KINE 439
PARAPHRASING ASSIGNMENT

1. Read over the following website pages on paraphrasing first:
   http://writingcenter.tamu.edu/content/view/23/0/

   http://gervaseprograms.georgetown.edu/hc/plagiarism.html#They

2. Then paraphrase 5 different statements of "fact" about physical activity and bone health derived from the following excerpt. Each paraphrase can be as long as 3 sentences, but must be in your own words (to qualify as a "paraphrase"). Also, after each paraphrase, insert citation (documenting source) according to Citation Guidelines handed to you in class.

Email this to Dr. Bloomfield at sbloom@tamu.edu by 5 PM Monday, June 25, 2007.

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Excerpt from: Bloomfield, S.A. Contributions of physical activity to bone health over the lifespan. *Top. Geriatric Rehab.* 21: 68-76, 2005.

Physical activity in children, adolescents, and young adults

From a public health perspective, there is little doubt that efforts to promote exercise for bone health should focus not on post-menopausal women or even the entire population over the age of 50 years but on children between the ages of 8 and 15. As seen in Figure 1, bone mass increases rapidly from birth to about age 20. Even once longitudinal growth of bone ceases after puberty, there are further gains in mineralization; peak bone mass is reached at most bone sites by the age of 30. Clearly, the more bone "in the bank" at the age of 30, the lower one's risk for reaching the high fracture risk zone in the years after age 60.

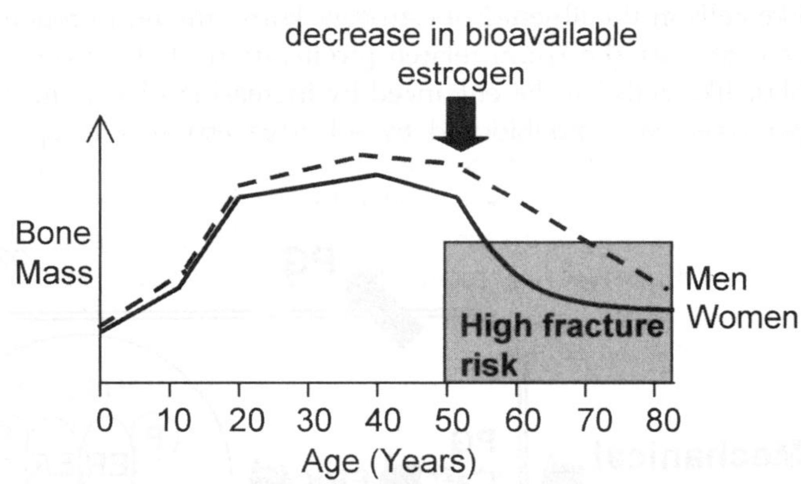

Figure 1. Bone mass changes with age, rapidly increasing during pubertal years and then plateauing between 20 and 40 years of age. Both men and women experience age-related bone loss after age 40, with women's rate of loss accelerated at menopause. The decrease in bioavailable estrogen is more gradual in men accounting for a steady decline in bone mass. Due both to this and the higher peak bone mass at age 40, bone mass in men does not decline into the high fracture risk zone until much later in life, absent other mitigating factors such as glucocorticoid use. Reproduced from Lee KCL and Lanyon L. Mechanical loading influences bone mass through estrogen receptor α. *Exer Sport Sciences Rev* 2004: 32:64-68, with permission of Lippincott Williams and Wilkins.

The seminal longitudinal observation studies of Bailey and colleagues documented that children gain an astounding 26% of their peak bone mass in a 2-year window during puberty (8). Further, girls and boys in the most physically active quartiles of this population had total body bone mineral content values that were 16% and 9% higher, respectively, than their peers in the least active quartile. Cross-sectional studies comparing BMD values in various athlete groups have confirmed the concept first demonstrated in animal research that activities involving high impact forces produced rapidly are the most osteogenic. For example, basketball and volleyball players and gymnasts who daily perform many jumps or landings from a height exhibit higher BMD values in the lumbar spine and femoral neck than do runners or swimmers (9,10). The latter group actually exercises in a semi-weightless environment and routinely exhibits BMD values no different from sedentary peers (11,12).

Ground reaction forces operating on the skeleton during jumping activities can be as high as 6- to 8-times-body weight, as compared to ground reaction forces of 1- to 3-times-body weight with walking or running (13). Exercise intervention trials in children and adolescents have tested the effectiveness of activities like plyometrics and step aerobics that involve jumping from a small height. Premenarcheal adolescent girls involved in step aerobics and plyometrics for 9 months achieved significant gains in BMC when compared to non-exercising age-matched peers (14). A number of school-based physical activity programs including jumping and calisthenics programs have been consistently successful in demonstrating impressive gains in bone mass in both young boys and girls (15-17).

Some data suggest that for girls, in particular, there may be a fairly narrow window of time during which increased activity has its most potent effect. Postmenarcheal girls (aged 13 years) performing the same step aerobics and plyometrics regimen as the premenarcheal subjects (aged 11 years) cited above (14) exhibited no greater gains in BMC than non-exercising control subjects. On the other hand, a 7-month program of plyometrics produced significant gains in bone mass in early pubertal (Tanner stages 2 and 3) but not pre-pubertal (Tanner stage 1) girls (18). An elegant cross-sectional study of tennis players (19) demonstrated that bilateral differences in humeral BMD are similar in these young athletes and less active controls at Tanner stage 1 but become progressively larger in tennis players (vs. controls) at Tanner stages 2, 3, and 4. Hence, it appears that vigorous activity has its greatest impact for young girls in early puberty and before the onset of menarche. It is likely that, with increasing availability of software for determining femoral geometry from DXA scan data, researchers will confirm that beneficial affects on bone cross-sectional geometry are also incurred with vigorous physical activity during these pubertal years (20).

Whether the same benefits to bone health can be derived with vigorous physical activity in the post-pubertal years is not as clear. The few longitudinal studies that have been performed in adolescent girls have not detected positive effects on bone mass (14,21) unless the study intervention duration exceeded 15 months. Resistance training for 15 months (22) or artistic gymnastics for 3 years (23), activities producing high-force muscle contractions and/or frequent impact loading, did produce significant gains in BMD.

There is evidence that young adults may continue to accrue bone mass, albeit at a slower rate, thoughout their third decade of life (24). This represents the final window of time during which peak bone mass might be augmented; well-controlled studies must make comparisons with carefully selected control groups to control for the accrual of bone mass observed in the absence of any significant activity. Modest increases in femoral neck and/or lumbar spine BMD ranging from 1 to 5% have been documented in individuals training for 6 -36 months (25-27). The most successful programs are the longest in duration and those involving a variety of activities, e.g., combined aerobics and resistance training. If, however, regular exercise is not matched by increased energy intake, a chronic negative energy balance results can lead to amenorrhea or sub-clinical disruption of reproductive hormone profiles, which often results in slow *loss* of bone mass even as physical activity continues (28). This is one clear example of the general concept that normal reproductive hormone profiles are required for a full osteogenic response to physical activity.