DoD Ergonomics Working Group NEWS

Issue 64, May 2007 www.ergoworkinggroup.org

Ergonomic Protection for Expectant Mothers: *A Physiological Perspective*

Most people readily recognize the signs of pregnancy and appreciate the drastic changes that take place. The most obvious sign is the weight gain that occurs as a result of the mass of the developing fetus and the additional weight gained by the mother to support the pregnancy. Though the mother feels the strain of the added weight, she and others have difficulty conceptualizing the amount of stress that occurs. On average, women gain approximately 33 pounds during pregnancy. This weight affects the expectant mother in everything she does:

- It increases the amount of stress imposed upon the muscles that power motion.
- It amplifies the stress on ligaments and other soft tissues that are stretched when assuming non-neutral postures.
- It causes huge increases in the amount of force that the body receives during abrupt impacts encountered when the foot strikes the ground while walking, running, or jumping. It should also be no surprise that carrying the additional weight causes pregnant women's hearts and lungs to work harder in order to meet increased oxygen and nutritional demands.

While weight gain is an obvious result of pregnancy, other not-so-obvious changes occur. Ligaments become more lax throughout the body. This laxity generally provides a positive benefit—protecting mother and neonate from injury during delivery by making the pelvic ring more pliable. However, it can be a liability. Joints are rendered less stable. Muscles contract stronger to buttress joints from the stresses of movement and impact. Usually the strategy of using additional muscle force to brace the joints is successful. One objective indicator of this increase in joint resilience is the amount of separation that occurs at the symphysis pubis which is located in the mid-line at the lower abdomen. The average woman realizes approximately 3/8 of an inch separation at that joint during pregnancy. However, in extreme cases separations as much as 3 3/4 inches have been measured. Larger separations create greater mechanical instabilities and degrade the quality of position sense that is relayed from receptors in the soft tissues surrounding the joints.

Continued on page 2

Identifying the Risks

The weight gain and joint laxity described in the previous section can yield musculoskeletal injuries due to heightened risks of falls, overuse, subluxations (especially in the pelvis), and spontaneous abortion. Injury risk is accentuated when expectant mothers are exposed to ergonomic risk factors such as:

- Non-neutral posture
- Whole body vibration
- Jolt
- Muscular or cardiopulmonary exertion

The risk of a pregnant worker falling while assuming non-neutral postures or working on unstable surfaces such as a ship deck is increased. This is principally due to balance impairment that results from the destabilizing effects of shifts in the center of gravity caused by increases in body mass and degradation of the quality of position sense information relayed by joints. Increases in abdominal girth from weight gain create another potential safety risk. Soft tissue compression from improperly applied seat belts may transfer enough force to the mother's abdomen to produce injury.

Overuse injuries are more likely to occur during pregnancy due to the increased load on muscles that must not only handle more weight but also work harder to stabilize joints. In cases of abnormal joint laxity, the muscles may not be able to generate sufficient force to make up for the lack of tension that the ligaments usually provide. Subluxations (minute shifts in the normal physical relationship between the bones within a joint) may occur. Osteopaths have noted several types of subluxation that can occur in the pelvis, including torsion or rotation of the hip bones or an upward slipping of the hip bones. A Naval shipyard worker who had this condition reported sacroiliac and pelvic pain after abruptly stepping down from a pier during the first trimester of her pregnancy. Even though this type of injury can occur during the outset of pregnancy, the literature reports that the highest risk is during the last trimester.

Most experts agree that the risk of manifesting an unfavorable event from exposure to an ergonomic risk factor is not the same throughout the term of the pregnancy. It is believed that the physiological changes of pregnancy increase susceptibility to musculoskeletal injuries from about 6 weeks after conception through 6 weeks after delivery. ***Perhaps the most important lesson here is that joint laxity occurs early in pregnancy—long before the mother's weight gain limits physical activities.*** Thus, women in physically demanding occupations may fail to receive cues to moderate their activity and continue to perform stressful tasks that could increase risk of musculoskeletal injury.

