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*Original Article*

# Frequency of Fall Risk in Patients with Diabetic Peripheral Neuropathy and its Impact on Quality of Life

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## ABSTRACT

**Background**: Diabetic Peripheral Neuropathy (DPN) is a common complication of diabetes mellitus, leading to a significant risk of falls and adversely affecting the quality of life (QOL). Understanding the frequency of fall risk and its impact on QOL among patients with DPN is essential for developing targeted interventions.

**Objective**: The study aimed to determine the frequency of fall risk in patients with diabetic peripheral neuropathy and assess its impact on their quality of life.

**Methods**: A descriptive cross-sectional study was conducted over six months at AIMS Diabetic Centre, Hayatabad Peshawar. A total of 246 patients with DPN, aged 40 years and above, were enrolled using a non-probability convenience sampling technique. Fall risk was evaluated using the Functional Reach Test (FRT), and quality of life was assessed through the Short Form-36 (SF-36) questionnaire. Data were analyzed using SPSS version 25, focusing on descriptive and inferential statistics.

**Results**: Among the participants, 69.5% (n=171) were identified at risk of falling. The FRT scores indicated that 13.0% (n=32) had a high fall risk, 45.93% (n=113) had a moderate fall risk, and 10.52% (n=26) had a low fall risk. Quality of life assessments revealed impairments across all domains of the SF-36, with significant variations observed between genders and DPN severity. The mean SF-36 score for physical functioning was notably lower among patients with a high fall risk.

**Conclusion**: The study underscores a significant association between DPN and an increased risk of falls, with a consequential negative impact on the quality of life. These findings highlight the need for integrated care strategies focusing on fall prevention and quality of life improvement for patients with diabetic peripheral neuropathy.

**Keywords**: Diabetic Peripheral Neuropathy, Fall Risk, Quality of Life, Functional Reach Test, SF-36, Diabetes Mellitus.

## INTRODUCTION

Diabetes mellitus (DM) is recognized globally as a chronic metabolic disorder that has emerged as one of the most significant health and socioeconomic issues of the 21st century. It is characterized by symptoms such as polyuria, polydipsia, and polyphagia, with untreated cases of both Type I and Type II diabetes often experiencing significant weight loss among other symptoms like fatigue, dry mouth, blurred vision, slow healing of wounds, and neuropathic pain including burning sensations and numbness in the feet (1). The prevalence of diabetes and impaired glucose tolerance has surged worldwide, with the International Diabetes Federation reporting an alarming 425 million individuals diagnosed with the condition globally. Estimates from 2017 indicated that 8.4% of the population aged between 18 and 99 years had diabetes, a figure projected to rise to 9.9% by 2045 (2,3).

Diabetic neuropathies, affecting 60% to 70% of diabetic patients, are a major complication of DM, disturbing various body organs. About one-third of these individuals suffer from diabetic polyneuropathy (DPN), which represents approximately 75% of all diabetic neuropathies. Distal symmetric polyneuropathy, a form of DPN, leads to neuropathic pain symptoms in 10-30% of those affected, manifesting as stabbing pains, burning sensations, hyperesthesia, or numbness, primarily in the lower limbs and exacerbating at

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night (5-7). This neuropathic pain significantly deteriorates the quality of life (QOL) of individuals, affecting employment status in 35-43% of patients and disturbing sleep in 43% of cases. Moreover, DPN notably impairs balance, thereby heightening the risk of falls, especially in the elderly with severe DPN (5).

The incidence of DM and its consequent neuropathies like DPN is expected to escalate, with projections indicating a rise from 171 million individuals in 2000 to 366 million by 2030. In Pakistan alone, the number of individuals suffering from DM is expected to increase from 5.0 million to 13.9% by 2030. Diabetic sensorimotor polyneuropathy, affecting roughly 50% of the diabetic population, is among the most common complications (10). Epidemiological studies have shown a wide variance in the prevalence of diabetic distal neuropathy, with rates ranging from 2.4% to 61.8% in different populations, indicating its commonality among patients with Type II diabetes.

Research has elucidated the multifaceted impacts of DPN on lower limb strength, functional performance, and the prevalence of foot ulcers, highlighting its contribution to reduced proprioception, muscle strength, and ankle mobility. This reduction in physical capabilities not only predisposes individuals to frequent foot infections, ulcerations, and amputations but also leads to imbalance and a heightened fall risk, thereby exacerbating psychological distress, mobility restrictions, and in severe cases, necessitating amputation. These outcomes severely limit social interactions and negatively influence the overall QOL of affected individuals (9, 16).

Diagnosis of DPN involves a comprehensive clinical history and examination, assessing symptoms related to both large and small nerve fiber involvement. Tools such as the Neuropad, Diabetic Neuropathy Examination score (DNE), and the Michigan Neuropathy Screening Instrument (MNSI) are employed for assessing various neuropathy-related symptoms and screening for the presence of DPN (17-20).

