


Promoting Adherence to Bone Loading Exercises in Postmenopausal Women: Applying Principals of Self-Efficacy and Self-Regulation

- Nancy Waltman, PhD, APRN-NP, College of Nursing
- Laura Bilek, PhD, PT, College of Allied Health Professions
- Melissa Cole, MA, Research Exercise Trainer – Co-Study Director for HOPS



1


Self-Efficacy



Dr. Albert Bandura: psychologist; researcher; father of social / cognitive theory (self-efficacy and self-regulation); Born in Alberta, Canada, 1925. Full professor at Stanford.

Self-efficacy: According to Bandura (*Self-Efficacy: The Exercise of Control*, 1997).

- "Task" self-efficacy is confidence in ability to perform tasks necessary to obtain desired outcomes
- "Barrier" self-efficacy is confidence in ability to overcome barriers to obtaining desired outcomes.



2

Self-Regulation

Regulating oneself; control from within instead of by an external authority (Bandura, *The primacy of self-regulation in health promotion*, 2005; Bandura, *Social Cognitive Theory*, 2011)

An introspective, conscious decision-making process involving:

- Self goal setting
- Self-observing or behavioral monitoring
- Self-evaluating
- Self-reacting
- Relapse prevention

Supported in numerous studies.



3

BACK TO PARENT STUDY:

Heartland Osteoporosis Prevention Study (HOPS) R01 Funded study

Bone Loading Exercises Versus Risedronate on Bone Health in Post Menopausal Women

Compares three treatments for improving bone strength & preventing osteoporosis (T score <-2.5) in women with low bone mass (T score -1 to -2.49) during their first 6 years post menopause.

NIH / NINR: 1RO15029-01
July 2014 – July 2020



4

Problem: Fractures

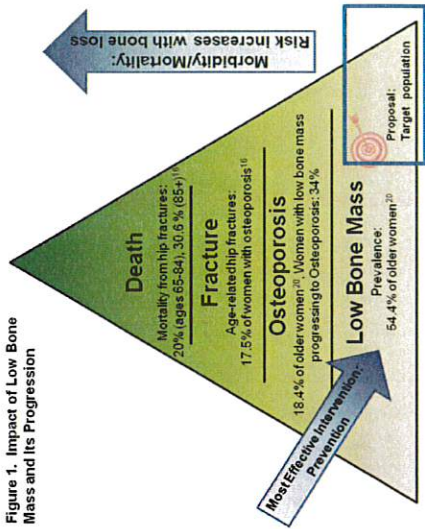
- 12.3 million persons in the US older than 50 years have osteoporosis.
- Fragility fractures associated with loss of independence and quality of life.




- After hip fracture: **50% loss independence and 21-30% mortality**
- Annual health care costs in US: **\$19 billion**
- 71% of fragility fractures occur in women**

5

Figure 1. Impact of Low Bone Mass and Its Progression




6

Purpose of Study, Sample, and Design

Purpose: To compare changes after 12 months in bone structure, bone mineral density (BMD), and bone turnover markers in women randomized to three treatment groups: Exercise group, Risedronate group, Control group.

Sample: Early post-menopausal women with low bone mass were randomized to a 12 month RCT (NCT02186600). Approximately 92 women in each group



7

276 Postmenopausal Women with Low Bone mass

Setting: Testing at Creighton Osteoporosis Research Center (CORC) and UNMC


Inclusion Criteria:

- Low bone mass (-1 to -2.49 T scores)
- Within 6 years of menopause
- Approval of primary care providers

8

Exclusion Criteria

- Osteoporosis (T score <-2.5)
- FRAX score indicating increased risk of major or hip fracture
- Currently on estrogen, tamoxifen, aromatase inhibitors
- Serum vitamin D level <10 or >100 mg/ml
- Over 300 lbs.
- Any condition prohibiting calcium, vitamin D, risedronate, or bone loading exercises



9

Why Postmenopausal Women?

