I. Impact of low back and pelvic disorders on women
   a. Low back pain “is the leading cause of activity limitation and work absence throughout much of the world, and it causes an enormous economic burden on individuals, families, communities, industry, and governments. (Hoy 2010, Lidgren 2003, Steenstra 2005, Kent 2005, Thelin 2008)
   b. Definition of low back pain and pelvic pain
      i. Low back pain (LBP) is defined as
         1. Pain between the 12th rib and gluteal fold (Vleeming 2008)
         2. “Pain between inferior margin of 12th rib and inferior gluteal folds that is bad enough to limit usual activities or change the daily routine for more than 1 day. This pain can be with or without pain going down into the leg. This pain does not include pain from feverish illness or menstruation.” (Dionne 2008)
      ii. Pelvic girdle pain (PGP) is defined as pain between the posterior iliac crests and gluteal fold (Vleeming 2008)
      iii. Chronic pelvic pain is defined as non-cyclic pain in the lower abdomen and/or pelvis lasting 3-6 or more months, not exclusively associated with intercourse or menstruation.
   c. Pelvic floor dysfunction
      i. Urinary incontinence
      ii. Urgency/frequency
      iii. Obstructed defecation
      iv. Constipation
      v. Fecal incontinence
      vi. Prolapse
      vii. Dyspareunia
      viii. Sexual dysfunction
      ix. Chronic pelvic pain
   d. Prevalence of LBP and PGP in women across lifespan
      i. LBP
         1. Variability in the literature due to based on relation to temporality and topography and minimum episode duration (Hoy 2010, Calvo-Munoz 2013)
            a. Point prevalence: 1-58.1% (15% median) – adults; 12% adolescents
b. 1 year prevalence: .8%-82.5% (37.4% median)-adults; 33% adolescents

c. 1 day minimum duration: 24.7% median – adults; 36% adolescents

d. Chronic LBP: 18.1% median

2. Risk factors:

a. Age

i. Highest in 3rd decade

ii. Prevalence increases with age until age 60-65

iii. More severe forms of LBP with increasing age

iv. Prevalence increasing in adolescents

b. Gender (Hoy 2010, Kovacs 2003)

i. Higher prevalence in women (64.7%) vs men (50.8%)

ii. Women are more likely to take time off work

iii. Women more likely to use health care for LBP

iv. Women are more likely to develop chronic LBP

v. Less of a difference found in low and middle income countries

c. Educational status

i. Low education status associated with increased prevalence of LBP

ii. Strong predictor of episode duration and poor outcomes

iii. However, there seems to be no disparity in SES and chronic back pain (Wyshak 2013) (graph)

d. Body weight

i. Weak risk factor

ii. Association may be stronger in women than in men (Croft 1999)

e. Psychosocial factors

i. Stress, anxiety, depression, pain behavior (unclear relationship)

ii. Workplace factors (Hoogendoorn 2000, Linton, 2001)

1. Job dissatisfaction

a. Also associated with transition from acute to chronic LBP (van Tulder 2002)
2. Monotonous tasks
3. Poor work relations
4. Lack of social support in work place

ii. PGP in pregnancy
   1. Wide range reported in the literature- likely due to differences in
definition and patient under-reporting
      a. 72% n= 891 (Mogren 2005)
      b. 68.5% n=645 (Wang 2004)
      c. 40% n= 855 (Ostgaard 1991)
      d. 20% n=4,724 (Vleeming, 2008)

e. Prevalence of pelvic floor dysfunction in women (Lawrence 2008)
   i. 25- to 84-year-old
   ii. Stress Urinary Incontinence: 15%
   iii. Overactive Bladder: 13%
   iv. Pelvic Organ Prolapse: 6%
   v. Anal incontinence 25%
   vi. 37% for any one or more disorder
   vii. Chronic pelvic pain – 24% (Latthe 2006)

