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RESEARCH ARTICLE

COMPARISON OF INFLAMMATORY MARKERS BETWEEN COVID VACCINATED POPULATION AND NATURALLY INFECTED POPULATION

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Abstract

The 2019 coronavirus disease (COVID-19) pandemic poses formidable obstacles in the fields of medicine, science, and public health. SARS-CoV-2 is a coronavirus that causes severe acute respiratory syndrome and may spread fast, with potentially fatal consequences. Establishing reliable laboratory biomarkers capable of risk-based patient classification is crucial for ensuring timely therapy. The study focuses on the problems of the COVID-19 vaccine and multisystem inflammatory syndrome. Multi-organ failure in patients with severe COVID-19 consequences is mostly caused by systemic vasculitis and cytokine-mediated coagulation abnormalities, as shown by a review of recently published data. In addition, the study examines biomarkers associated with COVID-19 disease progression. Lastly, the study focuses on Pro-Inflammatory Cytokines (Il-1 and Il-6) And Lung Inflammation by Coronavirus-19 and its Anti-Inflammatory Strategies.

Introduction:-

According to Meyers, (2022) despite the ongoing global pandemic of coronavirus 2–caused severe acute respiratory syndrome, many diagnostic and therapeutic challenges exist. As of February 11, 2020, the World Health Organization recognized SARS-CoV-2, a coronavirus illness first identified in December 2019 in Wuhan, China. The date of the formal pandemic declaration was March 11, 2020. There are around 67 million cases and over 1.5 million fatalities as of December 9, 2020. SARS-CoV-2 in adults is now understood to be a multisystem illness rather than only a virus that causes pneumonia and ARDS. Most kids, on the other hand, experience no symptoms or just minor ones. Critical sickness is very uncommon. More and more cases of a unique disease called multisystem inflammatory syndrome in children (MIS-C) are being recorded in kids. It is common for children with MIS-C to need intensive care due to their severe illness.

Bozkurt, (2021) stated that the PCR analysis of respiratory tract samples for SARS-CoV-2 nucleic acids confirms the presence of COVID-19 (PCR). The patient, the hospital, and the public health and administrative staffs all benefit greatly from a timely and precise diagnosis. The current epidemic has put a heavy burden on healthcare systems, which are struggling to keep up with the rapidly growing number of infected people. The use of biomarkers, which are indicators detected in a laboratory, has the potential to provide novel, objective information that can significantly alter various aspects of patient care.

Rabaan, (2022) stated that the treating physician still has to be properly updated, despite the expanding COVID-19 literature database, to provide the best treatment possible at the bedside. The purpose of this article is to provide

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doctors with the most recent and relevant information on the use of biomarkers in COVID-19. The diameter of coronaviruses, which ranges from 80 to 220 nm, is due to their spherical shape and single-stranded RNA makeup. Micro-droplet exposure from infected people or contact with contaminated fomites is the two primary modes of SARS-CoV-2 transmission. The virus invades the epithelial lining of the bronchi and alveoli, the smaller air passages, and the air sacs.

Costiniuk, (2021) analyzed that specifically, the virus's spike surface glycoprotein S interacts with angiotensin-converting enzyme 2 (ACE-2), a membrane carboxypeptidase found in the lungs' alveoli and bronchioles, with the greatest expression seen in type 2 pneumocytes, alveolar macrophages, and dendritic cells. In addition to the endothelium lining blood vessels, ACE-2 is found on the epithelial lining the digestive tract, the heart's pericytes, the proximal tubules of the kidneys, the skin, the reticuloendothelial system, and the brain. Obesity, chronic lung illness, cancer, and the use of immunosuppressive medicines are all associated with increased ACE-2 expression, as are age, gender, genetics, and the presence of these and other co-morbid disorders.

According to Goletti, (2021) initially, renin degrades angiotensinogen to produce angiotensin I, which is then degraded into angiotensin II by an angiotensin-converting enzyme. Activation of the AT1R (angiotensin II type 1 receptor) causes vasoconstriction, fibrotic remodeling, and inflammation. Vasodilation and reduced growth rate result from the activation of AT2R (angiotensin II type 2 receptor). Although the ACE/Ang II/AT1 axis promotes blood vessel growth, this process is attenuated by ACE2, which degrades angiotensin II into factors that inhibit this process. Therefore, ACE2 principally functions as a primary physiological regulator of angiotensin II, counteracting the effects of ACE. After a virus interacts with ACE-2, ACE-2 is taken into the cell, where it is downregulated and angiotensin II is increased. The latter, via AT1R, triggers downstream inflammatory pathways, resulting in the "cytokine storm" that damages various organs.

