Reference Material *for* Physical Activity

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Benefits of Physical Exercise

Physical exercise is an important component of a healthy lifestyle.

"The benefits of physical activity are well established, and emerging studies continue to support an important role for habitual exercise in maintaining overall health and well being."

There is a clear immense relationship between activity and mortality risk across activity categories, and the risk profile indicates that some exercise is better than more, and more exercise - up to a point - is better than less. Thus, public health efforts should be directed toward "getting more people more active more of the time.

BENEFITS

longevity
improvement in aerobic (heart) function
enhanced performance of work, recreational, and sport activities
decreased anxiety and depression
reduced body fatness

Reference:
American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

EXERCISE AND AGE

Although the greatest amount of oxygen that can used by the body during intense exercise VO2max (the greatest amount of oxygen that can used by the body during intense exercise) decreases with age and total body mass and fat weight increase with age, evidence suggests that this trend can be altered with aerobic training.

A 9% reduction in VO2max (the greatest amount of oxygen that can used by the body during intense exercise) per decade for sedentary adults after age 25 has been shown, but for active individuals the reduction may be less than 5% per decade.

10 year follow up data on athletes age 50 - 83 years of age showed VO2max (the greatest amount of oxygen that can used by the body during intense exercise) to be unchanged when training quantity and quality remained unchanged. Thus, lifestyle plays a significant role in the maintenance of fitness.

Reference:

American college of Sports Medicine. (1990). The Recommended Quantity and Quality for Developing and Maintaining Cardiorespiratory and Muscular Fitness In Healthy Adults. *Med Sci Sports Exercise.* 22.2, pp. 265 - 274.

Health Screening & Risk Assessment

Physical Activity Readiness Questionnaire (PAR-Q)

If you answer yes to any one of these questions,
contact your primary care provider before starting an exercise program.

1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
2. Do you feel pain in your chest when you do physical activity?
3. In the past month, have you had chest pain when you were not doing physical activity?
4. Do you lose your balance because of dizziness or do you ever lose consciousness?
5. Do you have a bone or joint problem that could be made worse by a change in your physical activity?
6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
7. Do you know of any other reason why you should not do physical activity?

American College of Sports Medicine. (1998*). ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription.* (3rd ed.). Baltimore: Williams and Wilkins.

Most adults do not need to see their physician before starting a moderate intensity physical activity program. However, men older that 40 years and women older than 50 years who plan a vigorous program (intensity > 60% individual maximum oxygen consumption or who have either chronic disease or risk factors for chronic disease) should consult their physician to design a safe effective program.

Reference:

Physical Activity and Public Health: A Recommendation From the Centers for Disease Control and Prevention and the American College of Sports Medicine. (01 February 1995*). Journal of the American Medical Association,* 273.5.

To ensure an optimal benefit-to-risk ratio, the exercise professional should incorporate some form of health appraisal before performing fitness testing or initiating an exercise program.

The purpose of a health appraisal is to provide information relevant to the safety of fitness testing before beginning exercise training, to identify known diseases and risk factors for cardiovascular disease and other potentially preventable chronic diseases so that appropriate lifestyle interventions can be initiated, and to identify additional factors that require special consideration when developing an appropriate exercise prescription and programming to optimize adherence, minimize risks, and maximize benefits.

Reference:

American College of Sports Medicine. (1998). ***ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*** **(3rd ed.). Baltimore: Williams and Wilkins.**

Behavior Modification

A fundamental objective of exercise prescription is to bring about a change in personal health behavior to include habitual physical activity. Thus the most appropriate exercise prescription for a particular person is the one that is most helpful in achieving this behavioral change.

The art of exercise prescription is the successful integration of exercise science with behavioral techniques that result in long term program compliance and attainment of the individual's goals.

Reference:
American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

An intention to exercise and awareness of the benefits of exercise and awareness of the benefits of exercise are weakly related to participation in physical activity.

Confidence in the ability to be physically active, perceived barriers to activity, and enjoyment of activity are strongly related to participation.

Low to moderate activities are more likely to be continued than high intensity activities.

Self regulating skills, such as goal setting , self monitoring progress, and self reinforcement, contribute to continued physical activity.

Current low participation rate may be due to the belief that to reap health benefits participants must engage in vigorous, continuous exercise.

Reference:
Physical Activity and Public Health: A Recommendation From the Centers for Disease Control and Prevention and the American College of Sports Medicine. (01 February 1995*). Journal of the American Medical Association,* 273.5.

Exercise Prescription - General

Physical Activity and Health: A Report of the Surgeon General:

In 1996, the Us Surgeon General's Report on Physical Activity and Health launched an effective awareness campaign encouraging Americans to simple "get moving". The report not only reached the American population at large but also influenced similar reports in other countries, resulting in a worldwide effort to make physical activity a routine part of life. To obtain a copy of this landmark report, visit http://www/nehc-med.navy.mil/hp/fitness/index.htm.

