

CARE OF BONES & JOINTS

Nirankar S. Agarwal, Ph.D.

Bones & Joints

Strong bones support us and allow us to move. They protect our heart, lungs, and brain from injury. Our bones are also a storehouse for vital minerals we need to live. Weak bones break easily, causing terrible pain. You might lose your ability to stand or walk. And as bones weaken, you might lose height.

Silently and without warning, bones may begin to weaken early in life if you do not have a healthy diet and the right kinds of physical activity. Many people already have weak bones and don't know it. Others are making choices that will weaken their bones later.

– Surgeon General's Report 2004

Until the 1970s it was widely believed that weakening of bones was "an inevitable consequence of ageing." It was gradually recognized, however, that ageing was merely one reason for the deterioration of bones, and multifaceted research in to bone health began around 1990. **Osteoporosis** (from Greek, osteon=bone; poros=passage), as the most common bone disease is known, is a hazardous condition in which the normally tiny apertures in the bone tissue become enlarged due to loss of bone mass with the consequence of weakening bone and the skeletal structure. Osteoporosis causes not only fractures but also back pain and loss of height, and in the elderly may even become life-threatening.

According to a 2003 report by World Health Organization, 75 million people are afflicted by osteoporosis in Japan, Europe and USA, and 2.3 million fractures occur annually in USA and Europe alone. Hip and spine fractures are the most troublesome because they severely restrict movement and make people depend on others for even small things. These fractures also take a long time to heal. Hip fractures in USA increased almost five-fold in fifty years, from a yearly figure

of 24 per 100,000 during 1928-32 to 115 in 1978-82. In early twenty first century, ten million Americans were afflicted by osteoporosis of the hip, leading to an annual figure of 300,000 hip fractures and 2.6 million doctor office visits for bone problems. "By 2020 half of all Americans over 50 will have weak bones unless we make changes to our diet and lifestyle" warns the Surgeon General in a 2004 report. Lifetime risk in over 50 year-old women for wrist, spine and hip fractures has been assessed at 40% (4 in 10), similar to coronary heart disease.

Women are three times more prone to osteoporosis than men, due mainly to smaller peak bone mass and large hormonal changes in middle age. For American women, the costs of osteoporosis are reported to be on par with such serious chronic diseases as breast cancer, diabetes, arthritis and chronic obstructive pulmonary disease.

Though bone & joint problems are becoming increasingly common in India, reliable data about the incidence of disease is not available. In a general way, however, WHO figures state that though half of 1.7 million hip fractures occurring in 1990 were in developed countries, 75% of the 6.3 million projected hip fractures occurring in 2050 will be in developing countries due in part to urbanization, increasing population & longevity, and rapidly changing nutritional & lifestyle habits in Asia and parts of Africa.

Bones

Adults typically have about 206 bones. Contrary to common belief, bones are not rigid static structures and even in adults, 5-10% of bone mass is remodeled every year. Bones serve a variety of important functions in the body which include:

- * A basic frame for body and supporting structure for

the organs

- * Protection of delicate tissues and organs
- * A firm grid against which muscles push and derive leverage for movement and locomotion
- * Manufacture of blood cells
- * A storehouse for minerals and lipids

Structurally bones and teeth are made up of the highest proportion of inorganic matter (65%) in the body. As in teeth, most of the mineral content is in the form of hydroxyapatite (a phosphoric acid salt of calcium), plus trace amounts of magnesium, fluorine, chlorine, iron and sodium. Collagen - a tough protein - constitutes the remaining 35% of the bone mass. The most abundant mineral calcium comprises 2% of the body weight of an adult, and practically 99% of it is stored in the bones and teeth. Calcium is of crucial importance to cell membranes, to muscles including heart muscle, and to neurons. Hence, bones as repository of calcium play a vital role in essential functions at the cellular level.

What can one do to build healthy bones and skeleton?

Bone mass continues to be built up from infancy till adulthood and it is generally maintained for a decade or two at about the same level. From mid 30s forwards, bone mass begins to decrease at variable rates of 4-15% per decade.

Two major parameters used to ascertain bone health are: bone mass density (BMD) and, bone mass content (BMC). BMD, measured as grams of hydroxyapatite per square centimeter, is directly related to bone strength. BMD and BMC increase rapidly during adolescence and generally attain a peak in young adulthood. Since bone content begins to dissipate usually at a constant rate after adulthood, a high peak bone mass will result in relatively stronger bones even later in life. Peak bone mass depends largely on three primary factors:

1. Heredity: Inherited factors may account for up to 50% of BMD and BMC in an individual. This means that individuals with strong bones will have a greater chance of bequeathing a predisposition to healthier bones in their progeny.

