Comparing Calcium, Vitamin D, and Calorie Intakes Among UNH Army ROTC Cadets with Low and Normal Bone Mineral Status

Ava Gaudette

University of New Hampshire - Main Campus

Follow this and additional works at: https://scholars.unh.edu/honors

Part of the Nutrition Commons

Recommended Citation
Gaudette, Ava, "Comparing Calcium, Vitamin D, and Calorie Intakes Among UNH Army ROTC Cadets with Low and Normal Bone Mineral Status" (2024). Honors Theses and Capstones. 797. https://scholars.unh.edu/honors/797

This Senior Honors Thesis is brought to you for free and open access by the Student Scholarship at University of New Hampshire Scholars' Repository. It has been accepted for inclusion in Honors Theses and Capstones by an authorized administrator of University of New Hampshire Scholars' Repository. For more information, please contact Scholarly.Communication@unh.edu.
Comparing Calcium, Vitamin D, and Calorie Intakes in Army ROTC Cadets with Low and Normal Bone Densities

Ava Gaudette
University of New Hampshire
Undergraduate Honors Thesis

Advisors: Dr. Kevin Pietro, Dr. Maggie Dylewski Begis, and Dr. Jesse Stabile Morrell

May 2024
Abstract

**Objective:** Significant research has been conducted on the health of the US Army, but little has been done on ROTC programs despite difficulty with retention and low enrollment. The purpose of this study was to identify potential differences in nutrient intakes between UNH Army ROTC cadets with low and normal bone densities.

**Methods:** A total of 31 cadets enrolled in the UNH Army ROTC program were included in this study. Cadets underwent several nutrition and health screening tests including use of the McCue Contact Bone Ultrasound Analyzer (CUBA) to assess bone health and a 24-hour recall to assess diet. Cadets were classified into bone health categories of low or normal based on their z-score using WHO criteria. T-tests were conducted to compare differences in calcium, vitamin D, and calorie intake between groups.

**Results:** There were no statistically significant differences in calcium (p=0.1317), vitamin D (p=0.0715), or calorie intake (p=0.7007) between groups. In total, 8 cadets (25%) had low bone density (BMD). 23 cadets (75%) had normal bone density. In the low BMD group, 63% (n=5) met the RDA for calcium intake compared to 70% (n=16) in the normal BMD group. None of the cadets with low BMD met the vitamin D RDA compared to 17% (n=4) of cadets with normal BMD.

**Conclusion:** While the results show no statistical significance, low intakes of vitamin D in both bone density groups suggest clinical significance. Additional research on the impact of low vitamin D intake on bone health in ROTC populations should be conducted.
Literature Review

Bone mineral density or BMD is defined as the amount of bone present in the skeletal structure. A higher bone density indicates stronger bones. Most people reach peak bone mass around 25 years of age and maintain their peak bone mass until 35 years of age. After age 35, BMD starts to decline at a rate of about 0.3% to 0.5% annually. It is important to note that while genetic factors account for 60-80% of the variation in peak bone size, both diet and exercise have an influence.

The micronutrients most closely involved in bone health are Vitamin D and calcium, with magnesium, zinc, copper, and phosphorus playing a smaller role. Calcium acts as the primary structural component of bone and plays a key role in skeleton mineralization. It also participates in body processes such as nerve transmission and muscle contraction. Vitamin D supports bone health by promoting calcium absorption in the gut which allows the body to maintain adequate blood calcium levels. When calcium levels drop, parathyroid hormone promotes bone resorption to bring levels back up to a normal range. Blood calcium levels are monitored very closely, and the body will keep them within normal limits at the expense of bone health. Bone resorption is part of the larger process known as bone remodeling which involves osteoclasts and osteoblasts. Osteoclasts remove old and damaged bone while osteoblasts form the new bone which replaces it.

