

Strenuous Exercise – Query for Genetic Health!!

G. Gandhi and Gunjan

Department of Human Genetics, Guru Nanak Dev University, Amritsar 143 005, Punjab, India

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ABSTRACT An exercise is an activity that requires physical or mental exertion, especially when performed to develop or maintain fitness. Fitness may be described as a condition that helps us look and feel good and do our best. Human efficiency and productivity are dependent on one's health and fitness and presently, health and fitness through physical activity are attaining popularity via exercises. Work-outs at gymnasiums highlight the changed lifestyle among youngsters, as a means of looking good, and among older ones for keeping fit and healthy. Since health is a form of homeostasis, balancing inputs and outputs of energy and matter in equilibrium, it implies good prospects for continued survival. However there is a cause for concern from exercise-induced DNA damage where the probable involvement of oxidatively damaged DNA may trigger cancer development and also since an association between oxidative damage to mitochondrial DNA and age-related degenerative diseases has been observed. The present study entailed informational inputs from personnel engaged in strenuous physical activity, either to promote a state of well being or to be aesthetically better or for performance in a sport event. The consequences of such intensive activity are discussed in the terms of genetic health.

INTRODUCTION

Health benefits of regular physical activity are quite evident with regular physical activity aiding in the prevention and management (U.S. Department of Health and Human Services 1996) of coronary heart disease, hypertension, non-insulin-dependent diabetes mellitus, osteoporosis, obesity, and mental health problems (e.g. depression, anxiety). It has also been associated with lower rates of colon cancer and stroke and may be linked to reduced back injury; in fact, physically active people outlive those who are inactive. Physical exercises actually involve movements of the body to achieve and maintain healthy conditions and a state of physical fitness and are also used as therapy to restore the body to a state of health. The World Health Organization in its constitution defines health: "as state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". This concept of 'being well' (wellness) goes beyond absence of mere disease and optimal physical fitness; rather it is the continuous and deliberate attempt for staying healthy and attain the highest potential for the total well-being.

Fitness is a holistic feeling or the state of well-being including physical and mental health as well as emotional satisfaction and self-awareness. Physical fitness has been defined in various terms: as the absence of disease; as an ability to perform certain sports skills; as the amount of musculature developed; specifically, it is the measure of the body's strength, endurance and flexibility (Uppal 2004), i.e. it is a set of innate or achieved attributes in a person that relate to the person's ability to perform physically (Health Development Agency (HAD) 2005; www.hda.nhs.uk). Fitness is hence, an individual quality that varies from person to person and is influenced by age, sex, heredity, personal habits, eating habits and exercise (Fitness Fundamentals-Developed by the President's Council of Physical Fitness and Sports 2005, www.who.org). Physical fitness can further be classified into two categories, namely: health-related physical fitness and motor skill-related physical fitness (Uppal 2004). The former entails regular and vigorous exercise to prevent degenerative diseases and to improve upon the hypo kinetic diseases and the latter improves the performance in games and sports. It is the activity performed in order to develop or maintain physical fitness and overall health.

Depending on the overall effect of exercise on the human body, it is generally grouped into three types (www.en.wikipedia.org):

Aerobic (Endurance) Exercises: Aerobic exercise is a type of exercise in which muscles

Address for correspondence:

Dr. G.Gandhi, Reader
Department of Human Genetics, Guru Nanak Dev
University, Amritsar 143 005, Punjab, India
Telephone: +91-183-2258802-09 Extn. 3444
Fax: +91-183-2258820
E-mail: gsbau@hotmail.com; gandhig07@hotmail.com

draw on oxygen and on fats and glucose in the blood and this increases cardiovascular endurance and cardiac capacity by using oxygen, creatine phosphate, fats, and glucose to produce adenosine triphosphate (ATP). Some examples are running (but not sprinting), cycling and long distance swimming and the “trendy” exercises performed at gymnasiums/gyms. Low-to-moderate-impact exercises are walking, swimming, stair climbing, step classes, rowing and cross-country skiing. Brisk walking burns as many calories as jogging for the same distance and has less risk for injury to muscle and bone.

High-impact exercises include running, dance exercises, tennis, racquetball, squash. The American College of Sports and Medicine (ACSM, www.acsm.org) guidelines for healthy aerobic activity are - exercising 3-5 days/week; warming-up for 5-10 min before aerobic activity; maintaining exercise intensity for 30 to 45 min; decreasing the intensity of the workout and stretch to cool down during the last 5-10 min.

Anaerobic Exercises: The early stage of all exercise is anaerobic and in this the body uses creatine phosphates during the earlier seconds of any type of physical exertion and carbohydrates only as the energy source but no fats. Energy is released and made available to muscles by converting immediately available sugars in the blood to lactic acid. In the subsequent aerobic phase, a more slowly available oxygen supply is required, enabling the lactic acid to be broken down to carbon dioxide and water, releasing larger amounts of energy. Heavy weight lifting, sprinting and jumping, and any exercise that consists of short exertion is an anaerobic exercise. This is carried out by body builders to build muscle mass and by athletes in non-endurance sports to build power since it increases short-term muscle strength.