Management strategies for diabetic neuropathy syndrome encompass both pharmacological and non-pharmacological approaches. Pharmacological treatments include anticonvulsants, topical agents, gabapentinoids, opiates, antidepressants, non-steroidal anti-inflammatory drugs, and mexiletines. Conversely, physical therapy plays a crucial role in non-pharmacological management, focusing on strengthening exercises, proprioceptive training, balance exercises, and aerobic workouts to enhance coordination, muscle strength, balance, and reduce the risk of falls and fractures. Studies have demonstrated the effectiveness of these interventions in improving sensorimotor function, vascular health, balance, and reducing neuropathic symptoms, ultimately contributing to the maintenance of skeletal muscle mass and improving the QOL in individuals with DPN (6, 21-27).

The primary objectives of this study were to ascertain the frequency of fall risk in patients with diabetic peripheral neuropathy and to evaluate the impact of this risk on the quality of life of the affected individuals. Through a meticulous exploration of the intricate relationship between DPN and fall risk, this research aims to shed light on the broader implications of diabetic complications on patient health outcomes and quality of life.

## MATERIAL AND METHODS

The methodology of the study was designed as a descriptive cross-sectional analysis, conducted over a span of six months. The objective was to assess the frequency of fall risk in patients with diabetic peripheral neuropathy (DPN) and its subsequent impact on their quality of life. A total of 246 participants were included in the sample, calculated using the Open Epi online calculator. This calculation was based on a margin of error of 5%, a confidence level of 95%, and an anticipated frequency of 20%, derived from previous literature (28). The study employed a non-probability convenience sampling technique for participant selection.

The inclusion criteria targeted patients diagnosed with diabetic peripheral neuropathy, aged 40 years and above, regardless of gender, who scored 4 points on the diabetic neuropathy symptom score. Exclusion criteria comprised patients with any foot infection or wound, those with medical or surgical conditions limiting functional mobility, non-ambulatory individuals, and those unwilling to participate in the study.

For the assessment of fall risk, the Functional Reach Test was utilized as a physical therapy outcome tool. This test measures balance and functional motion capabilities by having the individual stand, extend their arm to 90 degrees of flexion, and reach forward as far as possible without taking a step. The scoring was categorized into three levels of fall risk: a reach of 6 inches or less indicated a high fall risk, a reach between 6 to 10 inches suggested a moderate fall risk, and a reach beyond 10 inches was considered indicative of a low fall risk.

The Short Form-36 (SF-36) questionnaire was employed to evaluate the participants' functional health and well-being. This tool, developed in 1990, encompasses eight scales yielding two composite measures of physical and mental health. The physical health component is subdivided into physical functioning, role-physical, bodily pain, and general health, while the mental health component includes vitality, social functioning, role-emotional, and mental health. Scores range from 0 to 100, with higher scores indicating lower disability levels and vice versa (29).

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Data collection followed after obtaining approval from the Advanced Studies & Research Board (ASRB) and the Ethical Review Board of Khyber Medical University Peshawar, ensuring adherence to the ethical guidelines outlined in the Declaration of Helsinki. The study commenced with the consent from the head of the physical therapy department of AIMS Diabetic Centre Hayatabad Peshawar. Participants were provided with comprehensive information about the study through both verbal and written consent forms. Screening for eligibility was meticulously conducted, followed by the collection of demographic information, administration of the functional reach test, and the SF-36 quality of life questionnaire. The questionnaire was explained to participants in the local language for clarity and better understanding.

The collected data were analyzed using SPSS version 25. Statistical analyses were performed in the past tense, reflecting the study's completion, and adhered to third-person narrative consistency, ensuring a professional and standard presentation of the study's methodology in the realm of medical research.

## RESULTS

In the conducted study, a total of 246 participants were examined to assess the risk of fall and its impact on quality of life among individuals with diabetic peripheral neuropathy (DPN). The demographic distribution revealed a higher prevalence of DPN in males, with 143 participants (58.1%), compared to 103 female participants (41.9%)【Table 1】. A significant majority of the cases, 190 (77.2%), demonstrated bilateral involvement of DPN, whereas unilateral DPN was observed in 56 cases (22.8%)【Table 1】.

When exploring the risk of fall, it was found that a substantial proportion of the participants, 171 (69.5%), were at risk of falling. This concern was further substantiated by the Functional Reach Test (FRT) outcomes, which indicated varying degrees of fall risk among the participants. Specifically, 32 individuals (13.0%) were categorized as having a high fall risk, 113 (45.93%) had a moderate fall risk, and 26 (10.52%) were found to have a low fall risk, with the overall mean FRT score being 8.81 ± 2.71. Notably, males exhibited a slightly higher mean FRT score (9.21 ± 2.32) compared to females (8.26 ± 3.10), suggesting a gender difference in balance and fall risk【Table 2】.