The risk of exposure to mechanical stressors during pregnancy is not totally borne by the mother. The fetus incurs risk as well. Studies have determined that exposure to excessive occupational physical activity can have detrimental effects on pregnancy and may be associated with preterm labor or spontaneous abortion. ***Implementing appropriate controls is especially applicable to active duty military females since they have been shown to have five times more risk for preterm labor complications than civilian working women.***

Pregnancy-related Changes & Associated Injury Risks

Condition	Effect	Consequence
Increased Body Mass	Increased Body Girth	Girth increases force extended reaches that increase biomechanical forces and musculoskeletal injury risk.
	Altered Center of Gravity	The shift in the body's center of gravity increases demand on sensorimotor elements that underpin balance thereby increasing risk of slips, trips & falls.
	Increased Postural (static) Load	Inert tissues that statically support loads during awkward postures such as ligaments incur greater stress that, in turn, increases injury risk.
	Increased Muscular Exertion	Muscles work harder to support excess mass which increases risk for muscle fatigue & strain.
	Increased Cardiopulmonary Exertion	The cardiopulmonary system incurs greater demands to sustain activities & work, thereby increasing susceptibility for systemic fatigue and musculoskeletal injury.
	Increased Impact on Ground Contact	Increased body mass imparts more energy to the ground during foot strike and increases joint reaction forces. This increases the intensity mechanical stress sustained by the musculoskeletal system and injury risk.
Increased Joint Laxity	Increased Translation of Bones Within Joints	Pregnancy-related physiological changes increase laxity of soft tissues that provide static support to joints. Boney elements glide further within joints increasing risk of subluxation and dislocation.
	Increased Demand for Joint Stabilization	Muscles work harder to check excess glide within joints from pregnancy-induced laxity. This increases risk of muscle fatigue and strain.
	Altered Tensions in Joint Soft Tissues	Pregnancy-related laxity alters the quality of position information from mechanoreceptors. This may length reaction time to challenges from mechanical stressors and increase risk of injury and fall.

Mitigating the Risks

Once the health risks have been identified, strategies must be developed to control or eliminate them. ***Since the physiological adaptations to pregnancy impose additional demands upon the mother, it is even more important to implement the standard ergonomic risk reduction strategies.*** Exposures to biomechanical stress and energy expenditure demands can be reduced by designing jobs and workstations that permit workers to maintain neutral postures. Conditions can be made even more favorable by organizing items in the workstation to reduce excessive reaches and manual material handling.

For maximum protection from musculoskeletal injury, pregnant workers should implement interventions that target the specific health risks. Applying these focused interventions will require a cooperative effort of all of the safety and health professionals on the team. The risks of injury from falls can be reduced by identifying or eliminating environmental hazards that contribute to slips, trips, and falls. Workers and employers should be informed of the hazard potential and become proficient in applying risk avoidance strategies. Pregnancy accentuates fall risk by altering balance via changes in mass and center of gravity. Risk of falling can be reduced by providing mothers balance training. In order to avoid the risk of exposing mothers to potentially injurious movements, these programs should be designed by health professionals skilled in maternal care.