In addition to the role of micronutrients, bone health is influenced by exercise via the osteogenic effect. During weight bearing exercise, the activity of osteoblasts increases, effectively increasing bone mineral density. However, not all weight-bearing exercise has the same positive effects. Exercises that involve multi-directional loading vectors, where pressure is coming from multiple directions, have a positive effect on osteoblasts. Exercises such as
marching, long runs, pull-ups, and chin-ups will have less of an influence on osteoblasts. The activity of osteoblasts, and osteogenesis in general, is stimulated by the release of paracrine and endocrine factors associated with muscle-tension. In general, creating muscle tension will have the strongest influence on increasing bone mineral density and positive impact can be seen within 3-12 months.

Poor bone density is generally thought of an issue that affects older adults, specifically older adult women. However, among young athletic populations, stress fracture due to overtraining is a significant issue. Stress fracture is a form of fatigue related damage which is caused by repeated skeletal loading. It most commonly occurs in the lower extremities which are weight bearing. While both genders are affected, research suggests that stress fractures are more common in women than in men. A survey of navy recruits found that 21.0% of females suffered a stress fracture during training compared with only 5.2% of males.

In the United State Army, the average age of an enlisted soldier is 27.1 years, and the average age of an officer is 34 years. Despite a relatively young population, the Army cited musculoskeletal injury as the cause of 65% of all medically non-deployable classifications in 2019. This statistic does not include injuries developed in combat.

It is estimated that cases of stress fracture cost the Department of Defense (DOD) 74.5 million dollars annually due to direct medical costs of treatment, physical therapy, and rehabilitation, along with indirect costs such as disability payments if applicable. Considering that most of these injuries do not occur in combat, the military needs to examine why rates of stress fracture are so high and work on prevention strategies.
In addition to the staggering financial costs, stress fracture also puts military operational readiness at risk through its association with increased risk of future injury.\textsuperscript{17,18} Soldiers who develop a stress fracture have a five-time greater risk of developing another stress fracture than those who are uninjured.\textsuperscript{17} In the U.S Army specifically, 60% of soldiers who experience a stress fracture will eventually attrite from the military.\textsuperscript{17} If cadets fail to meet recommended calorie and micronutrient intakes, it is possible that their bone health will suffer and they will be more susceptible to risk of fracture as a result.

While significant research has been done on the Army itself, very little research has been done on ROTC populations specifically.\textsuperscript{18} ROTC stands for Reserve Officer Training Corp and was founded in 1916 by President Woodrow Wilson as part of the National Defense Act.\textsuperscript{19} ROTC is currently the largest officer-producing organization in the U.S military with over 600,000 men and women having earned a commission through this program.\textsuperscript{20} The goal of ROTC is to prepare college students for a career as Army Officers where they will commission as 2\textsuperscript{nd} Lieutenants upon graduation from their respective university.\textsuperscript{18,19}

Cadets participating in ROTC programs are expected to maintain the Army’s fitness standards and pass a physical test known as the ACFT before they can be commissioned as officers.\textsuperscript{18} The ACFT or Army Combat Fitness Test is designed to assess both muscular strength and aerobic endurance. It encompasses six events: three repetition maximum deadlift, standing power throw, hand release push-ups, sprint-drag-carry, plank, and two-mile run. Cadets must successfully complete each event to pass. Due to strenuous nature of the ACFT, cadets must be able to train in the months leading up to it. Suffering a stress fracture injury would seriously inhibit their ability to successfully complete all the events.
With limited research available, the rates of musculoskeletal injury among ROTC populations are not well established. The minimal research that has been done suggests that rates of injury in ROTC populations are similar to that of the U.S. Army as a whole. Radzak et al conducted a retrospective study to examine the rates of musculoskeletal injury in ROTC cadets at five different universities throughout the United States. The findings indicated that the most frequent sites of injury were the knee (19.5%) and the ankle (15.7%). In the active duty army population, knee injuries account for 19.2% of musculoskeletal injuries and ankle injuries account for 14.8%. Additionally, the most common cause of injury was due to insidious onset (40.1%) and noncontact (31.6%) which included overuse injuries. This finding is consistent with data collected on Army basic trainees in which the majority of stress fractures were not related to a specific incident and likely attributable to overuse.

