AWARD NUMBER: W81XWH-10-1-0276

TITLE: Exercise and Osteoporosis: A Dose-Response Meta-Analysis

PRINCIPAL INVESTIGATOR: George A. Kelley

CONTRACTING ORGANIZATION: West Virginia University Research Corporation
Morgantown, WV 26505

REPORT DATE: May 2011

TYPE OF REPORT: Annual

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for Public Release;
Distribution Unlimited

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.
**Exercise and Osteoporosis: A Dose-Response Meta-Analysis**

**Purpose:** Use the aggregate data meta-analytic approach to examine the does-response effects of exercise on bone.

**Scope:** Studies in adult men and women who had bone mineral density assessed at the lumbar spine and femoral neck.

**Major Findings:** Per our approved Statement of Work, no major findings were planned or expected during the first year of this important project. An extensive database of 917 studies was developed however.

**Subject Terms:** Exercise, physical activity, physical fitness, osteoporosis, bone, bone mineral density, meta-analysis, systematic review

<table>
<thead>
<tr>
<th>1. REPORT DATE</th>
<th>2. REPORT TYPE</th>
<th>3. DATES COVERED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 May 2011</td>
<td>Annual</td>
<td>1 May 2010 – 30 Apr 2011</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Virginia University Research Corporation</td>
</tr>
<tr>
<td>Morgantown, WV 26505</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Army Medical Research and Materiel Command</td>
</tr>
<tr>
<td>Fort Detrick, Maryland 21702-5012</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>12. DISTRIBUTION / AVAILABILITY STATEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved for Public Release; Distribution Unlimited</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>14. ABSTRACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose: Use the aggregate data meta-analytic approach to examine the does-response effects of exercise on bone. Scope: Studies in adult men and women who had bone mineral density assessed at the lumbar spine and femoral neck. Major Findings: Per our approved Statement of Work, no major findings were planned or expected during the first year of this important project. An extensive database of 917 studies was developed however.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15. SUBJECT TERMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise, physical activity, physical fitness, osteoporosis, bone, bone mineral density, meta-analysis, systematic review</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>16. SECURITY CLASSIFICATION OF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. REPORT</td>
</tr>
<tr>
<td>b. ABSTRACT</td>
</tr>
<tr>
<td>c. THIS PAGE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>17. LIMITATION OF ABSTRACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>UU</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>18. NUMBER OF PAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>19a. NAME OF RESPONSIBLE PERSON</th>
</tr>
</thead>
<tbody>
<tr>
<td>USAMRMC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>19b. TELEPHONE NUMBER (include area code)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Section</td>
</tr>
<tr>
<td>-------------------------------</td>
</tr>
<tr>
<td>Introduction</td>
</tr>
<tr>
<td>Body</td>
</tr>
<tr>
<td>Key Research Accomplishments</td>
</tr>
<tr>
<td>Reportable Outcomes</td>
</tr>
<tr>
<td>Conclusion</td>
</tr>
<tr>
<td>References</td>
</tr>
<tr>
<td>Appendix I</td>
</tr>
<tr>
<td>Appendix II</td>
</tr>
</tbody>
</table>
Introduction

Low bone mineral density (BMD) leading to osteopenia and osteoporosis as well as a subsequent increase in fracture risk is a major health problem among both current and former male and female military personnel (1-9). It is well established that two of the most common sites of fracture as a result of low BMD are the hip and spine. Exercise, a low-cost, readily available non-pharmacologic intervention, has been recommended for increasing and preserving BMD in adults (10). Recently, the Physical Activity Guidelines Advisory Committee Report published by the Department of Health and Human Services concluded that updated meta-analyses are needed for selected health outcomes such as BMD (11). In addition, the report also concluded that no meta-analysis to date has provided evidence of the dose-response effects of exercise on BMD (11). Given the former, the purpose of this proposed project is to use the aggregate data meta-analytic approach to determine the effects of exercise on BMD in adult humans. The specific aims of this project are to (1) determine the overall effects of exercise on BMD at the lumbar spine and femoral neck in adult humans $\geq$ 18 years of age; (2) for the first time, use recently developed load stimulus data for 48 different physical activities (walking, running, lower-body weight training, etc.) to determine the dose-response effects of exercise on BMD at the lumbar spine and femoral neck in adult humans $\geq$ 18 years of age. An exhaustive literature search for all randomized controlled trials dealing with the effects of exercise on BMD at the lumbar spine and femoral neck in adult humans $\geq$ 18 years of age will be conducted and dual-screening will be used in the selection of studies. Dual-coding will be utilized in the abstraction of data, including the assessment of study quality. Random effects, variance-known, multilevel meta-analysis models (method of moments approach) will be used to determine the overall (Specific Aim 1) and dose-response (Specific Aim 2) effects of exercise on BMD at the lumbar spine and femoral neck in adults $\geq 18$ years of age. In order to enhance the interpretation of findings and conclusions drawn, heterogeneity will be examined using the Q (13) and $I^2$ (14) statistics while publication bias will be assessed using the trim-and-fill approach of Duval and Tweedie (15). The results of this project will contribute to evidence-based guidelines in relation to the use of exercise in the prevention and treatment of osteopenia and osteoporosis among both civilian and non-civilian adults. Adherence to the exercise recommendations derived from our proposed work will have the potential to reduce and/or delay (1) the incidence and prevalence of osteopenia and osteoporosis, (2) the increased fracture risk associated with osteopenia and osteoporosis, and (3) the increased morbidity and mortality associated with osteopenia and osteoporosis related fractures, in both civilian and non-civilian adults.

