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Changes in Bone Health of Female College Students

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Changes in Bone Health of Female College Students

Sarah E Pogany, Jesse Stabile Morrell, Maggie Dylewski Begis, Gretchen Arnold

Objective: Identifying individuals with low bone ultrasound attenuation (BUA) z-scores under the age of 30 can allow for improvements of bone health through increased intake of calcium and vitamin D, physical activity, and avoidance of excessive alcohol or caffeine intake. The goal of this study was to assess changes in bone health and observe related risk factors among female college students.

Participants and Methods: Female students (n=38) enrolled in the Nutrition Program at the University of New Hampshire (UNH) who participated in the College Health and Nutrition Assessment Survey (CHANAS) were recruited to participate in a follow-up study during the fall 2019 semester. Subjects completed a bone health questionnaire and repeat bone ultrasonography measurements approximately 2.5 years after their first measurement. Bone ultrasound attenuation (BUA) z-scores from bilateral calcaneus bone were used to assess bone health. Subjects were categorized as low or normal bone status according to World Health Organization z-score criteria. Data are presented as means ± SD; changes in z-scores over time were assessed by a paired t-test; group differences were examined using independent t-tests.

Results: No significant differences in bone status were observed between 1st and 2nd measurements (-0.72 ± 0.10 vs. -0.90 ± 0.86, p=0.08). At the follow-up visit, 19 participants were classified as having normal bone (-0.22 ± 0.53) and 19 participants had low bone (-1.59 ± 0.43). Subjects with normal bone status participated in more vigorous or moderate physical activity compared to subjects with low bone status (9.4 ± 7.6 vs. 6.03 ± 5.3 hours/week, p=0.07), but this observation was not statistically significant. Alcohol intake, milk intake, and body mass index were not different between groups.

Conclusion: Among female college students, bone status as measured by ultrasound did not significantly change over time, however, findings suggest physical activity may be related to improved bone health. Alcohol intake, milk intake, or body mass index did not differ between students with normal vs. low bone status. Further research should be conducted to measure changes in bone health over time in a similar population using a larger number of participants.

LITERATURE REVIEW

Osteoporosis is a disease that is defined as low bone mass resulting in deterioration of bone structure.[1] This deterioration leads to increased fragility and susceptibility to fractures. In the United States, osteoporosis causes around 1.5 million bone fractures every year.[1] It is estimated that 1 out of 2 women over 50 years old will experience an osteoporosis-related fracture in their lifetime.[1] There is a high mortality risk related to osteoporotic hip fractures, therefore it is important to identify those with osteoporosis. In the U.S. it is estimated that 10 million people have the disease, while 34 million have low bone mass, also known as osteopenia.[1]

Early identification of women at risk of developing osteoporosis may help to decrease the progression of this disease.[1] Age and onset of menopause contribute to bone loss, therefore by maximizing peak bone mass during young adulthood, osteoporosis could be prevented later in life.[1] While research on adult bone health has been conducted with postmenopausal women, young women are the ideal population to investigate factors that influence bone health as peak BMI is normally reached between ages 20 and 25 in women.[2,3] Through lifestyle modifications, young women have the opportunity to maximize their bone mineral density (BMD). Lifestyle factors studied in relation to bone mineralization include calcium and vitamin D intake, alcohol intake, frequency of weight bearing physical activity and cessation of smoking.[2,3] Modifying one's lifestyle during early adulthood can help to improve bone mineral density and achieve peak bone mass. A more optimal peak bone mass may prevent osteoporosis later in life.

Bone status can be measured through different methods. Dual Energy Absorptiometry (DXA) is one method that measures bone mass and is known as the gold standard for diagnosis of osteoporosis. Quantitative Ultrasonography (QUS) can also be used to measure bone

integrity.[4] There are many reasons for why QUS scanners would be used instead of DXA scanners.[5] QUS scanners are smaller, more easily transported, and less expensive than DXA scanners. They also do not use ionizing radiation, unlike DXA.[5] QUS has been valued for its high correlation with BMD measurements.[4] It has also been confirmed in having high sensitivity to detect both osteopenia and osteoporosis.[6] QUS uses ultrasound waves that are altered in terms of shape, intensity and speed due to the physical and mechanical properties of bone.[5] Therefore, the bone tissue can be characterized in terms of ultrasound velocity and attenuation, thus producing broadband ultrasound attenuation (BUA) scores. When performing QUS on the calcaneus bone, it has been shown to predict hip fractures and all osteoporotic fractures in elderly women.[5] BUA Z-score > -1.0 is classified as normal, a score of < -1.0 and > -2.5 is classified as at risk of having osteopenia, while a Z-score of < -2.5 is classified as at risk of having osteoporosis, according to the diagnosis criteria set by World Health Organization (WHO).[5]