The distribution of fall risk by gender highlighted that among males, 13 (7.60%) had a low fall risk, 54 (31.57%) had a moderate fall risk, and 31 (18.12%) had a high fall risk. In contrast, among females, 26 (15.20%) were at low fall risk, 30 (17.54%) at moderate fall risk, and 17 (9.94%) at high fall risk【Table 3】. This distribution underscores the prevalence of fall risk across both genders, albeit with a slightly higher proportion of males in the moderate and high fall risk categories.

The study also examined the relationship between DPN side involvement and fall risk, revealing that individuals with unilateral DPN had a mean FRT score of 9.13 ± 2.65, whereas those with bilateral DPN had a slightly lower mean score of 8.72 ± 2.73. This suggests that bilateral DPN may be associated with a marginally increased risk of fall compared to unilateral DPN【Table 3】.

Marital status also appeared to influence fall risk, with married participants having a mean FRT score of 8.77 ± 2.78, compared to unmarried participants who had a slightly higher mean score of 8.94 ± 2.73. This indicates that marital status may play a role in the variability of fall risk among individuals with DPN【Table 3】.

Table 1: Demographics and Diabetic Peripheral Neuropathy (DPN) Characteristics

| Variable | Total Frequency (N=246) | Percentage (%) | Male Frequency | Female Frequency |
|---|---|---|---|---|
| Gender | 246 | 100 | 143 (58.1) | 103 (41.9) |
| Side Involved | | | | |
| Unilateral DPN | 56 | 22.8 | - | - |
| Bilateral DPN | 190 | 77.2 | - | - |

Table 2: Risk of Fall and Functional Reach Test (FRT) Outcomes

| Variable | Frequency (N=246) | Percentage (%) | Mean ± SD (Overall) | Mean ± SD (Male) | Mean ± SD (Female) |
|---|---|---|---|---|---|
| Risk of Fall | | | 8.81 ± 2.71 | 9.21 ± 2.32 | 8.26 ± 3.10 |
| Yes | 171 | 69.5 | | | |
| No | 75 | 30.5 | | | |
| Severity of Risk | | | | | |
| High Fall Risk | 32 | 13.0 | | | |
| Moderate Fall Risk | 113 | 45.93 | | | |
| Low Fall Risk | 26 | 10.52 | | | |

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Table 3: Distribution of Risk of Fall by Gender, Side Involvement, and Marital Status

| Variable | Low Fall Risk | Moderate Fall Risk | High Fall Risk | Mean ± SD (Unilateral DPN) | Mean ± SD (Bilateral DPN) | Mean ± SD (Married) | Mean ± SD (Unmarried) |
|---|---|---|---|---|---|---|---|
| Male | 13 (7.60%) | 54 (31.57%) | 31 (18.12%) | - | - | - | - |
| Female | 26 (15.20%) | 30 (17.54%) | 17 (9.94%) | - | - | - | - |
| Unilateral DPN | 7 (4.09%) | 22 (12.86%) | 13 (7.60%) | 9.13 ± 2.65 | - | - | - |
| Bilateral DPN | 34 (19.88%) | 67 (39.81%) | 28 (16.37%) | - | 8.72 ± 2.73 | - | - |
| Marital Status (Married) | 20 (11.69%) | 72 (42.10%) | 32 (18.71%) | - | - | 8.77 ± 2.78 | - |
| Marital Status (Unmarried) | 12 (7.01%) | 27 (15.78%) | 8 (4.67%) | - | - | - | 8.94 ± 2.73 |

Table 4: Quality of Life (SF-36) and Correlations

| SF-36 Component | Pearson Correlation (Risk of Fall) | Mean ± SD (Male) | Mean ± SD (Female) |
|---|---|---|---|
| Physical Functioning | 0.015 | 47.86 ± 27.29 | 43.35 ± 23.63 |
| Role Limitation due to Physical Health | 0.118 | 34.34 ± 31.23 | 27.91 ± 29.00 |
| Role Limitation due to Emotional Health | 0.044 | 49.93 ± 31.37 | 49.53 ± 35.87 |
| Energy/Fatigue | 0.071 | 33.06 ± 20.36 | 28.16 ± 18.31 |
| Emotional Wellbeing | 0.047 | 51.58 ± 26.54 | 46.40 ± 24.67 |
| Social Functioning | 0.162 | 44.36 ± 26.52 | 42.43 ± 27.72 |
| Pain | 0.178 | 44.75 ± 24.90 | 41.73 ± 25.68 |
| General Health | 0.075 | 35.82 ± 19.73 | 30.19 ± 22.81 |