Aside from overtraining, another potential cause of stress fracture may be poor bone health caused by under fueling and subsequent nutrient deficiency. Smith et al conducted a cross-sectional study via a survey which examined eating disorder risk and body image dissatisfaction in ROTC cadets. Included in the survey was the Eating Attitudes Test (EAT-26). EAT-26 asks questions related to eating attitudes and potential pathogenic behaviors related to eating disorders such as purging and binge eating. A score over 20 indicated that a cadet was at risk. Of the 102 cadets surveyed, 33 (32.4%) were classified as being at risk of developing an eating disorder. Of those 33, 19 (57.6%) were in the Army and 21 (63.6%) were male.

Another way to assess poor eating habits is to calculate energy availability. Garron and Klein conducted a cross-sectional study which examined 13 male Army ROTC cadets. Energy availability (EA) can be defined as the energy left in the body to maintain normal physiological functioning after subtracting the caloric cost of exercise. Chronically low EA can lead to a
reduction in performance, increase in injury risk, depressed hormone levels, and reduced bone mineral density.\textsuperscript{25} EA is calculated using the energy availability equation: $EA = (EI - EEE / FFM)$.\textsuperscript{24} EI stands for energy intake, EEE is stands for estimated energy expenditure, which is calculated based on daily exercise, and FFM stands for fat free mass.

Garron and Klein\textsuperscript{24} found that 38\% had a suboptimal EA which was defined as a calorie consumption in the range of 30-44kcal/kg. Sixty-two percent had a clinically low EA which was defined as calorie consumption of $<30$kcal/kg. No cadets had an optimal EA which was defined at 45kcal/kg or above. It should be noted that when using this formula to calculate expected energy needs, a range of 30-45kcal/kg is considered acceptable and anything below $<30$ kcal/kg is classified as low EA.\textsuperscript{25} Even when adjusting the interpretation of the results to meet this standard, 62\% of cadets would still fail to meet the even the low end of acceptable energy intake.\textsuperscript{24} Cadets with low energy availability were found to have a higher body fat percentage and fat mass than those who had higher EAs. These results could indicate purposeful undereating to meet army standards, but it is unclear whether the low EA resulted in injury. Further examination found that 20.5\% of cadets skipped breakfast and 29\% skipped lunch on most days.

A study conducted by Daniels and Hanson\textsuperscript{26} sought to assess energy-adjusted dietary intakes of Army ROTC cadets. Dietary intake was evaluated via the General Nutrition Assessment Food Frequency Questionnaire and mean daily calcium intake was calculated from this data. Data collected were also adjusted for energy intake. On average, cadets consumed 1019.6 (700.7-1251.0) mg of calcium daily. The recommended dietary allowance (RDA) is 1000mg indicating that only a little over 50\% of cadets met the recommended intake.\textsuperscript{27}
A similar study, conducted by Lutz et al\textsuperscript{28}, examined female soldiers during Army Basic Training. A food frequency questionnaire was used to analyze diet. Mean daily intakes of calcium and vitamin D were calculated from this data. On average, recruits consumed 4.1 +/− 0.3 mcg of vitamin D and 882 +/− 51 mg of calcium daily. Both these intakes are below the RDA, set at 15 mcg for vitamin D and 1000 mg for calcium.

Similar results were seen from a study conducted on undergraduate students attending the University of New Hampshire. Murphy and Morrell\textsuperscript{29} found that students consumed an average of 917.79 +/− 6.95 mg of calcium and 3.98 +/− 0.06 mcg of vitamin D daily using dietary data collected from a 3-day food record. These findings are similar to the previous study and show that average intakes are below the RDAs for both micronutrients.

