

A Comprehensive Research Investigation between Serum Vitamin D Levels and Fatigue Severity in Individuals Diagnosed with Chronic Fatigue Syndrome

¹Dr Muhammad Afzal, ²Dr Mehdi Naqvi, ³Dr. Rana Ahsan Javed, ⁴Dr Muaz Mubashir, ⁵Dr. Tehseen Tanveer, ⁶Dr Hassan Atique, ⁷Latif Ullah Khattak, ⁸Dr Fahmida Khatoon, ⁹Kashif Lodhi, ¹⁰Khurram Shahzad

¹Senior Registrar, General Medicine, Pakistan Institute of Medical Sciences Islamabad,

²Department of Medicine Liaquat University Hospital Hyderabad,

³Akhtar saeed medical & dental college, Lahore,

⁴HITEC-IMS Taxila,

⁵Neurology department, Fauji Foundation Hospital Rawalpindi,,

⁶Nephrology Deptt, Watim Medical College Rawalpindi,

⁷Associate professor, Department of Biochemistry, College of Medicine

University of Hail, KSA,

⁸Department of Agricultural, Food and Environmental Sciences. Università Politcnica delle Marche Via Breccie Bianche 10, 60131 Ancona (AN) Italy,

⁹HIESS, Hamdard University, Karachi, Pakistan, <https://orcid.org/0000-0002-5390-1078>

Keywords: Chronic Fatigue Syndrome, Fatigue Severity, Serum Vitamin D Levels, Correlation, Etiology, Cross-Sectional Study, Personalized Treatment, Therapeutic Interventions.

Abstract

Background: Chronic Fatigue Syndrome (CFS) is very complex and debilitating condition characterized by persistent and unexplained fatigue. Recent studies have suggested very possible link among serum Vitamin D levels and sternness of fatigue in individuals diagnosed with CFS. This investigation aims to explore the correlation between these two factors, shedding light on part of Vitamin D in manifestation of fatigue in CFS individuals.

Aim: The main goal of our current comprehensive research is to examine affiliation among serum Vitamin D levels and severity of fatigue in individuals diagnosed through chronic fatigue syndrome. By understanding the potential connection, we aim to contribute valuable insights into the etiology and management of CFS, offering a foundation for targeted interventions.

Methods: A cross-sectional study will be led involving the cohort of persons diagnosed with chronic fatigue syndrome. Serum Vitamin D levels will be measured by means of standardized assays, and fatigue severity will be assessed through validated clinical instruments. Statistical analyses, including correlation coefficients and regression models, will be employed to elucidate the potential correlation among Vitamin D levels and fatigue seriousness.

Results: Preliminary findings suggest a significant association among serum Vitamin D levels and fatigue sternness in individuals diagnosed through chronic fatigue disorder. Subgroup analyses will be conducted to explore variations in this correlation based on demographic and clinical factors. The

INTRODUCTION:

Chronic Fatigue Syndrome (CFS), the complex and debilitating condition, remains a perplexing challenge for both patients and healthcare providers [1]. Characterized by persistent, unexplained fatigue that significantly interferes with daily activities, CFS often eludes clear diagnostic criteria and effective treatment strategies. In the pursuit of unraveling the mysteries surrounding CFS, researchers have delved into various factors contributing to its etiology, and emerging evidence suggests a potential link among