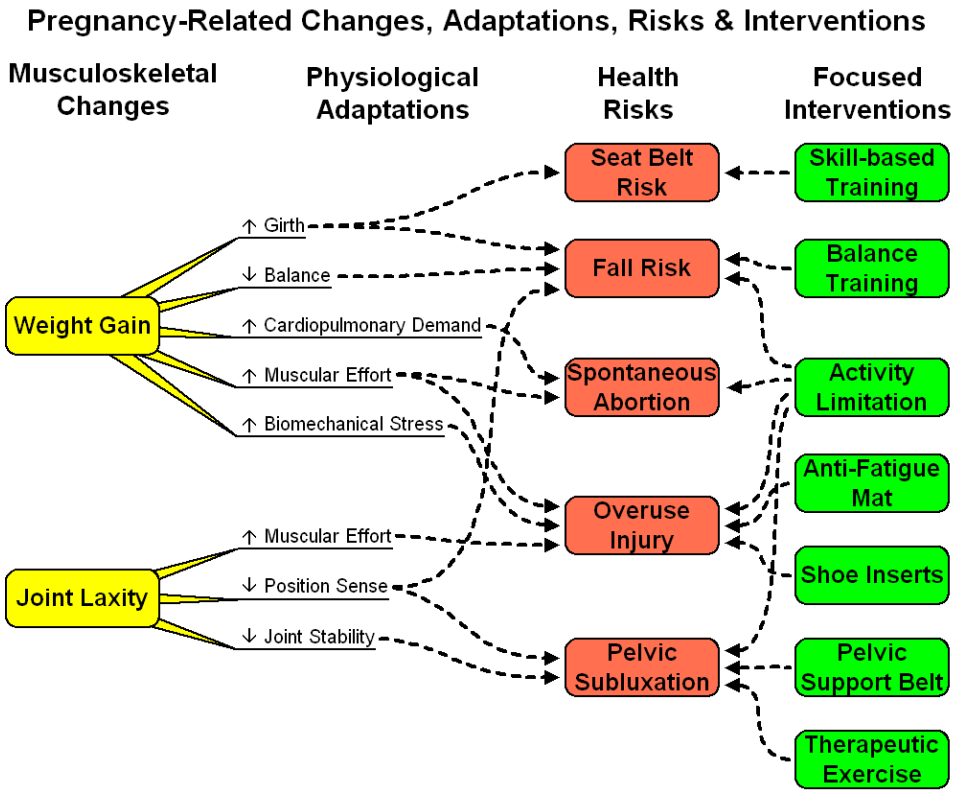
Expectant mothers can be protected from joint (including pelvic) subluxations by controlling the previously mentioned environmental hazards. They should also be restricted from performing movements that deliver high-impact forces to the body such as jumping or stepping down from a height. Abrupt pivoting motions should be avoided as well. Performing motions that include kneeling, deep half-kneeling, or deep squat postures could increase risk of injury to joints. That risk would be magnified if the performer carries, handles, or bears heavy loads. In some cases, it might also be necessary to limit or curtail participation in exercises that require the legs to move toward end range in opposite directions such as performing splits or aggressively exercising on elliptical machines. Many expectant mothers can improve joint stability by performing a properly designed therapeutic exercise program. A very small percentage of women who are medically diagnosed with significant pelvic instability are prescribed pelvic support belts for extra protection.

In truth, only a small percentage of women sustain acute joint or falling injuries during pregnancy. However, pain complaints are common.

> It has been estimated that during pregnancy nearly all women experience some degree of musculoskeletal pain, over 50% experience low back or pelvic pain, and 25% have "at least temporarily disabling symptoms."

These statistics are probably not surprising considering the tremendous metamorphosis that childbearing instigates. Mother's bodies are exposed to mechanical stress from increased mass and the internal biomechanical forces that are generated to manage that added weight. Susceptibility for developing musculoskeletal overuse problems persists throughout the term of the pregnancy and for a period of time thereafter. ***Proper application of ergonomics principles can diminish the probability of pregnancy-related musculoskeletal injuries.***

Research provides direction on ergonomic stressors that should be given top priority. Besides mitigating the maternal musculoskeletal injury risks, it is prudent to institute controls that may avert the previously mentioned pregnancy complications of preterm labor and spontaneous abortions. Two ergonomic risk factors have been associated with these complications—engaging in excessively physically demanding work and performing work that requires frequent bending. It would be prudent to restrict women from performing tasks that expose them to these stressors, particularly during the last trimester of pregnancy.



Conclusion

It is apparent that the physiological changes that occur during pregnancy put expectant mothers at increased risk of developing musculoskeletal overuse injuries. Injury risk can be reduced by identifying hazards and implementing interventions based upon sound safety and ergonomics principles.