

NIH News in Health

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Healthy Movements Your Body's Mechanics

Think about all the movements you do every day: walking, climbing stairs, typing, turning doorknobs and lifting. Your bones, muscles and joints all work together to make your body an amazingly movable machine. Like any machine, your body can suffer some wear and tear. It needs regular care and maintenance to keep moving with ease.

Scientists are studying the mechanical movements of our bodies to help us be as strong, flexible and mobile as possible throughout our lives. This type of research is called biomechanics. These studies are finding that the way you move—including walking, standing and bending—can affect your future mobility and overall health.

"All systems, whether in traditional mechanics or in the human body, are governed by the same basic physical laws," says Dr. Jeffrey Weiss, a biomechanics expert at the University of Utah. Body movements involve force, balance, gravity and motion. "Biomechanics is effectively applying the physics of mechanics to problems in biology and medicine," Weiss says.

The main moving parts of your body include the solid bones, the joint tissues that link bones together, and the muscles that attach to your bones. Your body has about 200 bones and more than 600 muscles.

These parts all work together to help you move throughout the day.

NIH-funded studies of biomechanics have already led to better ways to prevent muscle and joint injuries in kids during sports and play, and to help older people stay more mobile and independent. Some researchers are working to develop better artificial joints. Others have devised improved treatments for movement disorders such as cerebral palsy and Parkinson's disease.

Joints are a common source of problems and pain. Some joints, such as your shoulder joint, can move in many directions. But others, like your knee joint, can only bend one way. Any movements outside a joint's natural range might cause injury.

Dr. Timothy Hewett, head of sports medicine research at Ohio State University, has long studied a part of the knee joint known as the ACL (or anterior cruciate **ligament**). The ACL connects the thigh bone to the shin bone. When it stretches or tears, some people hear or feel a "pop." Athletes who need to make sudden stops or quickly change direction—as in basketball, tennis and soccer—are at risk for damaging the ACL.

Hewett and other biomechanics researchers use "motion capture" tools to study how people move. Reflective markers—about the size of coins—are attached to the skin



or clothing over people's joints and muscles to make it easy to visualize their movements on a computer screen. A series of cameras around the lab can then track how people run, jump, walk and twist. Feeding these data into computers allows scientists to create 3-D animations of full-body motions. It's the same type of technology used to make animated characters in Hollywood movies, such as *Shrek* or *Avatar*.

"Using the tools of biomechanics, we can tell what's normal and what's abnormal in movement, and we can measure the forces on the body," Hewett says. "We use biomechanics as a screening tool to figure out

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Definitions

Ligament

Tough, flexible tissue that connects bones to each other and holds your skeleton together.

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which athletes are at greater risk for injury and why.”

Hewett and his colleagues have identified certain movements that make some people more likely to get ACL injuries. For instance, athletes who allow their knees to collapse inward when landing from a jump are at risk for ACL tears. Once at-risk people are identified, coaches and physical therapists can develop exercises to help them strengthen certain muscles and learn to land and pivot in healthier, safer ways. “We’ve



Wise Choices Body Maintenance

- Maintain a healthy weight. Too much weight can make your knees and hips ache.
- Engage in muscle strengthening (resistance) activities that involve all your major muscle groups 2 or more times a week.
- Stay active all week long. Aim for 150 minutes of moderate intensity activity a week, such as brisk walking.
- Wear comfortable, properly fitting shoes.
- Eat a well-balanced diet. Get enough calcium and vitamin D daily to protect your bones.
- Try to avoid lifting heavy objects. If you need to lift something heavy, bend your knees and keep your back straight.

shown that we can use this information to reduce the relative risk of an ACL injury by 60-65%,” says Hewett.

Motion-tracking tools are also being used to learn how older people might avoid injury from falls. Dr. Clive Pai, a physical therapist and researcher at the University of Illinois at Chicago, explains, “We’re studying how older adults can learn to modify their movements to adapt to an unexpected environment, such as a slippery floor.”

Falls are serious at any age, but especially for older adults, who are more likely to break a bone. Each year, more than 1.6 million older Americans go to emergency rooms for fall-related injuries. “Falling causes a lot of suffering and is a huge problem for society,” says Pai.