Flexibility Exercises: Stretching improves the range of motion of muscles and joints by allowing a wider range of motion. The major flexibility exercises are for prevention of cramps, stiffness and injuries while certain flexibility practices like yoga reduce stress.

Other types include:

Aerobics: This is an effective physical exercise, done to music. In the 1960s, Dr. Med. Kenneth H. Cooper took the first step of the “aerob” training in US and introduced an exercise training in order to strengthen the heart and the lungs. There are different types of aerobics,

namely: circuit – aerobics, body styling, interval-aerobics, box-aerobics, aqua-aerobics, dance-aerobics, slide, etc.

Calisthenics (US usage): These are a variety of simple movements performed without weights or other equipment in order to increase body strength and flexibility using the weight of one’s own body for resistance. The history of Calisthenics is linked to gymnastics. Examples of Calisthenics exercises include sit-ups/crunches and press-ups or push-ups.

Cycling: It develops endurance, muscle speed, power and agility and is good for cardiovascular activities but it places very little stress on joints.

Walking: It is the simplest form of aerobic exercise, neither entailing overexertion nor injuries common for many other activities. The types of walking include bush walking, race walking, hill walking, folks marching, Nordic walking and hiking distance paths.

Jogging and Running: These are extensions of walking: jogging is covering very short distance at very low speed whereas running is covering in a few minutes several miles over the course of a marathon. Running takes less time for the same aerobic- and calorie-burning benefits.

Warming-up: This is carried out before performing any technical sports. It allows a gradual warming of the muscles, which lessens the likelihood of injuries during training or sport and of muscle soreness.

Sport: It is the major area of human interest and activity. A sport consists of a normal physical activity or skill carried out under publicly agreed set of rules and for a recreational purpose, i.e., for competition, for the development of skill, for self-enjoyment but mainly to attain excellence.

Swimming: This provides the best overall body workout as it uses most of the body’s major muscle groups during various strokes.

Yoga: It is the oldest known science of self-development involving mental, physical and spiritual controls. Yoga means ‘union’ or ‘yoking’ in Sanskrit, which is achieved through the practice and mastering of specific physical postures called *asana*, breathing exercises and meditation. Yoga is the collection or concentration of mind, meditation and contemplation.

Weight Training: This is an efficient method of developing the strength and size of skeletal muscles. Weight training involves progressively lifting by increasing amounts of weight and

includes varying number of exercises and items of equipment to target specific muscle groups. Weight training is also known as strength training or resistance training and is different from bodybuilding, weight lifting and power lifting.

Wrestling: The first wrestling competition in the modern Olympic Games was held in 1904. In India this has occurred over 400 years ago using the *Gurz* (*Gada* –the weapon of Lord Hanuman; a mace with a spherical head). The *Gurz* are handmade and vary in design and size, made up of silver or gold with inlaid precious stones. It is a symbol of spirit, strength and skill. Wrestlers (*Phelwans*; grappling champions) take part in wrestling competitions (*Dungals*, *Kushti*). India's wrestling authorities have banned the ancient sport of sandpit wrestling in an attempt to help its wrestlers keep pace with the rest of the world by training on mats. In wrestling, exercises include sit ups, pull ups, push ups, running, rope climbing, swinging weighted wooden clubs, swinging weighted ball and mace.

Body Building: This is the art of displaying the muscles of the physical body and had its beginnings in the late 19th century. In the sport of *competitive body building*, the physique is displayed, points given based on the aesthetic appearance (<http://en.wikipedia.org/wiki/Bodybuilding>); the sport was popular during 1880-1930. In competitive bodybuilding, bodybuilders aspire to develop and maintain an aesthetically pleasing-(by bodybuilding standards) body and balanced physique. It must not be mistaken with actual physical strength, or with Olympic weightlifting which requires strength and technique. Body building has a different regimen of training, diet, and basic motivation.

Warming-up Before Exercising

Warming-up is essential for keeping the joints and tendons healthy. Most injuries result from higher workload put on the muscles and tendons. Warmed-up soft tissues, tendons and muscles can handle those high demands better thereby reducing the risk from injury. Warm-ups are required in order to avoid injuries so that the schedule for the regularity of exercise may be maintained. This is especially necessary for body builders, power lifters and weight lifters since the heavy loads placed on their muscles and joints make them more prone to injuries. Warm-ups

before exercising elevate the temperature in the muscles and increase blood circulation so that heart-related risks are also reduced.