Body

For the first year of this project our Statement of Work included two tasks: (1) to search for pertinent literature dealing with the effects of exercise on bone mineral density in adults (Data Sources) and (2) to select studies that meet our inclusion criteria dealing with the effects of exercise on bone mineral density in adults (Study Selection). The first task was to be completed in Year 1 while the second task was to start in Year 1 with completion in Year 2. We are currently on target to meet these timelines. A description of each task follows.

Task 1 (Data Sources) – Per our original Statement of Work, we developed keywords to be used in our electronic database searches and which were specific to the six databases that we agreed to search. A copy of the search strategies for the six databases that we searched (PubMed, Embase, SportDiscus, Cochrane Central Register of Controlled Clinical Trials, CINAHL, Dissertation Abstracts International) can be found in Appendix I. The development of unique search strategies for each database required a considerable amount of time and effort. In addition to searching electronic databases, we cross-referenced from retrieved studies and hand searched the following journals: (1) Archives of Internal Medicine, (2) Bone, (3) Journal of Aging, (4) Journal of the American Medical Association (JAMA), (5) Journal of Bone and Mineral Research, (6) Journal of
Orthopedic Science, (7) Lancet, (8) Medicine and Science in Sports and Exercise, and (9) Osteoporosis International. From these exhaustive searches and after removing duplicates (n = 265), a database that includes a total of 917 studies was established (see Appendix II).

Task 2 (Study Selection) – Per our original Statement of Work we are nearing completion of Task 2 with full completion scheduled for the beginning of year 2. Specifically, studies from the reference list of 917 have been classified and the reviewing of each study for potential inclusion for coding and analysis is nearing completion. As can be seen in Appendix II, some of these studies are false-positives. However, regardless of the specificity of searching, this is a common occurrence in meta-analysis. As originally proposed, the final selection, coding, and analysis of studies will be completed by the end of year 2. The dual selection and review of studies for potential inclusion is a tedious and time-consuming endeavor.

Key Research Accomplishments

The key research accomplishment during the first year of this project was the development of an exhaustive database of 917 studies for dual review and potential selection, coding and analysis.

Reportable Outcomes

The key outcome from the first year of this project was the development of a database containing 917 references to review for potential inclusion in our aggregate data meta-analysis (See Appendix II).

Conclusion

The research completed during the first year of this project is important because it will allow for a thorough meta-analysis addressing the effects of exercise, including dose-response effects, on lumbar spine and femoral neck BMD in adult men and women.

References


Appendix I - Search Strategies For Database Searches

1. PubMed (MEDLINE)

# Query Limiters/Expanders Last Run Via Results
S7 (s3 and s6) Limiters - Date of Publication from: 19890101-20100631; Human; Age Related: All Adult: 19+ years
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - MEDLINE 402
S6 (s4 or s5) Limiters - Date of Publication from: 19890101-20100631; Human; Age Related: All Adult: 19+ years
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - MEDLINE 387298
S5 TX clinical w1 trial* Limiters - Date of Publication from: 19890101-20100631; Human; Age Related: All Adult: 19+ years
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - MEDLINE 324417
S4 TX random* w1 control* Limiters - Date of Publication from: 19890101-20100631; Human; Age Related: All Adult: 19+ years
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - MEDLINE 211688
S3 (s1 and s2) Limiters - Date of Publication from: 19890101-20100631; Human; Age Related: All Adult: 19+ years
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - MEDLINE 1672
S2 (MH "bone density") or TX bone w1 densit* Limiters - Date of Publication from: 19890101-20100631; Human; Age Related: All Adult: 19+ years
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - MEDLINE 21414
S1 MH exercise or TX exercise Limiters - Date of Publication from: 19890101-20100631; Human; Age Related: All Adult: 19+ years
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - MEDLINE 82574

