

# Comparison of Alkaline and Acid Base Diet Profiles and Its Correlation with Bone Mineral Density

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## Introduction

- Osteoporosis is a growing public health concern, with predicted osteoporotic fractures reaching epidemic proportions due to prolonged life expectancies of the elderly
- Strategies targeting the prevention of poor bone health are urgently needed, with emphasis placed on modifiable factors such as nutrition
- Previous studies suggest that dietary patterns that promote acidosis may have a negative effect on bone density, whereas a more alkaline-based profile would be associated with better bone health
- There has been substantial evidence that certain foods affect acid-base balance in the body. In general, a high protein diet is associated with being more acidic, while a fruit and vegetable diet has more of an alkalizing effect, and can reduce the acid load
- Thus, the aim of this study was to assess, in omnivores, vegetarians, and vegans bone mineral density using Dual-energy X-ray absorptiometry (DEXA) and compare it to their acid-base status as indicated by urinary pH, Potential Renal Acid Load (PRAL) and serum anion gap
- Our hypothesis was that plant-based diets would be associated with a more alkaline acid-base profile than omnivorous diets, and thus have a higher bone mineral density

## Methods

- A cross sectional study was conducted where we compared plant based vs omnivorous diets
- Eighty-two subjects were enrolled in the study (27 omnivores, 27 vegetarians, and 28 vegans)
- Requirements for enrollment: Have followed respective diet for 1 year, not endurance trained, not obese, no known medical issues, no prescription or recreational drug use
- Subjects were asked to fill out a medical history form, a 24-hour diet recall, and to complete a 24-hour urine collection
- After a few weeks, subjects returned to the test site to complete a DEXA scan
- Acid base-balance and bone health were determined using PRAL, urine pH, and anion gap as biomarkers for pH, and DEXA as an indicator of bone density
- Statistical analysis was performed used SPSS