Much research has been done to better understand factors that influence bone health. One of the most well-known factors known to influence bone health is intake of calcium and vitamin D. Dairy products serve as a rich source of calcium, vitamin D, and protein, therefore they may help reduce the risk of osteoporosis.[7] In 2015, Park et al[8] conducted a cross-sectional study that examined dietary habits and health behaviors in relation to obesity and bone mineral density (BMD) in a cohort of 160 female Korean nursing students. This study found that the prevalence of participants (20%) that fell below the normal BMD range was higher than past American and Japanese studies.[8] It was suggested that this may be due to the high rate of calcium and vitamin D deficiency observed. This high prevalence of deficiency may be attributed to a relatively low milk intake among subjects.[8] A similar result was found in a cross-sectional study by Hammad and Benajiba[9], which assessed risk factors leading to osteopenia and osteoporosis among 101

young Saudi females. The higher the frequency of consuming dairy products, the lower the prevalence of osteoporosis among the population.[9]

In 2019, Torres-Costoso et al[10] conducted a cross-sectional study that assessed the relationship between milk consumption and bone mineral density (BMD) in young adults and whether this relationship is mediated by body mass index (BMI), total lean mass or fat mass. The US 2015-2020 dietary guidelines recommend the consumption of skim or low-fat dairy products.[11] The results of the Torres-Costoso study showed no relationship between fat-free milk intake and total body BMD.[10] It was found that milk consumption does not have a direct effect on BMD, due to the fact that weight status, lean mass and fat mass percentage have mediator relationship with bone development. Body composition variables may have a very important role in the relationship between milk consumption and bone health.[10]

Physical activity is also a well-known factor related to bone health. Elgán et al[11] conducted a cross-sectional study that evaluated BMD and bone turnover in relation to lifestyle factors, dietary habits, physical activity, and physiological factors among 218 female students. It was found that the students with a high physical activity level had significantly higher BMD than the students with lower physical activity levels.[11] Similarly, in a population of Saudi females, it was found that the number of physically inactive females was higher in the osteopenic/osteoporotic group versus the normal bone group.[6] Tereszkowski et al[12] conducted a cross-sectional study that assessed BMD and lifestyle factors related to BMD in 52 young Canadian women recruited from a Nutrition program at a Canadian University. While physical activity was not found to be significantly related to BMD, it was found that whole body BMD had an inverse relationship with number of hours watching TV reported.[12] Therefore, sedentary activity may negatively impact BMD in a cohort of young adult females.

Alcohol displays a U-shaped relationship with BMD, therefore those who abstain from alcohol or drink excessive amounts of alcohol tend to have lower BMD than those who drink moderate amounts.[12] It has been suggested that moderate alcohol consumption in young females may result in acute suppression of bone resorption by reducing the activity of osteoblasts and osteoclasts, thus preventing bone loss.[13] Excessive alcohol consumption has been shown to reduce serum biomarkers of bone formation, thus preventing formation of denser bones.[13] In 2017, LaBrie et al[3] conducted a longitudinal to determine if heavy episodic drinking (HED) prevented female college students (n=87) in the U.S. from reaching peak bone mass (PBM). Frequent HED was defined as, between freshman year and sophomore year of college, consuming ≥ 4 drinks within a 2-hour period on ≥ 115 or more occasions.[3] More frequent HED during adolescence and young adulthood was associated with lower BMD at the lumbar spine (p=.04).[3] College age students are more at risk of not developing PBM, due to more frequent episodes of heavy drinking.