Snyman, (2021) pointed out that the principal hosts for the viruses are the alveolar epithelial cells, lymphocytes, and vascular endothelial cells. The virus suppresses the immune response by blocking the generation of interferons. Infection of nearby target cells and viremia result from viral replication, which in turn triggers an exacerbated pulmonary and systemic inflammatory response. This clarifies the predominance of ARDS, shock, and coagulopathy in the clinical presentation of severe COVID-19.

Objective of the study:-

The main objective of the study is to examine the Comparison of inflammatory markers between covid vaccinated population and the naturally infected population. The study also focuses on:

1. To examine Problems of the COVID-19 vaccine and multisystem inflammatory syndrome
2. To examine Biomarkers associated with COVID-19 disease progression
3. To make focus on Pro-Inflammatory Cytokines (Il-1 And Il-6) And Lung Inflammation By Coronavirus-19 and its Anti-Inflammatory Strategies
4. To explore Safety, tolerability, and immunogenicity of a recombinant adenovirus type-5 vectored COVID-19 vaccine

Literature Review:-

Problems of the COVID-19 vaccine and multisystem inflammatory syndrome

According to Grome, (2021) the 2019 coronavirus disease (or COVID-19) is a new and potentially catastrophic pandemic. Over 50 million individuals were infected, and over 1.2 million had died by the time it was released. Understanding the processes of viral replication and transmission, as well as host immune response and the creation of efficient therapies and prevention measures, is thus essential for global health. The epidemiological research implies that the worldwide infection rate will continue to climb until conclusive proof of a safe, effective, widely accessible, and widely accepted vaccination becomes available. The duration of protective immunity after vaccination or the host immunologic response to a naturally occurring illness is not well understood but is critical to both of these inflection points. The duration of immunity to severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) cannot be known unless the global medical community continues its painstaking and unwavering research of the growing literature on all aspects of SARS-CoV-2.

Zambrano, (2022) stated that despite a few great overviews of the pediatric global, information on children and the COVID-19 pandemic has been widely diverse and fast evolving, and there will be more advances in our knowledge

in the coming years. In particular, the world's pediatricians are waiting for the results of thorough research on a vaccination that is both safe and effective for kids. Large-scale studies of vaccine candidates' efficacy in adult patients are now underway across the globe, thus it makes sense to investigate their efficacy in children until after this stage of development has concluded. The inability of children to provide informed permission or even an informed assent to participate in trials with a high risk of severe damage adds another layer of difficulty to the investigation of vaccination effectiveness in pediatric patients. Moreover, given that children are often less seriously afflicted by the virus, it is even more important to have a large sample size in these pediatric, compared to adult, vaccination efficacy studies.

Woodruff, (2022) pointed out that the specific reason why youngsters tend to have milder symptoms when infected with COVID-19 is yet unknown. Definitions of MIS-C vary somewhat depending on the context, but they always include non-specific symptoms and a history of recent exposure to or positive for SARS-CoV-2. Significant coronary artery dilatation occurs in 17% of pediatric patients with this illness, and almost 30% of very ill children requiring extracorporeal membrane oxygenation support in a large Swiss and French cohort. Antibodies against SARS-CoV-2 were observed to be significantly higher in children with a severe MIS-C diagnosis. Antibodies to the spike protein and viral nucleocapsid were measured, together with receptor-binding domain and neutralization titers.

According to Xue,(2021) developing a vaccination in children is difficult because of the increased risk of inflammation. A serious result after immunization against SARS-CoV-2 might occur in otherwise healthy youngsters if the vaccine can produce such an antibody response. This is very worrying even in tiny numbers. Understanding the pathophysiology and processes linked with MIS-C sufferers is, therefore, crucial for studying vaccinations in children. To develop the safety profile necessary for widespread immunization of the world's pediatric population, it is essential to investigate the vaccine candidates for possible ties to causes of MIS-C.