Stretching causes flexibility and increases the elasticity of the soft tissues thereby making it less susceptible to injuries and delays fatigue and lactic acid accumulation. Sensory motor stimulation also occurs during warm-ups, which prepares the muscles for lifting heavy loads. This also increases the concentration and tunes the mind to the environment of the activity about to be performed. The sensory motor stimulation alerts the body towards musculoskeletal injuries and other problems that occur at high intensity exercise. Three basic kinds of warm-ups include the whole body warm-up (jogging, brisk walking, cycling, stair climbing, etc.), muscle stretching and body parts' exercises.

Cooling-down After Work-Outs

This is important in order to remove exercise-induced by-products from the muscles. During intense training, the blood circulation is raised and a large volume of blood returns to the heart after such demanding routines. Abrupt stoppage can lead to sudden and extreme accumulation of blood thereby interfering with the circulation to the heart, skeletal muscles and the brain, which can lead to dizziness and/or fainting. Besides this, slowly reducing the intensity level of the workout leads to a better recovery rate. Stretching after exercise helps to flush-out wastes from the worked area and reduces edema and lactic acid by transporting them out of the cellular environment and helping the body to recover rapidly. Low intensity aerobic exercises like cycling, walking and stretching are also good as cool-downs.

Types of Exercises Performed Without Modern Gadgets: These include various kinds of exercises for different body parts and are briefly described:

For the Thighs: The common modes are squatting, step-ups and use of leg press and the hack-squat machines.

Squat: A bar is put on trapezium across the shoulders and squatting is done by bending the knees followed by driving oneself upwards towards the starting position and stopping-off at the full standing position.

Leg Press: For this, positioning on the leg-press machine is done with feet shoulders' width apart and lowering of the weight is done slowly

till the knees almost reach the chest. The weight is pushed back up to the starting position but short of locking-out the knees.

Step-ups: A pair of dumbbells is held and one foot is put in front-on the bench- so that the knee is bent at a 90° angle while the other foot stays planted on the floor with the knee straight. Then stepping-up on the bench is done and the body is brought upwards by straightening the front knee.

Hack Squat: This is carried out by positioning on the hack squat-machine and descending slowly by bending knees under control and stopping 2 inches from above, and then immediately pushing oneself up with one's feet.

For the Chest: The use of bench press is made for exercising the chest.

Bench press: The bar-bell is gripped with a wider than a shoulder-width's grip and is held on the chest with the elbows in the extended state. The bar-bell is lowered slowly towards the middle of the chest by bending the elbows under control.

For the Back: Bending over rows is the common exercise for this.

Bent-over rows: The bar-bell is held while standing straight with the feet shoulder-widths' apart and back straight followed by bending forward at the waist and keeping the back between an angle of 45°-70°.

For the Lateral Muscles: Both pull-ups and the lats machine pull-downs are followed for this.

Pull-ups: By hanging on to an overhead bar one is to pull oneself upwards on the bar until the chin is at level with the bar or just above the bar. After a pause for a count of one, slow lowering is down till the elbows are about two inches from the bar.

Lats Machine Pull-down: While sitting on the Lats machine, the overhanging bar is held with a width as wide as the shoulders and the elbows are bent slightly. The bar is pulled down towards the upper chest by driving the elbows downwards till they are just under the chin and are then taken back to the starting position.

For the Shoulders: Use is done of the military press and the upright rows exercises.

Military Press: This is done by gripping a barbell and holding it overhead with elbows extended fully and standing straight. The barbell is slowly lowered towards the upper body-portion and pressing the weight back up to the resting position.

Upright Rows: Holding the barbell, pulling of

the bar is done upwards by bending the elbows and taking them upwards about the chin-or neck-level. Then lowering of the bar is done, stopping a few inches before reaching the full elbows' extended position.

For the Triceps: Parallel bar dips and triceps press downs are carried out.

Parallel Bar Dips: Positioning on the parallel bars is done by hanging with both elbows extended downwards and holding the bar at both sides. The knees are bent and lowering of the body is carried out by slowly bending the elbows.

Triceps Press Down: By facing the press-down machine, the pulley bar is brought to the lower chest with the elbows bent. The bar is pressed down by extending the elbows and slowly resting it back again.

Despite the benefits documented from vigorous activity, a number of studies in literature have reported induction of *genetic damage* in human subjects as well as in animal models after physical activity. There have also been documentations on the potential involvement of exercise-induced DNA damage with various diseases; other effects include the probable involvement of oxidatively damaged DNA in cancer development, and an association between oxidative damage to mitochondrial DNA and age-related degenerative diseases (Hartmann and Niess 2000). Exercising increases the demand for energy and energy production; this is met by an increased oxygen uptake, which is supplied to the active tissues (Remmen et al. 2003). During maximal muscle contraction, oxygen consumption in resting local muscle fibers increases several folds, more than the increase in whole body oxygen consumption. In order to produce increased energy in the form of ATP, there is an increase in electron flux, which however increases the local production of reactive oxygen species (ROS) and causes increased oxidative stress to the tissue. An increase in ROS occurring during/ after exercise cannot be coped by enough antioxidant production as the capacity of endogenous cellular defense system is affected (Sjodin et al. 1990). This results in oxidative stress, which leads to oxidative DNA damage. Oxidative DNA damage can cause base lesions, sugar lesions, single-and double-strand breaks, abasic sites, DNA-protein cross-links and DNA base modifications, among which 8-hydroxy-7,8-dihydro 2'-deoxyguanosine (8-OHdG) is the most important and extensively used biomarker of *in*

