PEAK BONE MASS DENSITY AMONG RESIDENTS OF METRO MANILA: A PRELIMINARY REPORT

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Abstract

Study Objective: To determine the peak bone mass density among residents of Metro Manila using dual X-ray absorptiometry (DEXA).
Design: Cross-sectional study
Setting: Philippine General Hospital, a university based tertiary care hospital, and St.Luke's Medical Center, a private tertiary care center.
Subjects: Forty five (45) healthy subjects aged 15-50 years old, all current residents of Metro Manila, were randomly chosen from among hospital companions were included in the study. There were 23 females and 22 males, with 3 to 4 subjects for each age range of 5.
Methods: Bone mass density measurements on the lumbar spine and the femur using dual X-ray absorptiometry (DPXL Lunar) were taken. The values were also age-matched and matched with that of a young adult based on programmed Caucasian norm provided by Lunar Co. The values were then scattered against age for each sex. Ten (10) cc of blood was also extracted from the patients, with the 5 cc of blood separated for future studies. Parathormone assay and biochemistry examinations were also done. Patients were also interviewed as to their lifestyle, diet, use of contraceptive pill or hormonal replacement treatment, using a Filipino version of the revised questionnaire on the WHO Study on Osteoporosis.Dietary content was estimated using a previous day food recall.
Results: The mean weight and height for females were 59.48±16.34 kgs. and 153.52±5.09 cms. respectively, and for males, 58.14±10.06 kgs. and 162.52±6.75 cms. respectively. The mean bone mass density at the L2L4 level for females was 1.12±0.11 g/cm^2 and 0.91±0.11 g/cm^2 at the femur. The highest BMD in both the lumbar spine femoral neck measurements among females was achieved among those aged 30-35 years of age with the lowest BMD occuring between 15-19 and 45-50 years of age in the lumbar spine among female subjects.The highest BMD at the lumbar spine and the femoral neck among males was achieved between the ages 30-35 years of age with the lowest BMD occurring between the ages 15-20 years old and incidentally in 2 subjects with ages between 40-44. There seems to be little bone loss among males beyond the age 35, unlike in the females.
Conclusions: Bone mass density among a sample of Metro Manila residents was determined using DEXA and the measurements on the lumbar spine and femoral neck. These were age-matched and matched with that of young adult based on Caucasian norm provided by the Lunar Co. Peak bone mass density in the L2L4 level among the females is reached between the ages 30-35 years old, afterwhich there is progressive bone loss with values in the 45-50 years old approximating the values in the 15-19 years old age range. A similar pattern is seen in the measurements taken at the femoral neck. Among males, the peak BMD is reached during the 30-35 years old, but there seems to be no rapid decline or rapid bone loss occuring thereafter, unlike in the female subjects.

Introduction:

Osteoporosis exacts a great toll of suffering and health care costs worldwide. Estimates have shown that the yearly cost of treatment of femoral fractures resulting from osteporosis in the United States alone has reached $5 billion a year[11]. The aging population has brought more proportion of our population at risk for osteoporosis [7].

There are no local figures citing the incidence of osteoporosis. In the Philippine General Hospital, a tertiary government referral center with a bed capacity of 1,487, the relative frequency of osteoporosis as primary diagnosis among patients consulting on an outpatient basis in the year 1993 was only 7/543,700 admissions, while that of hip fractures was 40/30,780 inpatient admissions[1]. These data however may not reflect the trend on a nationwide scale. But fractures among the elderly which probably resulted from osteoporosis has caused the Filipinos a relatively high death toll[3]. It is estimated that hospital confinement in a government hospital for fracture may cost the patient and the government approximately P30,000.00 ($1,250)[1]. This excludes the cost of lost opportunities and productivity on the part of the patient.

The average Filipino is at risk of developing osteoporosis. His poor nutritional intake[9], susceptibility to various diseases from infancy to adulthood[13] are factors which may affect his general development including bone density. On the other hand, the adequate sunshine throughout the year, abundant sea products in the diet which are rich sources of calcium, relatively lower protein intake[9], are factors which may obviate the development of osteopenia.

Bone mass density can be measured accurately, safely, and precisely by several methods. The use of dual energy X-ray absorptiometry (DEXA) has added advantage over the other methods in that it offers better precision with the least exposure time and absorbed radiation dose[6].