Reference:
United States Department of Health and Human Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, The President's Council on Physical Fitness and Sports. (1996). ***Physical Activity and Health: A Report of the Surgeon General.*** **Atlanta, GA.**

The essential components of an individualized exercise prescription include the following:
1. mode (what type of exercise)
2. frequency
3. intensity
4. time (duration)
5. progression of physical activity

Exercise prescription should be developed with careful consideration of the individual health status (including medications), risk factor profile, behavioral characteristics, personal goals, and exercise preferences.

PURPOSES OF EXERCISE PRESCRIPTION

Various purposes of exercise prescription include
1. enhancing physical fitness
2. promoting health by reducing risk factors for chronic disease
3. ensuring safety during exercise participation

In all cases, specific outcomes identified for a particular person should be the ultimate target of the exercise prescription.

The quantity of exercise needed to significantly reduce disease risk appears to be considerably less than that needed to develop and maintain high levels of physical fitness. For the sedentary person at risk for premature chronic disease, adoption of a moderately active lifestyle may carry important health benefits and represent a more attainable goal than achievement of a high VO2 max (the greatest amount of oxygen that can used by the body during intense exercise). Regardless, enhancing physical fitness whenever possible is a desirable feature of exercise prescription.

Reference:
American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

Based on the existing evidence concerning exercise prescription for healthy adults and the need for guidelines American College of Sports Medicine (ACSM) makes the following recommendations for the quantity and quality of training for developing and maintaining aerobic (cardiorespiratory) fitness, body composition, and muscular strength and endurance in the healthy adult:

1. frequency 3 - 5 times per week
2. intensity 60 - 90% Maximal Heart Rate (MHR)
3. duration 20 - 60 minutes of continuous aerobic activity

FITNESS

The ability to perform moderate to vigorous levels of physical activity without undue fatigue and the capacity of maintaining such ability throughout life.

Fitness is limited mainly to the following areas:

1. changes in VO2max (the greatest amount of oxygen that can used by the body during intense exercise)
2. muscular strength and endurance
3. body composition .

It has been pointed out that the quantity and quality of exercise needed to attain health related benefits may differ from what is recommended for fitness benefits.

It is now clear that lower levels of physical activity than what is recommended in this position statement may reduce the risk of certain diseases and yet may not be sufficient quantity and quality to improve VO2max (the greatest amount of oxygen that can used by the body during intense exercise).

Reference:
American college of Sports Medicine. (1990). The Recommended Quantity and Quality for Developing and Maintaining Cardiorespiratory and Muscular Fitness In Healthy Adults. *Med Sci Sports Exercise.* 22.2, pp. 265 - 274.

Physical activity has been defined as "any bodily movement produced by skeletal muscles that results in energy expenditure."

Physical activity is closely related to, but distinct from, exercise and physical fitness.

Physically active adults tend to develop and maintain higher levels of physical fitness.

Physical activity recommendations in Healthy People 2000 are to "increase to at least 30% of the proportion of people aged 6 and older who engage regularly, preferable daily, in light to moderate physical activity for at least 30 minutes per day. However , only 22% of adults are active at this level recommended for health benefits. 50% are somewhat active but do not meet this objective. 24% or more are completely sedentary.

EXERCISE EXCUSES

A lack of time is the most common sited barrier to participation in physical activity, and injury is a common reason for stopping regular activity.

LEADING PUBLIC HEALTH AGENCIES

Centers for Disease Control
American College of Sports Medicine
President's Council on Physical Fitness and Sports
American Heart Association

If Americans who lead sedentary lives would adopt a more active lifestyle, there would be enormous benefit to the public's health and to individual well - being. An active lifestyle does not require a regimented, vigorous exercise program. Instead, small changes that increase daily physical activity will enable individuals to reduce their risk of chronic disease and may contribute to enhanced quality of life.

Reference:

Physical Activity and Public Health: A Recommendation From the Centers for Disease Control and Prevention and the American College of Sports Medicine. (01 February 1995*). Journal of the American Medical Association,* 273.5.

Aerobic (Cardiorespiratory) Fitness

Improvement in the ability of the body to use oxygen efficiently, resulting in improved endurance, is one component of physical fitness.

Improvement in aerobic (cardiorespiratory) fitness is measured by assessing change in the maximal oxygen uptake (VO2max) (the greatest amount of oxygen that can used by the body during intense exercise), which in turn is directly related to the frequency, intensity, and duration of exercise.

Depending on the interaction of these prescription components, resultant increases in VO2max (the greatest amount of oxygen that can used by the body during intense exercise) may range from 5 to 30%.

Individuals with low initial levels of fitness, cardiac patients, and those exhibiting large losses of body weight will demonstrate the graded % increases in VO2max (the greatest amount of oxygen that can used by the body during intense exercise) . Similarly, more modest increases may be expected from healthy individuals with high initial levels of fitness and those who exhibit little change in body weight.

