Bone Mineral Content in Hawaiian, Asian, and Filipino Children

Marcella K. Nowack MS,* Shawna Brizzolara MD,*
David A. Lally PhD**

Os calcis bone mineral content (BMC) was measured by single photon absorptiometry in 86 children, ages 6 to 13 years from Hawaiian, Oriental, Caucasian, and Filipino ethnic groups. Pearson correlations indicated significant positive correlations between BMC and age, height, and weight. However, there were no significant differences in age, height or weight between ethnic groups. ANOVA revealed a significant effect of ethnic group on BMC with the Hawaiian group having a significantly higher BMC than the Asian or Caucasian groups. When age, height and weight were controlled for, ANCOVA still showed a significant effect of ethnicity on BMC. The current findings suggest that ethnic differences can develop early in life.

Introduction

Adolescence is a crucial time for the development of bone mass. Rapid increases in skeletal mineral are necessary to support increased body weight, muscle mass, and muscle strength. Previous studies of adults have identified many factors that influence bone mineral status including ethnic group, sex, exercise, and nutrition. Current data now indicates that similar factors also affect the skeletal development of children. Li et al found black children 1 to 6 years of age had a higher mean bone mineral content (BMC) than white children.[1] In another study, Bell and co-workers found that bone mineral density was greater in black than in white children between the ages of 7 and 12 years.[2] Contrary to these findings, a study by Gilsanz et al reported that vertebral bone density did not differ between black girls and white girls before puberty.[3] Most studies have compared bone mass in white and black subjects but have neglected to assess peoples of the Pacific. Hawaii encompasses many different ethnic groups including Hawaiians, Asians, Caucasians, and Filipinos. We studied the os calcis bone mineral content in children from these ethnic groups to determine whether the inter-ethnic differences found in other populations also occur between these groups.

University of Hawaii
*Department of Obstetrics and Gynecology and
**Department of Biomedical Sciences
1319 Punahou Street, Suite 833
Honolulu, Hawaii 96826
(808) 956-6439

Address reprint requests to:
Marcie K. Nowack
John A. Burns School of Medicine
Department of Obstetrics and Gynecology
University of Hawaii
1319 Punahou Street, Suite 833
Honolulu, Hawaii 96826

Materials and Methods

A group of 44 boys and 42 girls between the ages of 6 and 13 years was studied. The subjects were recruited at a children's fitness fair sponsored by the University of Hawaii John A. Burns School of Medicine and consisted of Hawaiian, Asian, Filipino, and Caucasian ethnic groups. Height and weight of each subject was measured at the time of the bone test. Each subject completed a questionnaire regarding basic physical characteristics, medication and vitamin use, exercise and calcium intake. Because of the vast array of mixed ethnic groups in Hawaii, the parents of each subject were asked to categorize their child into one of 4 ethnic groups based on their genetic dominance. The Hawaiian group included subjects of Polynesian descent, and the Asian group included Japanese, Chinese, and Korean subjects. BMC of the dominant os calcis was measured by single-photon absorptiometry with a Siemens OsteoAnalyzer Model Number SPSHA110.[4] All measurements were made by the same technician. The OsteoAnalyzer was standardized with a known phantom before the testing was performed. Because the data were obtained in a public health fair, it was not appropriate to ask the girls about the onset of menarche.

The data were analyzed using the SPSS statistical package. The procedures used were primarily analysis of variance (ANOVA) and analysis of co-variance (ANCOVA), Pearson correlation and partial correlation. All tests of significance reported employed two-tailed p values.

Table 1.—Age and Physical Characteristics of Subjects

Group	Age	Height (in)	Weight (lb)
Hawaiian (26)	9.5 ± 1.8	55 ± 5.1	80 ± 30
Asian (42)	9.1 ± 2.0	53 ± 5.0	72 ± 29
Caucasian (11)	8.5 ± 1.6	54 ± 3.8	71 ± 17
Filipino (6)	8.7 ± 1.2	54 ± 3.5	68 ± 19

Note. Analysis of variance showed no significant differences in age, height, or weight between ethnic groups ($F < 1.8$ and $p > .150$ for all).