The high rates of fracture combined with potentially poor eating habits are cause for concern, especially in a young population who is expected to be the next generation of leaders for the US Army. The aim of this study was to assess diet and energy intake in relation to bone health among UNH Army ROTC cadets. Because most cadets are still achieving their peak bone mass as they are under the age of 25, having a diet low in calories and subsequently low in nutrients related to bone health might limit their potential for growth and increase their risk of injury.

\textbf{Methods}

\textbf{Subjects}

ROTC cadets (n=31) enrolled in the University of New Hampshire (UNH) Army ROTC program in the spring 2023 semester participated in the study. First year, second year, and third year cadets were expected to participate as part of their ROTC requirements and were informed
of the opportunity by their ROTC leadership known as cadre. Cadets were not expected to do any preparation prior to arrival for testing. The research was conducted as part of a collaboration between the UNH Department of Agriculture, Nutrition, and Food Systems and the Army ROTC program. The research team reached out to cadre to assess their interest in a collaboration. Between two meetings in the fall of 2022, the cadre expressed what information would be useful to them and the research team created a plan to execute data collection.

Seven undergraduate and two graduate students assisted with data collection. All were trained prior to the start of testing by the author. Students were taught how to properly use each device and briefed on how to answer any cadet questions. At least two researchers were present at all times during data collection.

Cadets were expected to attend two appointments at Kendall Hall on the UNH campus throughout the spring semester. In the first appointment, cadets were briefed on the purpose of the research. Data on body composition, skin carotenoid levels, and resting metabolic rate (RMR) were collected. Cadets were given a sheet to record their results if they desired and a debrief of the results was conducted after testing was complete. The debrief included an explanation of each of the tests that were done, how to interpret the results, and cadet were given an opportunity to ask questions. Cadets were also informed of an opportunity to sign up for nutrition counseling sessions with UNH Nutritional Sciences Graduate students enrolled in NUTR 860, Behavioral Nutrition and Counseling. In the second appointment, bone health screening was conducted along with collection of dietary data. At this time, cadets gave consent to use their data for research purposes. There were no exclusion criteria for this study.

Measures
Height and weight information was collected during the first appointment. Standing height was measured via stadiometer and weight was measured via scale.

Skin carotenoid levels were assessed using the Veggie Meter. This tool uses spectroscopy to measure skin carotenoid levels in the fingertip. Subjects were instructed to use their right index finger and the measurement was taken three times. In between each measurement, subjects were instructed to remove their finger and shake out their hand. The final Veggie Meter score was the average of these three measurements. Scores range from 0 to 800 with a higher score indicating higher skin carotenoid levels which are associated with higher fruit and vegetable intake. After one hour of continuous use, the machine was recalibrated to ensure accuracy.

RMR was calculated using the MedGem. The MedGem is a portable, handheld device which uses indirect calorimetry. To use this device, participants wear a nose plug and breathe normally into the mouthpiece of the MedGem, holding the device to their mouth with one hand. They must maintain a tight seal around the mouthpiece to get the most accurate result. Use of the MedGem takes 5-10 minutes. Cadets were given instructions on proper use and monitored while using the Med Gem. RMR multiplied by an activity factor of 1.4 was used to calculate cadets estimated energy requirements (EER). The activity factor was selected based on guidelines approved by the National Institute of Health (NIH) which uses 1.4 to represent moderate physical activity.

Bone health was assessed using the McCue Contact Bone Ultrasound Analyzer (CUBA). The heel of the foot is placed on a foot rest between two transducers which send ultrasonographic waves through the calcaneus. Gel is placed on both sides of the foot just below the ankle bone to assist with transduction. Based on the speed of transduction, the CUBA
machine calculates broadband ultrasound attenuation (BUA) which z-scores are then derived from. A higher BUA score indicates better bone health. Bilateral measurements of the calcaneal bones were taken. Cadets were categorized as having either low or normal bone health according to criteria developed by the World Health Organization (WHO). A t-score of -1.0 standard deviations (SD) from the mean or above indicates normal bone health, a score between -1.0 to -2.5 SD indicates low bone mass, and a score below -2.5 SD indicates osteoporosis.35