vivo oxidative lesions (Helbock et al. 1999). Due to its mispairing properties, the 8-OHdG is directly involved in the process of carcinogenesis. The carcinogenic impact of oxygen radicals is based on oncogene activation or suppressor gene inactivation through chromosomal rearrangement. Furthermore, oxygen radicals induce genotoxic effects by indirect mechanisms leading to formation of chromosomal breaking agents, the clastogenic factors. Besides cancer, some of the diseases (Devasagayam and Kamat 2000) in which free radicals have been implicated (and which could well be triggered by strenuous exercise), include degenerative diseases associated with ageing (cardiovascular ailments, neurodegenerative diseases, decline in immune system, etc.) as well as metabolic disorders, lung diseases, ischaemia-reperfusion injuries, diabetes, cystic fibrosis, rheumatoid arthritis, etc.

The past few years has seen a resurgence and build-off of gymnasiums, health clubs and fitness centres. In Amritsar also, many such centers have mushroomed even within residences and have become commercial enterprises since physical exercises and workouts at gymnasiums have gained popularity especially among the youth in order to keep fit and healthy. In the present study, an effort was made to gather informational-inputs from a number of Fitness centres, Health clubs, Gymnasiums and *Akharas* regarding the exercise regimens and routines being practiced by those frequenting them, their lifestyle and habits, besides the collection of their demographic data.

MATERIALS AND METHODS

The study was conducted in Amritsar (2005-2006) to document the exercise regimen of healthy individuals working-out in health clubs for body building, in gymnasiums/gyms for keeping physically fit and in *Akharas* for becoming wrestling professionals. Information on 100 individuals regarding exercise regimen, types, schedule and their personal histories were recorded on specially designed questionnaires after informed consent. The study was cleared by the Institutional Ethical Committee. Detailed information about each individual was recorded for the following aspects: exercise schedule, workouts/ regimens, warm-ups, personal history, life style details, diet history, genetic history. The Sunshine Health Club and Fitness Health Club,

Shakti Nagar and Sharpe Shape Health Club, Hathi Gate, Amritsar, were frequented for body builders (n=40) data and the Shankar *Akhara* and the Kallu *Akhara* were visited for information on wrestlers (n=20). Individuals frequenting gymnasiums (n=40) were interviewed from Royal Arms Gym, Fitness Centre (GNDU Campus) and Big Guns (Cheharta, Amritsar). Only Royal Arms Gym was registered with the Indian Bodybuilding Association. The coach in these gymnasiums was either a qualified physiotherapist or a national level bodybuilding champion. Information regarding the specific guidelines or regimens for the registration of the gyms was not forthcoming from gym owners. In *Akharas*, a former wrestler imparted the techniques and tricks and also the types of exercises to perform for wrestling competitions. Some anthropometrical measurements were taken as was the demographic information. Maximal oxygen uptake ($\text{VO}_2 \text{ max}$ -a measure of the highest rate at which oxygen can be consumed by an individual during exercise at sea level and reflects the maximum rate of whole body oxygen-dependent ATP formation) estimation was carried out with the Step test (McArdle 2002).

RESULTS

The observations for the three categories of individuals performing strenuous exercises are presented. Body Builders (n=40) and wrestlers (n=20) were all male respondents belonging to the middle socio-economic status while there were both females (n=5) and males (n=35) wishing to be physically fit. Their demographic profiles are presented in Tables 1-4.

Body Builders: Data on 40 males body builders in Table 1 reveal their age-range (15-28 yrs), time since exercising (1-6 yrs), warm-up timing (20-45 min) and daily exercise routine (1-4 hrs) as well as their dietary patterns and life style habits.

Wrestlers: The selected wrestlers were males in the age range of 15-30 years (Table 2). All of them were students of middle socio economic status, exercising from last 5-6 years. There was no incidence of any disease among them and only five were married.