Low bone mass density measurement is predictive of fracture. Melton et. al.[6] has introduced a concept for fracture risk assessment, based on bone mass density measurements, which may be useful in osteoporosis prophylaxis and management. Thus, osteporosis is preventable.

There are yet no local studies which examined the bone mass density among normal urban-dwelling Filipinos. This study attempts to establish the peak bone mass density in this group, and to observe the trend in the BMD as a function of age. The data from this study will also be used to compare differences from other ethnic groups.

Study Design: Randomized, cross-sectional study.

Methods:

The patients for this study were randomly chosen from among the hospital companions in the Philippine General Hospital, a government tertiary care hospital, and St. Luke's Hospital, a private tertiary care center. Hospital companions are similar in characteristics compared to the neighbourhood controls and to hospital-patient controls in terms of height, weight, marital status, longest residence, education, cigarette smoking,

alcohol intake, annual income, proportion with salaries, medical history, parity, menopausal status, breastfeeding practices, and use of oral contraceptives[10]. All of them were residents of Metro Manila at least for the last 1 year, had no apparent underlying illness, and were not currently on any medication.

Ten (10) cc of blood was extracted from the subjects, preferably in a fasting state. Five (5) cc of whole blood was kept at ordinary freezer for future studies, and 5 cc of blood for biochemistry and parathromone assay was separated. Patients were then sent to St. Luke's Hospital, Radioisotope Laboratory for dual X-ray absorptiometry (DEXA).

To ensure quality assurance and quality control, appropriate measurements on a phantom provided by Lunar Co. was taken daily prior to initiation of each study session. The DEXA was performed using a DPXL Lunar machine with measurements taken on the lumbar spine and the femur. The patients were then interviewed using the Filipino version of the questionnaire on the WHO Study on Osteoporosis. This contains questions as to their lifestyle, smoking, exercise, use of contraceptive pills or hormonal replacement. A previous day's intake by recall was elicited. Food frequency table, total caloric intake, dietary protein, carbohydrates, fats and calcium content were computed based on the Food Composition Table[3].

Results:

Forty five (45) patients were included in this study, with 23 females and 22 males. The age range was 15-50 years old, with 3 to 4 patients for each age range of 5. Measurements on the anteroposterior lumbar spine and femur were taken and expressed as g/cm^2. For purposes of analysis, the measurements on L2L4 level and the femoral neck were included. The measurements were matched for age and that of a young adult, based on Caucasian norm programmed by Lunar Co. These were then scatterred against age for each sex.

Female Characteristics:

Except for 3 patients, all of the female patients were still menstruating. Not one had any use of contraceptive pill, none had been placed on hormonal replacement therapy, neither was anyone taking calcium supplement. All of them were non-smokers, and were not taking alcoholic beverages regularly. None had history of fracture in their adult life.

Anthropometrically, their mean height was 153.52 $\pm$ 5.09 cms. and the mean weight was 59.48 $\pm$ 16.34 kgs.

The mean bone mass density at the L2L4 level 1.12 $\pm$ 0.11g/cm^2. When age-matched, the mean was 94.30 $\pm$ 8.9% and when matched for young-adult, the mean was 93.48$\pm$9.38%. The range for L2L4 was 0.67 - 1.33 g/cm^2. The lowest bone density at the L2L4 level was between 15-19 and between 40-50 years of age. The highest bone mass density at the L2L4 level for females was noted among those between 30-35 years of age (Fig. 1).

The mean bone mass density at the femoral neck for females was 0.91±0.11 g/cm^2. When matched for age the mean was 93.39±12.58%, and when matched for that of the young adult, the mean was 91.96±10.22% (Fig. 2).

Their mean caloric intake was 1441.9±593.57 kcal, with the following mean composition: protein=51.65 ± 16.54 g, carbohydrates=243±105.5 g., fats=30.74 g. ±15.50, calcium content=661.53 ±489 g.

Male Characteristics:

The male subjects in this study were all active, most of them were cigarette smokers, and generally took alcoholic beverage at least 2 times a week. One patient had a history of wrist fracture resulting from a fall at his teen years.