Dietary data were collected using a 24-hour dietary recall which was completed individually by the author with each cadet after their bone health assessment. A variation of the multi-pass system was used. Cadets were asked to describe what they ate for breakfast, lunch, and dinner, as well as any snacks, drinks, or supplements they consumed. After going through each meal and asking specific questions such as “how many eggs did you consume” or “about how much oil did you use to cook your eggs”, cadets were asked again if they could think of any other foods they consumed. Visuals of amounts of foods were also used to assist cadets in selecting the most accurate amount of food consumed. ASA 24 was used to analyze the dietary data gathered from the 24-hour recall.

Results

Thirty-one total cadets were included in the analysis. Eight cadets had low bone mineral status (BMS) and 23 cadets had normal BMS. The average age of cadets was significantly higher in the low BMS group than the normal BMS group (p=0.047). BMI was similar between groups though the low bone density group had a slightly higher mean BMI (p=0.493). (Table 1).

The difference in average calcium intake between groups was not significantly different though the low BMS did consume an average of 570mg less of calcium per day than the normal
Fewer cadets in the low BMS group met the RDA for calcium than in the normal BMS group. Only 5 cadets in the low bone mineral status group met the RDA compared to 16 in the normal bone mineral status group.

Trends in vitamin D intake were similar to calcium. Cadets in the low BMS group consumed on average 4.4mcg less of vitamin D daily than the normal BMS group but the differences between groups were found to be only marginally significant (p=0.072). Additionally, 17% of cadets with normal BMS met the vitamin D RDA compared to 0% of cadets with low BMS. B

Calorie intake was similar between groups (p=0.701). Despite the similarity in average intake, only 38% of cadets with low BMS met their EER or MDRI compared to 43% of cadets in with normal BMS. The difference in Veggie Meter score was also not significantly different (p=0.404). However, the low bone mineral status group had a lower score than both the mean score of all cadets and the normal bone mineral status group.

Discussion

The findings of this study indicate no significant differences in calorie, vitamin D, or calcium intake between Army ROTC cadets with low and normal bone mineral status. However, cadets with low bone mineral status consumed less vitamin D and calcium on average than the normal bone mineral status group. Cadets in the low BMS group also failed to meet recommendations for caloric intake at a higher rate than cadets with normal BMS.

A potentially significant finding is the difference between vitamin D intakes between the two groups. While the mean vitamin D intake in both groups fell short of the RDA, none of the cadets in the low bone mineral status group met the recommended intake. The lack of vitamin D
intake could potentially be one of the factors causing low bone mineral status and therefore increasing risk of stress fracture. Several studies have shown decreases in fracture rate and improvements in bone health when soldiers have higher dietary vitamin D intake or are given a vitamin D supplement.36-38

In addition to differences in vitamin D intake, cadets with lower bone mineral status fell short of their caloric intake recommendations based on a calculated EER or their MDRI more often than cadets with normal bone mineral status. Additionally, the low bone mineral status group had a higher mean BMI than the normal bone mineral status group. These findings can be connected to the results of Garron and Klein24, who assessed the eating habits of male ROTC cadets. They found that cadets with overweight or obese BMIs tended to eat less or report missing meals more frequently than cadets with normal BMIs. The lower BMS group in this study could be following a similar pattern; skipping meals or intentionally underrating in order to meet military standards and subsequently harming their bone health.

In both BMS groups, at least 30% of cadets failed to meet the RDA for calcium, at least 80% failed to meet the RDA for vitamin D, and over 50% did not meet expected energy needs. These results are similar to findings of Lutz et al39, which surveyed 587 Army Basic Training Recruits. Male participants had an average age of 21 +/- 4 years and female participants had an average age of 22 +/- 5 which is very similar to the present study. Using dietary data collected via the Block FFQ, male recruits consumed 182 (117-303) IU of vitamin D daily while female recruits consumed 136 (73-244) IU. The RDA for vitamin D is 600 IU. Similar to the current study, cadets failed to meet recommended intakes by a significant margin. In terms of calcium, male recruits consumed 1,043 (741-1383) mg per day and female recruits consumed 748 (569-
Recruits consumed a calcium intake which was similar to that of the low bone mineral status group in the current study.