## Results

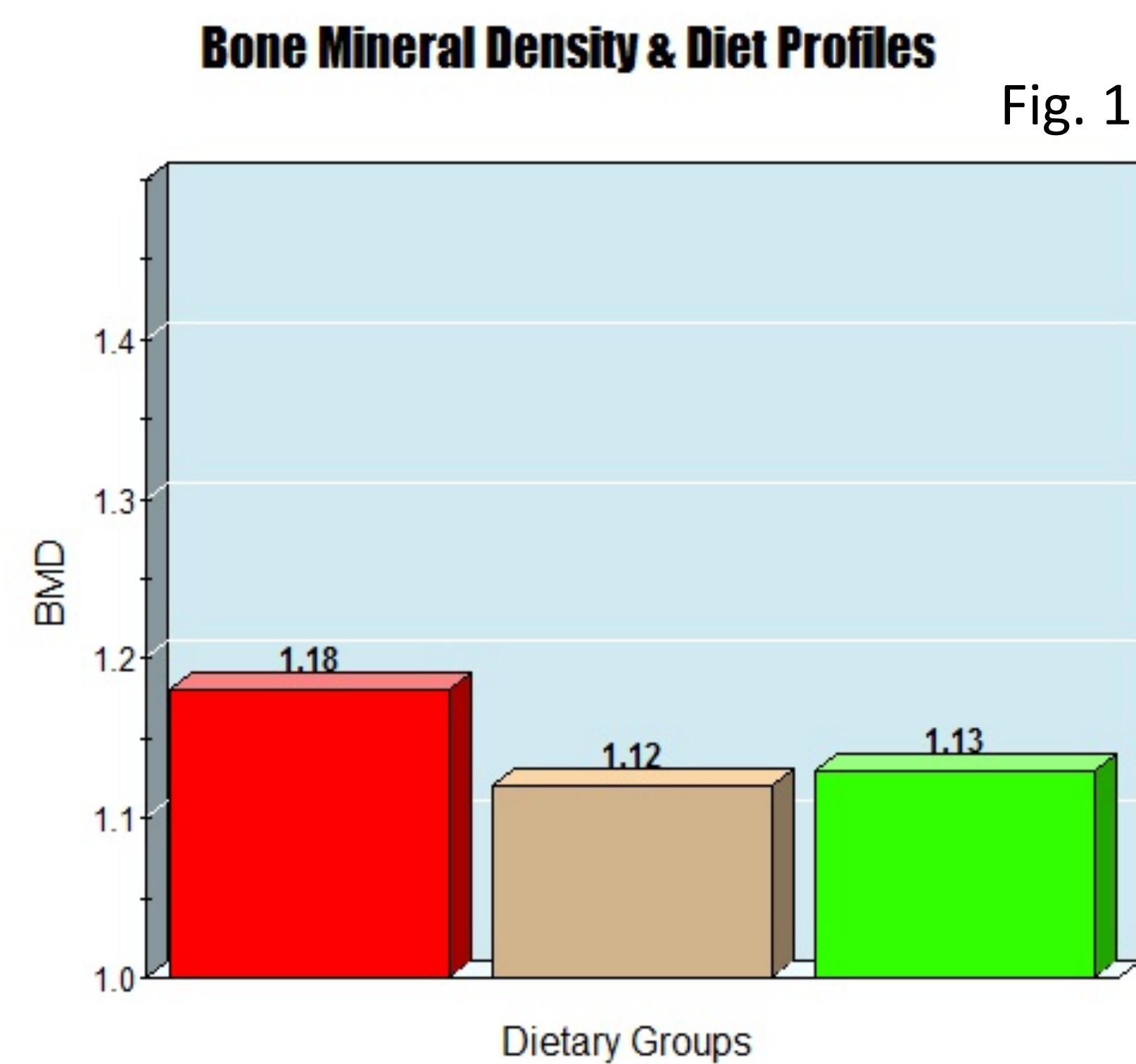


Fig. 1 Our results showed that bone mineral density did not differ significantly between groups