2. Nutrition: Sufficient **calcium, magnesium and phosphorus** are necessary for bone growth and maintenance. The demand for these nutrients is naturally highest in childhood and adolescence for maximal skeletal growth. Nuts, seeds (especially sesame), soya, whole grains and dairy are all excellent sources of these minerals. WHO points to the "paradox (that hip fracture rates are higher in developed countries where calcium intake is higher than in developing countries ...) clearly calls for an explanation. To date, the accumulated data indicate that the adverse effect of protein, in particular animal (but not vegetable) protein, might outweigh the positive effect of calcium intake on calcium balance." [http://www.who.int/dietphysicalactivity/publications/trs916/en/gsfao_osteo.pdf]. This observation does indicate that as far as bones are concerned, a vegetarian diet may be better. Studies have suggested a beneficial role of calcium supplements to achieve a daily target of at least 1,300 milligrams in children and adolescents.

Vitamin D (as vitamin D3 is generally known) is crucial for absorption of calcium and phosphorus by the intestine. It is also synthesized in dermis, the second layer of the skin, in presence of sunlight. In countries with inadequate sunshine, vitamin D is typically added to the calcium rich foods such as dairy, although nuts, seeds (especially sesame), soya, and whole grains are rich natural sources of vitamin D as well.

Phytoestrogens (sometimes called, dietary estrogens, are non-steroidal plant compounds) have been discovered to slow down bone loss and are fortunately found in many of the

same foods which are rich in calcium such as seeds – sesame, sunflower, pumpkin, linseed (flax), fenugreek, fennel – dairy, legumes, chickpeas and whole grains.

Adequate amount of **protein** in the diet is also necessary for bone growth and has a role to play in maintenance of bone mass in adults and the elderly. But as mentioned above, excess animal protein intake induces loss of calcium.

Trace amounts of other elements: iron, magnesium, fluorine and manganese, and adequate amounts of vitamins A, B12, C & K, are also required for healthy bones. Hormones, from pituitary, thyroid, parathyroid glands and testes and ovaries, are also involved in the proper growth & maintenance of the bones [Frederic H. Martini, *Fundamentals of Anatomy & Physiology*, Englewood Cliffs, New Jersey: Prentice Hall 1995, p 187-88].

A normal diet of wholesome grains, fruits, vegetables and dairy is alleged to provide all the nutrients needed for healthy bones.

3. Exercise: Continuous turnover of minerals in the bones means that bones can, and do adapt to change. Normal stress in moderate exercise helps maintain bone health. But bones degenerate rather quickly from disuse. For example, bedridden patients may lose up to a third of their bone mass in a few weeks. The young, however, can regain the lost mass rather quickly after resumption of normal body function & activities.

At least an hour of exercise is necessary for children and youngsters to form optimum peak bone mass. Weight bearing exercises – walking, skipping, rebounding, jogging – alert the body to try hard in increasing bone strength. Brisk walking in conjunction with supplementary body movements recommended in a later section ought to be particularly helpful in this regard. Hanging from bars places gravitational pull on the entire skeletal system. Regular bar practice of a few min-

utes will also help youngsters achieve optimum height.

Since bone loss is inevitable, what active preventive measures for a slow-down can be adopted?

Osteoporosis, literally larger pores within the bones, can even start in childhood due to malnutrition and lifestyle hazards and optimum bone mass may never be achieved. In later life practically everyone has some degree of osteoporosis. Some hazards for this condition are listed below:

1. Family history of bone fractures, particularly hip fractures, of close kin. People in this category can derive benefit from this knowledge by going extra length to strengthen their bones through better nutrition and longer exercise time.

2. Asian and Caucasian women are more prone to osteoporosis. This documented fact can be turned to advantage if stronger bones are developed early in life and hazards to bone health are shunned.

3. Frequent loss and gain in body weight, such as from on-off dieting cycles, may result in fragile bones.

4. Smoking exposes one to intake of a mineral, cadmium, which is a threat to bone mass. One pack of cigarettes a day can lead to bone loss. Even second hand smoking is a documented hazard.