Group	Age	Height (in)	Weight (lb)
Boys (44)	9.2 ± 2.0	54 ± 5.0	78 ± 33
Girls (42)	9.0 ± 1.7	53 ± 4.7	70 ± 21

Note. Analysis of variance showed no significant differences in age, height, or weight between the boys and girls groups ($F < 1.9$ and $p > .176$ for all).

*Values represent the means and standard deviations of the mean.

Results

Age and mean physical characteristics of the subjects are listed in Table 1. All tables contain the mean and standard deviation of the mean. Age, height, and weight did not differ by ethnic group ($p = 0.5$, 0.14, and 0.6, respectively) or by sex ($p = 0.6$, 0.9, and 0.2, respectively). Pearson correlations on all the children indicated significant positive correlations between bone mineral content (BMC) and age ($r = .53$), height ($r = .70$), and weight ($r = .69$) $p < .001$ for all (Table 4). BMC and calcium intake were not significantly correlated. Results of mean BMC measurements for each ethnic group are given in Table 2. Analysis of variance indicated a significant effect of ethnic group on BMC ($F = 3.76$, $p = .014$). Duncan multiple range test showed that the BMC of the Hawaiian group was significantly higher than that of the Asian and Caucasian groups. Results of the effect of ethnicity and age on BMC is shown in Table 3. Analysis of co-variance in all children showed that when age, height, and weight were controlled for independently, there was still a significant effect of ethnic group on BMC ($p < .045$ for each case).

Discussion

The results of this study suggest that BMC at the os calcis is higher in Hawaiian children than in Asian, Caucasian, and possibly Filipino children. (Because of a low representation of Filipino subjects in this study, the data pertaining to this ethnic group are weak.) The magnitude of the BMC difference found between these ethnic groups is similar to comparisons of black and white children.[5-8] Bell et al studied black and white children between the ages of 7 and 12 years and their data suggested the bone mineral density of the midradius, spine, and hip were greater in black than in white children. They also found body weight and age to be important determinants of bone mass and some influence of sex differences at this age.[5] Our study indicates similar findings with significant positive correlations between BMC and age, height, and weight. However, these variables did not differ by ethnic group (Table 1), and we still found a significant effect of ethnicity on BMC (Table 2). Using analysis of co-variance and controlling for weight and age, ethnic group still has a significant effect on BMC ($F = 4.50$ and 3.71 respectively, $p < .015$ for both), indicating that the difference in BMC between ethnic groups is not caused by weight or age. When height is controlled for, there is a decrease in the F value to 2.81 ($p = .045$), suggesting that part of the effect of ethnicity is due to height; however, there is still a significant part of the effect of ethnicity on BMC that is unexplained by any other variable. Our current findings suggest an ethnic difference in BMC independent of body weight, height, or age. As shown in Table 2, when the boys and the girls from each ethnic group were analyzed separately, ethnic group was marginally significant among the girls ($F = 2.73$, $p = .057$) and nonsignificant for the boys ($F = 1.75$, $p = .172$). We have no clear explanation for why there was an ethnic difference in the girls and not the boys. One suggestion may be that boys tend to be more active and

➤ *Continued on Page 393*

Table 2.—Os Calcis Mean Bone Mineral Content Levels (mg/cm2)

	Boys	Girls	Total
Hawaiian	318 ± 58 (14)	345 ± 82 (12)	330 ± 70 (26)
Asian	283 ± 54 (22)	278 ± 60 (20)	281 ± 56 (42)
Caucasian	283 ± 42 (6)	286 ± 70 (6)	284 ± 55 (12)
Filipino	360 (1)	275 ± 41 (5)	289 ± 50 (6)
Total	297 ± 56 (44)	296 ± 70 (42)	296 ± 63 (86)

Analysis of variance showed a significant difference in BMC between ethnic groups ($F = 3.80$, $p = .014$) with the Hawaiian group having a significantly higher BMC than the Asian and Caucasian groups. When only the girls were analyzed, ANOVA was still significant ($F = 2.73$, $p = .057$) with the Hawaiian girls being higher than the Asian; however, no significant differences were found in BMC between ethnic groups of boys ($F = 1.75$, $p = .172$). Analysis of variance showed no gender difference in BMC with these subjects ($p = .96$).
Values represent the means and standard deviations of the mean.