Figure 1 Overview of BMD values during life, indicating the importance of peak bone mass and the subsequent rate of decline in BMD in the development of primary osteoporosis

Men
Primary bone mass (green)
Age-related bone loss (yellow)


Women
Primary bone mass (green)
Age-related bone loss (yellow)
Menopause (red)

Age (years)

Bone mineral density (T-scores)

Nature Reviews | Rheumatology


Hendrickx, D. et al. (2016) A look behind the scenes: the risk and pathogenesis of primary osteoporosis. *Nat. Rev. Rheumatol.* doi: 10.1038/nrn.2016.14



10

Bone-Loading Exercise Intervention

- Resistance Training of the major muscle groups
- Jogging with added weights
- Exercises to provide impact on the lower extremities
- Women in exercise group also take OptimalCa+D




11

3 times wkly at fitness centers (45 min) for 12 months

Lunge - side view

INCORRECT

Women in exercise group also take OptimalCa+D



12

Outcome Measures


BMD – Hologic QDR2000 Dual Energy X-ray Absorptiometry at Creighton Osteoporosis Research Center (CORC).

- Measure of bone mass.
- Gold standard for diagnosis of osteoporosis.

Serum Biomarkers of Bone Formation (AlkphaseB) and Resorption (Serum Ntx)

- Rate of bone loss. Are women “fast” or “slow” losers of bone?
- Women with low BMD and high rates of bone resorption 4 to 5X more likely to fracture

Bone Structure Measures – Results being analyzed at present



13

Changes in BMD & Serum Biomarkers

Intent to treat analysis using hierarchical linear modelling


Mean changes in BMD at hip and femoral neck not different based on group assignment

Changes in BMD at the spine were significantly greater in risedronate group ($p < .001$)

At 12 months, improvements in hip, spine, and femoral neck BMD in risedronate group

Improvements in hip and spine BMD in exercise group


Greater reductions in both bone formation (AlkphaseB) & bone resorption (Serum Ntx) in risedronate group



14

Percent Changes in BMD at 12 Months Per Group

Site	Risedronate	Exercise	Control
Spine	+1.9	-0.9	-0.4
Hip	+0.9	+0.5	+0.5
Femoral Neck	-0.09	-0.4	-0.5



15

Adverse Effects to Treatments


Calcium supplements: Constipation ($n = 7$)

Risedronate: Gastrointestinal ($n=4$); Muscle or joint pain ($n=11$); Chest pain and dizziness ($n=2$)

Vitamin D: Two women ($n=2$) stated “they didn’t feel well on vitamin D”. No other adverse effects reported

Exercises:

- No women withdrew from study due to adverse events.
- Minor muscle soreness managed with adaptation to exercise program.
- 20 women in exercise program did withdraw from study. Most common reason was “lack of time”.
- Mean 12-month adherence to exercises in the 72 women remaining in the exercise group was 58.9%.



16

Conclusions / Discussion Based on Preliminary Findings from Parent Study


12 - month changes in bone structure currently being analyzed

Risedronate had greater increases in BMD at the spine and greater reductions in serum biomarkers of bone turnover

Women in exercise group also had increases in BMD at the spine and hip.

Although BMD is a strong predictor of fractures, only one-third of fragility fractures in women due to low BMD (Mai et al., 2019).

According to readings, bone-loading exercises can also reduce fractures by improving bone structure, muscle strength, balance, gait, and by reducing falls




17

Implications

All postmenopausal women with low bone mass should be taking calcium, vitamin D, and participating in bone-loading exercises.

Risedronate does result in increases in BMD and reductions in bone resorption, and is an extremely effective medication.


Because there are multiple causes of fragility fractures in women, individual programs should be developed that include prescribing interventions for prevention of fractures most applicable to women's assessed needs.



18

Problem of Sedentary Lifestyles in Postmenopausal Women

- More that 60% of women do not engage in recommended level of activity
- Only 9% of women engage in frequent and intense exercise programs
- After 6 months of exercises, 50% of women have discontinued.
- Causes:
Women lack confidence in performing exercises and require extra training. (Lack of self-efficacy) (Bandura, 1997,2005,2011)
There are numerous barriers to women performing exercises three times weekly (Rogers 2005, 2008, 2011)




19

Aims of this secondary analysis study:

Promoting Adherence to Bone Loading Exercises in Postmenopausal Women: Applying Principles of Self-Efficacy and Self-Regulation

- Describe relationships between self-efficacy (Self-Efficacy: Knowledge and Self-Efficacy: Barriers subscales) two weeks into the study and 12-month adherence to exercises.
- Describe relationships between barriers (scores on *BiI*) reported after 6 months of exercises and 12-month adherence to exercises

Examine self-efficacy and self-regulation techniques that could be used to promote adherence to exercises in research studies and in clinical practice



20

Women Assigned to Exercise Group who Completed study (n=72)

Midwestern women with low bone mass

54.7 / 3.0 years of age

Body Mass Index 25.9 / 4.5

84% White / Non-Hispanic

85% college or advanced degree



21

Promoting Adherence to Exercises using Self-Efficacy in Parent Study

Subject education, demonstration and return demonstration of exercises, goal-setting, symptom management, and providing graphic visual feedback

Measures of Self-Efficacy
Adapted from scale by Marcus et al. (1992)
Further methodological studies supported two subscales:

Self-Efficacy: Knowledge
4 items, $r=0.85$
"I know how to exercise as directed to minimize side effects."