Ouldali, (2022) analyzedvaccine development as just one aspect of risk assessment. A vaccination with no associated dangers is quite improbable. There is always a chance that an intervention might have unintended consequences, and that includes immunizations. Consequently, physicians all over the globe have difficulty effectively communicating the very low danger of bad effects from immunizations with the far greater possibility of considerable and long-lasting benefits to the individual and society as a whole. The worldwide economic crisis that has pushed so many families with children into poverty might be halted in its tracks with the broad distribution of a vaccine proved safe and effective against COVID-19 within the next 18 months, potentially saving millions of lives. If parents and others are not properly informed about the genuine advantages of vaccines for children, then the inherent hazards of pediatricsicknesses, such as COVID-19, measles, and several other life-threatening infections, will return to the globe. Those who are eligible for vaccinations and their parents must be educated to strengthen the bond between doctors and the patients they are trying to protect.

Biomarkers associated with COVID-19 disease progression

According to Blagojević, (2021) scientists seek accurate biomarkers of coronavirus disease 2019 (COVID-19) illness development to stratify people at high risk. Patients must be stratified into risk categories as soon as possible after diagnosis due to the fast nature of the disease's progress to allocate resources effectively. To determine which patients will experience rapid disease progression leading to severe complications and death, novel biomarkers are required. Understanding viral pathogenetic processes and the cellular and organ damage they cause is essential to the discovery of new biomarkers. The development of reliable biomarkers would aid in the diagnosis, clinical care, and avoidance of potentially fatal consequences.

Keykavousi, (2022) pointed out that initial research has uncovered the vasculitic mechanisms that lead to organ damage in critically sick individuals. Inflammatory cascades, complement activation, and the production of pro-inflammatory cytokines (including interleukin (IL)-6) all trigger these pathways. Standard laboratory assays like the D-dimer or prothrombin time/activated partial thrombin time (PT/aPTT) are poor at predicting the degree of vascular injury but are great at identifying pulmonary edema and acute respiratory distress syndrome (ARDS). High blood pressure and ischemic heart disease are two of the most prevalent co-occurring conditions. According to epidemiological data, these factors significantly affect the long-term health of SARS-CoV-2 patients.

Khan, (2021) pointed out that the other lab tests, like IL-6, D-dimer, lactate dehydrogenase (LDH), and transaminase determination, may help find patients who are at risk of death and who may benefit from anti-IL6 immunotherapies with tocilizumab. Even though cytokine analysis is expensive, most labs do not do it often. However, surrogate signs

of infection (ferritin, C-reactive protein (CRP)) related to IL-6 will become more important for predicting the outcome. The severity of ischemia and thromboembolic disease cannot be predicted by any single metric other than the D-dimer, prothrombin time (PT), and fibrin degradation product (FDP). Because of this, classifying patients into risk groups for early anticoagulant or fibrinolytic treatment might be challenging.

Shaath, (2021) analyzed that in the most recent revision of the New Coronavirus Pneumonia Treatment and Diagnosis Plan, patients with COVID-19 are rated as either mild, moderate, severe, or critical (trial version seven). Several hematological and biochemical indicators have been associated with COVID-19 severity. These markers include white creatine kinase (CK), lymphopenia, lactate dehydrogenase (LDH), White blood cell (WBC), C-reactive protein (CRP), and troponin. In the first week of a COVID-19 infection, a chest CT may reveal severe pneumonia, and new evidence suggests that homocysteine (Hcy), together with age, the monocyte-lymphocyte ratio (MLR), and the period between the onset of illness and hospitalization, maybea particular predictor of cardiovascular risk. However, these findings did not indicate the involvement of any additional organs.

