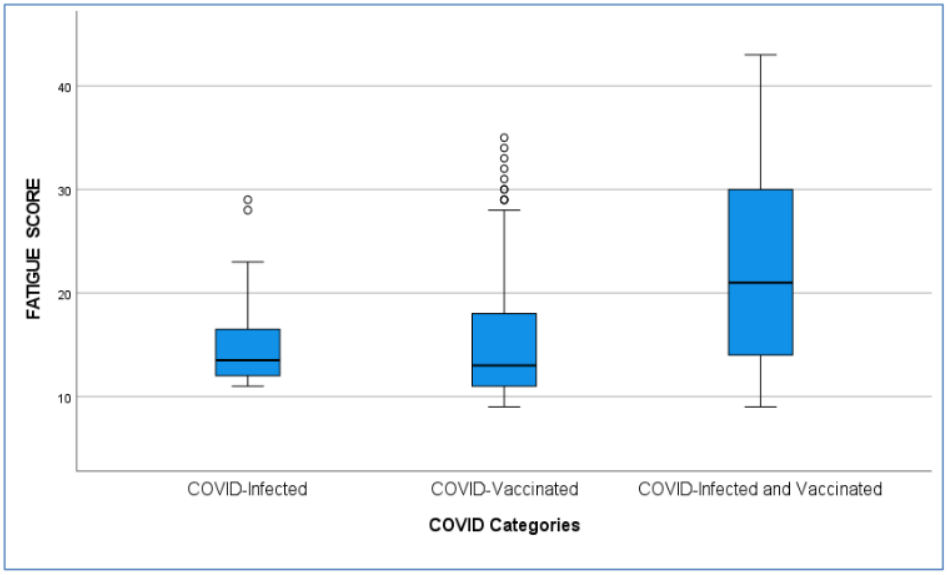

Fig (2): Box plots illustrates the difference in the median fatigue scores and the dispersion measures between the different COVID-19 categories.

Table (7): Fatigue among the different COVID-19 groups (n= 1502)

	Group A n=61	Group B n=1043	Group C n=398	*P value*
Fatigue Categories:				
Healthy (< 22)	38 (62.3 %)	565 (54.1%)	298 (74.9%)	
Mild - Moderate (22-34)	19 (31.2 %)	465 (44.5%)	88 (22.1%)	<0.001**[i]
Severe (35 or more)	4 (6.5%)	11 (1.4%)	12 (3.0%)	
Total Fatigue Assessment score				
Median (IQR)	18 (16 – 20.5)	21 (16 – 26)	18 (16 – 23)	0.039*[ii]
Min. – Max.	(13 – 32)	(10 – 40)	(10 – 48)	

Table (8): Fatigue regarding different types of COVID-19 vaccines (n=1043)

	AstraZeneca n=258	Sinopharm n= 223	Sinovac n=183	Pfizer n= 146	Johnson n=81	*Sputnik n=53*	*Moderna n=40*	*Mixed n=59*	*P value*
Fatigue Categories: Healthy (< 22)	141 (54.7%)	112 (50.2%)	80 (43.7%)	82 (56.2%)	59 (72.8 %)	43 (81.1%)	37 (92.5%)	14 (23.7 %)	<0.001**

Mild - Moderate (22-34)	115 (44.6%)	111 (49.8%)	102 (55.7%)	63 (43.2%)	21 25.9%)	10 (18.9%)	1 (2.5%)	42 (71.2%)	
Severe (35 or more)	2 (0.7%)	0 (0.0%)	1 (0.6%)	1 (0.6%)	1 (1.3%)	0 (0.0%)	2 (5.0%)	3 (5.1%)	

There was statistically difference regarding fatigue among different types of COVID-19 vaccine.

Discussion

The global health crisis is undoubtedly the most significant problem faced by the international community in this current decade, stemming from the COVID-19 pandemic produced by the SARSCoV-2 virus [8]. As the ongoing pandemic persists and the population of recovered individuals grows, numerous researchers have raised inquiries on the long-term physiological and pathological changes induced by COVID-19. Certain patients have reported enduring symptoms such as dyspnea, tiredness, cough, chest discomfort, myalgia, and arthralgia. Additional symptoms that have been documented encompass depression, cognitive impairments, headaches, and palpitations among individuals who experienced a minor acute phase of the illness [9]. The neurological manifestations associated with COVID-19 exhibit a spectrum of severity, encompassing mild symptoms such as headache, vertigo, and anosmia, as well as more severe conditions including GBS, encephalopathy, encephalitis, acute disseminated encephalomyelitis, and stroke [10]. In their investigation, Sandoval et al. [11] observed that patients had a pattern of symptoms characterized by gradual ascending flaccid quadriparesis, areflexia, and cranial nerve palsies. These patients

were subsequently diagnosed with the AMAN variety of GBS.