Table 3.—Effects of Ethnicity and Age on Bone Mineral Content in Normal Children

	BMC (mg/cm2) at Age			
	6 to 7	8 to 9	10 to 11	12 to 13
Hawaiian	275 ± 38 (4)	317 ± 31 (9)	336 ± 83 (9)	425 ± 66 (3)
Asian	251 ± 42 (8)	267 ± 45 (17)	300 ± 64 (8)	319 ± 63 (8)
Caucasian	238 ± 39 (2)	256 ± 38 (5)	331 ± 43 (5)	
Filipino	317 (1)	252 ± 35 (3)	332 ± 41 (2)	
Total	260 ± 41 (15)	277 ± 45 (34)	323 ± 65 (24)	347 ± 78 (11)

Analysis of variance showed significant ethnic differences in BMC in the 8 to 9 year olds and 12 to 13 year old age groups ($F = 4.22$ and 6.06, respectively, $p < .03$ for both) with the Hawaiian group having a higher BMC level. As expected, analysis of variance also showed a significant difference in BMC between age groups ($F = 8.23$, $p < .001$).

Values represent the means and standard deviations of the mean.

Table 4.—Ethnic Group Bone Mineral Content by Age, Height, and Weight

Bone Mineral Content	Weight	Height	Age
Whole Population	.692 83 p = .000	.701 84 p = .000	.534 84 p = .000
Hawaiian	.762 25 p = .000	.711 25 p = .000	.526 25 p = .003
Asian	.633 41 p = .000	.641 41 p = .000	.521 41 p = .000
Caucasian	.816 12 p = .001	.726 12 p = .006	.613 12 p = .023
Filipino	.840 6 p = .018	.824 6 p = .022	.460 6 p = .180

Bone Mineral Content in Children

➤ *Continued from Page 387*

physical activity affects BMC. However, we did categorize the subjects into active and inactive groups and found no significant association of activity with BMC.

Reid et al found BMC at the forearm bone of Polynesian women was about 20% higher than that of white New Zealand women.[5] In the subjects we tested, we found that BMC at the os calcis is about 20% greater in Hawaiian girls than in Caucasian girls, suggesting that the factors responsible for this difference operate early in life.

The reasons for inter-ethnic differences are not certain. In blacks, an increase in muscle mass has been shown that may be causally related to higher BMC. Hawaiians resemble blacks in having more muscle and denser bones than whites.[6] Muscle mass may influence bone mass by determining the magnitude of the forces transmitted through the skeleton. Another consideration is the differences that have been found between blacks and whites in the level of calcitropic hormones, which may be important to the development of a higher bone mass.[7] However, in another study by Reid and co-workers, their results demonstrated that Polynesians have slightly lower levels of 25OHD than whites, but did not differ significantly from them in other biochemical indices of calcium metabolism.[8]

In summary, differences in BMC by ethnic group, age, height, and weight were observed: BMC was higher in Hawaiian than in Asian or Caucasian children. A greater number of Filipino children need to be included in future studies to make a stronger representation of this ethnic group. The data suggest that ethnic differences may develop early in life. If these differences are maintained into adulthood, then different ethnic groups would differ in susceptibility to osteoporosis later in life.