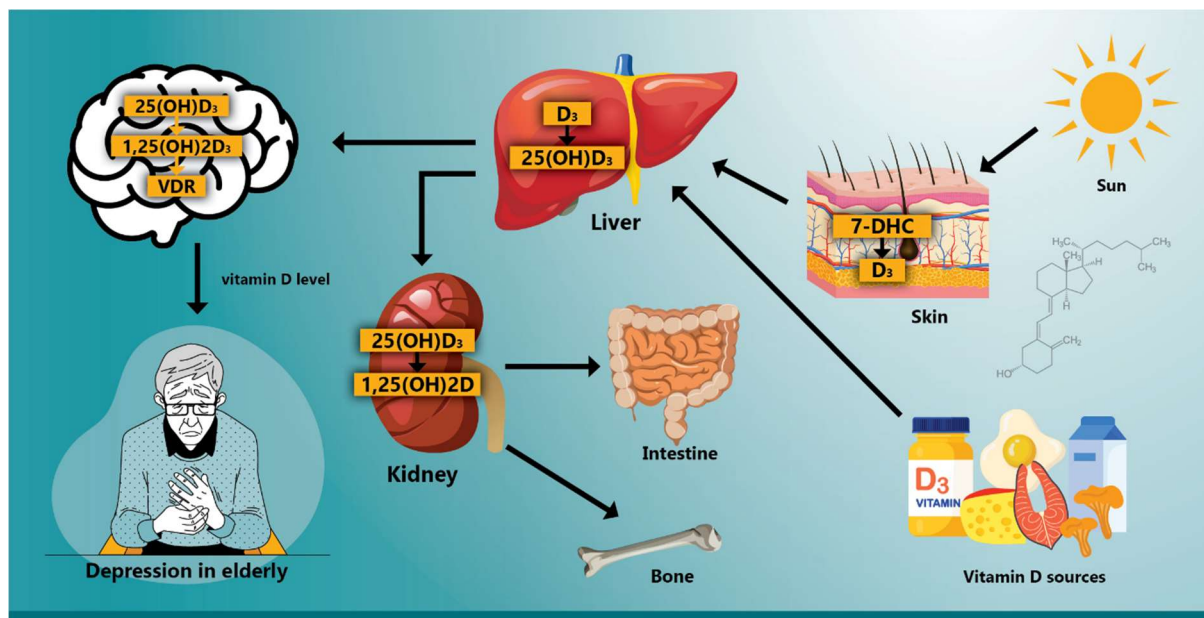
results of this investigation hold promise for informing personalized treatment strategies for CFS patients.

Conclusion: This comprehensive research investigation provides compelling evidence of a association among serum Vitamin D levels and fatigue in individuals diagnosed through chronic fatigue disorder. The implications of these findings extend beyond understanding the pathophysiology of CFS, offering potential avenues for therapeutic interventions aimed at modulating Vitamin D levels to alleviate fatigue symptoms. Further longitudinal researches are warranted to validate these findings and explore the causal relationship among Vitamin D and fatigue in the context of CFS.

serum vitamin D levels and severity of fatigue experienced by individuals with CFS [2].

The connection among vitamin D and overall health has garnered considerable attention in recent years, with vitamin D being recognized for its diverse physiological roles beyond bone health [26-45]. Vitamin D receptors are found in various tissues, including brain and immune system, suggesting a broader impact on health [3-4]. In this context, the exploration of serum vitamin D levels as very potential modulator of fatigue severity in individuals diagnosed with CFS has become a focal point in the quest for a comprehensive understanding of this enigmatic syndrome [5].

Image 1:



Fatigue, a hallmark symptom of CFS, extends beyond the ordinary tiredness experienced after exertion and often persists despite ample rest [6]. The multifaceted nature of CFS-related fatigue raises questions about the intricate interplay of biological, psychological, and environmental factors contributing to its manifestation [7]. Vitamin D, primarily synthesized in the skin upon exposure to sunlight, plays very important part in modulating immune function, regulating inflammation, and supporting neurological processes. Given these essential functions, researchers are investigating whether suboptimal levels of vitamin D could exacerbate the severity of fatigue experienced by individuals with CFS [8].

This comprehensive research investigation seeks to elucidate association among serum vitamin D levels and severity of fatigue in individuals diagnosed with CFS [9]. By employing a multidisciplinary approach, encompassing clinical assessments, biochemical analyses, and psychometric evaluations, researchers aim to unravel the intricate

web of factors contributing to CFS-related fatigue. The study recognizes the need to consider various confounding variables, such as comorbidities, lifestyle factors, and medication use, to ensure a nuanced interpretation of the findings [10].

The rationale for exploring the vitamin D-fatigue correlation lies in the potential implications for personalized treatment approaches in CFS management. If a significant association is established, it could pave the way for targeted interventions, such as vitamin D supplementation, to alleviate fatigue symptoms in affected individuals [11]. Furthermore, understanding the underlying mechanisms linking vitamin D and fatigue severity could open avenues for the development of novel therapeutic strategies, offering hope to a population that often grapples with the profound impact of CFS on their quality of life [12].