Many factors such as calcium and vitamin D intake, BMI, physical activity, alcohol intake, may contribute to bone health status. The goal of this study was to assess changes in bone health and observe related risk factors among female college students ages 20-24.

METHODS

Subjects

Female students (n=38) enrolled in the Nutrition Program at the University of New Hampshire (UNH) who had participated in the College Health and Nutrition Assessment Survey (CHANAS) were recruited to participate in a follow-up study during the fall 2019 semester. Subjects were recruited from the following junior and senior level nutrition classes: Treatment of Adult Obesity (NUTR 755), Nutrition in Exercise and Sports (NUTR 546) and Practical

Applications in Medical Nutrition Therapy (NUTR 775). Subjects were asked to complete a bone health questionnaire and schedule a bone health screening appointment. On appointment exit, participants were provided with current and previous bone health measurements, a z-score interpretation chart, diet information on calcium needs and information about which foods contain calcium (Appendix D & E). Resources were provided regarding who to consult with if further questions or concerns arose (Appendix F). Supplemental information regarding osteoporosis prevention was also provided. All participants provided informed consent prior to the start of the study (UNH IRB #5524) (Appendix C).

Measures (Survey and Bone Screening)

Using the online survey forum Qualtrics, participants completed a food frequency questionnaire composed of questions repeated from the College Health and Nutrition Assessment Survey.[14] These questions assessed the frequency of consuming calcium and vitamin D rich foods, alcohol intake, physical activity, and supplement and medications use. The questionnaire was also supplemented with questions from National Health and Nutrition Examination Survey 2015-2016 (NHANES) to further assess dietary intake.[15]

The questionnaire provided the subjects' contact information so that they were able to be contacted to schedule an in-person appointment for bone screening. Participants then scheduled a 10-minute appointment in which their weight was taken via a digital scale. Repeat bone ultrasonography measurements were conducted approximately 2.5 years after their first measurement.

Calcaneus bones were measured via bone ultrasonography using the McCue CUBA ultra-sonographer. Bone ultrasound attenuation (BUA) z-scores from bilateral calcaneus bone were used to assess bone health. Subjects were categorized as low or normal bone status according to

World Health Organization z-score criteria: Normal Bone Status (Z-score ≥ -1.0), Low Bone Status (At risk of Osteopenia: -1.0 to -2.5), or at risk of Osteoporosis (-2.5 and below).

Statistical Analysis

Bone health data are presented as means ± SD (TABLE 1). Significance is defined as *p<0.05*. Changes in z-scores over time were assessed by a paired t-test and group differences were examined using independent t-tests. All statistical analyses were performed using Excel 2019.

RESULTS

At the follow-up visit, 19 participants were classified as having normal bone (z-score: -0.22 ± 0.53) and 19 participants had low bone (z-score: -1.59±0.43). Demographics that were collected were mean current age and family history of osteoporosis. Mean current age of the low bone z-score group was 21 ± 1.1, while the mean current age of the normal bone z-score group was 21 ± 0.3. Both groups had 4 (21%) subjects that reported a family history (FH) of osteoporosis. In the low BMD group, 6 (31.5%) subjects reported unknown FH of osteoporosis, while 3 (15.8%) subjects in normal BMD group reported unknown FH. Nine (47%) subjects in the low bone group and 10 (53%) subjects in the normal bone group reported no FH of osteoporosis.

At the 1st and 2nd measurements, the mean body weights were not significantly different between the low bone and normal bone groups (1st: 129.4 ± 18.9 lbs vs 129.7 ± 21.1 lbs, *p=0.96*) and (2nd: 133.5 ± 11.2 lbs vs 135.3 ± 9.8 lbs, *p=0.42*) (TABLE 1). BMI at the 1st and 2nd measurements was also not significantly different between the low bone and normal bone groups (1st: 22.2 ± 3.2 kg/m² vs 22.2 ± 2.9 kg/m², *p=0.86*) and (2nd: 22.91 ± 3.45 kg/m² vs 23.09 ± 3.07 kg/m², *p=0.43*). None of the participants engaged in smoking cigarettes.