2. Embase

S1 224518  EXERCISE OR EXERCISE/DE
S2 41847  BONE(W)DENSIT? OR BONE(W)DENSITY/DE
S3 2630  S1 AND S2
S4 294309  RANDOM?(W)CONTROL?
S5 868757  CLINICAL(W)TRIAL?
S6 894597  S4 OR S5
S7 585  S3 AND S6
S8 578  S7/HUMAN
3. SportDiscus

# Query Limiters/Expanders Last Run Via Results
S11 (s7 and s10) Limiters - Published Date: 19890101-20100631
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - SPORTDiscus with Full Text 300
S10 (s8 or s9) Limiters - Published Date: 19890101-20100631
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - SPORTDiscus with Full Text 135179
S9 (teenager* or adolescent* or teen* or adult or senior or aged or geriatric or geriatrics or elder or elderly) Limiters - Published Date: 19890101-20100631
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - SPORTDiscus with Full Text 84621
S8 human Limiters - Published Date: 19890101-20100631
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - SPORTDiscus with Full Text 59183
S7 (s3 and s6) Limiters - Published Date: 19890101-20100631
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - SPORTDiscus with Full Text Display
S6 (s4 or s5) Limiters - Published Date: 19890101-20100631
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - SPORTDiscus with Full Text Display
S5 TX clinical w1 trial* Limiters - Published Date: 19890101-20100631
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - SPORTDiscus with Full Text Display
S4 TX random* w1 control* Limiters - Published Date: 19890101-20100631
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - SPORTDiscus with Full Text Display
S3 (s1 and s2) Limiters - Published Date: 19890101-20100631
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - SPORTDiscus with Full Text Display
S2 (MH "bone density") or TX bone w1 densit* Limiters - Published Date: 19890101-20100631
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - SPORTDiscus with Full Text Display
S1 TX exercise or MH exercise Limiters - Published Date: 19890101-20100631

S9  577  S8 AND PY=1989:2010
S10  296  S9 AND DT=ARTICLE
S11  296  S10 NOT DT=EDITORIAL
S13  54  FS=MEDLINE AND S11
4. Cochrane Central Register of Controlled Clinical Trials

(exercise):ti,ab,kw and (bone NEAR/1 densit*):ti,ab,kw and (random* NEAR/1 control*):ti,ab,kw and (human):ti,ab,kw, from 1989 to 2010 in Clinical Trials

5. CINAHL

# Query Limiters/Expanders Last Run Via Results
S7 (s3 and s6) Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - CINAHL with Full Text 224
S6 (s4 or s5) Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - CINAHL with Full Text 41070
S5 (MH "Clinical Trials+") Limiters - Published Date from: 19890101-20100631; Human; Age Groups: All Adult
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - CINAHL with Full Text 35755
S4 TX random* w1 control* Limiters - Published Date from: 19890101-20100631; Human; Age Groups: All Adult
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - CINAHL with Full Text 13913
S3 (s1 and s2) Limiters - Published Date from: 19890101-20100631; Human; Age Groups: All Adult
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - CINAHL with Full Text 672
S2 (NH "bone density") or TX bone w1 densit* Limiters - Published Date from: 19890101-20100631; Human; Age Groups: All Adult
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - CINAHL with Full Text 672
S1 MH exercise or TX exercise Limiters - Published Date from: 19890101-20100631; Human; Age Groups: All Adult
Search modes - Find all my search terms Interface - EBSCOhost
Search Screen - Advanced Search
Database - CINAHL with Full Text 2392

6. Dissertation Abstracts International

(kw: exercise and kw: bone and kw: densit*) and kw: random* years 1989-2010
Appendix II - Reference List of Studies to Review

(Note: Ref ID represents identification number of citation in our database)


(14) ABSTRACTS. Journal of Orthopaedic & Sports Physical Therapy 2004
Ref ID: 455