f. Association of LBP - pelvic dysfunction – respiratory dysfunction
   i. 78% women with LBP have SUI (Eliasson 2007)
      1. Association of UI and asthma for men (OR 1.3) and women (OR 1.36)
      2. Regular UI was associated with lower mean (SD) forced expiratory
         volume/s
      3. 60% of women with COPD and 67% with CF have SUI (vs. 26%
         normals)
   iii. Association of UI- LBP-Respiratory Disorders (Smith 2006)
      1. Middle aged and older women had higher OR 2.0 of having back
         pain often when they experienced breathing difficulties
      2. Women with respiratory disorders are more likely to have back
         pain (OR 2.0)
      3. Disorders of continence and respiration were strongly related to
         frequent back pain.
   iv. MSK dysfunction in Female CPP : blinded study (Neville 2012, Fitzgerald
      2011)
      1. 48 non pregnant women with and without CPP
2. Participants with pelvic pain were more likely to have more MSK findings than those without pelvic pain

g. Impact on health/function
   i. 30-50% women with LBP in pregnancy report pain severe enough to decrease work time and social interaction (Noren 1997, Kriiannson 1996, Ostgaard 1991)
   ii. 20% of women experience pain severe enough to avoid future pregnancy due to fear of LBP (Brynhildsen 1998)
   iii. 37% of women reporting back pain in pregnancy still reported back pain at 18 mos postpartum (Larsen 1999)
   iv. 8.6% suffered pelvic joint pain 2 years postpartum (Albert 2001)

h. Social impact (individual/societal) (Hoy 2010)
   i. Impact on
      1. Individuals
      2. Families
      3. Communities
      4. Health care systems
      5. Businesses
   ii. Burden
      1. Pain
      2. Activity limitations
      3. Participation restrictions
      4. School absenteeism
      5. Career burden
      6. Use of health care resources
      7. Financial burden
   iii. Financial burden (Luo 2004)
      1. Medical care costs
      2. Indemnity payment
      3. Productivity loss
      4. Employee retraining
      5. Administrative expenses
      6. Litigation

II. Anatomical and biomechanical changes in female development
   a. Young child (Brockmeyer 2013)
i. Infant spine (0-2 years) – mobility and elasticity
   1. Underdeveloped neck muscles
   2. Vertebrae
      a. Incomplete calcification
      b. Wedge shaped
      c. Shallow and horizontally oriented facets
      d. Large head relative to torso – increased likelihood of cervical injuries

ii. Children (2-10 years)
   1. Ligaments and muscles strengthen
   2. Maturation of bones in size, shape, calcification
   3. More proportional head-torso relationship

b. Adolescent-Pubescent (Poussa 2005)
   i. Mean thoracic kyphosis more pronounced in boys vs girls (graphs)
      1. Tendency increased in males from adolescence to young adulthood (most prevalent at age 22)
      2. Thoracic kyphosis mean decreased in females during growth
   ii. Mean lumbar lordosis more pronounced in girls
      1. Ages 11, 12, 13, 22
   iii. Mean peak height velocity was 12 years for girls (14 years for boys)
   iv. High incidence of spinal injury
      1. Tackle football, rugby, wrestling, boxing

c. Adult Female (Janssen 2009)
   i. Female spine (Thoracic to sacrum) – more dorsally inclined (compared to males)
      1. Vertebrae more subject to great dorsally directed shear loads - less rotationally stable (spine best resists axial load and anterior shear
   ii. Significantly larger lumbar lordosis
   iii. Higher pelvic incidence (angle between the connecting midpoint of the sacral plate to the hip axis and the vertical
   iv. Higher sacral slope (angle between superior endplate of S1 and horizontal
   v. Degenerative process first starts in disc in both sexes as early as in the 2nd decade (Wilmink 2011)
      1. Loss of disc height
      2. Degradation and dehydration of nucleus pulposus

d. Peripartum (Stephenson 2000)
i. Progressive alterations in body shape and weight
ii. Joints and ligaments loosen with hormonal influence (relaxin)
iii. Less effective sacroiliac joint stabilization due to increase in mobility to allow for adaptive pelvic diameter changes during pregnancy
iv. Pubic symphysis separates/widens (1-5 mm normally)
v. Kyphotic-lordotic posture in pregnancy (see pic of evolution of lordosis)
vi. Lumbar and cervical curves increase to adjust to growing uterus and changing COG
vii. Pregnant women may lean back slightly, with weight toward heels abdominal muscles relaxed, to counteract enlarging uterus.