Reference:
American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

The important factor is to design a program for the individual to provide the proper amount of physical activity to attain maximal benefit at the lowest risk for injury.

Emphasis should be placed on factors that result in permanent lifestyle change and encourage a lifetime of physical activity.

Exercise prescription is based upon frequency, intensity, duration, and mode of activity and initial level of fitness.

Improvement in VO2max (the greatest amount of oxygen that can used by the body during intense exercise) is directly related to frequency, intensity, and duration of training.

Depending on quantity and quality of training, improvement in VO2max (the greatest amount of oxygen that can used by the body during intense exercise)ranges from 5 to 30%.

There is genetically determined pretraining status of the trait and capacity to adapt to physical training. Thus, physiological results should be interpreted with respect to both genetic variation and the quantity and quality of training performed.

The minimal training intensity threshold for improvement in VO2max (the greatest amount of oxygen that can used by the body during intense exercise) is approx. 60% of the Maximal Heart Rate (MHR).

Reference:

American college of Sports Medicine. (1990). The Recommended Quantity and Quality for Developing and Maintaining Cardiorespiratory and Muscular Fitness In Healthy Adults. *Med Sci Sports Exercise.* 22.2, pp. 265 - 274.

Current low participation rate may be due to the belief that to reap health benefits participants must engage in vigorous, continuous exercise.

Those who are active on a irregular basis should strive to adapt a more consistent activity pattern.

Reference:

Physical Activity and Public Health: A Recommendation From the Centers for Disease Control and Prevention and the American College of Sports Medicine. (01 February 1995*). Journal of the American Medical Association,* 273.5.

For further information, see the following reference:

National Institutes of Health Consensus Development Panel on Physical Activity and Cardiovascular Health. (1996). Physical Activity and Cardiovascular Health. *Journal of the American Medical Association.* 276.3,pp.241-246.

Exercise Mode

The greatest improvement in VO2max (the greatest amount of oxygen that can used by the body during intense exercise) occurs when exercise involves the use of large muscle groups over prolonged periods and is rhythmic and aerobic in nature (e.g. walking, hiking, cycling, machine based stair climbing, swimming, dancing, rollerblading, cross country skiing, rope skipping.)

This wide range of activities provides for individual variability relative to skill and enjoyment, factors which influence compliance to the exercise program and thus desired outcomes.

Resistance exercise such as weight training should not be considered as an activity for increasing VO2max (the greatest amount of oxygen that can used by the body during intense exercise) but is an important component of a sound overall exercise plan.

Circuit weight training, which involved 10 to 15 reps. with 15 to 30 seconds rest between weight stations, results in an average improvement in VO2max (the greatest amount of oxygen that can used by the body during intense exercise) of about 5%, and thus is not generally recommended as an activity for improving aerobic endurance.

The risk of injury associated with high impact activities or high intensity weight training must also be weighed when selecting exercise modalities, especially for the novice exerciser or an obese individual. It may be desirable to engage in several different activities to reduce repetitive orthopedic stresses & involve a greater # of muscle groups.

It is important to consider other barriers that might decrease the likelihood of adherence to the exercise program (travel, cost, spousal or partner involvement, etc.).

Reference:

American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

Any activity that uses large muscle groups, can be maintained continuously and is rhythmical and aerobic in nature e.g., walking, hiking, running, jogging, cycling, bicycling, cross country skiing, dancing, rowing, stair climbing, roller blading, etc.

Endurance activities that require running and jumping are considered high impact types of activity and generally cause significantly more debilitating injuries to beginning as well as a long term exercisers than do low impact and non weight bearing type activities.

Beginning joggers have increased foot, leg, and knee injuries when training is performed more than 3 x week and longer than 30 minutes duration per exercise session. High intensity interval training (run - walk) compared to continuous jogging training was also associated with a higher incidence of injury. Thus, caution should be taken when recommending the type of activity and exercise prescription for the beginning exerciser.

Orthopedic injuries as related to overuse increase linearly in runners/joggers when performing these activities.

For injury prevention, important to select different types of activities and remember the effect the quantity and quality of exercise has an injuries.

An activity such as weight training should not be considered as a means of training for developing VO2max (the greatest amount of oxygen that can used by the body during intense exercise), but it has significant value for increasing muscular strength, endurance, and lean body mass.

Reference:

American college of Sports Medicine. (1990). The Recommended Quantity and Quality for Developing and Maintaining Cardiorespi ratory and Muscular Fitness In Healthy Adults. *Med Sci Sports Exercise.* 22.2, pp. 265 - 274.

Adults who engage in moderate intensity physical activity i.e. , enough to expend approximately 200 calories per day - can expect many of the health benefits.

EXAMPLE OF MODERATE ACTIVITIES:
walking 2 miles briskly
cycling for pleasure

swimming, moderate effort
leisure canoeing
mowing lawn
home repair, painting

Intermittent activity also has substantial benefits. Therefore, the recommend 30 minutes of activity also confers substantial benefits.
EXAMPLE: Walking up stairs instead to taking the elevator

Reference:
Physical Activity and Public Health: A Recommendation From the Centers for Disease Control and Prevention and the American College of Sports Medicine. (01 February 1995*). Journal of the American Medical Association,* 273.5.