Ref ID: 456

Ref ID: 457

Ref ID: 458

Ref ID: 459

Ref ID: 460

Ref ID: 461

Ref ID: 462

Ref ID: 463

Ref ID: 464

(24) Oral Presentations. Hormone Research 2005 September 2;64:16-44.
Ref ID: 465

Ref ID: 466

Ref ID: 467

Ref ID: 468

Ref ID: 469
Ref ID: 470

Ref ID: 471

Ref ID: 472

Ref ID: 473

Ref ID: 474

Ref ID: 475

Ref ID: 476

Ref ID: 477

(37) In brief. Active Living 2007 May;16(3):16.
Ref ID: 144

Ref ID: 478

Ref ID: 479

Ref ID: 480

Ref ID: 481

Ref ID: 482


(46) Proceedings of SRR. Clinical Rehabilitation 2008 September;22(9):856-63. Ref ID: 486


(54) Adie JW, Duda JL, Ntoumanis N. Free Communications. Journal of Sport & Exercise Psychology 2006 June 2;S23-S198. Ref ID: 492


(63) Almqvist E. Early parathyroidectomy in mild primary hyperparathyroidism: Effects on heart and bones. DAI 2006;68(01C):143. Ref ID: 1008

(64) Anderson FM. Effect of exercise on bone mineral density of the forearm in premenarcheal girls. DAI 1999;61(01B):223. Ref ID: 1009


(86) Barry DW, Kohrt WM. BMD decreases over the course of a year in competitive male cyclists. Journal of Bone & Mineral Research 2008 April;23(4):484-91. Ref ID: 63

(87) Bass SL. The prepubertal years: a uniquely opportune stage of growth when the skeleton is most responsive to exercise. Exercise and Sports Medicine 2000 August;30(2):73-8. Ref ID: 502

Ref ID: 242

Ref ID: 395

Ref ID: 302

Ref ID: 742

Ref ID: 503

Ref ID: 181

Ref ID: 396

Ref ID: 275

Ref ID: 504

Ref ID: 294

Ref ID: 397


(104) Berenson AB, Breitkopf CR, Grady JJ, Rickert VI, Thomas A. Effects of hormonal contraception on bone mineral density after 24 months of use. Obstetrics And Gynecology 2004 May;103(5 Pt 1):899-906. Ref ID: 171


Ref ID: 505

Ref ID: 506

Ref ID: 57

Ref ID: 167

Ref ID: 507

Ref ID: 60

Ref ID: 508

Ref ID: 74

Ref ID: 92

Ref ID: 163


(132) Brach JS, VanSwearingen JM, FitzGerald SJ, Storti KL, Kriska AM. The relationship among physical activity, obesity, and physical function in community-dwelling older women.


Brenneman SK, LaCroix AZ, Buist DSM, Chen Y, Abbott TA, III. Evaluation of decision rules to identify postmenopausal women for intervention related to osteoporosis. Disease Management 2003 September;6(3):159-68.


Brodowska A. [The influence of hormonal replacement therapy on bone density in postmenopausal women depending on polymorphism of vitamin D receptor (VDR) and estrogen receptor (ER) genes]. Annales Academiae Medicae Medicae Stetinensis 2003;49:111-30.


(152) Bunout D, Barrera G, de la Maza P, Avendano M, Gattas V, Petermann M, Hirsch S. The impact of nutritional supplementation and resistance training on the health functioning of


(162) Carrascosa A, Gussinye M, Terradas P, Yeste D, Audi L, Vicens-Calvet E. Spontaneous, but not induced, puberty permits adequate bone mass acquisition in adolescent Turner
Ref ID: 337

Ref ID: 519

Ref ID: 88

Ref ID: 1043

Ref ID: 43

Ref ID: 758

Ref ID: 759

Ref ID: 147

Ref ID: 760

Ref ID: 520

Ref ID: 93


Ref ID: 763

Ref ID: 764

Ref ID: 765

Ref ID: 360

Ref ID: 527

Ref ID: 402

Ref ID: 767

Ref ID: 1044

Ref ID: 78

Ref ID: 529

(193) Cussler EC, Lohman TG, Going SB, Houtkooper LB, Metcalfe LL, Flint-Wagner HG, Harris RB, Teixeira PJ. Weight lifted in strength training predicts bone change in postmenopausal
27