Four subjects (21%) in the low bone z-score group indicated that they could not recall the initial bone screening and 1 (5.2%) subject indicated that they were not sure if they remembered. All subjects (n=19) in the normal bone z-score group indicated that they did recall the initial bone screening.

From the low bone z-score group, 6 (40%) of the subjects that indicated remembering the 1st bone screening also reported that they were at risk of osteoporosis or osteopenia. Two (13%) subjects reported that they were not at risk of osteoporosis or osteopenia and 7 (47%) subjects reported that they could not recall if they were at risk of osteoporosis or osteopenia. From the normal bone group, 13 (68%) of the subjects reported that they could not recall if they were at risk for osteoporosis or osteopenia based on initial bone screening. Six (32%) subjects reported that they were not at risk for osteoporosis or osteopenia. Overall, the low bone group had a greater awareness of their bone health results at the 1st bone screening.

Four (21%) subjects in the low bone group reported making lifestyle changes post 1st measurement to improve their bone health. All of these 4 subjects reported increasing their calcium and vitamin D intake and only one indicated increasing physical activity. Only one subject in the normal bone group indicated making a lifestyle change to improve bone health after receiving initial bone screening results. This lifestyle change included increasing calcium and vitamin D intake per survey response.

Alcohol intake and milk intake were not significantly different between groups ($p<0.47$, $p<0.38$) (TABLE 1). The low bone group indicated that on average, they consumed 1.58 ± 1.07 servings of milk or milk products each day, while the normal BMD group consumed 1.68 ± 1.06 servings (TABLE 1). As for the total average of alcoholic drinks consumed each week, the low BMD group reported 7.00 ± 6.19 drinks and the normal BMD group reported 6.87 ± 5.91 drinks.

For supplement intake, 7 (37%) of subjects in the low BMD group reported using a multivitamin, 1 subject used a calcium supplement and 2 used a vitamin D supplement. Five subjects in the normal BMD group reported taking a multivitamin.

Of the 38 subjects that completed the study, no significant differences in bone status were observed between the 1st and 2nd measurements (-0.72 ± 0.10 vs. -0.90 ± 0.86, p=0.08). This result was however clinically significant, since there was approximately an 18% overall decrease in z-scores over 2.5 years. Subjects with normal bone status reported participating in more vigorous or moderate physical activity compared to subjects with low bone status (9.4 ± 7.6 vs. 6.03 ± 5.3 hours/week, p=0.07), but this observation was not statistically significant (*p=0.07*) (TABLE 1). When asked "During the past 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling," the low bone status and normal bone status groups reported 3.75 ± 1.06 days and 3.26 ± 2.33 days respectively. The low bone group reported engaging in moderate physical activities such as carrying light loads, bicycling at a regular pace, or double tennis an average of 2.9 days a week. The normal bone status group reported engaging in these activities an average of 3.2 days per week, which is slightly more than that of the low bone status group.

As for the amount of time that subjects spent walking on one of those days, the low BMD group reported that 1 subject reported "a little", 4 reported "a moderate amount", and 13 reported "a lot". No subjects in the normal bone group reported "a little", while 8 subjects reported "a moderate amount" and 11 reported "a lot". Although these descriptions may be subjective, the greater amount of walking reported by the normal bone group may be associated with better bone integrity. Likewise, the greater number of hours engaged in moderate or vigorous physical activity reported by the normal bone group may also be associated with better bone integrity.

<u>COMMENTS</u>

In this study, changes in bone health and related risk factors were evaluated with findings of no statistical significance. At 1st measurement, 18 total subjects included in this study were categorized as having low bone status and 20 subjects were categorized as having normal bone status. At the 2nd measurement, 19 subjects were categorized as low bone status and 19 were considered as having normal bone status. While the total number of subjects at risk for osteopenia was relatively the same at the 2nd measurement as the first, the subjects in each group were not necessarily the same. At the 2nd measurement, 5 subjects switched from the low bone status category to the normal bone status category. Also, at the 2nd measurement, 7 switched from the normal bone status category to the low bone status category. The rest of the subjects (n=26) at the 2nd measurement remained in the same bone status category as the 1st measurement.