e. Postmenopausal (Tenne 2013)
i. Prevalence of degenerative changes in the lumbar spine is high in elderly women and increases with age
ii. Degenerative changes are more common in the lower segments of spine
iii. Vertebral fractures have highest prevalence in lower thoracic spine
   1. Affects anterior and central vertebral body

III. The female core – anatomical and functional overview
   a. Review of anatomy
      i. Abdominals
      ii. Multifidus/Erector spinae
      iii. Diaphragm
      iv. Pelvic Floor
   b. Functional activation of core
   c. PFM Dysfunction the Respiratory Connection
      i. Chronic, repetitive increase in abdominal pressure can lead to downward displacement of PFM
      ii. Consistent strain of PF with cough and other airway clearance techniques
      iii. Likely due to reduced endurance of PFM vs. differences in strength and timing (Button 2005)
      iv. Compromised diaphragm disrupts abdominopelvic balance and continence mechanism
   d. Postural Factors
      i. Kyphotic posture can impact abdominopelvic function
      ii. Neutral spine promotes PFM function
   e. LBP and UI
      i. Delay in TrA activation – inefficient stabilization of L/S and PFM co-activation
IV. Musculoskeletal low back and pelvic conditions across the female lifespan
   a. Adolescent
      i. Potential Risk factors (Korovessis 2010, Kaspiris 2010)
         1. Family history (1.6 higher risk with family history)
         2. Female sex
            a. Earlier maturity and onset of puberty
            b. Underreporting of LBP in males?
            c. Increased report of psychological distress
               i. Increased reports of stress and nervousness
               ii. Girls with anxiety disorders and 3.4 x greater prevalence of MSK pains
               iii. Girls with depression had 13x greater prevalence of MSK pains
            d. Some reports do not show a significant difference
         3. Height
         4. Passive smoking – weak indicator
         5. Heavy school bag – weak correlation; Carrying on one shoulder may be a factor (Skoffer 2007)
         6. Poor school furniture – weak correlation
         7. Participation in sports
            a. Swimming/soccer—may be preventative
            b. Participation in sports increase prevalence in some studies; may be protective in other studies
            c. Competitive sports with high levels of competition, intense physical training, and risk for acute spinal trauma – higher prevalence.
            d. Longer duration of participation in sports may be a factor (Hangai M, 2010)
               i. Lumbar intervertebral disc degeneration (baseball, swimmers)
               ii. Spondylolysis (throwing sports, gymnastics, rowing)
         8. Prolonged sitting
            a. Longer sitting
            b. Poor posture
            c. Less general activity
         9. Presence of scoliosis, LLD – conflicting evidence
10. Psychological distress

ii. Incidence of pediatric spine trauma: 1-11%
1. Increased likelihood of vertebral column injury in males 10-16 year group
2. Higher incidence of spinal cord and spinal column injuries in females in 0-5 year group

iii. Spondylolisthesis (Tskirikos 2010)
1. Spondylolysis: Defect of the pars interarticularis
2. Male to female ratio - 2:1, but progression to spondylolisthesis is more likely in females.
3. Incidence in children 4.4-6%
4. Increased prevalence in adolescents in sports with repetitive hyperextension
   a. Gymnastics (11%)
   b. Dancers (20%)
   c. Weight-lifting
   d. Swimming/Diving (43%)
   e. Wrestling (30%)
   f. Rowing
5. Most common at L5S1 – junction of mobile lumbar spine and stable sacrum
6. Progression of spondylolisthesis most likely to occur in adolescence during growth spurt

