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Peripheral Neuropathy in Pregnant Women with Iron Deficiency Anemia: A Cross-Sectional Analytical Study

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ABSTRACT

Pakistan faces a high burden of nutritional anemias, with iron-deficiency anemia being the most prevalent. Imbalanced iron levels had a central role in neuropathies. **Objectives:** To assess the prevalence of peripheral neuropathy in pregnant women having Iron deficiency anemia through associated clinical and laboratory Parameters. **Method:** A cross-sectional analytical study was done at the Department of Obstetrics and Gynecology and the Clinical Neurophysiology Unit of Niazi Welfare Foundation Teaching Hospital, Sargodha, from July 1st, 2025 to November 30, 2025. A sample of 350 women was targeted using consecutive sampling. Both sensory and motor nerve conduction parameters of the lower limbs and upper limbs were evaluated. Data were analyzed using SPSS version 26. Chi-square tests assessed associations between anemia severity (mild: Hb 10–10.9 g/dL; moderate: 8–9.9 g/dL; severe: <8 g/dL) and peripheral neuropathy at significance level of p-value <0.050. **Results:** Out of 350 pregnant women, anemia was mild in 98 (28.0%), moderate in 164 (46.9%). Peripheral neuropathy was revealed in 102 women (29.1%,) Neuropathic symptoms involving numbness was revealed in 42.1%, tingling (paresthesia) in 38.7%, burning sensations in 35.5%, & reduced ankle reflexes in 27.4%. This study found a significant association between anemia severity and neuropathy frequency (χ^2 = 42.9, p<0.001), showing a marked increase in neuropathy prevalence with worsening anemia. **Conclusions:** Study reported that iron-deficiency anemia is associated with the onset and progression of peripheral neuropathy. These observations suggest that evaluation for iron deficiency should be routinely included when assessing patients presenting with peripheral neuropathy.

INTRODUCTION

Anemia represents a major contributor to the worldwide burden of disease [1]. World Health Organization estimates indicate that approximately 42% of children under five years of age and about 40% of pregnant women globally are affected by anemia [2]. Data show a high prevalence across different population groups in Pakistan, including 25% of men aged 15–49 years, 50% of women in the same age group, 31.1% of adolescent boys aged 15–19 years, 82% of adolescent girls, 70% of pregnant women aged 15–49 years, and 53.7% of children aged 6–59 months [3]. Anemia can be categorized into nutritional, hemorrhagic, aplastic, and hemolytic types according to its underlying cause [4]. As a developing country, Pakistan faces a high burden of nutritional anemias, with iron-deficiency anemia being the most prevalent [5]. Common causes of iron-deficiency anemia are inadequate iron intake, blood loss, malabsorption, and pregnancy [6]. Anemia affects children, women of reproductive age, and residents of lower socioeconomic status [7]. Iron is one of major element for neuronal and cognitive development of fetus.

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Inadequate iron delays cognitive, mental, and physical growth making prone to infections [8]. Iron is involved for brain metabolism, neurotransmitter functioning, and myelination [9]. Imbalanced iron levels had a central role in neuropathies, but clinically iron deficiency is not correlated with peripheral neuropathy in Pakistan. Peripheral neuropathy is a mechanism of nerve damage leading to weakness, numbness, pain etc. in hands and feet [10]. Nutritional deficiencies, diabetes mellitus, toxins exposure and injuries resulting from trauma contribute for damaging the nerves located outside brain and spinal cord leading to peripheral neuropathy [11]. In Pakistan, scarce data is available to reveal the relationship of IDA with peripheral neuropathy and stress the need of research studies to rule out the role of iron in neuronal development for fostering cognitive, physical, and mental development [12]. Neurologists perform nerve conduction studies (NCS) as parameter to measure the peripheral nerve dysfunction and find the extent of nerve fiber loss before appearance of clinical symptoms [13]. NCS serves a cost effective, non-invasive approach to investigate peripheral neuropathies for IDA patients [14].

Even though the earlier researches have addressed the diagnostic value of imaging and laboratory markers in obstructive jaundice, they have not been exhaustive in evaluating the combined validity and clinical value of both methods in distinguishing the underlying causes. Consequently, the research problem is to define the effective ways of diagnostic diagnosis, non-invasive, reliable methods of diagnosing the benign and malignant causes so that the patients may be managed in time and in a proper manner. This study was conducted to assess the prevalence of peripheral neuropathy in pregnant women with iron deficiency anemia through associated clinical and laboratory parameters. Finding will help policy makers to incorporate the evaluation of iron deficiency routinely when assessing patients presenting with peripheral neuropathy.