The mean height of the male subjects was 162.52±6.75 cms., with mean weight of 58.14±10.06 kgs.

The mean bone mass density at the L2L4 level was 1.17±0.16 g/cm^2. When age-matched, the mean was 94.47±12.69%, and when matched with that of a young adult, the mean was 94.27±12.45%. The range for L2L4 was 0.905 to 1.503 g/cm^2. (Fig. 3).

The mean bone mass density at the femoral neck was 1.01±0.16 g/cm^2 . When matched for age, the mean was 95.59±15.31%, and when matched with a young adult, the mean was 90.95±23.69%. (Fig. 4).

The mean caloric intake among males was slightly higher than those of females at 1714.86±524.01 kcal., with the following mean content: protein=64.55±24.27 g., carbohydrates=275.86±85.28 g., fats=44.36±24.01 g. and calcium=649.09±310.42 g.

Food frequency listing was also done so as to determine variety of food commonly consumed by the subjects. Lifestyle factors such as exercise were also noted although this was not analyzed.

Parathormone Assay:

Parathyroid hormone assay was also done using a Gamma-BCT Intact PTH kit (Immunodiagnostics Inc., U.K.) and a 5-well Packard gamma counter. The mean value for both sexes was 1.20 ± 1.01 pmol/L, with range of 0.7-4.4.0 pmol/L. The values do not vary with age in both sexes.

Discussion:

It is known that almost all fractures among the elderly is related to low bone mass. Several studies have shown that the risk of fracture can be asessed through bone mass density measurements. The risk of hip fracture could be predicted from the measurements taken on midshaft of radius among 521 Caucasian women who were followed for an average of 6.5 years[5]. The measurements on os calcis and in the radius predicted the risk of hip fractures in 9703 women followed for 2.2 years[3].

In the study conducted locally by Redoblado, De Guzman et. al.[12], the prevalence of osteoporosis in the high -risk group of women who underwent DEXA was high at 58%, while that of fractures was at 22%, reflecting the referral bias in this study population. It was also shown that the age-related changes in the spine and the femoral neck BMD had an initial steep uprise peaking at 37 years of age before gradually declining with age. Looking at site-specific relative risks, it was observed that for every 1 SD fall in the spine BMD from the peak adult bone mass, the relative risk of having either a spine or a hip fracture was increased about 1.7X. For the femoral neck, each 1 SD drop from the young adult value increased the risk for femoral neck fracture by about 5.8X, which was much higher than the relative risk with respect to the spine BMD. In this study, we took the BMD among presumably normal subjects with varying ages from 15-50 years old. Among female subjects, there was a steep uprise in the BMD noted initially reaching its peak between 30-35 years old, afterwhich a decline was observed with the values in the 45-50 years old approximating the values in the 15-20 years old. This observation was consistent with the findings of the previous study. Among the male subjects, a similar pattern was observed in that there was also an initial steep uprise reaching its peak in the 30-35 years old, but there was no rapid decline observed afterwards. It would have been more interesting if observations were taken beyond 50 years in both sexes.

Conclusions:

Bone mass density among hospital visitor-companions from a government and a private tertiary care hospital in Metro Manila, was determined using DEXA and the measurements on the lumbar spine and the femoral neck were age-matched and matched that of a young adult based on Caucasian norm provided by the Lunar Co. Peak bone mass density in the L2L4 level among females is reached between 30-35 years old, afterwhich there is progressive bone loss with values in the 45-50 years old approximating the values in the 15-19 years old range. A similar pattern is seen in the measurements taken at the femoral neck. Among males, the peak BMD is reached in the 30-35 years old range, but there seems to be no rapid decline or rapid bone loss occuring thereafter, unlike in the female subjects.

The subjects in this study were relatively of average height and weight for Asian physique, consumed low calcium, low fat and low calorie diet. The males were generally habitual smokers, and the females generally were non-contraceptive pill users. None were also on hormonal replacement treatment at the time of the study.

Parathyroid hormone did not seem to vary with age, although the observations were limited only up to 50 years old.

More subjects are needed in order to arrive at a statistically signifcant conclusion. They should be followed up on a long-term basis so as to assess fracture risk in this group.