The mean z-score of the low bone status group was -1.6 ± 0.4 and the mean z-score of the normal bone status group was -0.2 ± 0.5. The mean overall change in z-score in the low bone status group was negative (-0.3 ± 0.7). The mean change in z-score for the normal bone status group was positive (0.04 ± 0.9). Based on these results, the overall changes in bone integrity in the normal bone status group showed a greater improvement than the low bone status group. In fact, the low bone group showed an overall decline in bone integrity over time.

For the low bone status group, 3 out of 4 subjects that reported making lifestyle changes to increase bone health actually had negative changes in their Z-score from 1st to 2nd measurement. The other subject in the low bone status group that reported making lifestyle changes to increase bone health had no change in Z-score from 1st to 2nd measurement. As for the normal bone status group, the one subject that reported making lifestyle changes to increase

bone health had a decrease in Z-score from 1st to 2nd measurement. The author theorizes that increased physical activity may be related to better bone health, although no significant differences were observed between the 1st and 2nd measurements. The normal bone status group reported more hours of vigorous or moderate physical activity per week than the low bone status group, although this was not statistically significant (p=0.07).

Overall, no significant differences were observed between the groups when looking at the following variables: mean BMI, dairy intake, family history of osteoporosis and alcohol intake (TABLE 1). BMI slightly increased from 1st and 2nd measurements in both groups, with a mean increase of 0.7 kg/m^2 and 0.9 kg/m^2 for the low and normal bone groups, respectively. At the 2nd measurement, the mean servings of dairy per day were similar between groups, with means of 1.6 ± 1.1 and 1.7 ± 1.1, p=0.38. On average, about 75% of subjects consumed less than the three recommended servings of dairy per day. Also, at the 2nd measurement, the prevalence of family history of osteoporosis was 21% (4 subjects) in both groups. Mean alcoholic drinks consumed per week did not differ much between groups (7.0 ± 6.2) and (6.8 ± 5.9), respectively.

In this study current BMI was not found to be different between groups, although it is thought that BMI has a mediator relationship with milk consumption and bone status.[8] In a study by Torres-Costoso et al[8] it was concluded that regular milk consumption is not enough to optimize bone health because BMI plays a large role in this association. Greater BMI has a direct positive relationship with bone health status. Therefore, even though the normal bone group had a slightly higher current BMI, it was expected that those with a higher BMI would also have better bone health status. It is theorized that a greater BMI would put more stress on bones, thus resulting in better bone integrity.

While alcohol intake seemed to have no significant association with bone health, it was hypothesized that heavy consumption of alcohol would lead to decreased bone integrity. LaBrie et al[3], concluded that the frequency of heavy episodic drinking before reaching PBM may be negatively associated with bone health status in females. Heavy episodic drinking was defined as four or more drinks within a two-hour period. Both groups in this study had around 7 drinks per week. Due to the phrasing of the question on the survey, it is not known if the amount of drinks consumed per week were spread out throughout the week or just on one occasion. The evaluation of binge drinking episodes is relevant to this population in relationship to bone health. Due to the nature of the subjects being upperclassman college students, the author assumed that these drinks were likely consumed on the weekend. Since 20%-40% of PBM is influenced by lifestyle choices, it is important to understand if frequency and amount of consuming alcohol influences bone health.

Limitations of this study include small sample size which limits extrapolation and statistical analysis. The author speculates that a larger number of subjects would have resulted in statistical significance regarding variables such as physical activity. Having a larger sample size would have allowed us to evaluate differences in why subjects may have changed from one bone status category to the other between screenings. Recruiting from non-nutrition classes may have resulted in a larger sample size. This would have also allowed for the observation of differences between bone health and related factors of nutrition students and other majors.

The method of collecting data may have resulted in recall bias. A 24-hour food recall may have been better to assess dietary intake. In a study conducted by El Kinany et al[17], it was found that nutrient intakes reported using the FFQ were higher than those reported using the 24-hour recall method. It was also stated that this over-reporting is not uncommon when using a

FFQ.[17] More quantification of the diet would allow us to observe variables other than dairy, such as fish, dark leafy greens, etc. Calcium and vitamin D intake could have been analyzed from the recall to better understand those nutrients relationship with bone health. Clarification on whether plant-based milk products were considered as "milk products" on the survey may have been beneficial to better understanding milk product consumption.