Physically Active Individuals: The males (17-28y) mostly students with <1-9 years of exercising (daily for 40in.-3hr) were of height 160.00-188.80 cm, weight 60.0-85.0 kg, BMI 20.30-

Table 1: General information on body builders

<i>Life Style</i>	<i>Number</i>	<i>Percentage</i>
Alcohol intake	06	15.0
Non vegetarian	31	77.5
Smokers	21	52.5
Alcohol intake & Smokers	04	10.0
Mobile Users	24	60.0
Food Supplements	18	45.0
<i>Age (yr)</i>	<i>Number</i>	<i>Percentage</i>
15-20	21	52.5
20-25	13	32.5
25-30	06	15.0
<i>Warm-up Time (min)</i>	<i>Number</i>	<i>Percentage</i>
20-30	11	27.5
30-40	18	45.0
40-50	11	27.5
<i>Daily Schedule (hr)</i>	<i>Number</i>	<i>Percentage</i>
1-2	17	42.5
2-3	21	52.5
3-4	02	5.0
<i>Time Since Exercising (yr)</i>	<i>Number</i>	<i>Percentage</i>
1-3	30	75.0
3-6	10	25.0
<i>Height (cm)</i>	<i>Number</i>	<i>Percentage</i>
160-170	11	27.5
170-180	21	52.5
180-190	08	20.0
<i>Body Mass Index (BMI;kg/m²)</i>	<i>Percentage</i>	
Normal-18.5-22.9	34	85.0
Overweight at risk-23.0-24.9	06	15.0

BMI as per WPRO, 2000

28.30 kg/m² with VO₂ max 61.30–77.70 ml/kg/min (Table 3) and the females were in the age 20-25 yr, height 152.0-164.0 cm, weight 54-60 kg, BMI 22.50-25.30 kg/m² and VO₂ max 45.30-47.30 ml/kg/min (Table 4).

The various types of exercises performed by body builders (using specific equipment -Table 5) and wrestlers are presented in Tables 6 and 7, respectively, targeting various organs. The routine for exercises followed a rest day. The exercises done on a single day combined those targeting chest and lateral muscles (lats) or biceps and triceps or thighs and abs (abdominal muscles). The exercises performed by the physically active group included treadmill running, bicycle ergo meter, T-bar, ground pulley, bench press (flat/inclined/declined), pull-up close/wide grip, pull-down close/wide grip (Table 9). On alternate days different combinations were performed (Table 10).

Table 2: General information on wrestlers

<i>Life Style</i>	<i>Number</i>	<i>Percentage</i>
Alcohol intake	12	60.0
Non Vegetarian	18	90.0
Smokers	11	55.0
Alcohol intake & Smokers	9	45.0
Mobile users	11	55.0
<i>Age (yr)</i>	<i>Number</i>	<i>Percentage</i>
15-20	7	35.0
20-25	7	35.0
25-30	6	30.0
<i>Warm-up Time (min)</i>	<i>Number</i>	<i>Percentage</i>
20-30	9	45.0
30-40	6	30.0
40-50	5	25.0
<i>Daily Schedule (hr)</i>	<i>Number</i>	<i>Percentage</i>
1-2	6	30.0
3-4	13	65.0
5-6	1	5.0
<i>Time Since Exercising (yr)</i>	<i>Number</i>	<i>Percentage</i>
1-3	7	35.0
3-6	13	65.0
<i>Height (cm)</i>	<i>Number</i>	<i>Percentage</i>
160-170	7	35.0
170-180	5	25.0
180-190	8	40.0
<i>Weight (kg)</i>	<i>Number</i>	<i>Percentage</i>
60-70	5	25.0
70-80	7	35.0
80-90	4	20.0
90-100	4	20.0
<i>Body Mass Index (BMI;kg/m²)</i>	<i>Percentage</i>	
Normal-18.5-22.9	12	60.0
Overweight at risk-23.0-24.9	08	40.0
Obese I- 25.0-29.9	-	-

BMI as per WPRO, 2000

Types of Warm-up: The warm-up time ranged from 20-50 min for body builders and wrestlers and between none to 90 min by physically active individuals (Table 8): stretching, strengthening, skipping, jogging, running (treadmill), aerobics, jumping, cycling (bicycle ergo meter). Of the total physically active, only two males were not doing any of the warm-ups.

Nutritional Supplements: Specific calorific and protein requirements are recommended for those doing strenuous physical exercise and include egg whites, oat, bran, fruits (especially grapes), spinach, peas and potatoes and water (8-10 glass daily); the later as it performs various functions such as dissolving substances, being a medium for chemical reactions, a lubricant and assisting in temperature regulation.