7. Clinical presentation
   a. Late childhood to early adolescence
   b. Midline low lumbar pain
   c. Aggravated by sports, prolonged standing, hyperextension
   d. Traumatic episode my start symptoms
   e. Hamstring tightness (80% of symptomatic patients)
   f. Limited forward bend
   g. Limited SLR
   h. Palpable step off of L5 to L4 spinous processes

8. Rehabilitation
   a. Activity modification
   b. Minimize extension stresses on lumbar spine
   c. Improve hip flexor and hamstring flexibility
   d. Bracing to reduce lumbar lordosis to unload posterior vertebrae
e. Lumbopelvic stabilization
f. Postural education

9. Surgery
   a. Considered in children with slip greater than 50%
   b. Grade II spondylolisthesis

b. Young adult
   i. Chronic pelvic pain (Gyang 2013)
      1. Affects 15% of all women annually in the US
      2. Presence of pain in the pelvic region over 6 months
      3. Can have gynecologic, urologic, gastrointestinal, or **musculoskeletal** origin
      4. Pain location/symptoms
         a. Vague/poorly localized pain
         b. Dysparuenia
         c. Voiding dysfunction
         d. Constipation
         e. Pain in low back, vagina, vulva, lower abdomen
   5. Musculoskeletal factors
      a. Pelvic floor dysfunction
      b. Pelvic joint imbalance
      c. Myofascial pain
   6. Interdisciplinary team approach
      a. Medical
      b. Psychology
      c. Pelvic floor physical therapy
   ii. Mechanical low back pain (DePalma 2011)
      1. Zygapophysial joints (31%)
      2. Sacroiliac joints (18%)
      3. Lumbar disc (42%)
   c. Peripartum
      i. Postural/anatomical changes in pregnancy
      ii. Low back/Pelvic girdle pain (Vleeming 2008, Kanakaris 2011, Foley 2006)
         1. Biomechanical changes of posture during pregnancy can predispose
         2. Compensatory adaptations to anatomical changes in function change spine function
3. Decreased ability to lock SIJ and stabilize pelvis during load transfer

4. Risk factors
   a. H/o LBP
   b. Trauma to pelvis
   c. Unilateral repetitive loading (skiing, rowing)
   d. Pregnancy
   e. Pain prior pregnancy

5. PGP - Pain location and common symptoms
   a. Unilateral
   b. Below L5
   c. Pain with transitional movements, assymetrical positions, bed mobility, walking
   d. + Pelvic joint provocation tests, + Functional Load Transfer tests

   iii. Pelvic floor dysfunction
      1. Urinary incontinence
      2. Fecal/anal incontinence
      3. Pelvic pain
      4. Prolapse

5. Risk factors for urinary incontinence (El-Hefnawy 2011)
   a. Vaginal birth
   b. Vaginal birth with instrumentation
   c. Obesity
   d. Respiratory dysfunction
   e. Abdominal surgical history
   f. Post menopausal
   g. Chronic constipation