The mechanisms of action of COVID-19

Hashimoto, (2022) pointed out that understanding the molecular pathways by which viruses cause damage to human cells is crucial for developing effective pharmaceutical therapies and locating new biomarkers that might foretell the severity of cardiovascular damage or death. The main way the virus gets into a host cell is for it to bind to the membrane-bound form of angiotensin-converting enzyme 2 (ACE2) and for the host cell to then takes in the complex. There are versions of ACE2 that are attached to a membrane and versions that can dissolve in water. The soluble form of the N-terminal ectodomain, which is cut and secreted, is barely detectable in the blood. The membrane-bound form has an extracellular domain that is joined to the plasma membrane by a transmembrane domain. The role that increased ACE2 levels play in the onset of conditions including diabetes, CKD, and hypertension remains unknown. Kinins, apelins, neurotensins, dynorphins, ghrelin, amyloid, and angiotensin are all substrates for angiotensin-converting enzyme 2. After being activated, angiotensin-converting enzyme 2 (ACE2) converts both angiotensins I (Ang I) and angiotensin II (Ang II) into the tissue-protective form angiotensin (Ang) -(1-9).

Van Eijk, (2021) stated that the receptor-binding region of the new coronavirus spike (S) protein has been shown to bind robustly to ACE2 receptors. TMPRSS2, a serine protease, and acetyl-CoA dehydrogenase 2 (ACE2) are used by SARS-CoV-2 to prime the S protein. In addition to the lungs, ACE2 and TMPRSS2 are expressed in the epithelia lining the small intestine, the upper esophagus, the liver, the colon, the blood vessels, the heart, the kidneys, and the ovaries and testes. Because the COVID-19 receptor is so widely dispersed, it may be activated by a single traumatic event that causes widespread organ damage and ultimately results in systemic failure. Both the open reading frame (ORF8) and the surface glycoprotein were shown to be attached to the porphyrin, suggesting a second mechanism of action for SARS-CoV-2. This was shown by Wenzhong and Hualan. It is theorized that the proteins orf1ab, orf10, and orf3a cooperate to reduce hemoglobin's ability to transport oxygen and carbon dioxide by interfering with the chain's 1-beta segment. This viral process disrupts normal heme metabolism, which ultimately manifests as disease.

According to Malone, (2021) it is generally agreed that inflammatory cascades, cytokine storms, and the activation of coagulation cascades are the pathogenetic pathways initiated by COVID-19 during human infection. Critical complications from systemic vasculitis include sepsis, DIC, and sudden cardiac death.It has been determined that DIC is present in the vast majority of SARS-CoV-2 fatalities. Those who contract a virus run the risk of developing severe sepsis and organ failure. The inflammatory response that includes cytokine release, tissue factor production, and von Willebrand factor secretion is what causes DIC, which is often brought on by sepsis. When natural anticoagulants are not present, free thrombin may induce fibrinolysis and activate platelets. All SARS-CoV-2 fatalities had moderately to significantly elevated fibrin-related markers (D-dimer and fibrinogen degradation product), suggesting that these patients all experienced coagulation activation and secondary hyperfibrinolysis, particularly in the advanced stages of novel coronavirus pneumonia.

Andrews,(2021) analyzed that since the beginning of the emergency pandemic crisis, comparing people with and without the severe or deadly forms of COVID-19 using a battery of hematologic, biochemical, inflammatory, and immunologic markers has been of utmost scientific relevance. To optimize clinical care and avoid significant consequences after a diagnosis of COVID-19, it is required to classify patients into risk groups. By studying the pathophysiological mechanisms of systemic cardiovascular injury, scientists have gained new insight into the biochemical indicators linked to coagulation disorders. These are not only useful in predicting the severity of a

condition, but also in its treatment of it, since they inform the selection of medications to use in suppressing coagulation activity. As such, a laboratory score that takes into account hematological, inflammatory, biochemical, and immunological characteristics would be an invaluable tool for stratifying COVID-19-positive individuals into risk groups, which is essential for clinical and therapeutic purposes.