Table 3: General information on physically active males

Characteristics	Number	Percentage
<i>Age (yr)</i>		
17-22	21	60.00
23-28	14	40.00
<i>Height (cm)</i>		
160.00-179.00	25	71.43
180.00-189.00	10	28.57
<i>Weight (kg)</i>		
50.00-69.99	11	31.43
70.00-89.99	24	68.57
<i>BMI (kg/m²)</i>		
Normal 18.5-22.9	11	31.43
At risk 23.0-24.9	18	51.43
Obese-I 25.0-29.9	6	17.14
<i>VO₂ max (ml/kg/min)</i>		
60.00-69.99	17	48.57
70.00-79.99	18	51.43
<i>Time-since-Exercising (mon)</i>		
2-36 (≤3 yr)	25	71.43
≥36-72 (≥3 -6yr)	8	22.86
≥72-108 (≥6-9yr)	2	5.71
<i>Daily exercise time (min)</i>		
≤60 (≤1h)	13	37.14
≥60-120 (≥1-2h)	18	51.43
≥120-180 (≥2-3h)	4	11.43
<i>Warm-up (min)</i>		
0-30	32	91.43
31-60	2	5.71
61-90	1	2.86
<i>Life Style/Habit</i>		
Alcohol intake	5	14.28
Smoking	-	-
Non-vegetarian diet	16	45.71
Mobile phone usage	33	94.28
Dietary supplements	17	48.57
<i>Occupation</i>		
Students	31	88.57
Dhaba worker	1	2.86
Sales manager	1	2.86
Gym owner	1	2.86
<i>Marital Status</i>		
Married	1	2.86
Unmarried	34	97.15

Creatine powder, whey protein and soy protein were supplements taken by physically active individuals. Creatine (methyl guanodine acetic acid) comprises arginine, glycine and methionine. The creatine stored in the muscles binds with phosphorus to form creatine phosphate (CP), which has the ability to react with the ADP and converts it into ATP. It is also effective in decreasing excessive inflammatory conditions associated with muscle tissue, serum triglycerides and cholesterol levels. However a side effect of its supplementation has been reported as weight gain (www.en.wikipedia.org; recommended dose: 15-20 gm/day). Whey protein

Table 4: General information on physically active females

Characteristics	Number	Percentage
<i>Age (yr)</i>		
17-22	2	40.0
23-28	3	60.0
<i>Height (cm)</i>		
150.00-159.00	4	80.0
160.00-169.00	1	20.0
<i>Weight (kg)</i>		
45.00-55.99	2	40.0
56.00-66.99	3	60.0
<i>BMI (kg/m²)</i>		
Normal 18.5-22.9	1	20.0
At risk 23.0-24.9	2	40.0
Obese-I 25.0-29.9	2	40.0
<i>VO₂ max (ml/kg/min)</i>		
40.00-45.99	3	60.0
46.00-49.99	2	40.0
<i>Time-since-Exercising (mon)</i>		
2-3	3	60.0
≥3-5	2	40.0
<i>Daily Exercise Time (min)</i>		
≤60 (≤1h)	2	40.0
≥60-120 (≥1-2h)	3	60.0
<i>Warm-up Time (min)</i>		
0-30	4	80.0
31-60	1	20.0
<i>Life Style/Habit</i>		
Alcohol intake	0	-
Smoking	0	-
Non-vegetarian diet	2	40.0
Mobile phone usage	3	60.0
Dietary supplements	-	-
<i>Occupation</i>		
Students	5	100.0
<i>Marital Status</i>		
Unmarried	5	100.0

Table 5: Basic body building equipment used for exercising various body parts

Equipment	Target Organ
Cable crunch	Abdominal muscles (Abs)
Knee raise	Knees
Hanging knee raise	Lateral muscles (Lats)
Dumbbell row	Back
Dumbbells from raise	Anterior delt
Decline crunch	Oblique, upper Abs
Preacher curl	Biceps
Hammer strength dip	Lats
Cable press down	Triceps
Alternating dumbbell curl	Biceps

(WP) is the name for a collection of globular proteins isolated from whey- a mixture of beta-lactoglobulin (~65%), alpha-lactalbumin (~25%) and serum albumin (~8%). It accelerates muscle development and endurance. However excessive use of whey protein may cause liver problems (www.en.wikipedia.org; recommended dose: 10-15 gm/day). Soy protein (SP) is storage protein

Table 6: Types of exercises performed by body builders

Target organs	Exercises*	Daily duration (min)	No. doing various exercises	Percentage
Chest	Bench Press	30-50	18	45.0
Thighs	Knee Raise	40-50	25	62.5
Biceps, Triceps	Cables Press Down, Alternating Dumbbell	30-40	25	62.5
Abdominal Muscles	Decline Crunch, Cable Crunch	20-30	15	37.5
Lateral Muscles	Lateral Press, Hammer Strength Dip	20	20	50.0

* On alternate days, different combinations were performed, targeting different organs.

Table 7: Types of exercises performed by wrestlers

Target organs	Exercises*	Daily duration (min)	No. of individuals doing various exercises	Percentage
Chest	Push-ups	20-40	16	80.0
Thighs	Sit-ups	20-30	12	56.0
Biceps, Triceps	Pull-ups, Rope climbing	40-50	18	90.0
Abdominal Muscles	Swinging weighted wooden clubs	30-40	10	50.0
Lateral Muscles	Swinging weighted ball and mace	10-20	15	75.0

*On alternate days, different combinations were performed, targeting different organs.