Ref ID: 394

Ref ID: 211

(195) Czaja AJ. Drug Therapy in the Management of Type 1 Autoimmune Hepatitis. Drugs 1999 January;57(1):49-68. 
Ref ID: 530

Ref ID: 531

Ref ID: 532

Ref ID: 769

Ref ID: 770

Ref ID: 116

Ref ID: 86

Ref ID: 259

Ref ID: 380


Ref ID: 258

Ref ID: 776

Ref ID: 537

Ref ID: 942

Ref ID: 777

Ref ID: 538

Ref ID: 539

Ref ID: 1012

Ref ID: 387

Ref ID: 778
Ref ID: 540

Ref ID: 779

Ref ID: 277

Ref ID: 347

Ref ID: 107

Ref ID: 541

Ref ID: 191

Ref ID: 542

Ref ID: 543

Ref ID: 780


(249) Eastell R. Management of Bone Health in Postmenopausal Women. Hormone Research 2005 November 2;64:76-80. Ref ID: 549


(268) Evans EM, Racette SB, Van Pelt RE, Peterson LR, Villareal DT. Effects of soy protein isolate and moderate exercise on bone turnover and bone mineral density in
Ref ID: 792

Ref ID: 1013

Ref ID: 553

Ref ID: 793

Ref ID: 554

Ref ID: 555

Ref ID: 41

Ref ID: 794

Ref ID: 98

Ref ID: 215

Ref ID: 556

Ref ID: 406

Ref ID: 795

Ref ID: 77

Ref ID: 558

Ref ID: 559

Ref ID: 560

Ref ID: 796

Ref ID: 407

Ref ID: 561
Ref ID: 946

Ref ID: 947

Ref ID: 56

Ref ID: 356

Ref ID: 562

Ref ID: 312

Ref ID: 563

Ref ID: 1014

Ref ID: 325

Ref ID: 564


(301) Giaquinto S, Ciotola E, Margutti F. Gait during hydrokinesitherapy following total knee arthroplasty. Disability & Rehabilitation 2007 May 15;29(9):737-42. Ref ID: 565


(316) Gray RM. The effects of power and resistance training on bone mineral density. DAI 2007;68(08B):5049. Ref ID: 1016


(319) Gregg EW, Kriska AM, Salamone LM, Wolf RL, Roberts MM, Ferrell RE, Anderson SJ, Kuller LH, Cauley JA. Correlates of quantitative ultrasound in the Women's Healthy
Ref ID: 106

Ref ID: 270

Ref ID: 800

Ref ID: 801

Ref ID: 1017

Ref ID: 71

Ref ID: 348

Ref ID: 802

Ref ID: 803

Ref ID: 949

(329) Gusi N, Raimundo A, Leal A. Low-frequency vibratory exercise reduces the risk of bone fracture more than walking: a randomized controlled trial. BMC Musculoskeletal Disorders 2006;7:92.
Ref ID: 264


(348) Hawkins SA, Wiswell RA, Jaque SV, Constantino N, Marcell TJ, Tarpenning KM, Schroeder ET, Hyslop DM. The inability of hormone replacement therapy or chronic running to maintain bone mass in master athletes. The Journals of Gerontology Series A, Biological Sciences and Medical Sciences 1999 September;54(9):M451-M455. Ref ID: 376


(350) Hecker TM, Aris RM. Management of Osteoporosis in Adults with Cystic Fibrosis. Drugs 2004 January 15;64(2):133-47. Ref ID: 574

Ref ID: 235

Ref ID: 45

Ref ID: 21

Ref ID: 188

Ref ID: 951

Ref ID: 219

(357) Heinonen ARI. Exercise as an osteogenic stimulus. DAI 1997;59(04C,):0898.
Ref ID: 1018

Ref ID: 810

Ref ID: 70

Ref ID: 575

Ref ID: 84


(368) Hong WL. Tai Chi and resistance training exercise: Would these really improve the health of the elderly? DAI 2004;65(10B):5065. Ref ID: 1019


(371) Horea M. Refeeding in a rodent model of the female athlete triad. DAI 2004;65(02B):662. Ref ID: 1020