Pro-Inflammatory Cytokines (Il-1 And Il-6) And Lung Inflammation By Coronavirus-19 And Its Anti-Inflammatory Strategies

According to Conti, (2020) SARS-CoV-2, also known as CoV-19 (coronavirus disease-19), is the virus responsible for severe acute respiratory syndrome. CoV-19 may severely harm the respiratory system, especially the lungs, and has the potential to produce a global pandemic. While some have speculated that maybe scientists invented CoV-19 in a lab, the truth is that the recent outbreak of diseases is tied to the Wuhan seafood wholesale market, which deals in fish and other live animals including chickens, bats, and snakes. Ross, (2020) stated that throat and nasal swabs taken from individuals with the illness or suspected cases have been used to identify the pathogen. Different variables, including the number of deposited viruses (viral load), the surface type, the suspension medium, the temperature, and the relative humidity, all have a role in how long a virus may live on a given surface. Therefore, the length of time that CoV-19 may remain dormant on inert materials is unknown. While transmission by direct touch and air movement between closely spaced people is inevitable, transmission via indirect contact, that is with the contamination of inanimate objects, is less so. Once CoV-19 has contaminated an area, it may spread to the lungs by invading the mucous membranes of the nose, eyes, and mouth. While influenza viruses in general may stay active for months, COV-19 has a much shorter life expectancy in the open air, lasting just around 9 days.

Toniato, (2020) analyzed that for all viruses, a rise in temperature means less chance of reproduction. Currently, the inactivation temperature of CoV-19 is not understood, however, some studies claim that it can be inactivated at around 27° C, but resists the cold even below 0°C. Human COV-19 is classified as either low pathogenic or highly pathogenic, however, the infection does not always result in the classic symptoms and may even go unnoticed. According to Krishna, (2021) when CoV-19 is low in pathogenicity, it infects the upper respiratory tract and causes mild respiratory diseases like the common cold; however, when CoV-19 is high in pathogenicity, it causes severe acute respiratory syndrome, primarily through infection of the lower airways, leading to the release of pro-inflammatory cytokines and pneumonia, which can be fatal, especially in weakened subjects or those with relevant pathologies. Multiple strains of CoV-19 are possible and will be investigated shortly. Mortality and morbidity are higher among the elderly, who make up around 70% of the dead patients. The X chromosome is home to several genes that control immune cell development and function, which may explain why females are less susceptible to contracting CoV-19 than men.

Mormile, (2022) stated that damage to internal organs and acute respiratory stress syndrome are common outcomes of coronavirus-caused severe pneumonia due to the virus's propensity for fast reproduction, the infiltration of inflammatory cells, and heightened responses to inflammatory substances like cytokines. While infections in children are less common, they tend to have less impact if they do occur. Interestingly, there have been relatively few occurrences of infection in children less than 15 years old, perhaps because of their greater protection from acquired maternal immunity and their bigger and more effective thymus. Yu, (2021) stated that current estimates have the fatality rate at 2-3% owing to CoV-19, which is only slightly higher than that of a severe case of the seasonal flu but far lower than the 9-10% seen with SARS. Each infected person can infect two to three others; until the number of infected persons decreases below one, the epidemic will likely continue to spread. Better cleaning and disinfection of environmental surfaces, together with improved hand hygiene and mucous membrane and respiratory tract protective devices, are all important components of infection prevention and control.

Michot, (2020) analyzed thatto attack the efficiency of viral transmission, infected people must be placed in quarantine, implementing a containment strategy, which could include, where possible, isolation of the sick, including voluntary isolation at home, the closing of schools, the use of collective means of transport and the frequency of crowded places. Although the new coronavirus has certain structural similarities with the SARS virus, there are yet no treatment ingredients that can inhibit it and only supportive medications are available. According to Valizadeh, (2020) constant observation, quick diagnosis, and extensive study are vital to understanding the biology of the virus and its pathogenetic potency since these features enable to design of protection methods. Vaccination against CoV-19 is anticipated over the next 3–9 months, thanks to the extensive global research efforts presently ongoing. Current treatments often include the use of interferon and monoclonal antibodies, which are two examples

of non-specific anti-viral medicines. Immunoglobulins isolated from the blood of cured people were likewise effective but to a much lesser extent.

Gigante, (2020) examined that even if the proportion of mortality has been largely stopped and is primarily associated with persons with preexisting conditions, the incidence of CoV-19 continues to rise worldwide despite strict global containment and the quarantine established in all the afflicted nations. More than a hundred nations have been hit thus far, with the majority of deaths attributable to the virus's early introduction from afflicted regions. Since deaths that would have occurred anyway with typical seasonal flu are not disentangled in those percentages, it is also likely that in some countries more carriers transmitted the infection and that the percentage of deaths relative to the number of infected subjects was higher than in other countries. Paniri, (2020) pointed out that by wisely isolating the patients positive for CoV-19, the governments of the afflicted nations are averting a potential pandemic. Certainly, after a few months, the number of patients will drop, and with time the virulence will drastically decline or die out, as occurred with past viral infections. As with other influenza viruses, the CoV-19 virus causes an increase in interferons (IFNs) in immune cells, which strengthens defense against cancer and autoimmune illnesses, but this is only one of the many unfavorable consequences associated with this infection.