Exercise Frequency

The time constraints imposed on the individual influence both the duration and frequency of exercise sessions.

Number of exercise sessions per week will vary given caloric goals, participant preferences, and limitations imposed by the participant's lifestyle.

Obese individuals are at an increased relative risk for orthopedic injury, may require that intensity of exercise be maintained at or below the intensity recommended for improvement of aerobic (cardiorespiratory) endurance. Non weight bearing activities (and/or rotation of exercise modalities) may be necessary and frequent modifications in frequency and duration may also be required.

Reference:
American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

The amount of improvement in VO2max (the greatest amount of oxygen that can used by the body during intense exercise) tends to plateau when frequency of training is increased above 3 times a week.

The value of the added improvement found with training more than 5 days per week is small to not apparent in regard to improvement in VO2max (the greatest amount of oxygen that can used by the body during intense exercise).

Training less than 2 days per week does not generally show a meaningful change in VO2max (the greatest amount of oxygen that can used by the body during intense exercise).

Reference:
American college of Sports Medicine. (1990). The Recommended Quantity and Quality for Developing and Maintaining Cardiorespiratory and Muscular Fitness In Healthy Adults. *Med Sci Sports Exercise.* 22.2, pp. 265 - 274.

Exercise Intensity

In designing the exercise component of a weight loss program, the balance between intensity and duration of exercise should be manipulated to promote a high total caloric expenditure (300 to 500 calories per session and 1000 to 2000 calories per week for adults).

Intensity and duration of exercise determine the total caloric expenditure during a training session and are integrally related.

Similar increases in aerobic (cardiorespiratory) endurance may be achieved by a low intensity, long duration session as well as a higher intensity, shorter duration session as well as a higher intensity, shorter duration session.

The risk of orthopedic injury may be increased with the latter; however, programs emphasizing low to moderate intensity exercise with a longer training duration are recommended for most individuals.

American College of Sports Medicine (ACSM) recommends that the intensity of exercise be prescribed as 60% - 90% of maximum heart rate, or 50 - 80% of VO2max (the greatest amount of oxygen that can used by the body during intense exercise).

HEART RATE METHODS

Using heart rate as a guide to exercise intensity is useful.

Several important factors to consider prior to determining the level of exercise intensity include:
1. individual level of fitness
2. presence of medications that may influence heart rate
3. risk of cardiovascular or orthopedic injury
4. individual program objective

The goal should be to maintain an average heart rate close to the midpoint of the prescribed range:

220 - Age = Maximal Heart Rate (MHR)
60 - 90% of MHR = Target (Exercise) Heart Rate (THR)

Reference:
American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

Duration is dependent on the intensity of the activity. Thus, lower intensity activity should be conducted over a longer period of time.

Because of the importance of "total fitness" and the fact that it is more readily attained in longer duration programs, and because of the potential hazards and adhearance problems associated with high intensity activity, lower to moderate intensity activity of longer duration is recommended for the non athletic adult.

Intensity and duration of training are interrelated, with total amount of work accomplished being an important factor in improvement in fitness.

Improvement in fitness for activities performed at a lower intensity, longer duration compared to higher intensity - shorter duration if the total energy costs of the activities are equal.

Higher intensity exercise is associated with greater cardiovascular risk, orthopedic injury and low compliance to training then lower intensity exercise. Therefore, programs emphasizing low to moderate intensity training with longer duration are recommended for most adults.

Initial level of fitness is an important consideration in prescribing exercise. The person with a low fitness level can achieve a significant training effect with a sustained training heart rate as low as 40 - 50% of Maximal Heart Rate (MHR), while persons with higher fitness levels require a higher training stimulus.

Because of the endurance training regimens recommended by ACSM are for 60 minutes or less of physical activity, the system of classification of exercise training is recommended:

HR MAX	SCALE 1 - 10	BORG SCALE
< 35%	1-2 very light	<10
35 - 59%	3-4 light	10 - 11
60 - 79%	5-6 moderate (somewhat hard)	12 - 13
80-89%	7-8 heavy	14 - 16
≥ 90%	9-10 very heavy	> 16

The use of Heart Rate as an estimate of intensity of training is the common standard.

Recommended Perceived Exertion (RPE) has become a valid tool in monitoring exercise intensity. Once the relationship between heart rate and RPE is known, RPE can be used in place of the heart rate.

Intensity is important when maintaining the training effect. In series of experiments where frequency, intensity, or duration were manipulated, found that if intensity of training remained unchanged, VO2max (the greatest amount of oxygen that can used by the body during intense exercise) was maintained for up to a 15 week when frequency and duration of training were reduced by as much as 2/3. When frequency and duration were unchanged and intensity of training was reduced the 1/3 or 2/3, VO2max was significantly reduced.