Ref ID: 308

Ref ID: 960

Ref ID: 137

Ref ID: 135

Ref ID: 149

Ref ID: 818

Ref ID: 817

Ref ID: 583

Ref ID: 31

Ref ID: 584

Ref ID: 819
Ref ID: 10

Ref ID: 585

Ref ID: 246

Ref ID: 1021

Ref ID: 586

Ref ID: 233

Ref ID: 587

Ref ID: 192

Ref ID: 588

Ref ID: 55

Ref ID: 274
Ref ID: 412

Ref ID: 267

Ref ID: 373

Ref ID: 589

Ref ID: 413

Ref ID: 590

Ref ID: 414

Ref ID: 591

Ref ID: 592

Ref ID: 820

Ref ID: 141

Ref ID: 48

Ref ID: 382

Ref ID: 287

Ref ID: 203

Ref ID: 822

Ref ID: 201

Ref ID: 196

Ref ID: 823

Ref ID: 824

Ref ID: 825
Ref ID: 826

Ref ID: 827

Ref ID: 593

Ref ID: 1022

Ref ID: 186

Ref ID: 828

Ref ID: 829

Ref ID: 594

Ref ID: 205

Ref ID: 322


(454) Kirkwood RN, Culham EG, Costigan P. Hip moments during level walking, stair climbing, and exercise in individuals aged 55 years or older. Physical Therapy 1999 April;79(4):360-70. Ref ID: 230


(457) Kohrt WM, Ehsani AA, Birge SJ, Jr. Effects of exercise involving predominantly either joint-reaction or ground-reaction forces on bone mineral density in older women. Journal of Bone
Ref ID: 159

Ref ID: 11

Ref ID: 415

Ref ID: 831

Ref ID: 598

Ref ID: 597

Ref ID: 832

Ref ID: 217

Ref ID: 134

Ref ID: 136

(467) Kraemer K, Waelti M, de Pee S, Moench-Pfanner R, Hathcock JN, Bloem MW, Semba RD. Are low tolerable upper intake levels for vitamin A undermining effective food fortification
Ref ID: 599

Ref ID: 833

Ref ID: 600

Ref ID: 834

Ref ID: 835

Ref ID: 836

Ref ID: 601

Ref ID: 183

Ref ID: 291

(476) Kun Z, Bruce D, Austin N, Devine A, Ebeling PR, Prince RL. Randomized Controlled Trial of the Effects of Calcium With or Without Vitamin D on Bone Structure and Bone-Related Chemistry in Elderly Women With Vitamin D Insufficiency. Journal of Bone & Mineral

Ref ID: 837


Ref ID: 603


Ref ID: 371


Ref ID: 604


Ref ID: 838


Ref ID: 839


Ref ID: 87


Ref ID: 840


Ref ID: 366


Ref ID: 328

Ref ID: 244

Ref ID: 842

Ref ID: 416

Ref ID: 605

Ref ID: 606

Ref ID: 843

Ref ID: 844

Ref Type: Generic
Ref ID: 607

Ref ID: 85
Ref ID: 972

Ref ID: 845

Ref ID: 180

Ref ID: 142

Ref ID: 1045

Ref ID: 184

Ref ID: 335

Ref ID: 364

Ref ID: 846

Ref ID: 146
Ref ID: 608

Ref ID: 609

Ref ID: 610

Ref ID: 974

Ref ID: 847

Ref ID: 124

Ref ID: 975

Ref ID: 976

Ref ID: 977

Ref ID: 1025

Ref ID: 611


(528) Martyn-St James M, Carroll S. Progressive High-Intensity Resistance Training and Bone Mineral Density Changes Among Premenopausal Women: Evidence of Discordant Site-


(532) Mathur SR. Effect of protein source and exercise on skeletal health of growing female rats (Bone metabolism). DAI 1998;60(01B,):0135. Ref ID: 1026


(539) McCary J. Good Nutrition for the Golden Years. IDEA Fitness Journal 2008 March;5(3):52-60. Ref ID: 616


(564) Milliken LA. Bone mineral density, bone remodeling, insulin-like growth factors, hormone replacement therapy, and exercise training in postmenopausal women. DAI 1998;59(09B,):4572. Ref ID: 1028


(570) Murray RO. The Phenotype of Adults with Partial Growth Hormone Deficiency. Hormone Research 2005 November 2;64:12-7. Ref ID: 623

(571) Naghii MR, Mofid M. Elevation of biosynthesis of endogenous 17-B oestradiol by boron supplementation: one possible role of dietary boron consumption in humans. Journal of
Ref ID: 152