5. Higher consumption of alcohol (more than 30 mL a day) can decrease absorption of calcium by the intestine. It also hinders the obligatory activation of Vitamin D by the liver.

6. There is still much debate about the role of caffeine in bone loss. It is claimed that caffeine diminishes levels of all vitamin groups in the body [David & Dennis Singshank, *Personal Lifeplan for Health & Fitness*, Madison, Wisconsin: American Health & Nutrition 1983, p 89, 91]. It has also been shown that about 300 milligram caffeine (4 cups of coffee) can cause up to 5%

reduction in bone mass per decade [L. Massey and J. Berg, “The Effect of Dietary Caffeine on Urinary Excretion of Calcium, Magnesium, Phosphorus, Sodium, Potassium, Chlorine, and Zinc in Healthy Males”, *Nutrition Research*, 5 (1985): 1281-84]. Which means that one could lose as much as 20% of one’s bone mass in 40 years from a moderate consumption of coffee alone! But some health professionals claim that even smaller amounts may be harmful. Due to widespread use of minor amounts of caffeine in other foods such as soft & energy drinks, chocolates & candies, medicines, etc., it will surely be prudent to limit consumption of caffeine containing products. Surprisingly, in several studies, tea has not been found to be harmful for the bone mass.

7. Excess sodium has been found to cause loss of calcium in some studies. Common table salt is 40% sodium and one teaspoon contains 2,000 milligram (mg) of sodium. Recommended maximal daily intake is about 2,300 mg. Beware of the high amounts of sodium typically present in processed food items: tinned, frozen, prepackaged and precooked foods, cereals, fast foods and even sweets and candies. This means that habitual intake of fast foods is likely to cause fragile bones.

8. Consumption of acidic foods leaches out minerals

Most soft drinks have a pH of 2.4 – 4.0 which is quite acidic. pH is a scale of units expressing the acid and alkaline strength of a medium. It is a logarithmic scale of 0–14, with 0 being totally acidic, 7 being neutral and, 14 being totally basic. Being logarithmic, each unit expresses an increase or decrease of 10 fold. Hence, pH 4 is, $10 \times 10 \times 10 = 1,000$ times more acidic than a totally neutral medium, for example, water.

The table below gives a list of some common soft drinks in the marketplace. pH of blood is maintained between 7.35 to 7.45, which is slightly basic, for proper functioning of the

<u>Soft Drink brand</u>	<u>pH</u>	<u>Times acid strength from 7.4 (pH of blood)</u>
Coca Cola	2.53	87,000
Pepsi	2.49	91,000
Mountain Dew	3.22	11,800
Sprite	3.42	9,800
7-UP	3.19	12,000
Gatorade (sport drink)	2.95	44,500
Orange Minute Maid	2.80	46,000
Dr. Pepper	2.92	44,800
Lipton's Lemon Iced Tea	2.90	45,000

vascular system. As is evident from the figures in the table, all listed soft drinks are anywhere from 9,800 fold to 91,000 fold more acidic than the human blood. Any time soft drinks are consumed, excessive acidity needs to be neutralized. Please note that the body itself produces acids for its own purposes of digestion and energy generation. Excessive consumption of foods containing phosphorus, sulphur, chlorine, and iodine, can give rise to formation of inorganic acids. Phosphoric acid is also widely used in soft drinks, ostensibly to lower the freezing temperature and give that “chilly” sensation.

Dr. Susan Brown points out that our bodies evolved in an alkaline sea medium and that most of our metabolic, enzymatic, disease fighting, and maintenance mechanisms function best in a slightly alkaline environment. “To regain the life-supporting alkaline state, acids from all sources must be buffered or neutralized through combination with alkaline minerals” [Susan E. Brown, Ph.D., *Better Bones, Better Body*, New Canaan, CT: Keats Publishing 1996] To maintain the pH within the acceptable range, minerals from the bones are leached out to buffer (that is, neutralize) the inorganic acids, and a habitual consumption of soft drinks is therefore likely to lead to weaker

bones.

A piece of baffling statistic that “in recent years the frequency of hip fractures has increased dramatically among *young, healthy professional athletes*” (italics added for emphasis) [Frederic H. Martini, *Fundamentals of Anatomy & Physiology*, Englewood Cliffs, New Jersey: Prentice Hall 1995, p 277], may very well be due to excessively acid diet including sports drinks (generally within the pH range of 3 -5).