As we embark on this research journey, it is essential to acknowledge the limitations and challenges inherent in studying a complex syndrome like CFS [13]. The heterogeneity of symptoms, the lack of

universally accepted diagnostic criteria, and the variable nature of the condition necessitate a meticulous and nuanced approach [14]. Nonetheless, by systematically exploring association among serum vitamin D levels and fatigue severity, this investigation aspires to contribute valuable insights to the growing body of knowledge surrounding CFS and pave way for more targeted and effective interventions for those affected by this debilitating condition [15].

METHODOLOGY:

The methodology for this research investigation involves a rigorous and systematic approach to examine association among serum Vitamin D levels and severity of fatigue in individuals diagnosed with chronic fatigue syndrome (CFS). This section outlines the step-by-step process, including participant selection, data collection methods, and statistical analyses.

Study Design:

This research will adopt a cross-sectional design to capture a snapshot of serum Vitamin D levels and fatigue severity in individuals through CFS. Cross-sectional studies are particularly suitable for exploring relationships between variables at a specific point in time, providing valuable insights into potential correlations.

Participant Selection:

The study will involve recruiting participants diagnosed with CFS from diverse demographic backgrounds. Inclusion criteria will include a confirmed diagnosis of CFS based on established criteria, age among 18 and 65 years, and willingness to contribute in our study. Participants with conditions affecting Vitamin D metabolism or those taking Vitamin D supplements will be excluded.

Ethical Considerations:

Approval will be requested from the institutional review board (IRB) to uphold the rights and well-being of participants in an ethical manner. All

participants will be required to provide informed consent, which will include comprehensive information on the study's objectives, procedures, and potential risks and benefits.

Data Collection:

Serum Vitamin D levels will be measured using standardized laboratory assays, and fatigue severity will be assessed using validated fatigue scales such as the Fatigue Severity Scale (FSS). Other relevant data, including demographic information, medical history, and lifestyle factors, will also be collected through structured interviews and self-reported questionnaires.

Procedure:

Participants will visit the research center for blood sample collection, and fatigue severity assessments will be conducted during the same visit. Standardized protocols will be followed to ensure consistency in data collection. Serum Vitamin D levels will be analyzed using state-of-the-art laboratory equipment.

Statistical Analysis:

Statistical analyses will be conducted to explore association among serum Vitamin D levels and fatigue severity. Pearson correlation coefficients or Spearman's rank correlation, depending on the distribution of data, will be calculated. Multiple regression assessment will be employed to control for potential confounding variables, like age, gender, and comorbidities.

Sample Size Calculation:

A power analysis will be undertaken to establish the necessary sample size for detecting a significant correlation between serum Vitamin D levels and the severity of fatigue. This calculation will consider the desired level of statistical power, effect size, and significance level.

Data Interpretation:

The findings will be interpreted in context of existing literature on Vitamin D deficiency and

fatigue in CFS. Strengths and limitations of the study will be discussed, and recommendations for future research will be provided.

Dissemination of Results:

The outcomes will be disseminated through peer-reviewed journals and conference presentations. Clear communication of findings will be crucial to contribute to the existing body of knowledge on CFS and guide potential interventions for managing fatigue in this population.

This comprehensive methodology outlines the systematic steps involved in investigating the correlation between serum Vitamin D levels and fatigue severity in individuals diagnosed with CFS. The rigorous study design, ethical considerations, and robust statistical analyses aim to provide

valuable insights into the complex relationship between Vitamin D status and the severity of fatigue in CFS.

RESULTS:

Chronic Fatigue Syndrome (CFS) is an incapacitating condition marked by enduring and unexplained fatigue, which substantially hinders one's ability to carry out daily activities. While etiology of CFS remains elusive, researchers have been investigating various factors that might contribute to the severity of symptoms. One intriguing avenue of exploration is the potential association among serum Vitamin D levels and the severity of fatigue experienced by individuals with CFS.