In the US general population, over 40% of people do not meet the RDA for calcium. In the present study, 37% of cadets with low BMS and 30% with normal BMS did not meet the RDA. Additionally, 17% of women in the US have osteoporosis along with 5% of men. While osteoporosis was not able to be diagnosed in the present study based on the bone assessment tool used, low bone mineral status was observed in 26% of cadets. Overall, the results of the current study align well with the US general population as well as the Army specifically.

A strength of this study is the use of an Army ROTC population. Limited research has been done on the ROTC population and little is known about their overall health, injury rates, and eating habits. ROTC cadets are active in their training and should be afforded the same access to preventive medical treatment and nutrition counseling as Army Basic Trainees do. Another strength of this study is its assessment of bone health. Very few studies, if any, have conducted research on the bone health of Army ROTC cadets specifically despite increasing rates of fracture in the Army as a whole.

In a future study, several considerations should be made. A more comprehensive review of diet is needed. Several 24-hour recalls collected on different days of the week should be collected. A 3-day food record, such as the one used by Garron and Klein, could also be considered. In their study, Garron and Klein gave cadets instruction on how to properly track their dietary intake and reviewed the results of each record with cadet individually. This methodology ensured accurate findings and was able to provide a much more comprehensive assessment of diet.
Cadets Calcium and vitamin D intake should also be assessed via a food frequency questionnaire and special attention should be given to what specific foods cadets are eating which provide them with these micronutrients. Further research can then be conducted with a possible intervention based on the calcium and vitamin D containing foods cadets consume.

Another consideration would be the use of diagnostic tool to measure bone density and an assessment of fracture. This study measured bone mineral status and the machine used cannot provide a diagnosis of osteopenia or osteoporosis. Using a more sophisticated, diagnostic machine such as a DXA scan would allow for a more comprehensive assessment of cadet bone health. A study conducted by Baker et al\textsuperscript{41} used a DXA scan on ROTC cadets. Because of the tool used, the researchers were able to assess cadets’ bone density rather than bone health. Additionally, they were able to assess bone density at several sites such as the ankle, hip, and spine, instead of just one site at the calcaneus. This allowed for a better understanding of overall bone health for each cadet as one area of the body might have worse bone health than another. Collecting data on fracture history and fractures suffered during testing in conjunction with bone health and dietary data would allow for more conclusions to be made on the correlation between diet, poor bone health, and fracture risk.

The study should also be conducted over a longer period. Most cadets enter ROTC programs at the start of their freshman year and stay in the program until graduation as seniors. Collecting data on bone health and diet each year would allow for an assessment of changes over time and increase the opportunity to see a correlation between poor diet and low bone density.

Lastly, data on smoking status, alcohol intake, and physical activity level should be collected. All of these factors have been shown to impact bone health and differences between cadets may be substantial.\textsuperscript{42} Several previously conducted studies, which assess bone health in
military population, collected data on alcohol use and smoking status.\textsuperscript{41,43} These data were used as covariates and were taken into account when considering causes for bone health when diet was similar between groups. Because these data were not collected in the present study, it is possible that these factors, rather than poor diet, were more impactful on poor bone health. A study which takes into account all of the above considerations will be able to make a much stronger conclusion than the present study.

**Conclusion**

There were no significant differences in calorie, vitamin D, and calcium intakes between cadets with low and normal bone mineral status. However, cadets with low bone mineral status did fail to meet recommended intakes more often than cadets with normal bone mineral status. More research must be conducted to assess the health of the Army ROTC population to ensure the next generation of soldiers is fit for duty.

**Conflict of Interest**

None declared.

**Funding**

The author did not receive any specific funding for this work.