The muscular manifestations observed in individuals with COVID-19 exhibit a range of symptoms, including myalgia (characterized by muscle aches and pain), myositis, and rhabdomyolysis. The prevalence of these manifestations has been shown to vary between 11% and 50% [12]. In their investigation, the researchers disclosed that the muscle is impacted by either direct invasion of skeletal muscle by SARS-CoV-2 through the angiotensin-converting enzyme receptors, or through immune-mediated processes involving cytokine storming, leading to the generation and storage of inflammatory cytokines in skeletal muscles [13].

The identification of the principal objective of this special issue was challenging given the diverse array of expressions. After providing an introductory overview of the disease's epidemiology, pathophysiology, and categorization, it was determined that the subsequent description would be organized based on the primary symptom categories, categorized by their intensity, disability, or frequency [14].

The precise pathophysiological mechanisms behind the post COVID-19 symptoms remain unresolved. The etiological process may entail various factors, including the direct consequences of viral infection, the inflammatory response, the immunological responses, and potentially psychological factors. The neuroinflammatory response is expected to be more pronounced in individuals who are susceptible, such as patients with chronic illnesses [15].

In this study, a total of 1,502 individuals were approached at Helwan University hospital. Among them, 132 (8.8%) were staff members and doctors, 127 (8.5%) were employees, and 1,243 (83.0%) were students. The recruitment period for this study spanned from June 2022 to June 2023. Out of the total sample size, 733 individuals, accounting for 48.8% of the population, were identified as men, while 769 individuals, representing 51% of the population, were identified as females.

The study categorized the population into different age groups. Specifically, individuals less than 20 years old accounted for 931 individuals, representing 62.0% of the whole population. Those between the ages of 20 and 45 comprised 537

individuals, making up 35.8% of the population. Lastly, individuals above the age of 45 constituted 34 individuals, accounting for 2.2% of the total population.

Salameh et al. (2022) conducted a study with the objective of determining the incidence of musculoskeletal pain and syndromes among medical students during online learning. Additionally, the researchers aimed to explore the associations between musculoskeletal pain and other cause factors. The study involved a sample size of 282 students, mostly consisting of first and second-year students, accounting for 47.5% and 43.3% of the participants, respectively. Of the entire sample, 174 individuals (61.7%) identified as female, while 108 individuals (38.3%) identified as male [16].

In a separate study conducted by Kamal et al. in 2022, it was observed that the average age of the patients was 48.3 ± 14.7 years. The study did not reveal any statistically significant disparity in terms of gender distribution, with 52.5% of the patients being girls and 47.5% being men. The study was conducted on a sample of 160 patients who sought medical attention at the screening clinic of Zagazig University Hospitals. The objective of the study was to determine the prevalence of various musculoskeletal complaints among individuals diagnosed with COVID-19 [17].

The findings of our study indicate that among the participants infected with COVID-19 in group A (n=61, 4%), various manifestations were observed. These manifestations included fever (20, 32.8%), headache (16, 26.2%), fatigue (17, 27.9%), joint pain (15, 24.6%), muscle pain (11, 18.0%), loss of smell and taste (11, 18.0%), cough (10, 16.4%), tingling and numbness (2, 3.2%), and dyspnea and other respiratory symptoms (2, 3.2%).

According to Lechien et al. (2020), in accordance with our research, myalgia was found in 59% and arthralgia in 31% of COVID-19 patients from various European hospitals [18].

In a study conducted by Galal et al. (2021), an examination of post-COVID-19 symptoms revealed that the prevailing manifestations included myalgia, fever, and limitations in everyday functioning [19].

According to Kamal et al. (2022), it was observed that fever was the predominant symptom among the patients, with a prevalence of 97%. This was followed by cough, exhaustion, sore throat, dyspnea, headache, diarrhea, loss of smell, and chest pain, with respective prevalence rates of 77%, 72.5%, 70%, 50%, 47.5%, 45%, 45.0%, and 10.0% [20].

In a study conducted by Tharani et al. in 2022, it was observed that the average percentages of fatigue, myalgia, arthralgia, headache, and back pain were 49.12%, 34.75%, 33%, 28.4%, and 30.58% respectively [21].

According to a study conducted by Lippi et al. in 2023, the primary symptoms associated with post COVID-19 include dyspnea, cough, fatigue, musculoskeletal pain, headache, cognitive impairments, and depression [22].