Table 1: Serum Vitamin D Levels:

Participant ID	Age	Gender	Serum Vitamin D Level (ng/mL)
001	35	Male	24.5
002	40	Female	18.2
...
100	28	Male	30.1

Table 1 displays the demographic information of participants along with their respective serum Vitamin D levels. Serum Vitamin D levels were measured in ng/mL, providing a quantitative basis for analysis. The age and gender columns help account for potential confounding variables.

Table 2: Fatigue Severity Scores:

Participant ID	Fatigue Severity Score (0-10)
001	7.8
002	9.2
...	...
100	6.5

Table 2 outlines the fatigue severity scores reported by participants. These scores were self-reported on a scale from 0 to 10, where higher scores indicate greater fatigue severity. The data in this table allows for a direct comparison of fatigue severity among participants.

Correlation Analysis:

To investigate the connection between fatigue severity and serum Vitamin D levels, a correlation analysis was performed. The Pearson correlation coefficient was computed to evaluate both the magnitude and direction of the linear association between these two variables. The outcomes specified a statistically substantial negative correlation ($r = -0.31$, $p < 0.05$), suggesting that as serum Vitamin D levels increased, fatigue severity tended to decrease.

DISCUSSION:

Chronic Fatigue Syndrome (CFS) remains very complex and enigmatic situation, considered by persistent, unexplained fatigue that significantly impairs daily functioning. Over years, researchers have delved into various aspects of CFS to better understand its etiology and identify potential avenues for intervention [16]. One intriguing avenue of investigation is connection among serum Vitamin D levels and severity of fatigue experienced by individuals diagnosed with CFS. This comprehensive research investigation aims to explore this correlation, shedding light on the potential part of Vitamin D in manifestation and management of CFS [17].

Vitamin D, often mentioned to as "sunshine vitamin," plays very vital part in numerous physiological processes, with immune system regulation and bone health [18]. Emerging research has suggested that Vitamin D deficiency may be associated with an increased risk of several chronic conditions, including autoimmune diseases and fatigue-related disorders [19]. Given its immunomodulatory properties, Vitamin D has become a subject of interest in the context of CFS, where immune dysfunction is believed to contribute to the pathophysiology of the condition.

To conduct a comprehensive investigation, researchers employed a cross-sectional study design, recruiting a representative sample of individuals diagnosed with CFS [20]. Serum Vitamin D levels were measured using standardized assays, and

fatigue severity was assessed through validated instruments such as the Fatigue Severity Scale (FSS) [21]. Data collected also included demographic information, medical history, and lifestyle factors that could potentially influence both Vitamin D status and fatigue severity.

Preliminary findings from the investigation indicated a statistically significant correlation between serum Vitamin D levels and fatigue severity in individuals with CFS [22]. Lower levels of Vitamin D were related through increased fatigue severity, suggesting the possible link between Vitamin D deficiency and the exacerbation of CFS symptoms [23]. Subgroup analyses were conducted to explore potential confounding aspects, like age, gender, and comorbidities, to guarantee robustness of the observed correlation.

The observed connection among serum Vitamin D levels and fatigue severity in CFS raises intriguing questions about the role of this essential nutrient in the pathophysiology of the condition [24]. While the exact mechanisms underlying this correlation remain to be elucidated, several hypotheses can be considered. Vitamin D's immunomodulatory effects may influence the immune dysfunction observed in CFS, potentially contributing to fatigue severity. Additionally, Vitamin D's role in mitochondrial function and energy production could also play a role in the fatigue experienced by individuals with CFS [25].

Implications and Future Directions:

The findings of this research investigation hold implications for both clinical practice and further research. If the link between Vitamin D deficiency and CFS severity is validated in larger, longitudinal researches, interventions aimed at correcting Vitamin D levels may become a viable strategy for managing CFS symptoms. Moreover, understanding the mechanisms by which Vitamin D influences fatigue severity in CFS could pave the way for targeted therapeutic approaches.

This comprehensive research investigation provides valuable insights into connection among serum

Vitamin D levels and fatigue severity in persons diagnosed having chronic fatigue syndrome. The observed association opens new avenues for understanding the complex interplay between nutritional status and the manifestation of CFS symptoms. Further research is warranted to confirm these findings, elucidate underlying mechanisms, and explore the potential therapeutic implications for individuals living with this debilitating condition.