APPENDIX

Table 1. Characteristics in Both Sexes

Characteristic	Female	Male
Weight (kg.)	59.48±16.34	58.14±10.16
Height (cms.)	153.52±5.09	162.32±6.75
Calories	1441.9±593.57	1714.86±524.01
Protein(g.)	51.65±16.54	64.55±24.27
Carbohydrates (g.)	243±105.55	275.86±85.28
Fats (g.)	30.74±15.50	44.36±24.01
Calcium (mg.)	661.53±489	649.09±310.42
L2L4 (g/cm^2)	1.12±0.11	1.17±0.16
L-Youngadult (%)	93.48±9.38	94.27±12.45
L-Age-matched (%)	94.30±8.90	94.47±12.69
Femoral Neck (g/cm^3)	0.91±0.11	1.01±0.16
F-Young Adult (%)	91.96±10.22	90.95±23.61
F-Age Matched (%)	93.39±12.58	95.59±15.31

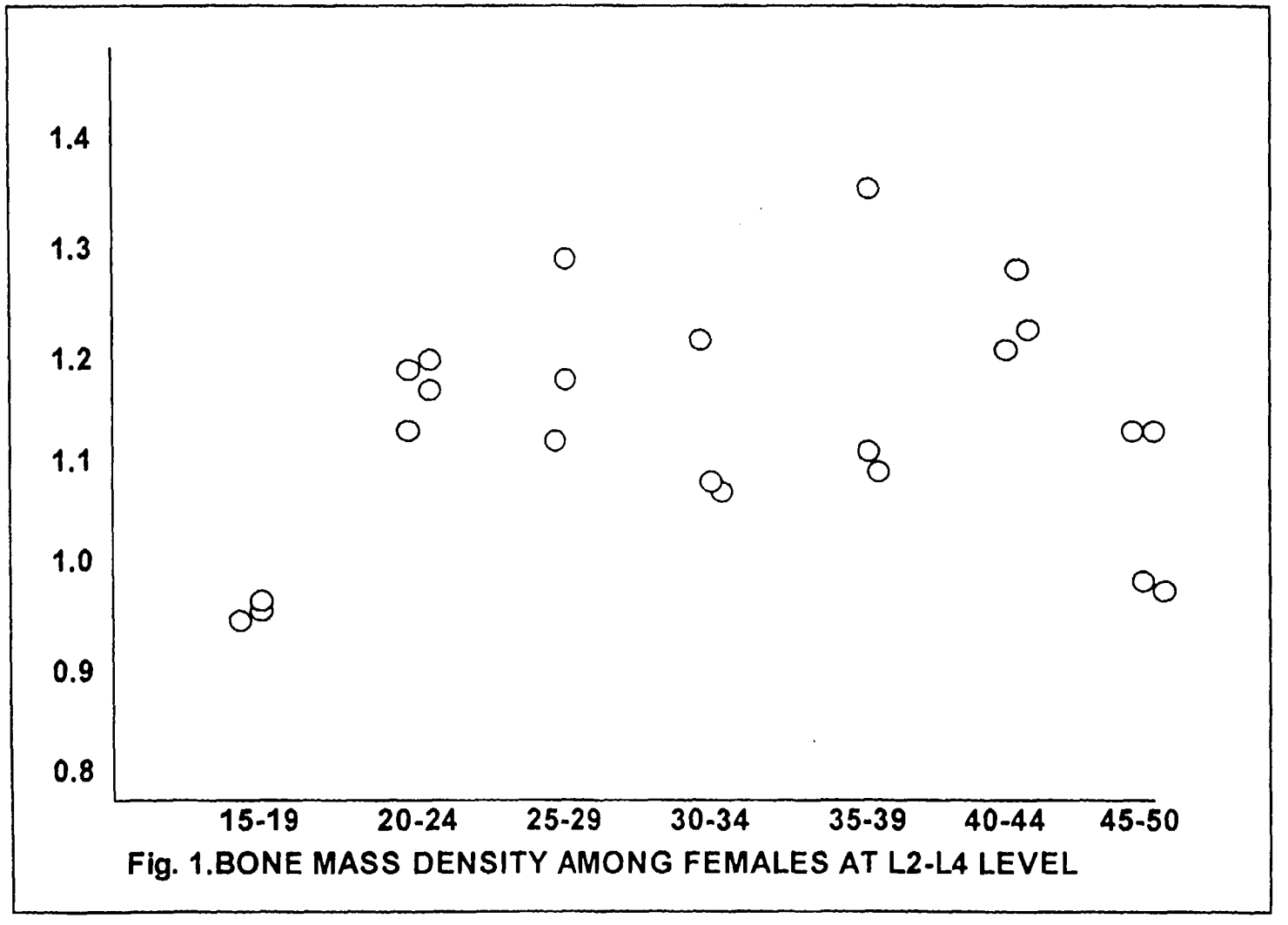

Fig. 1.BONE MASS DENSITY AMONG FEMALES AT L2-L4 LEVEL

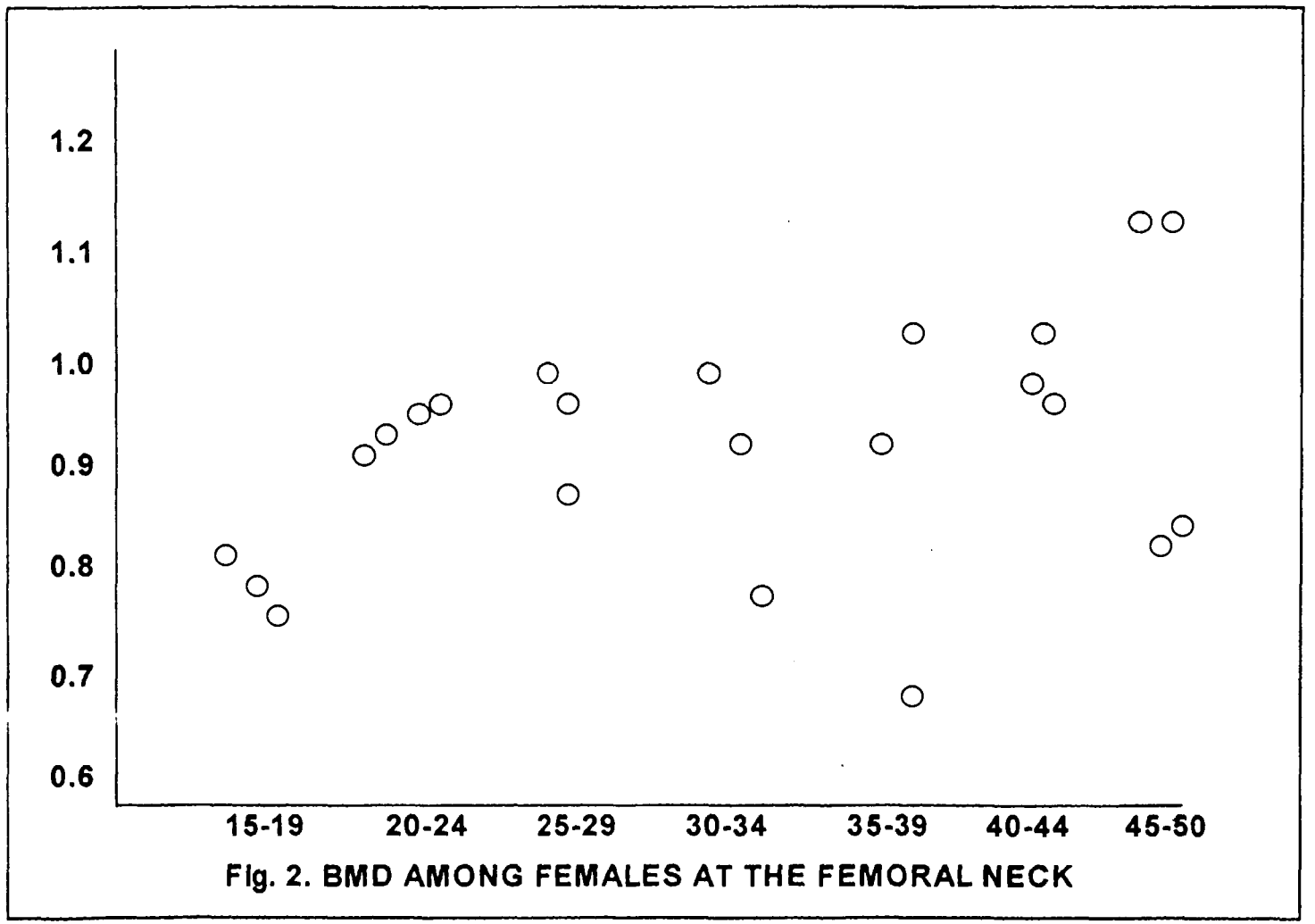

Fig. 2. BMD AMONG FEMALES AT THE FEMORAL NECK