Safety, tolerability, and immunogenicity of a recombinant adenovirus type-5 vectored COVID-19 vaccine

Zhu, (2020) stated that severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was initially detected in December 2019, which might readily pass from person to human and spread swiftly, producing a COVID-19 pandemic. Patients infected with SARS-CoV-2 were at high risk for serious sequelae such as pneumonia, acute respiratory distress syndrome (ARDS), multiple organ failure, and death, particularly in the elderly and those with prior respiratory or cardiovascular disorders. Moreover, a quarter of a million individuals had been infected with SARS-CoV-2 across 203 nations and territories by 4 May 2020, and over 239,000 had perished as a result. Management for epidemic control now entails the implementation of quarantine, isolation, and distance in the absence of proven effective prevention. The staggering death and morbidity rates associated with SARS-CoV-2 infection call for the rapid development of effective vaccines against COVID-19. Buchbinder, (2020) more than a hundred vaccine candidates are currently under development around the world, and at least eight of them have begun or will soon begin first-in-human studies. These include the mRNA COVID-19 vaccine developed by Moderna and the non-replicating adenovirus type 5 (Ad5) vectored COVID-19 vaccine developed by CanSino,also began testing on March 14.

Research Methodology:-

While focusing on the research methodology it was found that the study design was a Cross-Sectional-Observational Study. The subject inclusion criteria were RT-PCR positive individuals, Age -18to 45 years, both Male and Female while the exclusion criteria were Pregnancy, Age - <18 or >45 years, comorbidities such as malignancy and autoimmune disorder, subjects suffering from an inflammatory disease such as fatty liver, obesity, Diabetes Mellitus, Rheumatoid Arthritis, Parkinson's disease. The sample size was 40 subjects. The sample size was calculated by using sample size calculator.net software. The confidence level is 90%, the Margin of error is 5%, Prevalence of 31.5% based on the WHO database. It was a random sampling method.

Findings and Discussions:-

To examine the barplot among the vaccinated subject participants according to their age it was found that the maximum number of participants was age 20 and the least number of participants was age 26. To examine the pie chart of the vaccinated subject participants concerning gender it was found that 54% (20 persons) of female participants and 46% (17 persons) of male participants in this study.

To focus on analysis it was found that a totalof 37 subjects in vaccinated, out of that 20 subjects were female and 17 were male. There are 20 female subjects, the descriptive value of C-Reactive protein is 1.69 ± 2.35, the descriptive value of LDH is 159.20 ± 24.71, and the descriptive value of ferritin level is 24.52 ± 14.34. Also, there are 17 male subjects vaccinated, the descriptive value of C-Reactive protein is 2.21 ± 2.21, the descriptive value of LDH is 164.17 ± 26.19, and the descriptive value of ferritin value is 76.28 ± 34.78.

To examine the t-test it was found that on average there is no meaningful difference concerning gender in C-Reactive protein among vaccinated subjects. The difference among gender in C-Reactive protein among vaccinated

subjects by an average is -0.517. The 95% confidence interval of the difference is (-2.0515, 1.0175). The two sample t-test statistic value is -0.684 with 35 degrees of freedom and the p-value is 0.498. Therefore, there is no significant evidence to reject the null hypothesis at a 5% level of significance and conclude that there is no meaningful difference among gender of C-Reactive protein in vaccinated subjects.

To examine the two-sample t-test among vaccinated subjects of LDH concerning gender it was found that on average there is no meaningful difference concerning gender in LDH parameters among vaccinated subjects. The difference among gender in LDH parameters among vaccinated subjects by an average is -4.976. The 95% confidence interval of the difference is (-21.9880, 12.0350). The two sample t-test statistic value is -0.594 with 35 degrees of freedom and the p-value is 0.556. Thus, there is no significant evidence to reject the null hypothesis at a 5% level of significance and conclude that there is no meaningful difference among gender of LDH parameters in vaccinated subjects.

