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Assessment of Serum Ferritin Levels and Hematological Parameters in Healthy Individuals

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Abstract:
The evaluation of serum ferritin levels and blood counts in healthy individuals is crucial for understanding potential health trends and markers of inflammation. This study aimed to assess the correlation between serum ferritin levels and blood counts in apparently normal individuals . Venous blood samples (5ml) were collected from 88 healthy subjects for full blood count, malaria parasite, serum ferritin, and C-reactive protein (CRP) estimation. Subjects positive for malaria parasites or with elevated CRP levels were excluded. Statistical analysis using SPSS version 16 included Pearson's correlation tests ($p < 0.05$). Ethical approval and informed consent were obtained.
The median, mean, and modal ages of the subjects were 23.50 years, 25.25 years, and 16.00 years, respectively. The mean packed cell volume (PCV), total white blood cell (TWBC) count, platelet count, and serum ferritin level were 0.37L/L, 7.10 x 10(9)/L, 246.39 x 10(9)/L, and 18.35 ng/ml, respectively. Age significantly varied with serum ferritin, platelet count, and TWBC ($p > 0.05$). PCV, platelet count, and TWBC varied significantly across different age groups ($p < 0.05$), as did PCV in males compared to females ($p < 0.05$). Notably, serum ferritin levels in healthy subjects were lower than previously reported and did not significantly vary with blood counts.

Introduction:
Ferritin, a water-soluble protein, serves as the primary storage form of iron in the body, offering a crucial reserve that can be mobilized during periods of increased iron demand. Structurally, ferritin comprises two immunologically distinct subunits, H and L, controlled by different genes on chromosomes 11 and 19. Beyond its role in iron storage, ferritin acts as an acute phase reactant, often indicating disease states linked with inflammation, infection, and tissue damage. These conditions encompass a spectrum of common diseases like Parkinson's disease, renal and liver diseases, metabolic syndrome, pulmonary inflammation, rheumatoid arthritis, various cancers, and malaria. (Pelikan, 2012)
The upregulation of ferritin production in such conditions stems from complex interactions involving stress and inflammatory pathways. Pro-inflammatory cytokines such as tumor necrosis factor-alpha (TNF-α) and interleukin-1α (IL-1α) play pivotal roles, transcriptionally inducing the H chain of ferritin and consequently elevating serum ferritin levels. (Alkhateeb et al., 2012)
Similarly, blood cellular components experience diverse alterations in conditions associated with systemic inflammation and stress. This includes, but is not limited to, changes observed in diseases mentioned earlier. The response of blood cellular elements, particularly white cells, to systemic inflammation is closely tied to cytokine activity. Consequently, parameters like the neutrophil-lymphocyte ratio (NLR) and platelet-

lymphocyte ratio (PLR) are increasingly utilized as biomarkers for systemic inflammation and hold prognostic significance in certain diseases. (National Bureau of Statistics, 2009)
Despite the extensive literature on ferritin, inflammation, and blood counts in disease states, there remains a gap concerning their relationship in individuals without evident inflammation or disease, particularly in subjects. This study aims to address this gap by investigating potential connections between serum ferritin levels and blood counts in subjects devoid of clinical or laboratory evidence of inflammation. (Pan & Jackson, 2008)

Subjects and Methods:

The study involved 88 apparently healthy individuals aged 0-49 years who provided informed consent. Exclusion criteria included a history of chronic illness or liver disease, recent iron medication use within the last 6 months, and any symptoms of fever or general unwellness within the month preceding recruitment. These exclusions were confirmed through personal interviews conducted before enrollment. Participants positive for malaria parasites on blood film examination or with elevated C-reactive protein (CRP) levels were also excluded.

Ethical Consideration:

Ethical approval was obtained from the Institutional Review Board, and all participants provided informed consent before participating in the study.