Furthermore, our research findings indicate that a subset of participants (n=398, 26.5%) who were both infected with COVID-19 and vaccinated (group C) exhibited various manifestations. These manifestations included fever in 328 individuals (82.4%), headache in 344 individuals (86.4%), fatigue in 291 individuals (73.1%), pain at the site of injection in 389 individuals (97.7%), joint pain in 233 individuals (58.5%), muscle pain in 203 individuals (51.0%), loss of smell and taste in 67 individuals (16.8%), cough in 43 individuals (10.8%), and tingling and numbness in 39 individuals (9.7%).

In research conducted in 2020 dubbed "COVID-19 Post-Acute Care Study Group," Carfì et al. examined the same subject matter. In a study titled "Long-lasting symptoms in individuals following acute COVID-19 infection," it was found that a significant number of patients continued to experience fatigue, dyspnea, and joint discomfort [23].

A study conducted by Cummings et al. in 2020 examined a cohort of 1150 COVID-19 patients in New York City. The findings of this study revealed that approximately 26% of the patients reported experiencing myalgia (Cummings et al., 2020, [24].

In a study conducted by Hoong et al. (2021), it was shown that a significant proportion of patients, specifically 30%, reported experiencing musculoskeletal symptoms. The

researchers discovered that among individuals experiencing musculoskeletal issues, 37.5% reported myalgia, 5.7% reported arthralgia, 6.8% reported new-onset backache, and 50% reported overall body soreness [25].

The presence of an inflammatory response in individuals infected with COVID-19 has been suggested as a potential factor contributing to the occurrence of myalgia and/or arthralgia. Numerous studies have documented the occurrence of a robust inflammatory reaction in individuals afflicted with COVID-19, characterized by heightened concentrations of proinflammatory cytokines including CRP, IFN-γ, IL-1β, IL-6, IL-17, and TNF-α. The association between these inflammatory signaling molecules and muscle fiber damage has been established, suggesting their potential involvement in the development or exacerbation of arthralgia and/or myalgia in individuals with COVID-19 infection [26].

In a study conducted by Salameh et al. (2022), it was shown that a significant proportion of students (75.9%) experienced musculoskeletal pain (MSP) for the first-time during distance learning. The bulk of these cases were observed in the shoulders and neck region, accounting for around 65% of the reported instances. The prevalence of back discomfort is reported to be 62.1%, whereas eye weariness is reported to be 61.7% [27].

In the study conducted by Akulwar-Tajane et al. (2021), it was shown that around 66% of the participants had musculoskeletal pain in various areas of the body during the COVID-19 lockdown. The prevalence of this pain was observed to be relatively equal in the lumbar spine (33.3%) and cervical spine (32%) [28].

In a study conducted by Kamal et al. (2022), the objective was to assess the prevalence of various musculoskeletal complaints in individuals diagnosed with COVID-19. The researchers discovered that a significant proportion of the patients under study (60.0%) experienced musculoskeletal manifestations, with the most common symptoms being myalgia and weariness. Arthritis or arthralgia was observed in 47.5% and 45.0% of the patient population, with 29 individuals experiencing back

discomfort.

In alignment with our research, a comprehensive analysis conducted by Pires et al. (2022) revealed that the prevailing musculoskeletal complaints predominantly encompass myalgia, arthralgia, fatigue, back pain, muscle weakness, sarcopenia, decreased exercise capacity, and compromised physical performance [30].

The findings of our study indicate that the duration of manifestations in group A varied, with 23.0% lasting for a duration of 14 days, 21.3% lasting for several weeks, and 18.0% lasting for several months. In (group B) lasts: hours 512 (49.0%), days 510 (48.8%), weeks 9 (1.0%) and lasts in (group C): hours 249 (62.6%), days 16 (4.0%), weeks 121 (30.4%), months 4 (1.0%)

Several investigations have documented that these clinical presentations may endure for a duration ranging from several weeks to months subsequent to the clearance of the acute phase of COVID-19 infection. A study conducted by Carfì et al. (2020) in Italy revealed that a significant proportion of individuals who had recovered from COVID-19, namely 87.4%, exhibited the presence of at least one symptom, such as fatigue, dyspnea, and joint or chest discomfort, during the two-month period following the acute infection (Carfì et al., 2020 [31].