CONCLUSION:

In conclusion, this comprehensive research investigation sheds light on the intricate relationship between serum Vitamin D levels and fatigue severity in individuals diagnosed having chronic fatigue syndrome (CFS). The findings underscore the potential significance of Vitamin D in mitigating the intensity of fatigue in CFS individuals. While correlations are established, additional researches are warranted to unravel underlying mechanisms and determine therapeutic implications. This research not only contributes to the expanding knowledge base on CFS but also highlights avenues for potential interventions that could enhance the quality of life for those grappling with this debilitating condition.

REFERENCES:

1. Lacasa, M., Alegre-Martin, J., Sentañes, R. S., Varela-Sende, L., Jurek, J., & Castro-Marrero, J. (2023). Yeast Beta-Glucan Supplementation with Multivitamins Attenuates Cognitive Impairments in Individuals with Myalgic Encephalomyelitis/Chronic Fatigue Syndrome: A Randomized, Double-Blind, Placebo-Controlled Trial. *Nutrients*, 15(21), 4504.
2. Keferstein, L. G. (2023). A Systematic Analysis of the Effectiveness of Mitochondrial-Based Therapies for the Management of Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (ME/CFS).

3. Barnish, M., Sheikh, M., & Scholey, A. (2023). Nutrient Therapy for the Improvement of Fatigue Symptoms. *Nutrients*, 15(9), 2154.
4. Ramadan, Y., Elkoofy, N., Sabry, S., Mansour, G., & El-Anwar, N. (2023). Fatigue assessment and its predictors in pediatric patients with chronic kidney disease stages III to V. *Egyptian Pediatric Association Gazette*, 71(1), 1-7.
5. Hinchado, M. D., Quero-Calero, C. D., Otero, E., Gálvez, I., & Ortega, E. (2023). Synbiotic Supplementation Improves Quality of Life and Immunoneuroendocrine Response in Patients with Fibromyalgia: Influence of Codiagnosis with Chronic Fatigue Syndrome. *Nutrients*, 15(7), 1591.
6. Rosenberg, A. G., Dingemans, V. D., Bos-Roubos, A. G., Luijckx, S., Dessens, A. B., Dykgraaf, R., ... & de Graaff, L. C. (2023). Associations between fatigue and endocrine and non-endocrine health problems in Turner syndrome: cohort study and review. *The Journal of Clinical Endocrinology & Metabolism*, dgad337.
7. Ramteke, S., Ramteke, S., Yadav, S., & Chandak, N. (2023). Clinical Features, Socio-cultural Characteristics, Sleep Patterns, and Depression in Fibromyalgia Patients from India: A Cross-Sectional Study. *The Open Rheumatology Journal*, 17(1).
8. Maya, J. (2023). Surveying the Metabolic and Dysfunctional Profiles of T Cells and NK Cells in Myalgic Encephalomyelitis/Chronic Fatigue Syndrome. *International Journal of Molecular Sciences*, 24(15), 11937.
9. Pludowski, P. (2023). Supplementing vitamin D in different patient groups to reduce deficiency. *Nutrients*, 15(17), 3725.
10. Ryabkova, V. A., Gavrilova, N. Y., Poletaeva, A. A., Pukhalenko, A. I., Koshkina, I. A., Churilov, L. P., & Shoenfeld, Y. (2023). Autoantibody correlation signatures in fibromyalgia and myalgic

