Past and Present Habitual Physical Activity and Its Relationship With Bone Mineral Density in Men Aged 50 Years and Older in Brazil

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Background. The aim of this study was to determine the relationship between habitual physical activity (HPA) during life and bone mineral density (BMD) in men aged 50 years and older.

Methods. A total of 326 men aged 50 years and older, volunteers living in São Paulo city, Brazil, were studied. BMD was measured in the whole body, femoral neck, Ward’s triangle, trochanter, and lumbar spine (L2-L4) with a dual-energy x-ray absorptiometer. The HPA data were collected with questionnaires inquiring about physical exercise and occupational physical activity in the past and during the past 12 months and leisure and locomotor physical activity in the preceding 12 months. The relationship between BMD and HPA was analyzed using multiple linear regression models adjusted for age and body mass index (BMI).

Results. Practice of physical exercise in the past 10–20 years and leisure and locomotor physical activity in the preceding 12 months showed a significant positive correlation with BMD of whole body, femoral neck, trochanter, and lumbar spine, and this association was independent of age and BMI.

Conclusions. HPA can contribute to preserving BMD in men aged 50 years and older in Brazil, when it is practiced in the past 10–20 years and even in the present.

OSTEOPOROSIS is an important public health problem in the elderly population due to its contribution to the morbidity and mortality in this age group (1). Studies that investigated habitual physical activity (HPA) over a lifetime in women have demonstrated an association between the preservation of bone mineral density (BMD) and prevention of osteoporosis (2–6). However, these studies have been conducted in developed countries on populations with lifestyles differing from those of populations of developing countries. In addition, almost all them were conducted exclusively in women (4,7,8). The objective of the present study was to examine the relationship between HPA and BMD in men aged 50 years and older living in São Paulo, Brazil.

METHODS

Study Design
A cross-sectional study was carried out at Heliopolis Hospital, a public hospital for low-income people, in São Paulo, Brazil. São Paulo is an industrial city in southwest Brazil with almost 11 million inhabitants.

Study Population
The population under study were men aged 50 and older, spouses of women undergoing dual-energy absorptiometry studies, hospital employees, and outpatients, who volunteered to participate. Recruitment was carried out from February to August 1997. We excluded from the study men using any kind of medication or having medical conditions that could affect bone metabolism such as cancer, myeloma, rheumatoid disease, or hyperthyroidism, or men whose height was 190 cm or more, due to the image limits of the x-ray absorptiometer. Every participant was interviewed by a single research assistant.

The study was approved by the Ethics Committee of Heliopolis Hospital and of the School of Public Health at the University of São Paulo, and all the participants provided informed written consent.

Physical Activity Assessment
Physical activity was assessed using a Baecke questionnaire (9) and is reported as scores. The original English language questionnaire was translated into Portuguese and was adapted after obtaining permission from the authors.

The questionnaire evaluates lifetime occupational physical activity and contains items regarding main occupation, sitting down, standing, walking and carrying heavy loads at work, tiredness after work, and perspiring while working. In addition, the surveyed person was requested to classify his workload as very heavy, heavier, as heavy as, lighter, or very light, compared to people of the same age group. The questionnaire also contains items about physical exercise, with questions regarding the types of physical exercise (hours per week and months per year of practice) and prac-
ticing a second modality (hours per week and months per year of practice). The interviewee was asked to state if he considered that level of leisure physical activity was much greater, greater, the same as, lower, or much lower, compared to people of the same age group, and was asked about perspiration during leisure time and sporadic physical exercise at leisure time. Leisure physical activity included items such as watching television, walking or riding a bicycle during leisure hours and walking or biking reported as minutes per day, shopping, going to school, and going to work. The men were asked about occupational physical activity and physical exercise practice at different age ranges (10–20 years, 21–30 years, 31–50 years), and for the preceding 12 months, except for leisure physical activity that was only evaluated during the preceding 12 months. The summary of physical activity that classifies the energy expenditure of human physical activities was used to classify the types of occupational and physical exercise that did not appear in the Baecke questionnaire (10). These physical activities were classified into low, moderate, and high energy expenditure categories, based on the exercise physiology textbook of McArdle and colleagues (11).

Bone Mineral Density Assessment

BMD was measured with a dual-energy x-ray absorptiometer using a Lunar DPX densitometer and was expressed as g/cm². Measurements were made in the whole body, femur (neck, trochanter, and Ward’s triangle), and lumbar spine (L2 to L4), and the results were analyzed with the LUNAR software, version 3.1 (Lunar Corp., Madison, WI). The coefficient of variation for the measurements was 1.5% for the lumbar spine and 2% for the femoral area (neck, trochanter, and Ward’s triangle). Weight (kg) and height (cm) were measured, and body mass index (BMI) was estimated (kg/m²).

Statistical Analysis

The relationship between HPA and BMD was evaluated using the Spearman correlation coefficient and multiple linear regression models. The models were based on a stepwise forward procedure, and the variable was kept in the multiple model if it was significant ($p < .05$). Five multiple linear regression models were constructed using each BMD measurement (whole body, femoral neck, trochanter, Ward’s triangle, and lumbar spine) as a dependent variable. Scores of physical exercise, of occupational physical activity, as well as of leisure activity were considered independent variables. Age and BMI were analyzed as control variables.

RESULTS

Mean age of participants was 62.5 years ($SD = 7.9$ years), and BMI ranged from 15.5 to 41.8 kg/m² (mean = 26.7 kg/m²) (Table 1). Most of the men were white (80.6%) and married (86.5%), and only 12.3% had finished an educational level equivalent to high school or college.