Table 8: Types of warm-ups performed by physically active individuals

		Types of warm-ups								
	No.	Percent-age	Stretch-ing	Streng-thening	Skip-ping	Jog-ging	Run-ning (treadmill)	Aero-bics	Jump-ing	Cycling (bicycle ergometer)
Males	15	42.86	+	-	-	-	-	-	-	-
	1	2.86	-	-	-	+	-	-	-	-
	5	14.28	-	-	-	-	-	+	-	-
	5	14.28	-	-	-	-	+	-	-	-
	2	5.70	+	-	-	-	-	-	+	-
	2	5.70	+	-	-	-	+	-	-	-
	1	2.86	-	+	-	+	-	-	-	-
	1	2.86	-	-	-	-	+	-	-	-
	2	5.70	-	-	-	-	-	-	-	-
	1	2.86	-	+	-	-	-	-	-	-
Females	1	20.00	-	-	-	-	-	+	-	-
	1	20.00	-	-	+	-	-	-	-	-
	2	40.00	-	-	-	-	-	-	-	+
	1	20.00	-	-	-	-	+	-	-	+
	1	2.86	-	+	-	-	-	-	-	-

in discrete particles- protein bodies which contain ~60-70% of total soy bean protein. Soybeans contain metabolic proteins such as enzymes, trypsin inhibitors, hemagglutinins, and cysteine proteases. SP improves the physiological condition and leads to better performance (www.en.wikipedia.org; recommended dose: 10-15 gm/day). CP, WP and SP were the dietary supplements taken by body builders and physically active males (Table 11). However, 18 physically active males and neither the females nor the wrestlers were taking any of the dietary supplements. Endura Mega Mass (Gainer 4000 - soy protein, whey protein, casein, creatine, L-

glutamine, maltose, dextrin, sucrose, minerals, vitamins, approved flavours and preservatives) besides CP, SP and WP were being taken by the body builders.

DISCUSSION

The observations from the present study as elaborated above, emphasize the strenuous exercise regimen and routine being followed by all those desirous of being body builders, wrestlers and those wishing to be physically fit or maintaining fitness. The tremendously exhaustive work-outs being carried out from the

Table 9: Equipment used and types of exercises performed by physically active individuals

<i>Exercise Type</i>	<i>Muscle group focused</i>	<i>Execution</i>	<i>Equipment</i>
Treadmill running	Whole body	Running without moving any distance on treadmill machine	Treadmill
Bicycle Ergometer	Whole body	Cycling without moving any distance on stationary bicycle	Bicycle Ergometer
T-bar	Back	Standing with one leg in front of the other and bending over at 45°-90° angle, keeping the back flat and contracting both arms with T-bar weights in them and lowering down again. Legs switched with each set.	Dumbbell
Ground pulley	Triceps	Standing at the cable machine, gripping the handle and pushing it down, and slowly raising it back upto the starting position.	Machine
Bench Press Flat	Chest	With back flat on the bench without arching the back, the weights are lifted straight up, then after a pause brought back and down again.	Barbell
Inclined	Upper chest	Similar to flat bench press, this exercises is done by lying on an inverted bench, pushing weights up 90° from the ground.	Barbell
Declined	Lower chest	Similar to flat bench press this exercise is done by lying on an declined bench.	Dumbbell
Pull -up Close grip	Back	By pulling up the bar to the upper chest area and slowly lowering it with arms close together.	Machine
Wide grip	Back	By pulling up the bar to the upper chest area and slowly lowering it with arms fully extended.	Machine
Pull -down Close grip	Back	Grabbing the bars from overhead, pulling them down and slowly raising them with arms close together.	Machine
Wide grip	Back	Grabbing the bars from overhead, pulling them down and slowly raising them with arms fully extended.	Machine

Table 10: Types of exercises performed by physically active individuals

	<i>No</i>	<i>%</i>	<i>Types of exercise</i>										
			<i>Tread-mill run-ning</i>	<i>Bi-cycle ergo meter</i>	<i>T-bar</i>	<i>Ground pulley</i>	<i>Bench press</i>			<i>Pull-up</i>		<i>Pull-down</i>	
							<i>Flat</i>	<i>Incli-ned</i>	<i>Decli-ned</i>	<i>Close grip</i>	<i>Wide grip</i>	<i>Close grip</i>	<i>Wide grip</i>
Males	13	37.14	+	+	+	+	+	+	+	+	+	+	+
	6	17.14	-	+	+	+	+	+	+	+	+	+	+
	6	17.14	+	-	+	+	+	+	+	+	+	+	+
	8	22.86	-	-	+	+	+	+	+	+	+	+	+
	1	2.80	-	-	+	+	+	+	+	+	-	+	+
Females	1	2.80	+	+	-	+	+	+	+	+	-	-	-
	2	40.00	+	+	-	-	-	-	-	-	-	-	-
	1	20.00	+	+	-	-	-	-	-	-	+	-	-
	1	20.00	+	+	+	+	+	+	+	+	+	+	+
	1	20.00	+	+	+	-	+	+	+	+	+	+	+