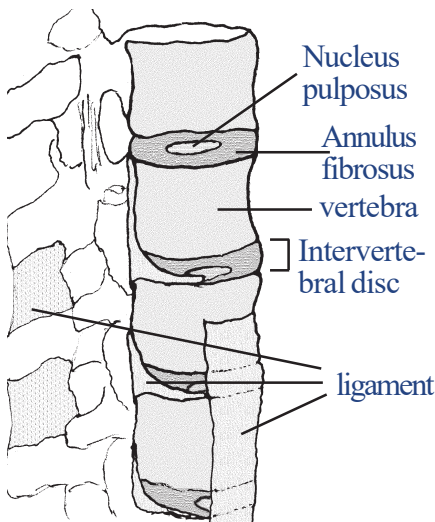
Since soft drinks are also implicated in decay of tooth enamel, obesity, heart disease, dehydration, etc., it will surely be prudent to limit their consumption to an occasional helping. Dr. Jeri Nieves, director of bone density testing at Helen Hayes Hospital in West Haverstraw, N.Y. is quoted as saying, "It's not like alcohol, where one drink a day is OK. Because bone mass is constantly changing throughout life, soda can cause bone loss at any stage." [<http://articles.chicagotribune.com/>, Elena Conis in Milk, soft drinks and bone strength, Chicago Tribune May 19, 2010]

Joints

Locomotion is essential for normal performance of the human body. Many functions, for example, walking, writing, picking and carrying things, looking sideways or behind, require body parts to be mobile and flexible. To accomplish these, human body has been equipped with bone joints. Bone surfaces within the joints are separated from each other by special cartilages, which are tissues similar to bones but softer. To preclude even minimal friction, gaps between cartilages of the movable joints are filled with a film of synovial fluid, a motor-oil consistency liquid secreted by the synovial membrane. This fluid lubricates the joint, absorbs shock, and is a conduit for transport of nutrients and the wastes.

What about the vertebral column?

Unlike more freely movable joints such as shoulder, knee, elbow, etc., the vertebral column has only a limited gliding capability. Most vertebrae are separated from each other by cartilage-pads called intervertebral discs. These discs are made up of an elastic nucleus pulposus at the centre, surrounded

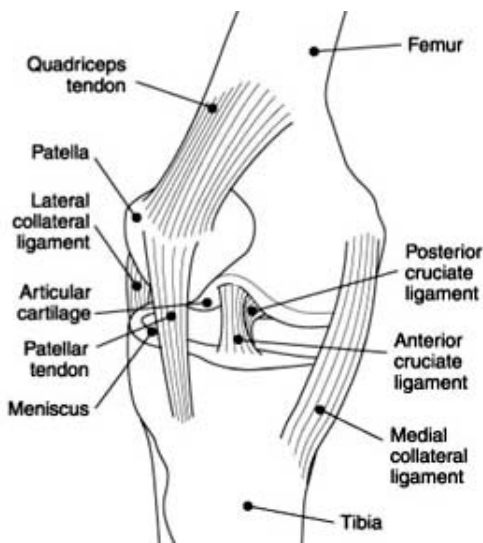


by a tough fibrocartilage layer called annulus fibrosus. The movement of the vertebral column is mostly dependent upon flexibility of the elastic fibres of the nucleus which are typically supple early in life. Without proper care, the flexibility of the discs is gradually reduced to such an extent that older people often shrink in height. These hardening and shortening pro-

cesses can, however, be delayed or even curtailed. Exercises or yogasanas for the vertebral column also benefit the ligaments of the spinal column. Formulators of yoga, assigned top priority to the suppleness of vertebral column in delaying the onset of old age. Needless to say, a flexible back bone is a great boon to other systems, such as the vascular and nervous systems.

Which exercises are most suitable for bones and joints?

Data from diverse sources are mounting that excessively intensive exercise may not be as beneficial as moderate exercise. Actually, it is alleged that overly strenuous exercise may even cause injury to the tendons, bones, and joints. It is an established fact that hip, knee and the ankle joints are quite stressed even during walking. Running and jogging subject them to more severe compression and to much higher pressures.



Knee Joint

http://www.niams.nih.gov/health_info/knee_problems/#4

Knee particularly is a highly complex joint – more like three joints than one – which upbears severe stress even during normal activity. Therefore knee injuries are not uncommon during inordinately stressful activities. Treatment of injuries to the knee can also be quite expensive without restoring its full functionality.⁷ An increasing number of doctors today is beginning to recommend brisk walking as

the best aerobic exercise.