When administering the survey to one of the classes, two questions were mistakenly omitted, and these questions were related to lifestyle factors. Because of this, the subjects that were affected by these omitted questions were asked to answer them at the bone health screening appointment. The extra time in between taking the survey and the bone screening appointment may have resulted in the change of the subject's responses, thus leading to possible recall bias.

During recruitment, a few of variables that were going to be measured such as dairy intake and frequency of physical activity were discussed. It was also implied that as nutrition majors with increased health awareness, it was hypothesized that bone health may have improved from the 1st measurement. In this study, following a script during recruitment may have eliminated potential recall bias by preventing the authors perspective from influencing subjects survey responses. In a study by Sayed-Hassan et al[18], it was found that young nursing students' awareness of osteoporosis risk factors did not necessarily translate into influencing lifestyle factors that may improve bone health. It was actually found that even though the young women believed osteoporosis was a serious disease, they still displayed high perceived barriers to exercise and calcium intake.[18] Therefore, the bone health results observed from this cohort of nutrition majors may not differ from the general college population.

This study used t-tests to assess differences between the two bone status groups, whereas an ANCOVA may have revealed more significant differences between groups. Advantages of

ANCOVA include improved ability to detect and estimate interactions, better power, and ability to deal with measurement error in the covariates.[19] Variables such as physical activity may have shown statistical significance if an ANCOVA was utilized. In future research, using a statistical analysis method such as an ANCOVA may be beneficial. In a review study by Troy et al[20], it was noted that high impact exercises such as jumping, aerobics, and running as well lower impact exercises such as walking, and weight training are recommended for the prevention of osteoporosis. Future studies that assess different types of weight bearing physical activities relationship with bone status, such as running or weight training, may be beneficial. This may provide a better understanding of which specific exercises may be most beneficial to building stronger bones in the female college population.

CONCLUSION

Assessing bone status using calcaneus ultrasonography is beneficial to identifying young females with low bone density. Among female college students, bone status as measured by ultrasound did not significantly change over time, however, findings suggest physical activity may be related to improved bone health. Remeasurement of subjects bone status after a period of time can be beneficial to improving bone health and provide insight of how lifestyle factors may impact bone health.

TABLE 1

Demographics	Low Bone Status	Normal Bone Status	P-Value
# of participants	N=19	N= 19	------------
Z-Score	-1.6 ± 0.4	-0.2 ± 0.5	<0.05
Change in Z-Score	-0.3 ± 0.7	-0.04 ± 0.9	0.26
Current Age (years)	21.1 ± 1.1	21.3 ± 0.3	0.47
Weight at 1st Measurement (lb)	129.4 ± 18.9	129.7 ± 21.1	0.96
Current Weight (lb)	133.5 ± 11.2	135.5 ± 9.8	0.42
Physical Activity/ Week (hours)	6.0 ± 5.3	9.4 ± 7.6	0.07
BMI at 1st Measurement (kg/m^2)	22.2 ± 3.2	22.2 ± 2.9	0.86
Current BMI (kg/m^2)	22.9 ± 3.5	23.1 ± 3.1	0.43
Family History of Osteoporosis (# of subjects)	4 (21%)	4 (21%)	_____
Alcoholic Drinks/ Week	7.0 ± 6.2	6.8 ± 5.9	0.47
Servings of Dairy/ Day	1.6 ± 1.1	1.7 ± 1.1	0.38

Table 1. Participants characteristics and comparison between the results found for both the Low Bone Status group and Normal Bone Status group. Z-score, change in Z-score, current age, weight at 1st measurement, current weight, physical activity per week, BMI at 1st measurement, Current BMI, alcoholic drinks per week, and servings of dairy per day are presented as the mean ± SD.

Appendix A:

University *of* New Hampshire

Research Integrity Services, Service Building
51 College Road, Durham, NH 03824-3585
Fax: 603-862-3564

23-Aug-2012

Morrell, Jesse Stabile
MCBS, Kendall Hall 418
Durham, NH 03824

IRB #: 5524
Study: College Health & Nutrition Assessment Survey
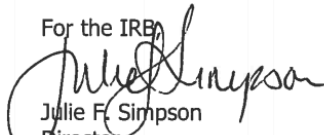**Approval Date:** 09-Aug-2012

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has
reviewed and approved the protocol for your study.