Ref ID: 860

Ref ID: 198

Ref ID: 420

Ref ID: 170

Ref ID: 1047

Ref ID: 862

Ref ID: 863

Ref ID: 980

Ref ID: 1029

Ref ID: 37

Ref ID: 103

Ref ID: 864

Ref ID: 624

Ref ID: 625

Ref ID: 197

Ref ID: 626

Ref ID: 627

Ref ID: 628

Ref ID: 629


(600) Opalek JM, Graymire VL, Redd D. Wheelchair falls: 5 years of data from a level 1 trauma center. Journal of Trauma Nursing 2009 April;16(2):98-102. Ref ID: 866


(603) Ornes LL, Ransdell LB, Robertson L, Trunnell E, Moyer-Mileur L. A 6-month pilot study of effects of a physical activity intervention on life satisfaction with a sample of three
Ref ID: 422

Ref ID: 635

Ref ID: 636

Ref ID: 637

Ref ID: 638

Ref ID: 868

Ref ID: 288

Ref ID: 869

Ref ID: 870

Ref ID: 640

Ref ID: 871
67


68

International 2003 August;14(8):677-82.
Ref ID: 194

Ref ID: 1049

Ref ID: 127

(627) Park SA. Gardening as a physical activity for health in older adults. DAI 2007;69(05B):2689.
Ref ID: 1030

(628) Parkhouse WS, Coupland DC, Li C, Vanderhoek KJ. IGF-1 bioavailability is increased by resistance training in older women with low bone mineral density. Mechanisms of Ageing and Development 2000 February 7;113(2):75-83.
Ref ID: 237

Ref ID: 82

Ref ID: 875

Ref ID: 643

Ref ID: 876

Ref ID: 644

Ref ID: 295

Ref ID: 645

Ref ID: 646

Ref ID: 1031

Ref ID: 647

Ref ID: 648

Ref ID: 877

Ref ID: 649

Ref ID: 650

Ref ID: 878

Ref ID: 1050

Ref ID: 214


(656) Pruitt LA, King AC, Obarzanek E, Miller M, O'Toole M, Haskell WL, Fast L, Reynolds S. Reliability of the 7-Day Physical Activity Recall in a Biracial Group of Inactive and Active
Ref ID: 653

Ref ID: 654

Ref ID: 392

Ref ID: 655

Ref ID: 15

Ref ID: 284

Ref ID: 425

Ref ID: 879

Ref ID: 656

Ref ID: 657

Ref ID: 880
Ref ID: 658

Ref ID: 881

Reid IR. Therapy of osteoporosis: Calcium, vitamin D, and exercise. American Journal of the Medical Sciences 1996;312(6):278-86.
Ref ID: 1051

Ref ID: 263

Ref ID: 50

Ref ID: 350

Ref ID: 81

Ref ID: 882

Ref ID: 883

Ref ID: 282
Ref ID: 884

Ref ID: 174

Ref ID: 659

Ref ID: 1052

Ref ID: 660

Ref ID: 661

Ref ID: 271

Ref ID: 89

Ref ID: 391

Ref ID: 311

Ref ID: 303


Ref ID: 675

(722) Salem GJ. Response of immature rat femoral neck and lumbar vertebrae to moderate exercise (Femoral vertebrae, biomechanics). DAI 1991;52(03B,:):1280.
Ref ID: 1032

Ref ID: 9

Ref ID: 122

Ref ID: 676

Ref ID: 250

Ref ID: 677

Ref ID: 678

Ref ID: 310

Ref ID: 889

Ref ID: 679


Ref ID: 683

Ref ID: 684

Ref ID: 894

Ref ID: 220

Ref ID: 685

Ref ID: 895

Ref ID: 896

Ref ID: 178

Ref ID: 296

Ref ID: 324

(753) Shirley AB. Women's health: With a focus on HRT and osteoporosis. DAI 2002;64(01C):137. Ref ID: 1033


(762) Skelton DA, Stranzinger K, Dinan SM, Rutherford OM. BMD improvements following FaME (Falls Management Exercise) in frequently falling women age 65 and over: an RCT... 7th World Congress on Aging and Physical Activity. Journal of Aging & Physical Activity 2008 July 2;16:S89-S90. Ref ID: 897
Ref ID: 898

Ref ID: 690

Ref ID: 359

Ref ID: 899

Ref ID: 182

Ref ID: 987

Ref ID: 691

Ref ID: 900

Ref ID: 901

(772) Sparks PL. The relationship of vitamin D and selected nutrient intakes, sex hormone binding globulin and markers of bone turnover to bone mineral density in exercising and non-exercising postmenopausal women taking or not taking HRT. DAI 2001;62(09B):3974.
Ref ID: 1034