Exercises that improve your balance and strengthen your muscles can help to prevent falls. Pai and his colleagues have also found that people can be trained to avoid falls if they practice walking over unstable—but safe—surfaces in the laboratory. “People age 65 and older can adapt and remember remarkably well how to keep their body posture upright when disturbances occur in the environment if they’ve encoun-



Definitions

Arthritis

Swelling (inflammation) in one or more of your joints, leading to pain and loss of motion.



Web Links

For more about your body’s mechanics, click the “Links” tab at:

<http://newsinhealth.nih.gov/issue/Jul2013/Feature1>

tered similar situations 2 or 3 times before,” Pai says.

Biomechanics can also be used to guide treatments for movement problems. Weiss uses computer models to look at how hip joints are stressed when someone walks or travels up and down stairs. He’s analyzing both normal hips and those with a condition called hip dysplasia. “Hip dysplasia produces an instability that can lead to early onset of **arthritis** over time,” Weiss says. Eventually, these computer models might help doctors choose appropriate treatments and figure out which patients could benefit from surgery.

People with cerebral palsy, Parkinson’s disease and multiple sclerosis could also benefit from biomechanical analysis. “We use motion tracking to look at how well these patients are walking and what might be wrong, so we can try to do something about it,” says Dr. Diane Damiano, a physical therapist who heads biomechanics research at the NIH Clinical Center in Bethesda, Maryland. “We focus on helping patients to strengthen their muscles and work to improve their balance and coordination. We’re also looking at brain activation while they’re moving. That can give us clues to how these movements are controlled by the brain.”

Muscle strengthening and proper joint alignment are important for just about anyone who wants to stay flexible and mobile. “The bottom line is that everybody needs to be active,” Damiano says. “We want to make it so that all people can move better, regardless of their age or health condition.” ■

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Stay Cool

Getting Too Hot Can Be Dangerous

Many people love the warm summer months. But hot and humid days can sometimes be dangerous. It's not good for the body to be too hot for too long. Too much heat can damage your brain and other organs. It's important to keep your cool when the days are hot.

Your body has its own natural cooling system. Sweating is key to cooling when hot weather or exercise causes your body temperature to climb. When sweat dries, it carries heat away from your body's surface and lowers your temperature. When sweating isn't enough to help you cool down, you're at risk for a heat-related illness called hyperthermia.

Hyperthermia can happen to anyone. Older people, infants and young children, and people who are ill, obese or on certain medications are especially at risk. These people may be more sensitive to the effects of extreme heat and less likely to

sense or respond to changes in temperature.

"High temperatures can cause various organs within the body not to function optimally," says Dr. Marie Bernard, deputy director of NIH's National Institute on Aging. Excess body heat can stress the heart and harm the brain. It might even lead to a coma.

Hyperthermia can cause several heat-related illnesses, ranging from mild to serious. These include heat cramps, heat edema, heat exhaustion and heat stroke.

Heat cramps are the painful tightening of muscles in your stomach, arms or legs. If you have heat cramps, find a way to cool your body and be sure to drink plenty of fluids. Heat edema is a swelling in your ankles and feet when you get hot. Elevating your legs should help. If that doesn't work fairly quickly, check with a health professional.

Heat exhaustion is a warning that your body can no longer keep itself cool. You might feel dizzy, thirsty, weak, uncoordinated and nauseated. Your skin might feel cold and clammy, and you may have a rapid pulse. If this happens, drink plenty of fluids and rest in a cool place. If you're not careful, heat exhaustion can progress to heat stroke.

Heat stroke is a life-threatening form of hyperthermia that occurs when your body temperature reaches 104° Fahrenheit or more. Heat stroke can lead to confusion, fainting, staggering, strange behavior or dry, flushed skin. Heat stroke is a medical emergency.

"If you and a loved one are at a picnic, for example, and it's very hot



and humid that day, and they start complaining of being dizzy or seem disoriented, you need to be very concerned," says Bernard. "You need to get them into a cool place, put cool compresses on their neck and wrists, and call 911."