If primary purpose of the training program is for weight loss, the exercise sessions of greater frequency and duration of training and low to moderate intensity are recommended. Programs with less participants generally show little or no change in body composition.

Significant increases in VO2max (the greatest amount of oxygen that can used by the body during intense exercise) have been shown with 10 - 15 min of high intensity training. Thus, if total body mass and fat weight reduction are not considerations, then shorter duration, higher intensity programs may be recommended for healthy individuals at low risk for cardiovascular disease and orthopedic injury.

Reference:

American college of Sports Medicine. (1990). The Recommended Quantity and Quality for Developing and Maintaining Cardiorespiratory and Muscular Fitness In Healthy Adults. *Med Sci Sports Exercise.* 22.2, pp. 265 - 274.

Moderate physical activity is actively performed at an intensity of 3 to 6 METS - the equalivent of brisk walking at 3 to 4 mph.

Because most adults do not currently meet the standard described, almost all should strive to increase their participation in physical activity that is of at least moderate intensity. Those who do not engage in regular physical activity should begin by incorporating a few minutes of increased activity into their day, building up gradually to 30 minutes per day of physical activity.

Reference:

Physical Activity and Public Health: A Recommendation From the Centers for Disease Control and Prevention and the American College of Sports Medicine. (01 February 1995*). Journal of the American Medical Association,* 273.5.

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Exercise Duration

The time constraints imposed on the individual influence both the duration and frequency of exercise sessions.

Typically, caloric goals can be best met in sessions lasting 20 - 30 min. excluding time spent warming up and cooling down.

American College of Sports Medicine (ACSM) recommends 20 - 60 minutes of continuous aerobic activity.

For severely deconditioned individuals, multiple sessions of short duration (less than 10 minutes) may be necessary.

Increases in exercise duration should be instituted as the individual adapts to training without evidence of undue fatigue or injury.

In designing the exercise component of a weight loss program, the balance between intensity and duration of exercise should be manipulated to promote a high total caloric expenditure (300 to 500 calories per session and 1000 to 2000 calories per week for adults.

Obese individuals are at an increased relative risk for orthopedic injury, may require that intensity of exercise be maintained at or below the intensity recommended for improvement of aerobic (cardiorespiratory) endurance. Non weight bearing activities (and/or rotation of exercise modalities) may be necessary and frequent modifications in frequency and duration may also be required.

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Reference:

American college of Sports Medicine. (1990). The Recommended Quantity and Quality for Developing and Maintaining Cardiorespiratory and Muscular Fitness In Healthy Adults. *Med Sci Sports Exercise.* 22.2, pp. 265 - 274.

Every US adult should accumulate 30 minutes or more of moderate intensity physical activity on most, preferably all, days of the week.

Adults who engage in moderate intensity physical activity i.e. , enough to expend approximately 200 calories per day - can expect many of the health benefits.

EXAMPLE OF MODERATE ACTIVITIES:
walking 2 miles briskly
cycling for pleasure
swimming, moderate effort
leisure canoeing
mowing lawn
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Intermittent activity also confers substantial benefits. Therefore, the recommend 30 minutes of activity also has substantial benefits.
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Weight Management / Obesity

RECOMMENDED WEIGHT LOSS PROGRAMS

For most persons, the optimal approach to weight loss combines a mild caloric restriction with regular aerobic exercise and avoiding nutritional deficiencies.

A desirable weight loss program is one that meets the following criteria:

1. provides intake not lower than 1200 calories per day for normal adults and ensures a proper blend of foods to meet nutritional requirements. (Note: this requirement may not be appropriate for children, older individuals and athletes)

2. includes healthy foods acceptable to the dieter in terms of sociocultural background, usual habits, taste, costs, and ease in acquisition and preparation.

3. results in a maximal weight loss of 1kg/week.

4. includes the use of behavior modification techniques to identify and eliminate diet habits that contribute to malnutrition.

5. includes an exercise program that promotes a daily caloric expenditure of 300 or more calories. For many participants, this may be accomplished with low intensity, this may be accomplished with low intensity, long duration exercise, such as walking.

6. provides that new eating and physical activity habits can be continued for life in order to maintain the achieved lower body weight.

7. in designing the exercise component of a weight loss program, the balance between intensity and duration of exercise should be manipulated to promote a high total caloric expenditure (300 to 500 calories per session and 1000 to 2000 kcal per week for adults).

Obesity may be functionally defined at the percent body fat at which disease risk increases.

Body fat is reduced when a chronic negative caloric balance exists.

2 recommendations of reducing body fat:

1. Exercise: increase caloric use through exercise
2. Nutrition: Decrease in caloric intake

Exercise increases energy use and slows the rate of fat-free tissue loss that occurs when a person loses weight by severe caloric reduction.

Exercise also helps maintain resting metabolism (through increased muscle mass thus the rate of weight loss).