**Approval is granted to conduct your study as described in your protocol for one
year from the approval date above.** At the end of the approval period you will be asked
to submit a report with regard to the involvement of human subjects in this study. If your
study is still active, you may request an extension of IRB approval.

Researchers who conduct studies involving human subjects have responsibilities as outlined
in the attached document, *Responsibilities of Directors of Research Studies Involving
Human Subjects.* (This document is also available at http://unh.edu/research/irb-
application-resources.) Please read this document carefully before commencing your work
involving human subjects.

If you have questions or concerns about your study or this approval, please feel free to
contact me at 603-862-2003 or Julie.simpson@unh.edu. Please refer to the IRB # above in
all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,

Julie F. Simpson
Director

cc: File
    Reilly, Ruth

Appendix B:

University *of* New Hampshire

Research Integrity Services, Service Building
51 College Road, Durham, NH 03824-3585
Fax: 603-862-3564

06-Aug-2019

Morrell, Jesse Stabile
MCBS, Kendall Hall 418
Durham, NH 03824

IRB #: 5524
Study: College Health & Nutrition Assessment Survey
Review Level: Full
Approval Expiration Date: 09-Aug-2020

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved your request for time extension for this study. Approval for this study expires on the date indicated above. At the end of the approval period you will be asked to submit a report with regard to the involvement of human subjects. If your study is still active, you may apply for extension of IRB approval through this office.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the document, *Responsibilities of Directors of Research Studies Involving Human Subjects.* This document is available at http://unh.edu/research/irb-application-resources or from me.

If you have questions or concerns about your study or this approval, please feel free to contact me at 603-862-2003 or Julie.simpson@unh.edu. Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,

Julie F. Simpson
Director

cc: File
Reilly, Ruth
Begis, Maggie

Appendix C

University *of* New Hampshire

Research Integrity Services, Service Building
51 College Road, Durham, NH 03824-3585
Fax: 603-862-3564

04-Nov-2019

Morrell, Jesse Stabile
ANFS, Kendall Hall 115
Durham, NH 03824

IRB #: 5524
Study: College Health & Nutrition Assessment Survey
Approval Expiration Date: 09-Aug-2020
Modification Approval Date: 01-Nov-2019
Modification: Addition of Measures

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 for review and approval prior to implementation.

Approval for this protocol expires on the date indicated above. At the end of the approval period you will be asked to submit a report with regard to the involvement of human subjects in this study. If your study is still active, you may request an extension of IRB approval.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the document, *Responsibilities of Directors of Research Studies Involving Human Subjects.* This document is available at http://unh.edu/research/irb-application-resources or from me.

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 consult with their BSC or UNH Purchasing 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, the researcher 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. The IRB wishes you success with your research.
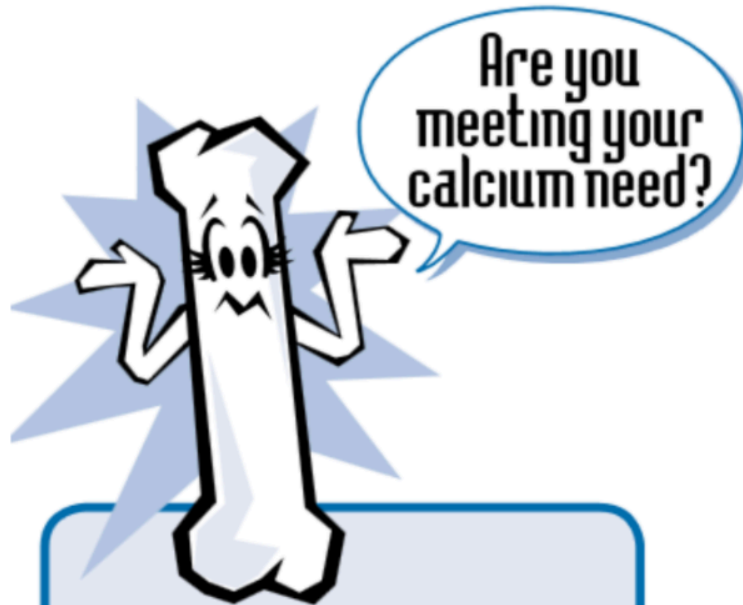
For the IRB,

Julie F. Simpson
Director

cc: File

Appendix D

Are you meeting your calcium need?