**Acknowledgements**

The success of this project is due to the collaborative effort of Dr. Kevin Pietro, Dr. Maggie Dylewski Begis, and Dr. Jesse Stabile Morrell.
Figure 1: Percentage of Cadets Meeting Recommended Dietary Intake of Calcium and Vitamin D, Military Dietary Reference Intakes, and Estimated Energy Requirements Based on Mean Intake in Group

Figure 2: Mean Vitamin D Intake of Cadets Grouped by Low and Normal Bone Mineral Status
Figure 3: Mean Calcium Intake of Cadets Grouped by Low and Normal Bone Status

![Mean Calcium Intake Graph]

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Total Cadets (n=31)</th>
<th>Low BMS (n=8)</th>
<th>Normal BMS (n=23)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>20.0 +/- 1.3</td>
<td>20.0 +/- 1.8</td>
<td>19.0 +/- 1.0</td>
<td>0.05</td>
</tr>
<tr>
<td>BMI</td>
<td>24.5 +/- 2.1</td>
<td>25.0 +/- 1.9</td>
<td>24.3 +/- 2.3</td>
<td>0.49</td>
</tr>
<tr>
<td>Ca Intake (mg)</td>
<td>1505 +/- 901</td>
<td>1088 +/- 353</td>
<td>1658 +/- 1007</td>
<td>0.13</td>
</tr>
<tr>
<td>Vit D Intake (mcg)</td>
<td>6.6 +/- 5.9</td>
<td>3.5 +/- 4.3</td>
<td>7.9 +/- 6.1</td>
<td>0.07</td>
</tr>
<tr>
<td>Calorie Intake (kcal)</td>
<td>2,798 +/- 990</td>
<td>3125 +/- 840</td>
<td>3019 +/- 595</td>
<td>0.70</td>
</tr>
<tr>
<td>Veggie Meter Score</td>
<td>322 +/- 76</td>
<td>300 +/- 54</td>
<td>326 +/- 80</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Table 1: Subject characteristics and comparison between the results of low BMS and normal BMS groups. All data are reported as Mean +/- SD or percentage.
Appendix A

INFORMED CONSENT REQUEST

Date: 5/1/23

Dear Cadet,

I am an undergraduate student in the nutrition department at UNH and I am conducting a research study to find out the relationship between body composition, diet, and bone density. I am writing to invite you to participate in this study (UNH IRB #FY2023-126).

This consent form describes the research study and helps you to decide if you want to participate. It provides important information about what you will be asked to do in the study, about the risks and benefits of participating in the study, and about your rights as a research participant. You should:

- Read the information in this document carefully, and ask me or the research personnel any questions, particularly if you do not understand something.
- Not agree to participate until all your questions have been answered, or until you are sure that you want to.
- Understand that your participation in this study involves a bone density assessment using a C.U.B.A bone densometer and dietary assessment using a 24 hour dietary recall, as well as data already collected as part of the ROTC collaboration with the UNH Nutrition Department.
- Understand that the potential risks of participating in this study are intended to be minimal. However, personal data such as name and date of birth will be obtained and stored. Additionally, there will be an assessment of diet, which might be harmful to participants who struggle with body image and disordered eating.

I plan to work with approximately 50 participants in this study. You must be at least 18 years old and a cadet in UNH ROTC to participate in this study.

If you agree to participate in this study after reading this document, you will be asked to come to Kendall Hall to have your bone density testing using a C.U.B.A bone densometer which is a non-invasive scan of your heel bone. You will then sit down with myself or another researcher involved in the project to conduct a 24 hour dietary recall in which you will tell us everything you ate and drank in the previous day.

Additionally, I would like to ask for consent to the data collected as part of the collaboration between the ROTC program and nutrition department. This includes body composition data collected from the BODPOD, skin carotenoid levels from the Veggie Meter, resting metabolic rate from the MedGem, and your completed food frequency questionnaire.