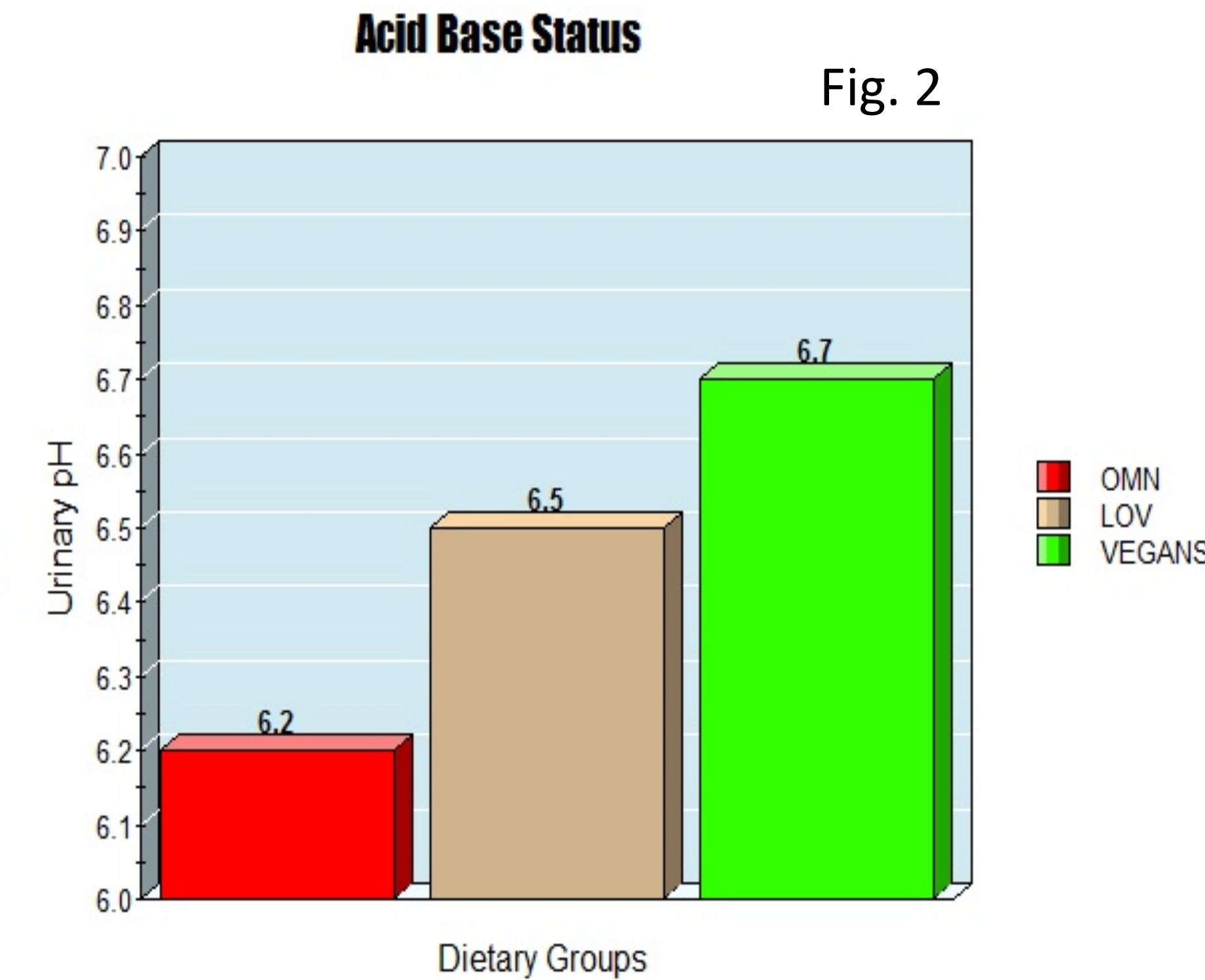


Fig. 2 Lacto-ovo and vegan diets were more alkaline compared to meat based diets ( $6.5 \pm 0.4$ ,  $6.7 \pm 0.4$ , and  $6.2 \pm 0.4$  pH respectively,  $p = 0.003$ ).

	OMN	LOV	VEGAN
Urinary pH	0.602 *	0.003	-0.008
Protein, g	0.190	0.262	0.434 *

Fig. 3

<sup>1</sup> Asterisk denotes a significant correlation: Pearson's Correlation,  $p < 0.05$ .

- Fig. 3 Urinary pH was found to have a statistically significant correlation with omnivores, whereas dietary protein had a significant correlation with vegans
- In our study, protein intake was found to be reduced by ~30% in individuals adhering to a lacto-ovarian or vegan diet; yet protein was only associated with bone mineral density in those following vegan diets

## Conclusion

- Our cross sectional study comparing three diet groups showed that there was no significant variation in BMD, however there was a significant correlation among protein in vegans and pH status in omnivores
- The significance of this study is that it provides knowledge in the area of osteoporosis prevention and perhaps specific recommendations based on diet groups: increased fruit and vegetable intake for those with high meat consumption, to improve the acid-base homeostasis, and increased plant protein intake for individuals who follow a plant-based diet

## Discussion

- Our study showed that there was no significant variation in BMD between the three diet groups, although the urinary pH was more alkaline for those adhering to meatless diets
- A review of the literature shows that there are a few possible explanations for our findings. Bone metabolism is a dynamic and sensitive system, where alterations in either pH or specific nutrients will tip the balance to either more resorption or formation of bone
- Several studies suggest that protein is important for insulin-like growth factor I (IGF-I) to induce activation of osteoblasts, and thus protein deficiency prohibits the positive effects of IGF-I on cortical bone
- On the other hand, several studies suggest that while protein is crucial for bone health it also contributes to the dietary acid load which can adversely affect bone integrity
- This state of acidosis causes the release of alkaline bone minerals, in order to balance the hydrogen ions created by the diet, specifically the high acid load created by high animal consumption
- Thus, the similar bone mineral density found amongst the three diet groups can perhaps be explained by the cancelling effect occurring by the positive and negative attributes of each diet

## Acknowledgements

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