Calcium intake is important throughout life, but calcium needs vary depending on age and other factors. The current recommendations are listed below.

Age (mg)	Calcium recommendation
1-3 Yrs	500 mg
4-8 Yrs	800 mg
9-18 Yrs	1,300 mg
19-51 Yrs	1,000 mg
51+ Yrs	1,200 mg

Pregnant women

18 and under	1,300 mg
19 and over	1,000 mg

Postmenopausal women

on Estrogen Replacement Therapy (ERT)	1,000 mg
not on ERT	1,500 mg
over 65	1,500 mg

Source: Food and Nutrition Board, Institute of Medicine-National Academy of Sciences Dietary Reference Intakes, 1998.

Appendix E

Did You Consume Enough Calcium Yesterday?

In the table, fill in the number of servings and the total number of milligrams of calcium corresponding to the calcium-rich foods you ate yesterday. Add up your total.

Note: Products will differ in their calcium content, so check the Nutrition Facts label on your favorite brands.

Food Item	Serving	Number of servings consumed	Calcium (mg) per serving	Total calcium (mg)
Dairy				
Yogurt, plain, nonfat	1 cup		450	
Yogurt, plain, low-fat	1 cup		415	
Milk	1 cup		300	
Chocolate milk 1%, 2%	1 cup		285	
Calcium-fortified soy milk	8 oz		275	
Swiss cheese	1 oz		270	
Provolone cheese	1 oz		210	
Cheddar cheese	1 oz		200	
Colby cheese	1 oz		180	
Mozzarella, part skim	1 oz		180	
American cheese	1 oz		150	
Pudding, custard	1/2 cup		150	
Frozen yogurt	1/2 cup		100	
Ice cream	1/2 cup		90	
Cottage cheese, low-fat	1/2 cup		75	
Parmesan cheese, grated	1 Tbsp		70	
Cream cheese, light	1 oz		40	
Meat and Meat Alternatives				
Tofu, raw, firm	1/2 cup		260	
Soybeans, mature, boiled	1/2 cup		175	
Tofu, raw	1/2 cup		130	
Navy beans, boiled	1 cup		128	
Refried beans, canned	1 cup		120	
Almonds, shelled	1 oz		100	
Pinto beans, boiled	1 cup		80	
Kidney beans, boiled	1 cup		50	
Fruits and Vegetables				
Spinach, boiled	1/2 cup		122	
Kale, boiled	1/2 cup		50	
Orange	1 medium		50	
Raisins, seedless	2/3 cup		50	
Broccoli, cooked	1/2 cup		40	
Corn tortilla	1 medium		40	
Celery, cooked	1/2 cup		30	
Dates, dried	10		30	
Spinach, raw	1/2 cup		30	
Celery, raw	1 - 7.5" long stalk		20	
Breads and Cereals				
Instant oatmeal, dry	1 oz		160	
Whole wheat bread	1 slice		25	
Other				
Calcium Supplement				
Total				

Total Calcium Intake _____ – Calcium Recommendation _____ = _____
If you have a negative number, increase your calcium intake by that amount to meet your calcium recommendation.

Source: Food and Nutrition Board, Institute of Medicine-National Academy of Sciences Dietary Reference Intakes, 1908.

Appendix F

GUIDE TO UNDERSTANDING Z-SCORES RESULTS

<u>Category</u>	<u>Z-scores</u>
Normal Bone Density	-1 and above
Low-Bone Density (Osteopenia)	Between -1 and -2.5
Osteoporosis	-2.5 and below

With your health plan, free services are available.
If you have further questions regarding results, please contact:

Health and Wellness Contact Information
- **Health and Wellness phone number: (603) 862- 9355**
- **Education/Counseling: (603) 862-3823**
- **Dietitian: laila.hammam@unh.edu**

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