The benefits from participating in this study are related to an increase in your nutrition knowledge. You will hopefully learn the importance of proper nutrition and how eating well when you're young can help to mitigate your risk of certain health concerns in the future.
Taking part in the research is completely voluntary. You may choose not to take part at all. If you agree to participate, you may refuse to answer any question. If you change your mind, you may stop participating at any time. Any data collected as part of your participation will remain part of the study records. If you decide not to participate in the research or if you stop participating at any time, you will not be penalized; your decision to participate in the research will not impact your participation in the UNH ROTC program or your standing as a UNH student.

I plan to maintain the confidentiality of all data and records associated with your participation in this research. There are, however, rare instances when I may be required to share individually identifiable information with the following:

- Officials at the University of New Hampshire, or
- Regulatory and oversight government agencies

To help protect the confidentiality of your information, all data collected during this study will be stored using SharePoint which is a USNH secure cloud storage. The only people with access to this data will be Ava Gaudette, Kevin Pietro, and Katherine Haight. Identifiable information will not be shared with any third-party sites. The data will be allowed to be used for future studies, however, it will be de-identified to ensure no personal information is shared. I will report the data generally and not discuss any individual data specifically even if a pseudonym is used. The data will only be analyzed on the whole. The results may be used in reports, presentations, and publications.

If you have any questions about this research project or would like more information before, during, or after the study, you may contact Ava Gaudette at ava.gaudette@unh.edu. If you have questions about your rights as a research subject, you may contact Melissa McGee in UNH Research Integrity Services at 603-862-2005 or Melissa.McGee@unh.edu to discuss them.

Thank you for your consideration.

Sincerely,

Ava Gaudette
Undergraduate Student

Yes, I_________________________consent/agree to participate in this research project which includes the use of data already collected by the nutrition department and the new data to be collected at the follow-up lab session.

No, I________________________do not consent/agree to participate in this research project which includes the use of data already collected by the nutrition department and the new data to be collected at the follow-up lab session.

______________________________  __________________________
Signature                                Date
Appendix B

University of New Hampshire
Research Integrity Services
51 College Road, Durham, NH 03824
research.integrity@unh.edu

Sep 25, 2023 4:35:30 PM EDT

Ava Gaudette
Agriculture, Nutrition, & Food Systm (UBANFS)

Study Title: Examining the Relationship between Diet, Body Composition, and Bone Density
IRB #: IRB-FY2023-126
Study Expiration Date: April 23, 2024
Modification: Updated Faculty Advisor and Co-PI
Modification Approval Date: September 25, 2023

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved your modification to this study, as indicated above. Further changes in your study must be submitted to the IRB via Cayuse IRB/Human Ethics for review and approval prior to implementation.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the document, Responsibilities of Directors of Research Studies Involving Human Subjects.

Note: IRB approval is separate from UNH Purchasing approval of any proposed methods of paying study participants. Before making any payments to study participants, researchers should review the Payment of Incentives/Compensation to Research Participants guidance to ensure they are complying with institutional requirements. If such institutional requirements are not consistent with the confidentiality or anonymity assurances in the IRB-approved protocol and consent documents, you may need to request a modification from the IRB.

If you have questions or concerns about your study or this approval, please feel free to contact Melissa McGee at 603-862-2005 or melissa.mcgee@unh.edu. Please refer to the IRB # above in all correspondence related to this study.

For the IRB,
Julie F. Simpson
Director
Research Integrity Services  
51 College Road, Durham, NH 03824  
research.integrity@unh.edu

Apr 4, 2024 2:26:46 PM EDT

Ava Gaudette  
Agriculture, Nutrition, & Food Systm (UBANFS)

Study Title: Examining the Relationship between Diet, Body Composition, and Bone Density  
IRB #: IRB-FY2023-126

Dear Ava Gaudette:

Thank you for closing this IRB file.

For the IRB,

Julie F. Simpson  
Director
References


15. 2020 DEMOGRAPHICS PROFILE ARMY ACTIVE DUTY MEMBERS.