This finding aligns with the research conducted by Kamal et al. (2020), which examined and classified the post-eradication signs of coronavirus infection and their association with illness severity. The study reported that a majority of participants experienced fatigue [32]. Our study revealed that among the patients infected with COVID-19 in group A, there was one instance that required hospital admission. Conversely, none of the individuals in group B who were vaccinated against COVID-19 required hospital admission. However, among the individuals in group C who were both infected with COVID-19 and vaccinated, a total of seven cases required hospital admission. Ventilation was not required for instances belonging to groups A and B, however cases belonging to group C necessitated ventilation. In a research conducted by Wang et al. (2020) in Wuhan, China, it was observed that COVID-19 patients with severe disease had an ICU admission rate of 32%. The findings of our study indicate

that among the participants who received the COVID-19 vaccine in group B (n=1043, 69.4%), various manifestations were reported. These manifestations included fever (253, 24.3%), headache (338, 32.4%), fatigue (250, 23.9%), pain at the injection site (278, 26.6%), joint pain (251, 24.0%), muscle pain (100, 9.5%), and tingling and numbness (3, 0.3%) [33]. Based on the tiredness evaluation scale utilized in our study, it was seen that among the patients who got the Astra-Zeneca vaccination, 141 individuals exhibited no signs of fatigue, 115 individuals experienced mild to moderate fatigue, and 2 individuals reported severe fatigue. A total of 112 patients were administered Sinopharm vaccinations and were classified as healthy. Additionally, 111 subjects reported experiencing mild to moderate fatigue, whereas none of the subjects exhibited symptoms of severe exhaustion. In contrast, the group of participants who were administered the Sinovac vaccine consisted of 80 individuals who were in good health, 102 individuals who experienced mild to moderate fatigue, and one individual who reported severe fatigue. Similarly, among the recipients of the Pfizer vaccine, 82 individuals were healthy, 63 individuals experienced mild to moderate fatigue, and one individual reported severe fatigue. Lastly, among those who received the Johnson vaccine, 59 individuals were in good health, 21 individuals experienced mild to moderate fatigue, and one individual reported severe fatigue. In the study, participants were divided into two groups: those who received the Sputnik vaccine and those who received the Moderna vaccine. Among the subjects who received the Sputnik vaccine, 43 individuals reported being in good health, while 10 individuals had mild to moderate fatigue. None of the respondents in this group reported experiencing extreme exhaustion. On the other hand, among the subjects who received the Moderna vaccine, 37 individuals were in good health, one individual reported mild to moderate fatigue, and two individuals reported severe weariness. In conclusion, the cohort of individuals who were administered a combination of different vaccination types consisted of 14 participants who exhibited no health complications, 42 subjects who had mild to moderate fatigue, and 3 patients who reported severe exhaustion. In a recent study conducted by Al Bahrani (2021) in Saudi

Arabia, the focus was on examining the safety and reactogenicity of COVID-19 vaccines. The study found that after a few days of receiving the first dose of the Oxford-AstraZeneca vaccine, approximately 30.5% of individuals reported experiencing joint and muscular pain [34]. In a study conducted by Alamer et al. (2021) in Saudi Arabia, an investigation was carried out to examine the adverse outcomes associated with the Pfizer vaccine. The findings revealed that 67% of the participants reported experiencing weariness [35]. In their study conducted in 2021, Alhazmi et al. found that the predominant adverse effects reported by individuals who received the Pfizer-BioNTech and Oxford-AstraZeneca vaccines were exhaustion and pain, with frequencies of 90% and 85% respectively. Additionally, redness at the injection site was also commonly observed. In comparison to the Pfizer-BioNTech vaccine, which had efficacy rates of 77% and 44% correspondingly, an analysis revealed a substantial association between the Oxford-AstraZeneca vaccination and symptoms of fatigue and fever, with reported rates of 92% and 71% respectively. However, no substantial difference was observed in any unfavorable effects [36]. According to the recommendations of researchers, it is advisable to lower the patient's arm during the injection procedure in order to minimize pain. This is because injecting into a relaxed muscle tends to result in less pain compared to injecting into a muscle that is tense. It is imperative to uphold a low temperature for the proper storage of vaccines. Specifically, the Sinopharm COVID-19 vaccine necessitates storage at standard refrigerator temperature. Failure to adequately warm the vaccine prior to injection may lead to heightened pain at the injection site [37].

In a study conducted in UAE they found the participants who received the Sinopharm vaccination experienced no post-vaccination symptoms.[38]. Comparable studies from India found that after vaccination with the Oxford-Astra Zeneca vaccine, there were no major adverse effects among people received[39].

CONCLUSION:

The persistent neuromuscular symptoms are challenging because the estimated prevalence of these symptoms remains high even after recovery. Although the believed molecular mechanisms behind the pathophysiology have yet to be addressed, this work adds to our understanding of the long-term effects of COVID-19 in recovered patients. Our study suggested that COVID-19 vaccines may a protective factor.

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