Preparation prior to beginning an exercise program for an obese individuals is important; most are sedentary and have had bad experiences with exercise in the past.

1. past exercise history
2. potential scheduling difficulties
3. locations where exercise might be performed
4. initial exercise prescription should be based on low intensity and progressively longer durations of activity.

On the basis of each person's response to the initial exercise program, the exercise professional should eventually work toward increasing the intensity to bring the person to a target heart rate range suitable for aerobic (cardiorespiratory) conditioning.

BENEFITS OF DECREASED BODY FAT

1. decreased hypertension
2. decreased diabetes
3. decreased cardiovascular disease
4. improved social stigma
5. improved physical working capacity.

PRINCIPLES THAT SHOULD BE EMPLOYED IN MODIFYING BODY COMPOSITION:

1. CALORIC BALANCE: Caloric balance refers to the difference between caloric intake (the energy equivalent of the food ingested) and caloric expenditure (the energy equivalent of resting metabolic rate, activity, thermic effect of food, etc.) Body weight is lost when caloric use exceeds caloric intake (negative balance) and weight is gained when the opposite situation exists.

1 lb. of fat is equalivent to approximately 3500 calories of energy.
Although it is predictable that shifts in caloric balance will be accompanied by change in body weight, the nature of weight loss varies markedly with the specific behaviors that lead to caloric imbalance. EX: fasting and extreme caloric restriction (starvation or semistarvation diets) cause substantial losses of water and fat free tissue. In contrast, an exercise induced negative caloric balance results in weight loss consisting primarily of fat.

2. HIGH RESISTANCE EXERCISE PROGRAMS may lead to a gain in fat free weight (muscle), while aerobic (cardiorespiratory endurance) training usually results in a maintenance of (or slight increase in) fat free weight. Both types of programs can contribute to a loss of body fat, although aerobic activity is more efficient because it involves a sustained high rate of energy expenditure.

Obese individuals are at an increased relative risk for orthopedic injury, may require that intensity of exercise be maintained at or below the intensity recommended for improvement of aerobic (cardiorespiratory) endurance. Non weight bearing activities (and/or rotation of exercise modalities) may be necessary and frequent modifications in frequency and duration may also be required.

Reference:
American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

Total body mass and fat weight are generally reduced with endurance training programs, while muscle tissue remains constant or increases slightly.

Weight loss programs using dietary manipulation that result in a more dramatic decrease in total body mass show reductions in both body fat and lean body mass pounds.

When these programs are conducted in conjunction with exercise training, fat is decreased more effectively.

Programs that are conducted at least 3 times a week of at least 20 minutes duration and of sufficient intensity to use approximately 300 calories per exercise session are suggested as a threshold level for total body mass and fat weight loss.

Using 200 calories per session has also been shown to be useful in weight reduction if the exercise frequency is at least 4 times a week.

If primary purpose of the training program is for weight loss, exercising at a greater frequency and duration of training and low to moderate intensity are recommended.

Significant increases in VO2max (the greatest amount of oxygen that can used by the body during intense exercise) have been shown with 10 - 15 minutes of high intensity training. Thus, if total body mass and fat weight reduction are not considerations, then shorter duration, higher intensity programs may be recommended for healthy individuals at low risk for cardiovascular disease and orthopedic injury.

Reference:

American college of Sports Medicine. (1990). The Recommended Quantity and Quality for Developing and Maintaining Cardiorespiratory and Muscular Fitness In Healthy Adults. *Med Sci Sports Exercise.* 22.2, pp. 265 - 274.

Rate of Progression

Individual progression depends on the following:
1. functional capacity (what individual can perform)
2. medical and health status
3. age
4. individual activity preferences
5. goals

For apparently healthy adults, endurance aspect of exercise prescription has 3 stages:
1. initial
2. improvement
3. maintenance

INITIAL
1. light muscular endurance exercises
2. low level aerobic activities (40 to 60% of heart rate reserve or VO2max (the greatest amount of oxygen that can used by the body during intense exercise))
3. exercises which are compatible with minimal muscle soreness discomfort and injury
4. exercise adherence may decrease in too aggressively initiated
5. stage usually lasts 4 to 6 weeks, but the length depends on the adaptation
6. duration = 12 to 15 minutes and progress to 20 minutes
7. frequency = 3 times a week, non consecutive days
8. goals should be established early in the exercise program; goals should be realistic - establish awards.

IMPROVEMENT
1. 4 to 5 months
2. target range increases to 50 - 85% VO2max (the greatest amount of oxygen that can used by the body during intense exercise)
3. duration is increased consistently every 2 - 3 weeks until participants are able to exercise for 20 to 30 minutes continuously
4. frequency depends on adaptation. Age and exercise level should be considered

MAINTENANCE

1. maintenance begins after the first 6 months
2. individual may no longer be interested in further increasing the conditioning stimulus
3. further improvement may be minimal, but continuing the same workout routine enables the individual to maintain their fitness levels
4. goals of program should be reviewed and new goals set
5. to maintain fitness, a specific exercise program should be designed that will be similar in energy costs to the conditioning program and satisfy the needs and interests of the participant
6. important to include exercises that the individual finds enjoyable.