Self-Efficacy: Barriers
6 items, $r=0.86$
"I will exercise even though I feel I don't have time".



22


No procedure using Self-Regulation to Promote Adherence in Parent study

We did measure barriers to adherence in study (related to non-adherence to exercise in numerous studies)

Self-reported barriers measured by *Barriers Interference Instrument (BII)*.

- Developed by Rogers et al. (2005, 2008, 2011) based on Bandura's Social Cognitive Theory, numerous methodological studies.
- 20 items measuring frequency of barriers last 3 months on scale one to 5
- R for total scale = 0.92

Sample barrier items: cost, lack of skills, family responsibilities, lack of time, fear of injury.




23

Measures and Timelines

Subjects completed:

- Demographic profile at baseline
- Self-Efficacy Knowledge and Barriers subscales at 2 weeks
- Barriers Interference Instrument (BII) at 6 months
- Adherence to exercises measured using exercise logs and fitness center reports
 - At 6 months = 68.2% At 12 months = 58.9%



24

Results of Secondary Analysis Study

Aim 1: Describe relationships between self-efficacy (*Self-Efficacy*: Knowledge and Self-Efficacy; *Barriers subscales*) two weeks into the study and 12-month adherence to exercises.

- Self-efficacy subscale scores at two weeks were not significantly correlated with 12-month adherence to exercises.

Aim 2: To describe relationships between barriers reported after 6 months of exercises and 12-month adherence to exercises


- 17 of the 20 *B/I* items were negatively correlated with adherence rates ($p < .001$ or $p < .005$). (When barriers more frequent, adherence rates decreased)



Relationships between *B/I* items and Adherence

First 10 items: Ratings are how often barrier items interfered with exercise in past 3 months: Scale of 1 to 5 (Never to Very often)


Items on Instrument	M / SD	r	p
Lack of time	2.5/1.2	-.572	<.001
Exercise not in routine	1.5/.08	-.502	<.001
Lack of self-discipline	1.8/1.0	-.489	<.001
Fatigue	1.7/0.9	-.464	<.001
Procrastination	1.7/0.8	-.450	<.001
Inconvenient schedule	1.7/0.9	-.399	<.001
Lack of enjoyment from exercise	1.5/0.8	-.393	<.001
Weather	1.4/0.7	-.388	<.001
Exercise not priority	1.5/0.7	-.364	<.001
Lack of company	1.2/0.7	-.320	<.001



Relationships between *B/I* items and Adherence


Second 10 items

Items on Instrument	M / SD	r	p
Exercise is boring	2.5/1.2	-.306	<.005
Family responsibilities	1.5/0.8	-.300	<.005
Cost of exercising	1.8/1.0	-.292	<.005
Lack of skills	1.7/0.9	-.275	<.005
Feeling ill	1.7/0.8	-.266	<.005
Pain or discomfort	1.7/0.9	-.263	<.005
Lack of knowledgeable staff	1.5/0.8	-.245	<.005
Lack of equipment	1.4/0.7	-.189	NS
No facilities or space	1.5/0.7	-.167	NS
Fear of injury	1.2/0.7	-.072	NS



Results of Secondary Analysis Study

- The only demographic characteristic of subjects related to adherence was body mass index (BMI).
- Regression Analysis:**
 - 4-Predictor Model: 1) and 2) Self-efficacy; Knowledge and Barriers subscale scores; 3) total *B/I* score; and 4) BMI.
 - Accounted for 37.9% of the variability ($R^2 = 0.379$).
 - The most important predictors were the 6-month total *B/I* scores (Beta = -0.549) and the BMI (Beta = -0.235).