To focus on a two-sample t-test among vaccinated subjects of ferritin level concerning gender it was found that the difference of gender in ferritin level among vaccinated subjects by an average is -51.755. The 95% confidence interval of the difference is (-69.0222, -34.4889). The two sample t-test statistic value is -6.085 with 35 degrees of freedom and the p-value is less than 0.0001. Hence, there is significant evidence to reject the null hypothesis at a 5% level of significance and conclude that there is a mean difference among gender of ferritin levels in vaccinated subjects.

To examine the barplot among the infected subject participants according to their age it was found that the number of participants among infected subjects concerning age. Here the maximum number of COVID-infected participants in the age of 29 and there is only one subject of age 18. While examining the pie chart of the COVID-infected subject participants concerning gender it was found that that 51% (19 persons) of female participants and 49% (18 persons) of male participants in this study.

While examining the study it was found that included a total of 37 subjects were infected, out of that 19 subjects were female and 18 were male. In the 19 female subjects, the descriptive value of C-Reactive protein is 5.67 ± 7.88, the descriptive value of LDH is 177.29 ± 71.56, and the descriptive value of ferritin level is 111.82 ± 105.72. Also, there are 18 male subjects infected, the descriptive value of C-Reactive protein is 7.58 ± 7.90, the descriptive value of LDH is 220.55 ± 74.92, and the descriptive value of ferritin value is 317.19 ± 258.05.

While comparison of gender in C-Reactive protein among infected subjects The difference among gender in C-Reactive protein among infected subjects by an average is -1.905. The 95% confidence interval of the difference is (-7.17801, 3.36695). The two sample t-test statistic value is -0.734 with 35 degrees of freedom and the p-value is 0.468. Thus, there is no significant evidence to reject the null hypothesis at a 5% level of significance and conclude that there is no meaningful difference among gender of C-Reactive protein in infected subjects.

While Comparison of gender in LDH among infected subjects it was found that the difference among gender in LDH parameters among infected subjects by an average is -43.257. The 95% confidence interval of the difference is (-92.14547, 5.63120). The two sample t-test statistic value is -1.796 with 35 degrees of freedom and the p-value is 0.081. Thus, there is no significant evidence to reject the null hypothesis at a 5% level of significance and conclude that there is no meaningful difference among gender of LDH parameters in infected subjects.

To compare gender in ferritin level among infected subjects it was found that the mean difference among gender in ferritin level concerning infected subjects is -205.375. The 95% confidence interval of the difference is (-335.7033, -75.0466). The two sample t-test statistic value is -3.199 with 35 degrees of freedom and the p-value is 0.003. Therefore, there is significant evidence to reject the null hypothesis at a 5% level of significance and conclude that there is a mean difference among gender of ferritin levels in infected subjects.

Conclusion and Recommendations:-

Since the onset of the emergency pandemic crisis, it has been of great scientific importance to compare individuals with and without the severe or lethal forms of COVID-19 using a battery of hematologic, biochemical, inflammatory, and immunologic indicators. To optimize clinical care and avoid significant consequences after a diagnosis of COVID-19, it is required to categorize patients into risk groups. Several hematological (lymphocyte count, neutrophil count, and NLR), inflammatory (CRP, ESR, IL-6), and particularly biochemical (D-dimer,

Troponins, CK) characteristics correlate with poor prognosis or exist in COVID-19 patients, suggesting their use as predictive biomarkers. Severe instances of COVID-19 may be identified with the help of coagulation and liver markers.

Biochemical biomarkers related to coagulation disorders were previously obscured, but new light was shed on them after autopsy cohorts revealed the importance of pathophysiological processes of systemic cardiovascular damage (vasculitis, DIC, myocardial infarction). These are useful not just as predictors of the severity of illness, but also as guides for treatment, as medications that inhibit coagulation processes are at the heart of most modern medicine. The ability to stratify COVID-19-positive patients into risk groups using a laboratory score that incorporates hematological, inflammatory, biochemical, and immunological characteristics would be of paramount value in the clinical environment and therapeutic therapy.

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