Sample Collection/Analysis:

Venous blood samples (5ml) were collected via clean venipuncture following standard procedures. 2.5ml of blood was dispensed into an Ethylene Diamine Tetra-acetic acid (EDTA) bottle for full blood count and malaria parasite detection, while the remaining 2.5ml was dispensed into a plain bottle for serum ferritin and CRP estimation. Serum Ferritin levels were assessed using solid-phase Enzyme-linked Immunosorbent Assay (ELISA) reagent kits from ZIP CLOC® Inc., while Serum CRP was measured using CRP latex kits from BIOSYSTEMS® Inc. The manufacturer's instructions were strictly followed, and each test kit included positive and negative controls. Malaria parasitemia was determined through microscopic examination of thick and thin blood films stained with 3% Giemsa stain, with a blood slide considered negative after scanning at least 100 fields without detecting a malaria parasite. An elevated CRP level was defined as ≥1.0mg/dl.
Full blood count (FBC) was manually determined using standard methodologies.

Statistical Analysis:

Data analysis was conducted using SPSS version 16 (SPSS Inc., Chicago IL). Descriptive statistics such as median, mode, mean, and standard deviations were calculated. The Kruskal-Wallis statistical test was employed to assess differences in ferritin levels between males and females, with a significance level set at $P<0.05$. Associations were evaluated using Pearson's linear regression for bivariate correlation, with a coefficient of $P<0.05$ considered significant.

Results

In this study, 88 subjects were included, ranging in age from 0 to 49 years, with a median age of 23.50 years. The mean and modal ages were 25.25 years and 16.00 years, respectively. The mean values for packed cell volume (PCV), total white blood cell (TWBC) count, platelet count, and serum ferritin level were 0.37L/L, 7.10 x 10^9/L, 246.39 x 10^9/L, and 18.35 ng/ml, respectively.
Statistical analysis revealed a significant association between the ages of study subjects and serum ferritin levels, platelet count, and TWBC ($p > 0.05$). However, there were no significant differences observed between serum ferritin levels and blood counts among subjects ($p > 0.05$).
Furthermore, there was a significant difference noted in the median PCV and platelet count, as well as the mean TWBC, across different age groups in the study population ($p < 0.05$). However, no significant difference was observed in the median serum ferritin levels across age groups ($p < 0.05$).

Regarding gender differences, there was a significant difference in the median PCV between male and female subjects ($p < 0.05$). However, no significant differences were found in serum ferritin levels, TWBC, and platelet count between male and female subjects ($p > 0.05$).

Discussion

The mean age of our study population was 25.25 years, with a mean serum ferritin level of 18.35 ng/ml. This differs from a study in Lagos, Nigeria, which reported higher serum ferritin levels in healthy individuals, possibly due to regional or tribal differences between the study populations. Variations in serum ferritin levels with race and age have been documented in previous reports, with Caucasians often exhibiting higher levels compared to our study population. (Chen et al., 2014)

Although our subjects had mostly normal blood counts, mild anemia (mean PCV 0.37L/L) was observed alongside low serum ferritin levels, indicating a potential negative iron balance in apparently healthy individuals. Further studies with larger cohorts are needed to explore this and other markers of iron status. (Cheesbrough, 2006)

We found a significant correlation between age and serum ferritin, platelet count, and white blood cell count (WBC). Platelet count, WBC, and PCV showed significant variation across different age groups, consistent with known trends in blood counts throughout life stages. Serum ferritin levels increased progressively with age in our study, yet no significant difference was noted when subjects were grouped by age ranges. (Tan et al., 2012)

Graphically, serum ferritin levels exhibited a progressive rise with age, with a slight dip observed in the 10-19 age group, possibly due to increased iron utilization during growth spurts. Subjects aged 0-9, 10-19, and 20-29 years had serum ferritin levels below 12 ng/ml, indicating a need for further investigation into iron deficiency in these age brackets. (Yoo et al., 2012)

Although males had higher serum ferritin levels than females, this difference was not statistically significant. Factors such as body mass index (BMI), menstrual blood loss, and dietary factors may contribute to gender differences in serum ferritin levels and blood counts. (Odunukwe et al., 2000)

This study is limited by the absence of additional measures of iron status and the relatively small sample size of apparently healthy subjects studied. Further research with a broader range of iron status markers and larger sample sizes would enhance our understanding of iron balance in healthy populations. (Leitch et al., 2007)

Conclusion

In conclusion, our study indicates that apparently healthy individuals exhibit lower serum ferritin levels compared to other regions and these levels do not significantly vary with blood counts. While this lower serum ferritin level may reflect regional or tribal differences, further research is warranted to confirm this finding. We recommend future studies to include additional markers of body iron status and involve larger sample sizes to validate and expand upon our results.

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