Osteo-arthritis (degenerative joint disease) from normal wear and tear afflicts a whopping 25% of women and 15% of men 60 years and older in the USA. Regular exercise has been shown to be of significant benefit even after the onset of this disease. Certainly regular joint exercise continued through middle age will delay and even preclude the onset of this debilitating condition.

Specific exercises for the Joints

Vertebral Column

There are six motions which strengthen the spinal column and keep it flexible and optimally functional:

a. Sideways stretch and contraction

Stand with feet parallel and about 1S feet apart. Raise right hand with the arm along the right side of the head and ear and bend at the waist to the left. Left hand slides down the left thigh and calf. Keep the body in one plane. Hold for a count of 10, and revert back to starting position.



Now repeat with the opposite side. Stand with feet parallel and about a half meter apart. Raise left hand with the arm along the left side of the head and ear and bend at the waist to the right. Right hand slides down the right thigh and calf. Keep the body in one plane. Hold for a count of 10, and revert back to starting position.

Benefits: The exercises provide a thorough stretch and contraction alternately to the sides of spinal column.

b. Forward & backward stretch and contraction

Feet together. Raise hands and bend backwards at the waist. Hold for a count of 5.



Bring hands slowly forward and downwards and touch the ground in front with your fingers. Strive to place your palms on the ground next to the toes with forehead touching the knees. Try not to bend the knees. Hold for

a count of 5. Do five of each forward & backward bends alternately.

Benefits: The postures provide alternate stretch and contraction of the spinal column. Muscles of the back, abdomen and the chest, shoulders, hands and feet are toned.

c. Twists

Feet parallel and 5 meter apart. Stretch hands to the sides at shoulder level, palms facing down. Keeping the feet firmly



grounded, twist torso to the right, hold for a count of 2. Then with a steady motion twist all the way to the left and hold for 2 counts. Repeat 9 times.

Benefits: The twists provide flexibility to the vertebrae, muscles and the nerves of the spinal column. Good exercise to reduce waist fat.

Wrists

Feet together. Stretch hands to the front at shoulder level. Join fingers and thumb. Now rotate palm and fingers of both



hands at the wrist 10 times clockwise, and 10 times anticlockwise [see picture].

Hands to the side. Join fingers and thumb. Now rotate palm and fingers of both hands at the wrist 10 times clockwise, and 10 times anticlockwise [see picture]

Benefits: Strengthens the muscles and nerves of the wrists and keeps the joint supple. Also exercises the muscles of upper back.

Shoulder

Stand with feet together. Hands to the sides. Close your fists. Now raise your hands in front and rotate at the shoulders 10 times clockwise and 10 times anticlockwise (see pictures)

Benefits: Strengthens and develops shoulder muscles and provides suppleness to the shoulder joint. Muscles of upper



back and vertebrae gain flexibility and strength. Provides relief to stiffness in the upper back. Daily practice keeps onset of spondylitis at bay.

Ankles

Sit with legs stretched in front. Palms on the sides near the hips to provide balance and support. Keep thighs, knees and calves on the ground. Feet touching together. Stretch toes away from the body. Hold for two counts. Bring toes



towards the body. Hold for two counts. Do ten times.

Now, rotate both feet at the ankles 10 times clockwise and 10 times anticlockwise [See pictures]

Benefits: Strengthens the muscles of the ankle and provides flexibility to the ankle joint. People prone to ankle injury will derive much benefit from these exercises.

Elbows

Standing, touch fingers to the shoulders. Stretch hands to the



front until parallel to the ground. Repeat twenty times.

Benefits: Muscles of arms, forearms are strengthened. Elbow joints become supple.

Knee

A. Sit on a mat with legs stretched in front. Keep thighs, knees and calves on the ground. Feet touching together. Now



bend the right leg at the knee and place your palms with interlaced fingers under the knee. Press the right thigh to the abdomen and touch your chin to the right knee. Strive to bring right heel closer to the body. Left leg is stretched out in front with toes pointing away from the body. Hold for 15 counts.

Now reverse the positions of the legs. Stretch the right leg in front and stretch toes away from you. Bend the left knee, place interlaced fingers under the knee and press the left thigh to the abdomen. Touch your chin to the left knee.

Strive to bring left heel closer to the body. Hold for 15 counts.