Reference:

American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

MAINTENANCE OF THE TRAINING EFFECT

In order to maintain fitness, exercise must be continued on a regular basis.

A significant reduction in aerobic (cardiorespiratory) fitness occurs after 2 weeks of detraining, with participants returning to near pretraining levels of fitness after 10 weeks - 8 months of detraining.

Those individuals who have undergone years of continuous training maintain some benefits for longer period of detraining then subjects from short term training studies.

Intensity is important when maintaining the training effect. In series of experiments where frequency, intensity, or duration were manipulated, found that if intensity of training remained unchanged, VO2max (the greatest amount of oxygen that can used by the body during intense exercise) was maintained for up to 15 weeks when frequency and duration of training were reduced by as much as 2/3. When frequency and duration unchanged and intensity of training was reduced the 1/3 or 2/3, VO2max (the greatest amount of oxygen that can used by the body during intense exercise) was significantly reduced.

Reference:

American college of Sports Medicine. (1990). The Recommended Quantity and Quality for Developing and Maintaining Cardiorespiratory and Muscular Fitness In Healthy Adults. *Med Sci Sports Exercise.* 22.2, pp. 265 - 274.

Calories and Exercise

Since reduction of body fat is a frequently desired outcome in exercise programs, considerable research has been directed to ascertaining the appropriate volume of activity necessary to reduce body fat.

American College of Sports Medicine (ACSM) recommends *MINIMAL* threshold of 300 calories per exercise session performed 3 days a week, or 200 calories per session done 4 days per week. i.e. 800 - 900 calories per week (or approximately 1000 calories).

To achieve optimal physical activity levels, the goal is to bring the weekly expenditure closer to 2000 calories as health and fitness permits.

Reference:

American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

Muscular Strength & Endurance

The term “muscular fitness” has been used to describe the integrated status of muscular strength and muscular endurance.

If properly conducted, programs for the development of muscular fitness can help maintain or improve posture and prevent or reduce muscular low back pain.

MUSCULAR STRENGTH: refers to the maximal force that can be generated by a specific muscle or muscle group.

MUSCULAR ENDURANCE: is the ability of a muscle group to execute repeated contractions over a period of sufficient time duration to cause muscular fatigue.
EX: 60 second sit up test
maximal number of push ups that can be performed without rest.

Although aerobic activities have been shown to be effective for developing aerobic (cardiorespiratory) fitness, most have little influence on muscular strength or muscular endurance, especially of the upper body.

Every activity, including activities of daily living (ADL) requires a certain percentage of an individual’s maximal strength and endurance.

The maintenance or enhancement of muscular strength and muscular endurance enables an individual to perform such tasks with less physiological stress.

Resistance training of moderate intensity (sufficient to develop and maintain muscular fitness and lean body weight) should be an integral part of adult fitness and rehabilitative exercise programs.

BENEFITS

1. development and maintenance of muscular strength and muscle mass
2. increase in bone mass
3. increase in strength of connective tissue
4. modest improvements in aerobic (cardiorespiratory) fitness
5. reductions in body fat
6. modest reductions in blood pressure
7. improved glucose tolerance
8, improved blood lipid and lipoprotein profiles

These health benefits have been most often associated with circuit weight training, which is a method of resistance training in which a series of exercises are performed in succession with minimal rest between exercises.

Muscular strength and endurance are developed by the overload principle. By increasing the resistance to movement or the frequency or duration of activity to levels above those normally experienced.

Muscular strength is best developed by using weights that develop maximal or nearly maximal muscle tension with relatively few repetitions.

Muscular endurance is best developed by using lighter weights with greater number of repetitions.

For improvement in both muscular strength and endurance, most experts recommend 8 to 12 repetitions per exercise.

Any overload will result in strength development but higher intensity effort at or near maximal effort will produce a significantly greater effect.

The intensity of resistance training can be manipulated by varying the following:

1. weight
2. number of repetitions
3. length of the rest interval between exercises
4. number of sets of exercises completed

Muscular strength and endurance can be developed by means of the static or dynamic exercises. Dynamic resistance exercises are recommended for most adults.

SAFETY GUIDELINES

Resistance training for the average participant should be

1. rhythmical
2. performed at a moderate to low speed
3. involves a full Range of Motion (ROM)
4. not interfere with normal breathing - heavy resistance exercise combined with breath holding, can cause a dramatic, acute increase in both systolic and diastolic blood pressure

RESISTANCE TRAINING GUIDELINES

1. Perform a minimum of 8 to 10 separate exercises that train the major muscle groups

2. A primary goal of the program should be to develop total body strength in a relatively time efficient manner. Programs lasting longer than 1 hour per session are associated with higher drop-out rates.

