

Original Article

Evaluation of Serum Vitamin D Levels and its Association with Increased Risk of Pressure Ulcer among Non-Ambulatory Patients

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ABSTRACT

Background: Pressure ulcers are a significant health concern for non-ambulatory patients, often resulting from prolonged immobility. Vitamin D, recognized for its role in skin health and wound healing, may influence the development of these ulcers. This study examines the relationship between serum vitamin D levels and the prevalence of pressure ulcers in individuals unable to walk or move independently.

Objective: To explore the association between serum Vitamin D levels and the risk of pressure ulcers, aiming to contribute to the literature and improve patient outcomes through evidence-based healthcare practices.

Methods: A cross-sectional study was conducted at Sheikh Zayed Hospital and Bahria International Hospital, Lahore, from August 2023 to January 2024. Seventy non-ambulatory patients were recruited using a non-probability convenient sampling method. The Braden scale was employed to assess pressure ulcer severity, and serum vitamin D levels were measured through blood samples.

Results: Participants had a mean age of 38.5 years (SD = 6.27) and a mean non-ambulatory duration of 13.72 days (SD = 5.22). Gender distribution was 55.7% female and 44.3% male. Historical pressure ulcer incidence was 10%. The leading reasons for hospitalization were stroke (28.6%), neuromuscular conditions (31.4%), and road traffic accidents (38.6%). A significant positive correlation was found between Braden scale scores and vitamin D levels (11.91 ± 3.40 and 11.40 ± 3.40 respectively, Pearson correlation coefficient = 0.71, $p < 0.01$).

Conclusion: There is a significant association between low serum vitamin D levels and an increased risk of developing pressure ulcers in non-ambulatory patients, supporting the need for vigilant monitoring and management of vitamin D levels.

Keywords: Ergocalciferol, Pressure ulcers, Serum Vitamin D, Vitamin D3, Wound healing.

INTRODUCTION

Pressure ulcers, also known as bedsores or pressure sores, are localized injuries to the skin and/or underlying tissue, typically over a bony prominence, resulting from sustained pressure or friction. These injuries can lead to tissue necrosis due to prolonged pressure that compromises the blood supply to the affected area. Commonly found in individuals who are unable to ambulate, such as those confined to bed or dependent on wheelchairs, pressure ulcers are influenced by several factors including immobility, compromised skin integrity, diminished circulation, and poor nutritional status (1). The prevention and management of pressure ulcers remain significant challenges in healthcare settings.

The National Pressure Ulcer Advisory Panel (NPUAP) has categorized pressure ulcers into several stages based on their severity. Stage I ulcers are characterized by non-blanchable erythema of intact skin, indicating early tissue damage. Stage II involves partial thickness skin loss of the epidermis and/or dermis, presenting as an open or ruptured blister. Stage III is identified by full-thickness skin loss without extension into the underlying fascia, affecting the subcutaneous tissue. Stage IV ulcers exhibit complete skin thickness loss

with extensive damage to muscle, bone, or supporting structures. Ulcers that are unstageable involve full-thickness tissue loss, where eschar or necrotic tissue obscures the extent of damage (2).

The development of pressure ulcers is a complex interplay of factors such as reduced blood flow, tissue hypoxia, and cellular damage. Extended pressure on specific body areas can constrict blood vessels, depriving tissues of necessary oxygen and nutrients, leading to cell death. This condition is exacerbated by factors such as inflammation, bacterial colonization, and impaired wound healing mechanisms, potentially resulting in infection and further tissue damage (4).

Vitamin D, often referred to as the "sunshine vitamin," plays a crucial role in bone health by promoting calcium absorption and bone mineralization. However, recent studies have also highlighted its involvement in immune regulation, inflammation control, and cellular proliferation. The presence of vitamin D receptors in skin cells suggests its importance in maintaining skin health and function (5). Vitamin D₃, synthesized in the skin through exposure to UVB light, and vitamin D₂, found in plant-based sources, undergo similar metabolic processes in the liver and kidneys to produce their active forms, essential for various bodily functions (6).

The optimal range for serum 25(OH) D levels is considered to be between 30 and 50 ng/mL, with levels between 20 and 30 ng/mL regarded as insufficient and those below 20 ng/mL as deficient. Maintaining adequate vitamin D levels is vital not only for bone health but also for optimal cellular and immune functions (7).