*On alternate days, different combinations were performed

past 2-9 years daily for 1-6hr with warming-up sessions of 20-90min in this group of 15-30 years old (with only ~ 36% overweight and Obese I) individuals using modern and traditional gadgets indicate the changing scenario from “performance testing” to “fitness testing and physical activity for health”. Physical activity is one of the

cornerstones of a healthy lifestyle. The benefits derived from physical exercise are widely known. However there is ample evidence that during physical activity/exercise, free radical production is increased causing oxidative stress. If not adequately removed by antioxidant defenses, free radicals react with membranes (lipids), proteins,

Table 11: Nutritional supplements taken by body builders and physically active males

No.	Percentage	Creatine powder	Whey protein	Soy protein
<i>Body Builders</i>				
3	7.50	+	-	-
1	2.50	+	+	-
12	30.00	-	+	-
1	2.50	+	+	+
23	57.50	-	-	-
<i>Physically Active Males</i>				
3	8.57	+	-	-
1	2.86	+	+	-
12	34.29	-	+	-
1	2.86	+	+	+
18	51.43	-	-	-

nucleic acids, and other components to initiate/cause cellular damage and degeneration. This implies that in individuals performing various strenuous exercises (as also being performed by the present study group), there exists a potential for harm and damage from exercise-induced stress. The damage to macromolecules in the intracellular environment, especially to DNA, bodes a sign of ill-health and is a cause for concern meriting precautionary measures.

Free Radicals in Biological Systems: An overproduction of free radicals or a drop in the level of the antioxidant defenses, leads to an imbalance and causes deleterious effects, i.e. oxidative stress. The primary site of oxidative damage (Hartmann and Neiss 1999) is DNA leading onto ROS-induced single-and double-strand breaks, base alterations, damage to deoxyribose, formation of DNA-protein cross-links, etc. Mechanisms by which exhaustive exercise can induce DNA damage includes: mitochondrial electron transport chain, ischemia-reperfusion mechanism, xanthine oxidase catalyzed reaction, inflammatory mechanism, production of catecholamine. DNA breaking, absent in muscles of sedentary normal mice but present in mdx mice at rest, dramatically increased after exercise (Sandri et al. 1996) and shed new light on exercise-induced muscle damage and on its progression in dystrophinopathies.

Genetic Damage Studies Following Strenuous Exercising: The effects of heavy exercise on genetic damage have been studied. Energy demand during physical exercise was reported (Pilger et al. 1997) to cause an increased oxygen uptake and supply to active tissues, which increases the rate of free oxygen radical

production and thereby affecting the capacity of endogenous cellular defense system.

The micronucleus test was performed (Schiffli et al. 1997) on PHA-stimulated blood lymphocytes of six healthy volunteers before and after exhaustive sprints. The number of micronuclei was significantly increased and this indicated that exhaustive physical exercise caused severe mutations at the chromosome level in the blood lymphocytes. Hartmann et al. (1998) reported that exercise-induced DNA effects in human leukocytes were not accompanied by increased formation of 8-hydroxy-2-deoxyguanosine or induction of micronuclei in short distance triathlon runners. Exercise-induced chromosomal damage was also observed in trained and untrained subjects (Umegaki et al., 1998). Niess et al. (1998) showed that intensive anaerobic and intensive endurance exercise induced DNA damage in leukocytes. A study by Mars et al. (1998) also suggested that high intensity exercise could cause lymphocytic apoptosis. In stressed trout, Villarini et al. (1998) also detected DNA damage in nucleated erythrocytes using the comet assay. Tsai et al. (2001) also reported that oxidative DNA damage in human peripheral leukocytes increased in individuals performing massive aerobic exercise. Mastaloudis et al. (2004) documented that endurance exercise resulted in DNA damage. These observations reveal that exercised-induced oxidative stress often leads to genetic damage and since excess free-radical formation has been hypothesized to contribute to cancer, atherosclerosis, aging, and exercise-associated muscle damage, individuals pursuing such arduous activities are potential targets for ill-health. Antioxidant supplements such as vitamin C, vitamin E, and beta-carotene have been promoted for enhancing exercise performance and for preventing certain diseases. In view of trying to balance the oxidative-stress (and hence the induced genetic damage) and susceptibility to associated diseases and cancers, the prescription of a daily diet containing five to seven servings of fruits and vegetables as suggested by Adams and Best (2002) may probably also prove beneficial to those individuals strenuously exercising for physical fitness and sport.

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