Air conditioning is the best way to protect against hyperthermia. If you don't have air conditioning, go to places that are cool on hot and humid days. Try community centers, shopping malls, movie theaters, libraries or the homes of friends and family.

Heat-related illness is preventable. Still, hundreds of deaths from extreme heat events occur in the United States each year. It's important to be aware of who's at greatest risk so you can take steps to help beat the heat. ■



Wise Choices Keeping Cool

- Get out of the sun and into a cool place.
- Drink plenty of liquids, especially water. Avoid drinks that contain alcohol.
- Limit use of the oven if you don't have air conditioning.
- Dress for the weather. Wear light-colored, loose-fitting clothing.
- Shower, bathe or sponge off with cool water.
- Cover windows with shades, blinds or curtains during the hottest part of the day.
- If you need help paying your electric bills to run an air conditioner, visit www.acf.hhs.gov/programs/ocs/resource/liheap-brochures.



Web Links

For more about heat-related illness, click the "Links" tab at:

<http://newsinhealth.nih.gov/issue/Jul2013/Feature2>

Health Capsules

For links to more information, see these stories online:
<http://newsinhealth.nih.gov/issue/Jul2013/Capsule1>

Looking at Your Risk of Stroke

A simple set of questions for checking your heart health might also help predict your stroke risk, a new study suggests. The finding hints that even small improvements to your lifestyle might help prevent strokes.

Stroke is the fourth leading cause of death nationwide. It occurs when blood vessels that supply the brain become ruptured or blocked. When blood can't carry nutrients and oxygen to brain cells, the cells stop functioning and die.

A list of 7 key health factors—called Life's Simple 7 (LS7)—was developed by the American Heart Association to assess health status. LS7 score is measured by looking at the 7 factors: physical activity, diet, weight, blood pressure, blood sugar,

cholesterol and smoking. Each of these factors can be categorized as ideal (high score), average (medium score) or poor (low score). A high score on the LS7 has been linked to low rates of cardiovascular disease and death.

NIH-funded scientists tested to see if the LS7 score could also assess stroke risk. They studied nearly 23,000 people with an average age of 65 years. The researchers found that each "better" category for overall LS7 score corresponded to a 25% drop in stroke risk. Even participants with only one "ideal" factor had a lower stroke risk compared to those with none.

Health status varied widely for each of the 7 factors. For example,

most participants (84%) had an ideal status for smoking, but none (0%) had an ideal diet.

The findings suggest that you might reduce stroke risk by improving 1 or more of these 7 factors. Get active; eat healthy foods; have a healthy weight; don't smoke; control cholesterol; manage blood pressure; and keep blood glucose in check. Learn more about Life's Simple 7 and use the free assessment tool at this American Heart Association website: <http://mylifecheck.heart.org/>. ■

Coping With Traumatic Events

Trauma can affect both your body and your mind. A traumatic event might be a personal tragedy, such as being in a car crash or losing a loved one. It could be a public tragedy, such as the Boston Marathon bombing or a natural disaster. Just seeing or hearing about devastating events can feel distressing, even if you aren't personally involved.

People respond to crises in different ways. It's common to feel sad, vulnerable or anxious. But if you continue to feel afraid and upset weeks or months later, consider seeking professional help. You may have post-traumatic stress disorder (PTSD) or depression. These conditions can

affect people of any age.

Children are especially sensitive to violent events or disasters. They may feel intensely hurt or frightened and find it difficult to recover. Like adults, kids need emotional support from loved ones. They may also need medical care and counseling.

NIH's newly updated Web page at www.nlm.nih.gov/health/topics/coping-with-traumatic-events can help you learn more about how trauma can affect you and what to do when problems persist. The page links to videos and information about PTSD, depression and related conditions. You'll also find tips for helping children and teens cope with violence and disasters. ■

Featured Website NIAMS Kids Pages

www.niams.nih.gov/Health_Info/Kids

It's smart to form habits that can help keep your bones, joints, muscles and skin healthy for years to come. This newly updated site for kids—from NIH's National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)—can help you keep your body working and moving with ease.



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