Table 5: Correlations with Functional Reach Test

| Variable | Pearson Correlation Value |
|---|---|
| Age | 0.69 |
| Gender | -0.174 |
| Marital Status | 0.029 |
| DPN Side Involved | 0.631 |

The impact of DPN on quality of life was evaluated using the SF-36 questionnaire, which showed varying scores across different domains for both genders. Males generally reported higher scores in physical functioning, role limitation due to physical health, and emotional wellbeing compared to females. However, the Pearson correlation analysis between the risk of fall and quality of life domains revealed low to moderate correlations, with social functioning and pain showing the most significant correlations (0.162 and 0.178, respectively)【Table 4】.

Correlation analysis with the Functional Reach Test further highlighted significant associations, particularly the correlation between age and DPN side involved with FRT scores (0.69 and 0.631, respectively), indicating that these factors are significant predictors of fall risk in this population【Table 5】. The negative correlation with gender (-0.174) suggests that males and females may experience different levels of fall risk, potentially influenced by factors not fully explored in this study.

## DISCUSSION

The study conducted at AIMS Diabetic Centre Hayatabad Peshawar sought to determine the frequency of fall risk among patients with diabetic peripheral neuropathy (DPN) and its impact on their quality of life. The findings revealed a significant prevalence of fall risk within this population, underscoring a negative correlation between the risk of falling and the quality of life among individuals with DPN. This correlation aligns with previous research by Parasoglou et al. (2017), which highlighted the detrimental effects of DPN on skeletal muscle function, contributing to an increased risk of falls, abnormal gait, and balance issues. The congruence

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between these studies underscores the pervasive impact of DPN on functional impairments, further exacerbated by the associated risk of falls (30).

The study's results resonate with findings from Tofthagen et al. (2011), who reported a significant increase in fall risk with the severity of chemotherapy-induced peripheral neuropathy. Despite differing etiologies, the similarity in outcomes suggests a universal link between peripheral neuropathy and an elevated fall risk, irrespective of the underlying cause (31). Similarly, research by M.M Thet et al. (2019) on the impact of peripheral neuropathy on Activities of Daily Living (ADL) in individuals with Type 2 Diabetes Mellitus (T2DM) found that neuropathy was closely associated with difficulties in performing both upper and lower limb activities, reinforcing the current study's observations on the functional limitations imposed by DPN (32).

Further supporting this study's findings, Ragnhild I Cederlund et al. explored the correlation between the duration of diabetic neuropathy, hand dysfunction, and daily functional impairments in men with type 2 diabetes. The study concluded that longer durations of neuropathy are directly linked to hand dysfunction and reduced ADL capabilities (33), highlighting the broader impacts of DPN on quality of life. In contrast, a study by P. Danial et al. (2019) investigating the relationship between balance problems and quality of life in type-II diabetic patients found a significant correlation between physical limitations and fall risk, albeit focusing primarily on one domain of the SF-36. This finding partially diverges from the present study, which noted fall risk impacts across all domains of the SF-36, suggesting a more extensive influence of fall risk on the quality of life than reported by Danial et al. (11).

Conclusively, the study demonstrated that a majority of the participants, 69.5%, were at a moderate risk of falling, with a notable percentage presenting a substantial fall risk. The analysis further indicated that males and females were both susceptible to moderate fall risks, yet females exhibited lower scores in the functional reach test, highlighting gender differences in fall risk and functional impairment.

The study, while insightful, faced limitations such as a scarcity of literature for thorough comparison, lack of financial funding, a brief duration, and the absence of a comparison group. These limitations underscore the need for broader research to validate and expand upon these findings.

Recommendations for future research include conducting multi-centered studies with larger sample sizes across different regions of Pakistan to gain a comprehensive understanding of DPN's impact on fall risk and quality of life. Additionally, the organization of workshops to raise awareness about DPN and its consequences on life quality is advised. Interventional studies exploring the effectiveness of therapeutic exercises could offer valuable insights into mitigating the negative impacts of DPN. Promoting awareness of the benefits of physiotherapy in managing DPN is also recommended to enhance patient outcomes and improve quality of life.

## CONCLUSION

This study conclusively demonstrated a high prevalence of fall risk among patients with diabetic peripheral neuropathy, significantly impacting their quality of life. The findings highlight the critical need for healthcare professionals to incorporate fall risk assessment and management strategies as integral components of DPN treatment protocols. By doing so, it is possible to mitigate the negative impacts on quality of life, emphasizing the importance of comprehensive care approaches that address both the physiological and functional aspects of diabetic complications. Future research should focus on expanding the knowledge base through larger, multi-centered studies and exploring the effectiveness of targeted interventions to improve the quality of life for individuals with DPN.

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