Higher and Lower Adherers to Exercise

- 72 women divided into lower and higher adherers using median split.
- Lower adherers had higher BMI measures at baseline ($M/SD = 27.2/4.4$), indicating they were overweight.
- Higher adherers had a normal BMI at baseline ($M/SD = 24.6/4.0$).
- Lower adherers reported "lack of time" as a barrier to exercise occurring "often"
- Higher adherers reported "lack of time" as a "rare" barrier ($t=-4.996, p<.001$).



29

Conclusions and Implications of Study for Clinical Practice and Research

- The most common barriers reported were **Lack of time, exercise not in routine, lack of self-discipline, fatigue, procrastination**
- These barriers could be addressed using techniques for self-regulation.
- Guidelines (key points) to be used in clinical to assist patients in managing their time and in maintaining adherence to exercise.
- For research studies: Use of Acceptance-Based Therapies (ABT) to facilitate commitment to participation in exercise programs.



30

For Clinicians: Key Points for Patients "Making Time for Exercise"

- Recognize your own self-worth
- Acknowledge that investing in personal development such as exercise will improve your overall quality of life
- Your personal development is your priceless gift to family and friends
- Develop long-term goals that prioritize exercise
- Enlist family and friends to help you to achieve your goals
- Every day:
 - Set short-term goals and activities to meet goals daily



31

For Clinicians: Key Points for Patients "Making Time for Exercise" - continued

- Engage in priority activities first
- Identify barriers to your accomplishment of goals
- Develop strategies for preventing and reducing barriers
- It's not the number of activities you perform, it is the quality of the activities.
- Set activities and goals for exercise that are reasonable and flexible
- References: Bandura, 2011; Gierc et al., 2016; Jeng et al., 2004; McArthur et al., 2014; Tracy, 2013.



32

For Researchers: Self-Regulation: Acceptance-Based Therapy (ABT Intervention)

- Seminars, interactive activities, group participation, written homework. (Forman & Butryn, 2015)

Components of ABT Intervention / Session Topics

- Values clarity / commitment enhancement
- Distress tolerance
- Awareness Training
- Summary / Meeting challenges to adherence



33

Values clarity / commitment enhancement Session: Part I


- Identifying benefits of exercise / physical activity, guidelines and procedures.
- Recognizing sedentary lifestyle is a default position
- There is intrinsic preference to conserve energy
- Resisting default position involves conscious decision making
- Personal values should guide conscious decision-making and behavioral commitments



34

Values clarity / commitment enhancement Part II


- Freely and personally choosing meaningful, higher-order life values.
- Example: "to live a long and healthy life and not have to be dependent on others".
- Realistic short-term and long-term goals should be set to reflect values.
- Values and behavioral commitments must be strong enough to direct conscious decision-making and overcome default decisions providing momentary pleasures.
- Example: Based on personal life values, making a deliberate choice to exercise rather than sleeping an extra hour in the morning.



35

Distress tolerance


- Temptations, urges to avoid exercise often occur in today's environment
- Ability to adhere long-term to exercise depends on ability to tolerate some unpleasant internal experiences (e.g., fatigue, a sense of deprivation).
- Distress tolerance is acceptance of a less pleasurable state over a more pleasurable state, when doing so is in the service of a valued goal.
- For example, experiencing the pleasure that comes from exercising which, at least for the moment, would be less than the pleasure of watching a favorite TV program.



36

Awareness

- Self-monitoring: Allows individuals to be aware of and override automatic default processes and activities that provide momentary pleasure, and to choose activities that support the value of their long-term health




37

Summary Session

Meeting Challenges to adherence to exercises. Using skills for self-regulation and self-efficacy

- Assessing feedback on progress in meeting outcomes and short-term and long-term goals
- Resetting goals as needed
- Using strategies to make exercise more pleasurable
- Using strategies to reduce barrier interference
- Forming habits that promote long-term health




38

References

Mai, H.T., Tran, T.S., Ho-Le, T.P., Center, J.R., Eisman, J. A., Nguyen, T.V. (2019) Two-thirds of all fractures are not attributable to osteoporosis and advancing age: Implications for fracture prevention. *J Clin Endocrinol Metab.* 104: 3514-3520


Forman, E.M. & Butryn, M.L. (2015) A new look at the science of weight control: How acceptance and commitment strategies can address the challenge of self-regulation. *Appetite* 84: 171-180 (Acceptance-Based Therapy)

In addition, refer to the references listed in the JAANP publication posted on the CENTRIC website



39

Thank you, Questions?



40