References

1. Li JY, Specker BL, Ho ML, et al. Bone mineral content in black and white children 1 to 6 years of age. *Am J Dis Child.* 1989;143:1346-1349.
2. Bell NH, Shary J, Stevens J, et al. Demonstration that bone mass is greater in black than in white children. *J Bone Min Res.* 1991;6:719-723.
3. Gilsanz V, Roe TF, Mora S, et al. Changes in bone density in black girls and white girls during childhood and puberty. *N Eng J M ed.* 1991;325:1597-1600.
4. Vogel JM, Wasnich RD, Ross PD 1988 The clinical relevance of calcaneus bone mineral measurements: a review. *Bone and Min.* 1-24.
5. Ott SM. Bone density in adolescents. *N Eng J Med.* 1991;325:1646-1647.
6. McCormick DP, Ponder SW, Fawcett HD, Palmer JL. Spinal bone mineral density in 335 normal and obese children and adolescents: Evidence for ethnic and sex differences. *J Bone Min Res.* 1991;6:507-513.
7. Reid IR, Mackie M, Ibbertson HK. Bone mineral content in Polynesian and white New Zealand women. *Brit Med J.* 1986;292:1547-8.
8. Reid IR, Cullen S, Schooler NE, et al. Calcitropic hormone levels in Polynesians: Evidence against their role in interracial differences in bone mass. *J Clin Endo Metab.* 1990;70:1452-6.

Classified Notices

To place a classified notice:

HMA members.— Please send a signed and typewritten ad to the HMA office. As a benefit of membership, HMA members may place a complimentary one-time classified ad in *HMJ* as space is available.

Nonmembers.— Please call 536-7702 for a nonmember form. Rates are $1.50 a word with a minimum of 20 words or $30. Not commissionable. Payment must accompany written order.

Services

Experiencing a high-turnover with your billing personnel? Pathfinder Business Services offers an in-house medical billing service at reasonable rates. Free consultation. Call 625-1085.

Medical Billing Services. EMC claim processing, patient statements. We pick up and deliver accurate work. Call for rates: Med Con, 236-0285.

Position Available

Medical director.—Exciting opportunity in a multicultural, nonprofit community health center in rural, coastal Oahu. The health center provides a full range of outpatient and emergency medical services for the Waianae Coast with more than 100,000 patient visits a year. Applicants must be board-certified in a primary care specialty with 5 years of clinical practice and at least 3-5 years of medical administrative experience including managed care. Full benefits package and competitive salary. Send CV by mail or fax to: Waianae Coast Comprehensive Health Center, Medical Administrative Office, 86-260 Farrington Highway, Waianae, HI 96792. Fax (808) 696-0389 or phone (808) 696-7081.

Office Space

Physician Office to Share.—Pioneer Federal Building, N King St; good location, easy terms, available now. Call Thelma, 845-7173.

Sports medicine and orthopedic surgical practice.—Willing to share office space at Queen's POB 1 and Pali Momi POB. Complete staff, managerial system, radiology, and physical therapy svcs available. Call Diane Fong, 536-4992, M-W-F or 487-7231 T-Th.

Practice For Sale

Busy Dermatology Practice for Sale.—Downtown in prestigious new building. Timing and other arrangements flexible. Will introduce. Telephone: Business hours–528-1717; evenings–732-6215.

Sports Medicine and Orthopedic Surgical Practice.—Willing to share office space at Queen's POB location. Complete staff, managerial system, radiology and physical therapy services available. Contact Diane Fong at 536-4992 M-W-F or at 487-7231 T-Th.

For Sale

1995 BMW 530i.—8 cylinder, leather, 2,900 miles. $41,500 ($7,000 to $8,000 below dealer price.) 944-4312 days; 395-2785 eves.

Ultrasound Equipment for Sale.—ATL Ultramark 4, human factors cart, Mitsubishi P60u printer, Datacom module disk storage, multiple probes: Mechanical 5 MHz IVT, 5 MHz and 3.5 MHz linears, 5 MHz mechanical sector, 3 MHz mechanical sector, Access 10 PV sector. Operator's manual. Call 944-9144

Exam tables for sale.—Custom made, metal frame, vinyl covered. $200 each, firm. Call 521-3473.

Wanted

Wanted.—Two large lateral filing cabinets for medical records. Please call 623-7553.

Locum Tenens

Physician with surg background available for locum tenens on Oahu. Gen practice, family practice, urgent care, ER, and ENT experience. Call (808) 737-5820.