BMD values for whole body, Ward’s triangle, and trochanter were significantly correlated with physical exercise during all periods of life and with leisure physical activity during the preceding 12 months (Table 2). Scores for the practice of physical exercise from 10 to 20 years of age showed a significant positive correlation with BMD for all sites. Practice from 21 to 30 years and 31 to 50 years of age was also significantly correlated with BMD at all sites except for the lumbar spine. Scores for the leisure physical activity during the preceding 12 months showed a significant positive correlation with BMD for all sites. Occupational physical activity was significantly correlated with BMD only for the trochanter from 31 to 50 years of age and for the femoral neck and lumbar spine for the preceding 12 months.

Table 3 shows the final multiple linear regression models. Physical exercise from 10 to 20 years of age as well as leisure and locomotor physical activity during the preceding 12 months were independent factors for increased BMD at all sites, and this effect was independent of BMI and age.

DISCUSSION

This is the first study to analyze the relationship between HPA and BMD in men living in a developing country. The association of BMD with HPA throughout life and the preservation of BMD in men aged 50 years and older is documented, similar to the findings reported in other studies in men (12,13).

In the present study, physical exercise from the age of 10 to 20 years old was correlated significantly with BMD at all the sites studied. We believe that this fact greatly contributes to the peak of bone mass that occurs during this period (14).

Studies that investigated the practice of physical exercise from the age of 10 to 30 years old showed that activity at this age is important for the preservation of lumbar spine and femoral neck BMD in Brazilian women (4), of whole body, femur (neck, trochanter, and Ward’s triangle), and lumbar spine BMD in American women (5), and of lumbar spine BMD in Finnish women (6).
Table 2. Spearman Correlation Coefficient ($r$) Between BMD (g/cm$^2$) and HPA Scores According to Age in Adult and Older Men, São Paulo, Brazil, 1997

<table>
<thead>
<tr>
<th>Scores of Physical Activities</th>
<th>Whole Body $r (p)$</th>
<th>Femoral Neck $r (p)$</th>
<th>Ward’s Triangle $r (p)$</th>
<th>Trochanter $r (p)$</th>
<th>Lumbar Spine $r (p)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–20 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE</td>
<td>0.21(&lt;.001)*</td>
<td>0.19(&lt;.001)*</td>
<td>0.18(&lt;.001)*</td>
<td>0.16(0.003)*</td>
<td>0.15(0.006)*</td>
</tr>
<tr>
<td>OPA</td>
<td>0.01(8.25)</td>
<td>0.05(3.26)</td>
<td>−0.03(574)</td>
<td>−0.04(437)</td>
<td>−0.03(574)</td>
</tr>
<tr>
<td>21–30 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE</td>
<td>0.14(0.010)*</td>
<td>0.17(0.002)*</td>
<td>0.12(0.024)</td>
<td>0.13(0.020)*</td>
<td>0.10(0.062)</td>
</tr>
<tr>
<td>OPA</td>
<td>−0.05(3.90)</td>
<td>−0.02(1.702)</td>
<td>−0.07(208)</td>
<td>−0.09(394)</td>
<td>−0.10(0.063)</td>
</tr>
<tr>
<td>31–50 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE</td>
<td>0.14(0.010)*</td>
<td>0.16(0.003)*</td>
<td>0.12(0.025)*</td>
<td>0.12(0.027)*</td>
<td>0.09(0.095)</td>
</tr>
<tr>
<td>OPA</td>
<td>−0.05(3.54)</td>
<td>−0.05(3.71)</td>
<td>−0.07(201)</td>
<td>−0.12(0.026)*</td>
<td>−0.08(1.64)</td>
</tr>
<tr>
<td>The preceding 12 months</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE</td>
<td>0.16(0.003)*</td>
<td>0.16(0.004)*</td>
<td>0.14(0.014)*</td>
<td>0.12(0.024)*</td>
<td>0.10(0.072)</td>
</tr>
<tr>
<td>OPA</td>
<td>0.09(1.16)</td>
<td>0.13(0.020)*</td>
<td>0.14(0.10)*</td>
<td>0.08(1.31)</td>
<td>−0.04(0.468)</td>
</tr>
<tr>
<td>LLPA</td>
<td>0.16(0.003)*</td>
<td>0.21(&lt;.001)*</td>
<td>0.22(&lt;.001)*</td>
<td>0.22(&lt;.001)*</td>
<td>0.11(0.043)*</td>
</tr>
</tbody>
</table>

Notes: BMD = bone mineral density; HPA = habitual physical activity; PE = physical exercise; OPA = occupational physical activity; LLPA = leisure and locomotor physical activity.

* $p < 0.05.$

Occupational physical activity during the preceding 12 months was important to explain the femoral neck BMD. This relationship is still little studied in the literature and its possible beneficial contribution to the preservation of BMD is unclear. Glynn and colleagues (12) showed that occupational physical activity during the preceding 12 months in older American men was not correlated with BMD of the femoral neck, trochanter, or Ward’s triangle, and more studies are needed to explain the relationships between occupational physical activity and BMD.

Leisure and locomotor physical activity like walking or riding a bicycle during leisure hours, spending less time watching television, and going to school, work, or shopping on foot can contribute to the preservation of BMD. A recent study on older English women found a significant correlation between walking and activities like climbing steps and BMD of the trochanter and whole body (2).

These results of leisure and locomotor physical activity are important for the new paradigms of physical activity in the field of public health because these types of activities can be incorporated into the daily routine of the population (15).

We conclude that physical exercise during adolescence and the young adult years and leisure and locomotor physical activity in older years can contribute to the preservation of BMD in adult and older men.

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References


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