B. While walking, step on heels and then place rest of the foot down. Walk twenty steps alternating right and left heels. Repeat several times during the day.

Benefits: both A & B strengthen knee and ankle joints. Pressure of thigh on the abdomen in A helps remove excessive gas also.

Fingers

Exercise the fingers by forcefully contracting and stretching the fingers (see pictures). This exercise can be done many times during the day whenever you remember to do it. In particular, while walking these can be done without additional expenditure of time.

Feet

Few of us pay much attention to our feet. They are taken for granted as something for locomotion. Statistics show that half of American population suffers from some foot disorder. When we have to seek help for carrying out even simple functions of our body, it dawns on us that feet are of paramount importance to our physical and mental well-being. For, to depend on others for basic functions of the body



is what people seem to dread most in old age.

What can be done for the feet?

1. Walk regularly barefoot for some time. This provides good exercise to the arch of the foot, essential for balancing body weight.
2. Shoes that pinch are a curse; circulation of blood is impaired resulting in more fatigue. Whenever necessary, wear roomy shoes.
3. High heels disbalance the body and increase the risk of fall, joint disorders, and stunted growth in children.
4. Wash feet with cool water after taking off the shoes, and rub them dry with a coarse towel. It is important to clean and dry the skin between the toes to avoid fungal growth.
5. Stretch and contract the toes frequently during the day.
6. A good exercise for feet while walking can be practised as follows:
 - * When you take a step forward, finish it by raising your body on the toes. Do not stop. Just raise your body as you begin to take off the foot from the ground. It is a sort of rolling motion towards the end of the step. This will exercise the arch of the foot as well as the toes. Do it for a number of steps intemittently.
 - * Step forward consciously on the heel (described under 'Knee' earlier). Feel the stretch on the back side of calf muscles, knee and ankle. Then flatten the foot out. Placing the foot in this manner exercises sole from the heel to the middle of the foot, benefits the arch of the foot, and exercises the knee joint well.

TimeSaving-WalkingPlus (TSWP)TM

Many exercises for joints and bones detailed hereafter can be inculcated in to your daily routine for saving time. The activities you can practise while walking include:

Neck: Move head down and touch chest with the chin. Move head up and look at the sky. Repeat 20 times. Move head to the right, then move it left. Do it 20 times.

Shoulders: Rotate arms at the shoulders clockwise and anticlockwise 20 times each while walking. [See under ‘Shoulders’ above]

Vertebral Twists: Raise hands to shoulder level. Keep walking, twist the torso at the waist to the left and place right palm & fingers on the left shoulder and left hand fingers on the right side of the waist. Hold for three counts. Reverse. Raise hands to shoulder level; twist torso to the right placing left palm & fingers on right shoulder and right hand fingers on the left side of the waist. Start with three twists, and gradually increase to ten. [This variation of twists can be practised while you continue to walk. The ‘Twists’ described earlier are better from a stationary stance]

Wrists: Rotate wrists while holding arms parallel to the ground first sideways and then in front. Do clockwise and anticlockwise 10 times at each position. [See under ‘Wrists’ above]

Elbows: Raise arms in front parallel to the ground. Bend forearm at the elbow and touch the shoulders with fingertips. Back to beginning position. Do 20 iterations. [See under ‘Elbows’ above]

Palm and finger joints: Raise arms in front parallel to the ground. Forcefully close fingers into a tight fist. Open and repeat 20 times.

Knee & ankle: As you walk, step deliberately on the heel and then put the rest of the foot on the ground. Feel the tension in the knee joint as well as the ankle joint. Practise doing this while doing wrist or elbow exercises simultaneously. [See under ‘Knee’ above]

Vertebral stretch and feet: Raise arms high, fingers point-



ing to the sky. Stretch body upwards as you walk and raise yourself high up on the toes at the end of the step. Try walking for 30 seconds. Gradually increase to a minute. [See picture]

Incorporation of these **TimeSaving-WalkingPlus™** routines into your walking regimen, will substantially cut down time required for the care of joints and the bones.

CAUTION: TSWP should of course be done only on walkways with no bicycle/motorized traffic. One should get used to do them only gradually. Initiallty you might feel embarassed when people look askance at you, but that will pass soon enough when you realize the benefit of time saved.

Aspiration

विश्वं पुष्टं ग्रामे अस्मिन्ननातुरम् ।।

– *Yajurveda* 16:48

In this village [global village],
may all sentient beings be robust and healthy