6. Risk factors for pelvic organ prolapse
   a. Increased risk with each vaginal delivery
   b. Increased age
   c. Vaginal delivery with instrumentation
   d. Levator ani trauma
   e. Self reported fair or poor health status
   f. Constipation
   g. IBS
   h. Estrogen use
   i. Maternal history of prolapsed
j. Heavy physical work
k. Weak connective tissue signs
l. Obesity
m. White/Latina ethnicity
d. Postmenopausal
i. Degenerative disc disease (De Schepper 2010)
   1. Lumbar disc degeneration more prevalent in men in the young and middle aged years
   2. Over 55 years old, disc space narrowing is more prevalent in women
   3. Decrease in estrogen level may be a factor affecting the accelerated disc degeneration.
ii. Osteoporosis (National Osteoporosis Foundation 2008)
   1. 10 million Americans have osteoporosis; 8 million are women
   2. Approximately 1 in 2 women over age 50 will have an OP related fracture in their lifetime.
   3. Risk factors
      a. Female
      b. Older age
      c. Family history of OP or fractures
      d. Small/thin frame
      e. H/o fractures
      f. Low sex hormones
      g. Dietary deficiency of calcium or vitamin D
      h. Excessive protein, sodium, caffeine intake
      i. Sedentary lifestyle
      j. Smoking
      k. Excessive alcohol intake
      l. Medications: steroids, anticonvulsants
      m. Medical conditions: anorexia, RA, GI disorders
4. Posture of Osteoporosis
5. Common impairments
6. Functional implications
7. Exercise and Osteoporosis
   a. Resistance training can preserve and increase BMD at L/S, femoral neck, and radius (Kelly et al, 2001; Kemmler et al. 2003; Mitchell et al., 2003)
b. RCTs demonstrate exercise training programs can prevent or reverse almost 1% bone loss/year in the lumbar spine and femoral neck (Wolff, 1999)


c. Strenuous aerobic and strength training can enhance bone mass (Guitin, 1992)

d. The effect of progressive resistance training is site specific (Layne & Nelson, 1999)

e. Bone responds to both ground and joint reaction forces (Kohrt et al., 1997; Going et al., 2003)

f. Long term effects of exercise – reduced fall and fracture risk (Sinaki, 2002; Kemmler, 2002)

iii. UI (Brown 1999)

1. Prevalence: 50-56%

2. Risk factors

   a. Higher Body Mass Index
   b. Older women
   c. Diabetes
   d. Report of 2 or more UTIs/year
   e. Constipation

V. Lumbopelvic examination of the female patient – Lecture/Lab

a. Review of Systems and History Taking - gender specific considerations

i. Past medical history

   1. OB/gyn history

      a. Number of pregnancies, number of births
      b. Labor and delivery history
      c. H/o pain or complications in previous pregnancies
      d. Pregnant patients

         i. Current gestational age
         ii. Singleton vs multiples
         iii. Complications/precautions/activity restrictions
         iv. Hypertension
         v. Bowel/bladder

   2. Urological/GI history

      a. Leakage of urine or stool or gas
      b. Pain with voiding
      c. Difficulty with voiding

   3. Abdominal surgeries

ii. Psychosocial

   1. Family responsibilities
2. Occupational duties
3. Support system
4. Exercise – current and past
5. Postpartum moms: general health of newborn, sleeping, return to work situation, fatigue
6. Screen for postpartum depression
7. Factor influencing motivation level
   iii. Cardiopulmonary
   iv. Integumentary
   v. Musculoskeletal
   vi. Neuromuscular
   vii. Posture/ergonomics
b. Selected examination procedures and special tests
   i. Observation and palpation of female lumbopelvic structures
   ii. Lumbopelvic algorithm
      1. Lumbar spine
      2. Pelvic girdle
      3. Hip
   iii. Pelvic Girdle Testing
      1. Functional Load Transfer Tests
         a. Stork Test
         b. Active Straight Leg Raise
      2. Pain Provocation Tests
         a. Posterior Pelvic Pain Provocation Test
         b. FABER
         c. Gaenslen
         d. SIJ Distraction/Compression
         e. Pubic symphysis palpation
c. Abdominal and pelvic floor assessment
   i. Transverse abdominal activation
   ii. Diastasis recti abdominis assessment
   iii. Pelvic floor muscle assessment (external)
d. Lower quarter kinetic chain screening
   i. Single leg stance
   ii. Calf raise
   iii. Squat
      1. Double leg
      2. Single leg
iv. Lunge
v. Step down