Emerging research suggests that nutritional factors, including vitamin D levels, might influence the risk of pressure ulcer development through their effects on tissue health and wound healing. Low serum levels of vitamin D have been associated with an increased risk of various health issues such as infections, diabetes, and cardiovascular diseases. Although limited, existing studies suggest a potential link between low serum vitamin D levels and an increased risk of pressure ulcers in non-ambulatory patients (8). The immunomodulatory and anti-inflammatory properties of vitamin D, along with its role in collagen synthesis, cell division, and angiogenesis, are critical for tissue repair and remodeling during wound healing (9, 10).

The objective of this research is to evaluate whether there is an association between elevated serum levels of vitamin D and a reduced risk of pressure ulcers in non-ambulatory patients. By exploring this relationship, this study aims to enhance the existing knowledge base on wound care and prevention strategies for this vulnerable population. Should a significant association be identified, healthcare professionals might consider implementing targeted interventions such as vitamin D supplementation or increased sun exposure, particularly for high-risk patients. Ultimately, the findings of this study could contribute to a deeper understanding of the pathogenesis and prevention of pressure ulcers, thereby improving patient care within the healthcare system.

METHODS

Over a period of six months, from July to December 2023, a cross-sectional study was conducted at Sheikh Zayed Hospital and Bahria International Hospital in Lahore. The study employed a non-probability convenience sampling technique to recruit a sample of 70 participants. This sample size was determined using the single mean population proportion formula from select statistical software. The research targeted a specific demographic: individuals aged between 50 and 80 years, encompassing both genders, who were non-ambulatory for at least one week. This criterion ensured that participants had sufficient immobility, a necessary condition for the potential development of pressure ulcers.

Participants included in the study were either paraplegic or quadriplegic, had sustained injuries from road traffic accidents or strokes, or suffered from advanced arthritis or severe musculoskeletal injuries, such as spinal fractures or significant lower limb fractures. Exclusion criteria were rigorously applied to maintain the integrity of the study. Patients with incomplete medical records, severe cognitive impairments that precluded understanding of the study procedures or provision of informed consent, or a known history of pressure ulcers were excluded. Similarly, those with significant comorbidities that could influence the development of pressure ulcers or existing skin diseases were not considered for inclusion.

The primary tool for assessing the severity of pressure ulcers was the Braden scale, a validated measure in clinical research for this purpose. Serum vitamin D levels were also critically analyzed, with insufficiency defined as levels below 600 IU (15 mcg) for participants aged 50 to 70 and below 800 IU (20 mcg) for those older than 70. Data collected from the study were systematically organized into tables and graphs to facilitate a clear understanding of the findings.

For the analysis of the data, the Statistical Package for Social Sciences (SPSS) software, version 24, was utilized. A Pearson correlation test was specifically applied to examine the relationship between serum vitamin D levels and the risk of developing pressure ulcers. This statistical approach was chosen to rigorously assess potential correlations and draw relevant conclusions from the dataset. The findings from this study are poised to contribute valuable insights into the prevention and management of pressure ulcers in non-ambulatory patients, emphasizing the role of vitamin D in tissue health and resilience (PSRD-CRS/USK/PL-23).

RESULTS

The results of the study provided a comprehensive overview of the demographic and clinical characteristics of the participants, along with insights into the relationship between vitamin D levels and pressure ulcer risk as assessed by the Braden scale. The participants had a mean age of 38.5 years, with a standard deviation of 6.27, indicating a relatively young cohort for a study typically focused on older adults. This deviation from the expected age range suggested a broader applicability of the findings across different age groups. The duration for which participants had been non-ambulatory averaged 13.72 years, with a standard deviation of 5.22, underscoring the chronic nature of their conditions. The gender distribution within the study was fairly balanced, with 44.3% male and 55.7% female participants. The predominant medical conditions included a history of stroke, accounting for 55.7% of the sample, and various neuromuscular conditions, making up 44.3%. Notably, 10% of the participants had experienced pressure ulcers in the past, highlighting a subgroup particularly at risk.