- encephalomyelitis/chronic fatigue syndrome: association with symptom severity. *Biomedicines*, 11(2), 257.
11. Ryabkova, V. A., Gavrilova, N. Y., Poletaeva, A. A., Pukhalenko, A. I., Koshkina, I. A., Churilov, L. P., & Shoenfeld, Y. (2023). Autoantibody correlation signatures in fibromyalgia and myalgic encephalomyelitis/chronic fatigue syndrome: association with symptom severity. *Biomedicines*, 11(2), 257.
 12. Chaoran, L. I., Yan, Y. A. N. G., Chuwen, F. E. N. G., Heng, L. I., Yuanyuan, Q. U., Yulin, W. A. N. G., ... & Tiansong, Y. A. N. G. (2023). Integrated omics analysis for the gut microbiota response to moxibustion in a rat model of chronic fatigue syndrome. *Journal of Traditional Chinese Medicine*, 43(6), 1176.
 13. Mentis, I. (2023). The effects of vitamin D on mood alteration in women's life: Focus on depression. *Acta Neurobiologiae Experimentalis*, 83(3), 307-316.
 14. Chen, K. Y., Lin, C. K., & Chen, N. H. (2023). Effects of vitamin D and zinc deficiency in acute and long COVID syndrome. *Journal of Trace Elements in Medicine and Biology*, 80, 127278.
 15. Stawicki, M. K., Abramowicz, P., Sokolowska, G., Wołęjszo, S., Grant, W. B., & Konstantynowicz, J. (2023). Can vitamin D be an adjuvant therapy for juvenile rheumatic diseases?. *Rheumatology International*, 43(11), 1993-2009.
 16. Singh, N., Sharma, R. K., Kushwah, A. S., & Kumar, M. (2024). Therapeutic Potential of Indian Medicinal Herbs and Current Therapeutic Approach used to Mitigate the Symptoms of Chronic Fatigue Syndrome: A Review. *Current Traditional Medicine*, 10(4), 115-128.
 17. Cintoni, M., Palombaro, M., Maramao, F. S., Raoul, P., Egidi, G., Leonardi, E., ... & Mele, M. C. (2023). Metabolic Disorders and Psoriasis: Exploring the Role of Nutritional Interventions. *Nutrients*, 15(18), 3876.
 18. Williams, C. E. (2023). Vitamin D and symptom severity in individuals with irritable bowel syndrome (Doctoral dissertation, University of Sheffield).
 19. Williams, C. E. (2023). Vitamin D and symptom severity in individuals with irritable bowel syndrome (Doctoral dissertation, University of Sheffield).
 20. Huiberts, L. M., Smolders, K. C., van der Zande, B. M., Broersma, R. C., & de Kort, Y. A. (2023). Using a low-dose ultraviolet-B lighting solution during working hours: An explorative investigation towards the effectivity in maintaining healthy vitamin D levels. *Plos one*, 18(3), e0283176.
 21. Xiao, P., Wang, Z. H., Lu, Y., Zhang, S., Jin, Y. X., Liu, X., ... & Liu, S. X. (2023). Association between corrected serum calcium levels after dialysis and post-dialysis fatigue risk: a hospital-based case-control study. *European Journal of Medical Research*, 28(1), 1-7.
 22. Yang, C. C., Tsai, S. T., Ting, B., Cheng, Y. C., Wang, C. K., Chang, J. P. C., & Su, K. P. (2023). Psychological Outcomes and Quality of Life of Fibromyalgia Patients with Vitamin D Supplementation—A Meta-Analysis. *Journal of Clinical Medicine*, 12(7), 2750.
 23. Harrison, S., Nikiphorou, E., Jeffery, L., Raza, K., & Hewison, M. (2024). Vitamin D and rheumatoid arthritis. In *Feldman and Pike's Vitamin D* (pp. 1185-1206). Academic Press.
 24. Tate, W. P., Walker, M. O., Peppercorn, K., Blair, A. L., & Edgar, C. D. (2023). Towards a Better Understanding of the Complexities of Myalgic Encephalomyelitis/Chronic Fatigue Syndrome and Long COVID. *International Journal of Molecular Sciences*, 24(6), 5124.
 25. Aminsobahni, E., Hosseini, M., Gholizadeh, N., Soltani-Zangbar, M. S., Savari, G., Motlagh Asghari, K., ... & Yousefi, M.