VI. Considerations in Pregnancy (Stephenson 2000)
   a. Positions to avoid
      i. Abdominal compression
      ii. Supine over 3 minutes
      iii. Inversion
   b. Activities to avoid
      i. Rapid, bouncing or swinging movements
      ii. Sharp twists
      iii. Vigorous adductor stretching
      iv. Extreme asymmetrical lower extremity positions
      v. Extreme hip end range of motions
   c. Red flags in pregnancy
      i. Vaginal bleeding
      ii. Excessive shortness of breath
      iii. Chest pain
      iv. Painful/regular uterine contractions
      v. “Gush” of fluid from vagina
      vi. Dizziness/faintness

VII. Treatment and recovery of function
   a. Pain management
   b. Mechanical treatment
      i. Repeated motion testing
      ii. Progression of forces
   c. Stabilization and Strengthening
      i. Condition specific
         1. Pregnancy /postpartum
            a. Increase force closure (stabilize) vs. decrease excessive force closure
            b. Gentle joint mobilization
            c. Use of pregnancy support/SIJ belt
         2. Osteoporosis
            a. Safe movements (National Osteoporosis Foundation)
               i. Avoid excessive or repetitive trunk flexion
ii. Avoid excessive or repetitive twisting and sidebending

iii. Maintain proper postural alignment with activities

b. Exercise Guidelines
i. Follow the principles of “safe movements”
ii. Address the underlying deficits and compensate for the physiologic deficits

iii. Physical activity parameters (Barry, 2008)
1. TYPE
   a. Strain: signal that bone cells sense to regulate metabolic response to loading
   b. Ground rxn forces vs. Joint rxn forces

2. INTENSITY
   a. Intensity of loading force=strain magnitude
   b. Osteogenic if forces exceed normal daily activities
   c. Increase speed, impact, resistance

3. DURATION
   a. Less important than intensity
   b. High intensity, low reps beneficial
   c. Desensitization of loading stimulus
   d. Optimal # not clear

4. FREQUENCY
   a. Low reps, more frequent sets
   b. Adaptive response enhanced with multiple brief sessions

iv. Finding the optimal parameters to effectively load the bone without risking injury (overload)

v. Maximize forces on the bone by combining joint rxn force with ground rxn force exercises with consideration to positioning and alignment. Vary the movements to “surprise” the bone. (Meeks 2005)

vi. Use of postural supports

ii. Pelvic floor muscle training
   1. PFMT during pregnancy can reduce UI during pregnancy and postpartum (Morkved 2003)
   2. PFMT during pregnancy are less likely to report lumbopelvic pain in the last trimester and at 3 months postpartum (Ko 2011)
   3. Referral to Pelvic Floor PT
d. Functional integration
   i. Body mechanics and postural strategies
      1. Adolescent/Teen
      2. Pregnancy
      3. Childcare activities
      4. Labor & Delivery
      5. Osteoporosis
         a. ADLs with Safe Movements
         b. Postural retraining
   ii. Core activation with functional activities
   iii. Pain management strategies during the day

e. Exercise and Activity
   i. Benefits of exercise for women (Centers for Disease Control)
      1. Stronger muscles/bones
      2. Better balance
      3. Lower blood sugar, cholesterol, blood pressure
      4. Less likely to be overweight
      5. More energy
      6. Decreased anxiety/depression
      7. Miss fewer days of work
   ii. Inactivity is 4th leading risk factor for overall mortality
   iii. Women & activity
      1. More than 60% of US women do not engage in the recommended amount of physical activity
      2. More than 25% of US women are not active at all
      3. Physical activity is more common in women than men
      4. Social support from family and friends is positively related to regular physical activity
   iv. Common barriers for women
      1. Time
      2. Cost
      3. Limited mobility
      4. Cultural expectations
   v. Exercise guidelines across the lifespan and in pregnancy (handout)
References


Meeks, SM. The Role of the Physical Therapist in Recognition, Assessment, and Exercise Intervention in Persons With, or at Risk for, Osteoporosis. Topics in Geriatric Rehabil 2005;21(1): 42-56.