The analysis of the Braden scale scores and vitamin D levels revealed that both variables had the same mean value of 11.40, with a standard deviation of 3.40. A further examination using a Pearson correlation test demonstrated a strong positive correlation between the Braden scale scores and vitamin D levels, with a correlation coefficient of 0.71 at a significance level of 0.01. This significant correlation suggested that higher levels of serum vitamin D might be associated with better scores on the Braden scale, indicative of a lower risk of pressure ulcer development.

Overall, these findings underscore the potential link between adequate serum vitamin D levels and reduced risk of pressure ulcers in non-ambulatory patients. The strong positive correlation between vitamin D levels and Braden scale scores supports the hypothesis that vitamin D may play a crucial role in maintaining skin integrity and preventing pressure ulcers in this vulnerable population. This association warrants further investigation to develop targeted interventions that could enhance patient outcomes by mitigating one of the most challenging complications in immobile patients.

Table 1: Braden scale score & Vitamin D levels in mcg

	Mean±S.D
Braden scale score	11.91±3.40
Vitamin D levels in mcg	11.40±3.40

Table 2: Correlation

Pearson Correlation			
		Braden Scale Score	Vitamin D levels in mcg
Braden Scale Score	Pearson Correlation	1	0.71
	Sig. (p-value)	<0.01	<0.01
Vitamin D levels in mcg	Pearson Correlation	0.71	1
	Sig. (p-value)	<0.01	<0.01

Correlation is significant at the 0.01 level (p-value).

DISCUSSION

The study revealed a strong positive correlation between serum vitamin D levels and the risk of pressure ulcers among non-ambulatory patients, substantiating the hypothesis that adequate vitamin D may play a protective role in pressure ulcer prevention. The analysis showed a significant correlation coefficient of 0.71, with Braden scale scores and serum vitamin D levels suggesting that higher levels of this nutrient are associated with a lower risk of developing pressure ulcers. These findings align with previous studies indicating that vitamin D plays a crucial role in skin health and may influence wound healing processes through its anti-inflammatory and immunomodulatory properties (11, 13, 14).

The study draws on a rich body of literature that has similarly identified a link between vitamin D deficiency and various health complications. For example, lower vitamin D levels have been associated with an increased risk of dementia and cardiovascular diseases, highlighting its broad impact on health beyond bone maintenance (11, 16). These connections underscore the multifunctional roles of vitamin D, which also extend to influencing the severity and frequency of conditions that compromise skin integrity and wound healing, such as diabetes and vascular diseases (17, 18).

However, it is important to consider the complexity of factors influencing pressure ulcer development. The study by Manley and others underscores that a high-calorie, high-protein diet supplemented with specific nutrients can significantly affect the healing process of pressure ulcers, suggesting that nutrition plays a critical role in managing and preventing these injuries (26). Similarly, factors such as albumin levels, diabetes, and age have been shown to significantly correlate with pressure ulcer healing, indicating that multiple variables contribute to the risk and management of these wounds (19-21).

This study's strengths include its robust methodological approach and the use of validated tools like the Braden scale to assess pressure ulcer risk. However, there are limitations that must be acknowledged. The cross-sectional design restricts the ability to establish causality between vitamin D levels and pressure ulcer risk. Additionally, the study did not control for potential confounders such as dietary intake, sun exposure, or comorbidities, which might affect vitamin D levels and pressure ulcer development.

Future research should aim to address these gaps by incorporating longitudinal designs, diverse populations, and controlling for additional variables that affect skin integrity and wound healing. Moreover, further studies should explore the mechanisms through which vitamin D exerts its effects on skin health and evaluate the efficacy of vitamin D supplementation in preventing pressure ulcers across different settings and populations. Understanding the optimal dosage, timing, and duration of vitamin D supplementation could significantly enhance the management strategies for pressure ulcers, ultimately improving patient safety and well-being.

CONCLUSION

The findings from our study indicate a significant association between low serum vitamin D levels and an increased risk of pressure ulcer development in non-ambulatory patients, underscoring the importance of vitamin D in maintaining skin health. This association supports the clinical relevance of routinely monitoring and managing vitamin D levels in this vulnerable population. Ensuring adequate vitamin D status could be a key strategy in preventing pressure ulcers, thereby improving patient outcomes and quality of life. Future interventions could include targeted vitamin D supplementation or strategies to enhance sun exposure, tailored to meet the specific needs and conditions of non-ambulatory individuals to effectively mitigate their risk of developing pressure ulcers.

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