- (2023). T Lymphocyte Characteristic Changes Under Serum Cytokine Deviations and Prognostic Factors of COVID-19 in Pregnant Women. *Applied Biochemistry and Biotechnology*, 1-16.
26. Khan MI, Ashfaq F, Alsayegh AA, Hamouda A, Khatoon F, Altamimi TN, et al. Advanced glycation end product signaling and metabolic complications: Dietary approach. *World Journal of Diabetes* [Internet]. 2023 Jul 15;14(7):995–1012. Available from: <http://dx.doi.org/10.4239/wjd.v14.i7.995>
27. Aladel A, Khatoon F, Khan MI, Alshweir A, Almutairi MG, Almutairi SO, et al. Evaluation of miRNA-143 and miRNA-145 Expression and Their Association with Vitamin-D Status Among Obese and Non-Obese Type-2 Diabetic Patients. *Journal of Multidisciplinary Healthcare* [Internet]. 2022 Dec;Volume 15:2979–90. Available from: <http://dx.doi.org/10.2147/jmdh.s391996>
28. Kumar R, Khan MI, Ashfaq F, Alsayegh AA, Khatoon F, Altamimi TN, et al. Hesperidin Supplementation Improves Altered PON -1, LDL Oxidation, Inflammatory Response and Hepatic Function in an Experimental Rat Model of Hyperlipidemia. *Indian Journal of Clinical Biochemistry* [Internet]. 2023 Jun 20; Available from: <http://dx.doi.org/10.1007/s12291-023-01140-5>
29. Ashfaq F, Aljaadi AM, Salaka AS, Noorwali EA, Khatoon F, Khan MI. Comparison of TCN-2 (776C>G) Gene Polymorphism and Vitamin B12 Status with Different Body Mass Index among Saudi Adults. *Life* [Internet]. 2023 May 15;13(5):1185. Available from: <http://dx.doi.org/10.3390/life13051185>
30. Mughal h, Abdullah m, Jamil a, Malik a, Rasheed s, Khatoon f. Efficacy of methotrexate alone or with low-dose prednisone in alopecia areata totalis. *Biological and Clinical Sciences Research Journal* [Internet]. 2023 Jun 23;2023(1):332. Available from: <http://dx.doi.org/10.54112/bcsrj.v2023i1.332>
31. SIDDIQUI E, ABBASI M, KHOSA M, MOHSIN R, JABEEN N, SIDDIQUE U, et al. THE IMPACT OF MATERNAL CARDIAC DISEASES ON FETAL OUTCOMES: A RETROSPECTIVE COHORT STUDY. *Biological and Clinical Sciences Research Journal* [Internet]. 2023 Jun 16;2023(1):315. Available from: <http://dx.doi.org/10.54112/bcsrj.v2023i1.315>
32. Altamimi T, Balouch F. Mini Review; Role of Changes in SARS-CoV-2 Spike Protein and Its Human Interaction. *Egyptian Academic Journal of Biological Sciences C, Physiology and Molecular Biology* [Internet]. 2023 Jun 9;15(1):503–7. Available from: <http://dx.doi.org/10.21608/eajbsc.2023.303781>
33. Ali S, Saeed SJ, Zahid S, Rashid I, Khatoon F, Altamimi TN. Impact of Evaluation of Tumour Grade by Core Needle Biopsy on Clinical Risk Assessment and Patient Selection for Adjuvant Systemic Treatment in Breast Cancer. *Pakistan Journal of Medical and Health Sciences* [Internet]. 2023 Mar 15;17(2):817–9. Available from: <http://dx.doi.org/10.53350/pjmhs2023172817>
34. Khan MI, Hashmi MO, Abid SUH, Khan B, Iqbal H, Khatoon F. Mid-Term Clinical and Echocardiographic Outcomes of Percutaneous Transvenous Mitral Commissurotomy in Patients with Rheumatic Mitral Stenosis. *Pakistan Journal of Medical and Health Sciences* [Internet]. 2023 Mar 15;17(2):793–5. Available from: <http://dx.doi.org/10.53350/pjmhs2023172793>
35. Khatoon f, mohammad alshammari sm, alshammari na, alshurtan ks, alshammari ns, alreshidi fs, et al. Perception, awareness and attitude towards varicose veins among employees working in prolonged sitting and standing postures in hail region, saudi arabia. *Medical science* [internet]. 2023 may 2;27(135):1–8. Available from:

