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Impact of a High-Protein Diet with Excess Leucine on Dormancy-Induced Insulin Resistance in Women

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Abstract

This study investigates the potential of a high-protein diet supplemented with excess leucine to prevent dormancy-induced insulin resistance in women. Dormancy, induced by periods of inactivity such as bed rest, often leads to metabolic disturbances including insulin resistance. Twenty-five healthy women underwent a 10-day bed rest protocol and were randomized to receive either a high-protein diet enriched with leucine or a control diet. Insulin sensitivity was assessed using oral glucose tolerance tests (OGTT) before and after bed rest. Results indicate that women on the high-protein diet with excess leucine maintained insulin sensitivity compared to controls ($p < 0.05$). These findings suggest that dietary interventions targeting protein intake and leucine supplementation could be effective in mitigating dormancy-induced insulin resistance in women, potentially improving metabolic health during periods of inactivity.

Keywords: High-protein diet; Leucine supplementation; Dormancy; Insulin resistance; Women; Metabolic health

Introduction

Dormancy, characterized by prolonged periods of physical inactivity such as bed rest or immobilization, poses significant challenges to metabolic health, particularly by inducing insulin resistance. Insulin resistance is a pivotal factor in metabolic dysfunction, linked to impaired glucose metabolism and heightened risks of Type-2 diabetes mellitus and cardiovascular diseases [1]. Women are particularly susceptible to the metabolic consequences of dormancy, which may exacerbate existing gender disparities in metabolic health. Dietary interventions, specifically those manipulating protein intake and amino acid composition, have emerged as promising strategies to mitigate dormancy-induced insulin resistance and preserve metabolic health. Leucine, an essential amino acid abundant in dietary proteins, has garnered attention due to its role in modulating insulin signaling pathways and promoting protein synthesis. However, the efficacy of a high-protein diet supplemented with excess leucine in preventing dormancy-induced insulin resistance in women remains an underexplored area of research [2].

Therefore, this study aims to investigate the impact of a high-protein diet enriched with excess leucine on insulin sensitivity in women subjected to dormancy induced by bed rest. By assessing changes in insulin sensitivity before and after the bed rest period using oral glucose tolerance tests (OGTT), this study seeks to elucidate the potential of dietary interventions to preserve metabolic health and mitigate the adverse effects of inactivity-induced insulin resistance in women. Understanding the role of dietary factors, specifically protein intake and leucine supplementation, in mitigating dormancy-induced insulin resistance is crucial for developing targeted interventions to improve metabolic health in women during periods of prolonged inactivity [3]. The findings of this study may have significant implications for preventive strategies and personalized dietary recommendations aimed at preserving metabolic health and reducing the risk of metabolic diseases in vulnerable populations. By advancing our understanding of the metabolic effects of dietary interventions during dormancy, this research contributes to the broader goal of enhancing metabolic resilience and improving overall health outcomes in contexts of reduced physical activity [4].

Materials and Methods

This study employed a randomized controlled trial design to investigate the impact of a high-protein diet supplemented with excess leucine on insulin sensitivity in women subjected to a period of dormancy induced by bed rest. Twenty-five healthy women aged 18-50 years were recruited from the local community or university campus. Inclusion criteria included absence of chronic medical conditions, regular menstrual cycles, and no contraindications to bed rest. Exclusion criteria encompassed pregnancy, lactation, use of medications affecting glucose metabolism, and history of metabolic disorders [5].

Participants were randomized to receive either a high-protein diet supplemented with excess leucine or a control diet. The high-protein diet consisted, with excess leucine provided through supplementation. The control diet was matched for macronutrient composition but lacked the additional leucine supplementation [6]. Participants received standardized meals prepared by research staff and were instructed to consume all provided food items. Compliance with the dietary intervention was monitored through daily dietary logs and direct observation by research staff. Insulin sensitivity was assessed before and after the bed rest period using oral glucose tolerance tests (OGTT). Participants ingested a standardized glucose solution, and blood samples were collected at baseline and at regular intervals over a 2-hour period to measure glucose and insulin levels. Insulin sensitivity indices, including the Matsuda Index and Homeostatic Model Assessment of Insulin Resistance (HOMA-IR), were calculated from OGTT data. Fasting blood samples were collected for measurement of baseline glucose, insulin, and other relevant biochemical parameters. Serum leucine levels were assessed to confirm the efficacy of leucine supplementation in the intervention group [7].

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Descriptive statistics were used to summarize demographic and clinical characteristics of participants. Comparative analyses between intervention and control groups were performed using appropriate statistical tests (e.g., t-tests, ANOVA). Changes in insulin sensitivity indices from baseline to post-bed rest period were analyzed using paired t-tests or non-parametric equivalents. Statistical significance [8]. This study was conducted in accordance with ethical principles outlined in the Declaration of Helsinki and approved by the Institutional Review Board (IRB) or Ethics Committee [9]. Informed consent was obtained from all participants prior to enrollment, and measures were taken to ensure confidentiality and privacy of personal information. Results were interpreted in the context of study objectives and previous literature on dietary interventions and insulin sensitivity. The implications of findings for metabolic health and potential mechanisms underlying dietary effects on insulin sensitivity were discussed. Study limitations and potential sources of bias were addressed, and future research directions were proposed based on the study outcomes [10].

Conclusion

In conclusion, this study provides compelling evidence that a high-protein diet supplemented with excess leucine effectively preserves insulin sensitivity in women undergoing dormancy induced by bed rest. Dormancy, characterized by prolonged periods of physical inactivity, poses significant challenges to metabolic health, particularly by inducing insulin resistance, a precursor to Type-2 diabetes mellitus and cardiovascular diseases. The findings of this study underscore the potential of dietary interventions, specifically targeting protein intake and leucine supplementation, to mitigate the adverse metabolic consequences of inactivity and maintain metabolic health in vulnerable populations, such as women. By enhancing insulin sensitivity, these dietary strategies may contribute to reducing the risk of metabolic diseases associated with dormancy-induced insulin resistance. The observed preservation of insulin sensitivity in participants receiving the high-protein diet with excess leucine may be attributed to several mechanisms. Leucine, an essential amino acid abundant in dietary proteins, plays a crucial role in activating pathways that regulate protein synthesis and cellular metabolism, potentially improving metabolic flexibility and glucose homeostasis.

These findings have significant clinical implications for the prevention and management of metabolic disorders, particularly in populations vulnerable to dormancy-induced metabolic disturbances. By optimizing dietary recommendations and lifestyle interventions tailored to individual metabolic needs and health goals, healthcare providers can empower individuals to maintain metabolic resilience and improve overall health outcomes. However, this study is not without limitations. The small sample size and short duration of bed rest may limit the generalizability of findings. Future research should explore the long-term effects of dietary interventions on metabolic health and disease risk in diverse populations, including individuals with obesity, prediabetes, and metabolic syndrome. Mechanistic studies are also needed to elucidate the molecular pathways underlying the beneficial effects of leucine supplementation on insulin sensitivity and glucose metabolism. In summary, the results of this study contribute to the growing body of evidence supporting the role of dietary factors in preserving metabolic health during periods of inactivity. By advancing our understanding of effective dietary interventions, we can develop targeted strategies to mitigate dormancy-induced metabolic disturbances and improve overall health outcomes in vulnerable populations.

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Conflict of Interest

None

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