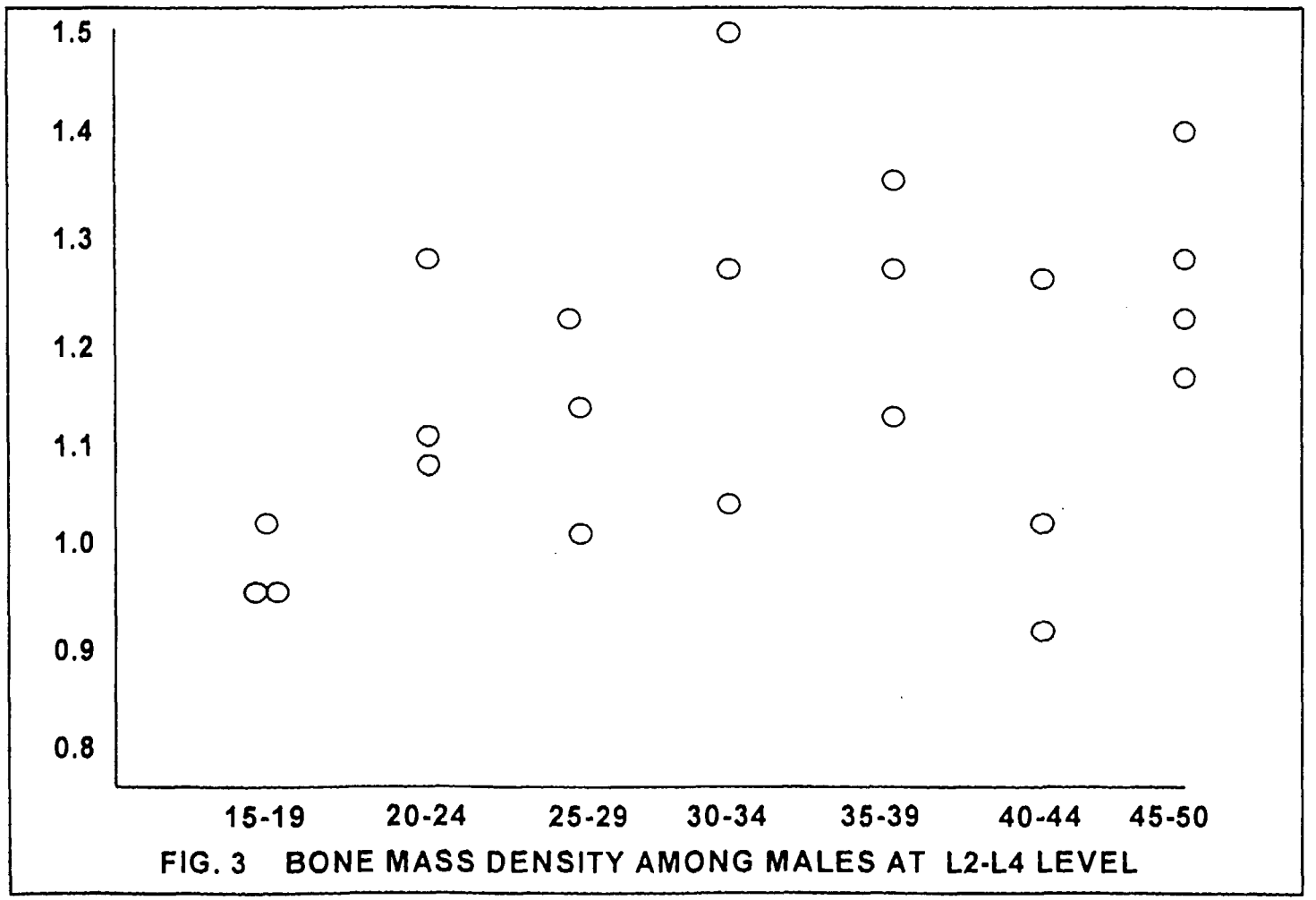

FIG. 3 BONE MASS DENSITY AMONG MALES AT L2-L4 LEVEL

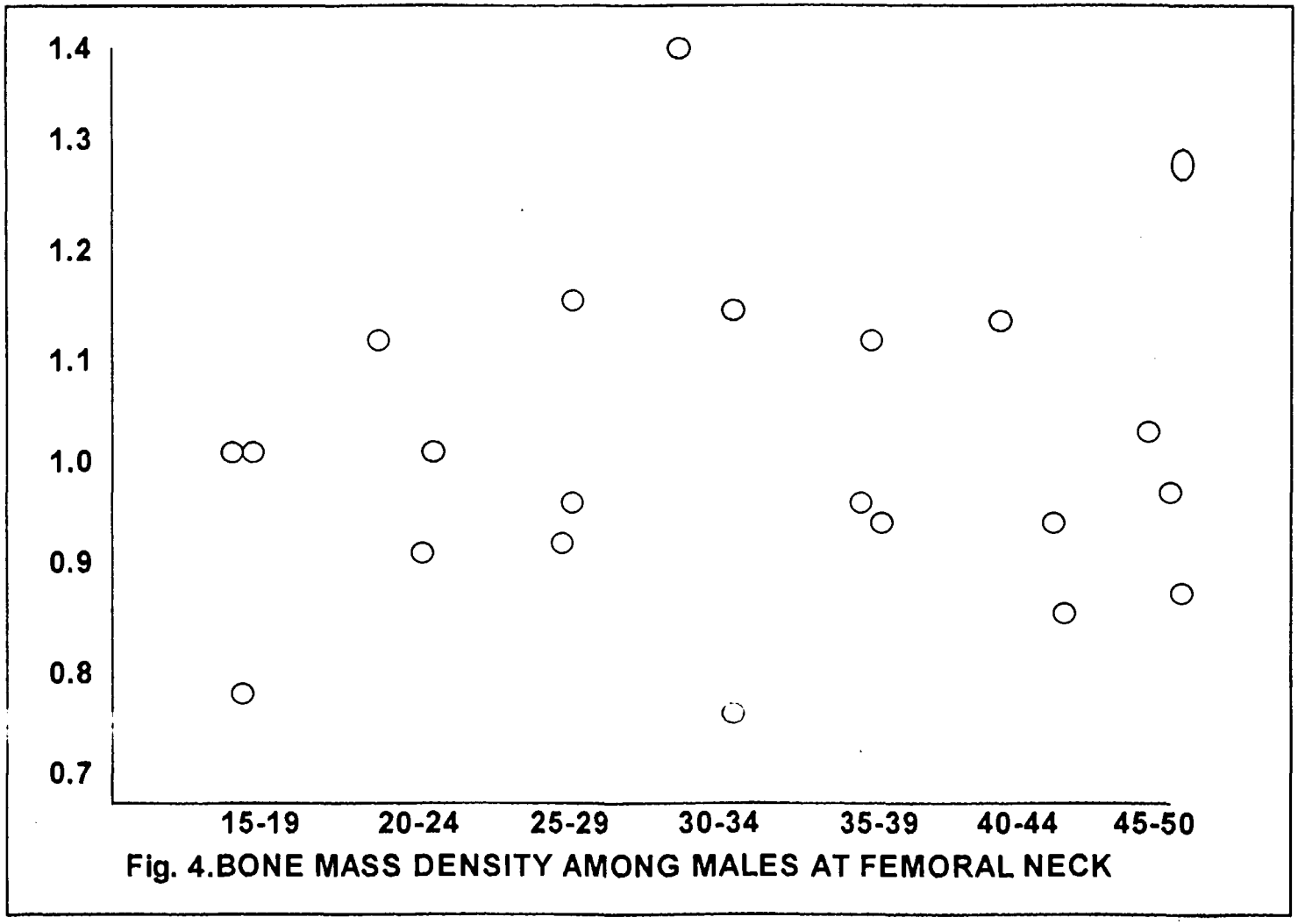

Fig. 4.BONE MASS DENSITY AMONG MALES AT FEMORAL NECK

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