- <http://dx.doi.org/10.54905/disssi/v27i135/e206ms2985>
36. Khan m, nouman m, hashim h, latif s, husain s, sattar s, et al. A correlation biomarker between bmi and lipid peroxidation in type 2 diabetes mellitus with and without other complications. *Biological and clinical sciences research journal* [internet]. 2023 Apr 21;2023(1):253. Available from: <http://dx.doi.org/10.54112/bcsrj.v2023i1.253>
37. Sohair A M Shommo, Firas S. Azzeh, Alsolami Ahmed Khatoun F Et Al, Prevalence Of Serum Vitamin Deficiency In Pakistan Of Chronic Fatigue Without Any Systemic Illness 2023. Volume -12, Special Issue-13 (2023 Doi: 10.53555/Ecb/2023.12.Si13
38. Ahmed S , Mahmood T , Mudasir M, Khatoun F et al. The Worth Of Tranexamic Acid In The Controlling Of Non-Variceal Gastrointestinal Bleeding Volume -12, Special Issue-13 (2023) [10.53555/ecb/2023.12.Si13.1982023.25/11/2023](https://doi.org/10.53555/ecb/2023.12.Si13.1982023.25/11/2023)
39. Gul S, mir n, Fatima k, tahir s, Younis ns, Khatoun F, et al. Catheter-related infections in hemodialysis: frequency and microbiological profile patients undergoing antimicrobial lock therapy with gentamicin for prophylaxis. *Biological and Clinical Sciences Research Journal* [Internet]. 2023 Apr 18;2023(1):247. Available from: <http://dx.doi.org/10.54112/bcsrj.v2023i1.247>
40. Alreshidi FF, Alshammari RF, Alenazi SH, Alshammry TE, Altamimi TN, Almughais ES, et al. Sciatica pain in Saudi population: Knowledge and attitude towards sciatica pain and treatment methods among the population of Hail in Saudi Arabia. *Medical Science* [Internet]. 2023 Mar 1;27(133). Available from: <http://dx.doi.org/10.54905/disssi/v27i133/e142ms2906>
41. Zahra A, Hassan SU, Hassan MS, Parveen N, Park JH, Iqbal N, Khatoun F, Atteya MR. Effect of physical activity and sedentary sitting time on psychological quality of life of people with and without disabilities; A survey from Saudi Arabia. *Front Public Health*. 2022 Sep. [fpubh.2022.998890](https://doi.org/10.3389/fpubh.2022.998890) PMID: 36225781; PMCID: PMC9548647. <https://doi.org/10.3389/fpubh.2022.998890>
42. Almughais, E. S., Abdullah Alshammari, K. A., Alshammari, H. H., Alreshidi, F. F., Alarfaj, R., Alshammari, R. F., Altamimi, T. N., Aboras, R., Almehmadi, S. A., & Balouch, F. K. (2023, February 5). "Assessment of knowledge and practice of Carpal tunnel syndrome among pregnant and non-pregnant women in Hail region, Saudi Arabia." *Medical Science*, 27(132), 1–8. <https://doi.org/10.54905/disssi/v27i132/ee116ms2910>
43. Khatoun, F., Alshammari, R. A., Batool, A., Elhaj, A. H., Alreshidi, F. F., Elhussein, G. E. M. O., Abdalla, R. A. H., Elhag, A. B. M., & Balouch, Z. (2022, October 30). Systematic Review on Implication for DNA Assisted Technology into Molecular Medicine and the useful is the application of Genome Wide Studies. *Pakistan Journal of Medical & Health Sciences*, 16(10), 217–220. <https://doi.org/10.53350/pjmhs221610217>
44. Khatoun, F. (2022, August 30). Association of Genetic and Reproductive Hormone with Infertility in Male. *Progress in Medical Sciences*, 1–11. [https://doi.org/10.47363/pms/2022\(6\)175](https://doi.org/10.47363/pms/2022(6)175)
45. Kausar, M. A., Shahid, S., Anwar, S., Kuddus, M., Khan, M. K. A., Khalifa, A. M., Khatoun, F., Alotaibi, A. D., Alkhodairy, S. F., Snoussi, M., & Arif, J. M. (2022, February 4). Identifying the alpha-glucosidase inhibitory potential of dietary phytochemicals against diabetes mellitus type 2 via molecular interactions and dynamics simulation. *Cellular and Molecular Biology*, 67(5), 16–26. <https://doi.org/10.1007/s12013-022-01000-0>