METHODS

A cross-sectional, analytical study was conducted at the Department of Obstetrics and Gynecology and the Clinical Neurophysiology Unit of Niazi Welfare Foundation Teaching Hospital (NWFTH), Sargodha, from July 1st, 2025 to November 30, 2025 after taking ethical approval letter (NM&DC-IRB-110) from the Institutional Review Board (IRB) committee having Ref No: IRB/NM&DC/758. NWFTH is a major tertiary care teaching hospital serving diverse urban and rural populations. Pregnant women aged 18–40 years with confirmed iron-deficiency anemia were eligible for inclusion. IDA was defined as hemoglobin <11 g/dL and serum ferritin <30 ng/mL [15]. Women were excluded if they had known diabetes mellitus, vitamin B12 deficiency (serum B12 <200 pg/mL), renal or liver disease, a history of alcohol misuse, neurological diseases unrelated to IDA, or if they declined consent. On the Open Epi software, using an expected frequency of peripheral neuropathy of 25% among anemic pregnant women (based on pilot observations), a confidence level of 95%, and a precision of 5%, the minimum sample size was calculated as 289. A sample of 350 women was targeted after considering dropouts using consecutive sampling and data collection was done after informed consent from patients. History pertaining to patients' demographics and symptoms of numbness, tingling, burning, AND Reduced ankle reflexes to verify peripheral neuropathy was documented in a predesigned performa. Neurological examination including sensory and motor function was conducted. Latest two weeks' lab investigation of CBC for Hb, Serum ferritin and B12 levels were reviewed. Both sensory and motor nerve conduction parameters of the lower limbs (sural nerve, peroneal nerve) and upper limbs (median nerve) were evaluated. Peripheral neuropathy was diagnosed if NCS indicated reduced conduction velocities and/or low amplitudes consistent with axonal or demyelinating patterns. Peripheral neuropathy was defined as presence of clinical symptoms or signs (sensory or motor) corroborated by abnormal NCS findings consistent with sensory, motor, or mixed neuropathy [11].

SPSS version 26.0 was used for data analysis. Mean, standard deviation, frequencies, and percentages were calculated for descriptive data. Chi-square tests assessed associations between anemia severity, mild: Hb 10–10.9 g/dL; moderate: 8–9.9 g/dL; severe: <8 g/dL [16], and peripheral neuropathy at p-value <0.005.

RESULTS

A total of 350 pregnant women with confirmed iron-deficiency anemia were enrolled. Mean age was 27.3 ± 5.4 years (range 18–40). The majority (72.6%) were in the second or third trimester of pregnancy. Mean hemoglobin was 8.9 ± 1.5 g/dL, and mean serum ferritin was 18.6 ± 7.2 ng/mL. Distribution of anemia severity was mild in 98 (28.0%), moderate in 164 (46.9%) & severe in 88(25.1%). The normality of data distribution was assessed using the Shapiro–Wilk test (Table 1).

Table 1: Demographics of Pregnant Women with Iron-Deficiency Anemia (n=350)

Characteristics	Mean ± SD / n (%)
Age (Years)	27.3 ± 5.4
Age Range (Years)	18–40
Hemoglobin (g/dL)	8.9 ± 1.5
Serum Ferritin (ng/mL)	18.6 ± 7.2
Gestational Age	
Second And Third Trimester	254 (72.6%)

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First Trimester	96 (27.4%)
Severity of Anemia	
Mild Anemia	98 (28.0%)
Moderate Anemia	164 (46.9%)
Severe Anemia	88 (25.1%)

Findings show that peripheral neuropathy was identified in 102 women, yielding a frequency of 29.1%. Among these sensory symptoms were present in 72 women (70.6%), motor symptoms in 12 women (11.8%), & both sensory and motor symptoms in 18 women (17.6%). The most frequently reported neuropathic symptoms were: numbness 43/102 (42.1%), tingling (paresthesia): 39/102 (38.7%), burning sensations: 36/102 (35.5%), and reduced ankle reflexes: 28/102 (27.4%). Symptoms were generally more pronounced in the lower limbs than the upper limbs (Table 2).