Ref ID: 902


(780) Stewart SR. The effects of an 18-month weight-training and calcium-supplementation program on bone mineral of adolescent girls. DAI 1997;59(02B,):0608. Ref ID: 1036


(786) Svendsen OL, Hassager C, Christiansen C. Effect of an energy-restrictive diet, with or without exercise, on lean tissue mass, resting metabolic rate, cardiovascular risk factors, and bone in overweight postmenopausal women. American Journal of Medicine 1993 August;95(2):131-40. Ref ID: 125


Ref ID: 990

Ref ID: 698

Ref ID: 907

Ref ID: 434

Ref ID: 156

Ref ID: 699

Ref ID: 36

Ref ID: 435

Ref ID: 381

Ref ID: 262
Ref ID: 700

(806) Tsai YK, Chen HH, Lin IH, Yeh ML. Qigong improving physical status in middle-aged women. Western Journal of Nursing Research 2008 December;30(8):915-27.
Ref ID: 306

Ref ID: 701

Ref ID: 109

Ref ID: 117

Ref ID: 908

Ref ID: 289

Ref ID: 113

Ref ID: 909

Ref ID: 173

Ref ID: 702


(822) Vainionpaa AJ. Bone adaptation to impact loading—significance of loading intensity. DAI 2007;68(04C):951. Ref ID: 1037


(831) Vatanparast H, Whiting SJ. Calcium Supplementation Trials and Bone Mass Development in Children, Adolescents, and Young Adults. Nutrition Reviews 2006 April;64(4):204-9. Ref ID: 704


Ref ID: 914

Ref ID: 148

Ref ID: 319

(840) Vincent KR. The effects of resistance exercise on lipid peroxidation, bone metabolism, and physical performance in adults aged 60--85 years. DAI 1999;60(09B):4513.
Ref ID: 1038

Ref ID: 915

Ref ID: 916

Ref ID: 75

Ref ID: 917

Ref ID: 254

Ref ID: 353

Ref ID: 436

Ref ID: 1056

Ref ID: 999

Ref ID: 187

Ref ID: 918

Ref ID: 189

Ref ID: 919

Ref ID: 706

Ref ID: 1039

Ref ID: 378

Ref ID: 317
Ref ID: 1000

Ref ID: 707

Ref ID: 708

(861) Ward KA, Roberts SA, Adams JE, Lanham NS, Mughal MZ. Calcium supplementation and weight bearing physical activity--do they have a combined effect on the bone density of pre-pubertal children? Bone 2007;41:496-504.
Ref ID: 1001

Ref ID: 1040

Ref ID: 920

Ref ID: 1055

Ref ID: 1002

Ref ID: 1041

Ref ID: 249

Ref ID: 384
Ref ID: 239

Ref ID: 710

Ref ID: 711

Ref ID: 712

Ref ID: 713

Ref ID: 921

Ref ID: 437

Ref ID: 714

Ref ID: 922

Ref ID: 715

Ref ID: 46
Ref ID: 716

Ref ID: 224

Ref ID: 717

Ref ID: 718

Ref ID: 1003

Ref ID: 719

Ref ID: 923

Ref ID: 924

Ref ID: 439

Ref ID: 1004


Wolf SL, Sattin RW, Kutner M, O'Grady M, Greenspan AI, Gregor RJ. Intense Tai Chi exercise training and fall occurrences in older, transitionally frail adults: a randomized, controlled trial... includes commentary by Lavery L and Studenski S. Journal of the American Geriatrics Society 2003 December;51(12):1693. Ref ID: 925


Wootten DF. Short term time-course skeletal responses to high intensity physical exercise. DAI 2001;66(11B):5936. Ref ID: 1042


(904) Yoshimura N. [Intervention in lifestyle factors for the prevention of osteoporosis and osteoporotic fractures]. Clinical Calcium 2005 August;15(8):1399-408. Ref ID: 443


(910) Zeilman CJ, III. Inflammatory bowel disease, osteoporosis, exercise, and bone mineral density University of Florida; 2007. Ref ID: 930
Ref ID: 931

Ref ID: 1007

Ref ID: 932

Ref ID: 150

Ref ID: 724

Ref ID: 83

Ref ID: 72