Table 2: Clinical Manifestation of Peripheral Neuropathy in Pregnant Women with Iron-Deficiency Anemia (n=350)

Clinical Manifestation	n (%)
Numbness	43 (42.1%)
Tingling (Paresthesia)	39 (38.7%)
Burning Sensations	36 (35.5%)
Reduced Ankle Reflexes	28 (27.4%)

Abnormal NCS results were categorized as sensory axonal neuropathy found in 82 women (80.4%) & mixed sensorimotor neuropathy in 20 women (19.6%). No cases of purely demyelinating neuropathy were observed. The sural nerve was affected in most cases, followed by peroneal nerve abnormalities. There was a significant association between anemia severity and neuropathy frequency (χ^2 = 42.9, p<0.001), showing a marked increase in neuropathy prevalence with worsening anemia (Table 3).

Table 3: Frequency of Peripheral Neuropathy by Anemia Severity (n=350)

Anemia Category	Total (n)	n (%)
Mild (Hb 10–10.9)	98	11 (11.2%)
Moderate (Hb 8–9.9)	164	42 (25.6%)
Severe (Hb <8)	88	49 (55.7%)

Cross-tabulation results showed observed counts with and without neuropathy across anemia categories (Table 4).

Table 4: Cross-tabulation of Peripheral Neuropathy by Anemia Severity

Anemia Category	Neuropathy Present, (n)	Neuropathy Absent, (n)	Total, (n)
Mild (Hb 10–10.9)	11	87	98
Moderate (Hb 8–9.9)	42	122	164
Severe (Hb <8)	49	39	88
Total	102	248	350

DISCUSSION

Iron plays a crucial role in nerve myelination, neuronal metabolism, and dopamine neurotransmission. Nerve conduction studies have the capacity to investigate cases of peripheral nervous system disorders, including peripheral nerves, nerve roots, muscles, and neuromuscular junction [17]. This study found that peripheral neuropathy was present in nearly one-third (29.1%) of pregnant women with iron-deficiency anemia attending a tertiary hospital. The frequency observed is higher than what is usually reported in general non-pregnant populations with IDA but aligns with the notion that pregnancy may amplify the neurological impact of iron deficiency [18]. Although direct comparisons are limited due to the scarcity of similar studies, available literature suggests a variable prevalence of neuropathic symptoms in IDA. Iron is associated with peripheral neuropathy in pregnancy. Similarly, a study examining the NC velocities of all the nerves revealed a decrease in amplitude and nerve conduction velocities in IDA patients compared to the controls, and these were reversed with iron replacement therapy [19]. The findings that iron is linked with peripheral neuropathy. Similarly, Paunikar *et al.* conducted a study on patients with iron-deficiency anemia. Motor nerve conduction studies (NCS) were performed bilaterally on the median, ulnar, and posterior tibial nerves. The neurophysiological parameters assessed included distal latency (DL), motor nerve conduction velocity (MNCV), and compound muscle action potential (CMAP) amplitudes under standardized conditions. The results showed that patients with iron-deficiency anemia had significantly prolonged distal motor latencies, slower MNCV, and reduced CMAP amplitude in all the nerves examined [20]. These findings support that iron deficiency affects nerve conduction and is associated with peripheral neuropathy, similar to the present study. Moreover, the study of Kulaszyńska *et al.* supports the idea that iron-deficiency anemia affects the peripheral nervous system. Results validate the notion that iron therapy in patients with polyneuropathy and carpal tunnel syndrome proved fruitful to combat neuropathies [21]. These results are similar to the current study findings and augment that imbalanced iron levels had a central role in neuropathies. Major strengths of this study are the reflection of valuable insights for promoting screening of anemic women in the early detection of subclinical peripheral neuropathy.

This study also has several limitations, such as the fact that multivariable logistic regression analysis could not be executed due to limited covariate data. Second, other potential contributing factors, such as gestational diabetes, thyroid disorders, folate deficiency, nutritional status, and socioeconomic factors, were not assessed. Third, the study lacks a non-anemic control group for comparison. Future research should include multicenter

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follow-up studies with larger sample sizes, non-anemic controls, and additional risk factors to evaluate the role of iron as an independent predictor of peripheral neuropathy and enhance the applicability of the results. Although the study offers valuable insights for improving peripheral neuropathies in IDA.

CONCLUSIONS

A study reported that iron-deficiency anemia is linked with the onset and progression of peripheral neuropathy. These findings can serve as a reference for clinicians and policymakers to consider including a complete blood count (CBC) as an initial screening measure when evaluating peripheral neuropathy in individuals with IDA.

Authors' Contribution

Conceptualization: JA
Methodology: MZ, TB, AZ
Formal analysis: MBAS
Writing and Drafting: MZ, TB, SA
Review and Editing: JA, MBAS, MZ, TB, AZ, SA, BJ

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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