3. Perform one set of 8 - 12 repetitions of each of these exercises to the point of fatigue

4. Perform these exercises at least 2 days per week while more frequent training and additional sets or combinations of sets and reps elicit larger strength gains, the additional improvement is relatively small.

5. Adhere as closely as possible to the specific techniques for performing a given exercise.

6. Perform every exercise through a full Range of Motion (ROM).

7. Perform both the lifting (concentric phase) and lowering (eccentric phase) portion of the resistance exercises in a controlled manner.

8. Maintain a normal breathing pattern, since breath holding can induce excessive increases in blood pressure.

9. If possible, exercise with a training partner who can provide feedback, assistance, and motivation.

Reference:
American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

STRENGTH TRAINING: Strength training of moderate intensity, sufficient to develop and maintain fat-free weight (FFW), should be an important part of an adult fitness program. One set of 8 - 12 reps of 8 - 10 exercises that condition the major muscle groups at least 2 days per week is the recommended minimum.

An activity such as weight training should not be considered as a means of training for developing VO2max (the greatest amount of oxygen that can used by the body during intense exercise). Weight training has significant value for increasing muscular strength, endurance, and fat free weight (FFW).

Studies evaluating circuit training weight training conducted almost continuously with moderate weights, using 10 - 15 reps per exercise session with 15 to 30 rest between bouts of activity show an average improvement in VO2max (the greatest amount of oxygen that can used by the body during intense exercise) of 6%. Thus, circuit weight training is not recommended as the only activity used in exercise programs for developing VO2max.

When strength training exercise was reduced from 3 or 2 days a week to at least 1 day per week, strength was maintained for 12 weeks of reduced training. Thus, it appears that missing a training session periodically will not adversely muscular strength and endurance.

SPECIFICITY: The effect of exercise training is specific to the area of the body being trained. EX: Training the legs will have little or no effect on the arm.

Resistance training should be performed through a full range of motion (ROM) for maximum benefit.

Muscular strength and endurance are developed by the OVERLOAD PRINCIPLE i.e. by increasing more than normal the resistance to movement or frequency and duration of activity.

Muscular strength is best developed by using heavy weights (that require maximum or nearly maximum tension development) with few repetitions, and muscular endurance is best developed by using lighter weights with greater number of repetitions.

To some extent, both muscular strength and endurance are developed under each condition, but each system favors a more specific type of development.

Thus, to elicit improvement in both muscular strength and endurance, most experts recommend 8 - 12 reps. per exercise session.

Any magnitude of overload will result in strength development, but higher intensity effort at or near maximal effort will give a significantly greater effect.

The intensity of resistance training can be manipulated by varying the following:
1. weight load
2. repetition
3. rest time between exercises
4. number of sets completed

Caution is advised for training that emphasizes lengthening (eccentric) contractions, compared to shortening (concentric) or isometric contractions, as the potential for skeletal muscle soreness & injury is accelerated.

Muscular strength and endurance can be developed by means of static (isometric) or dynamic (isotonic or isokinetic) exercises.

For healthy adults, dynamic resistance exercises are recommended.

The expected improvement in strength from resistance training is difficult to assess because increases in strength are affected by the participant's initial level of strength & their potential for improvement.

Although literature reflects a wide range improvement in strength with resistance training programs, the average improvement for sedentary young and middle aged men and women for up to 6 months or training is 25 - 30%.

Results of improvement in strength resulting from isometric training have been of the same magnitude as found with isotonic training.

GUIDELINES FOR RESISTANCE TRAINING FOR AVERAGE HEALTHY ADULT:

1. minimum of 8 - 10 exercises involving the major muscle groups should be performed a minimum of 2 times per week
2. minimum of 1 set of 8 - 12 repetitions to near fatigue should be completed

These minimal standards for resistance training are based on 2 factors:

1. time it takes to complete a comprehensive well rounded program is important. Programs lasting more than 60 min. per session are associated with higher dropout rates.
2. Although greater frequencies of training and additional sets or combinations of sets and repetitions elicit larger strength gains, the magnitude of difference is usually small.

Although resistance training equipment may provide a better graduated and quantitative stimulus for overload then traditional calisthenics exercises, calisthenics and other resistance types of exercises can still be effective in improving and maintaining strength.

Reference:

American college of Sports Medicine. (1990). The Recommended Quantity and Quality for Developing and Maintaining Cardiorespiratory and Muscular Fitness In Healthy Adults. *Med Sci Sports Exercise.* 22.2, pp. 265 - 274.

Musculoskeletal Flexibility

Optimal musculoskeletal function requires that the adequate range of motion be maintained in all joints.

FLEXIBILITY: is the maximum ability to move a joint through a range of motion.

Like muscular strength, flexibility is specific.

Of particular importance is maintenance of flexibility in the lower back and posterior thigh regions. Lack of flexibility in this area may be associated with an increased risk for the development of chronic lower back pain.

Several types of stretching:
1. static
2. ballistic (bouncing)
3. Propriorecptive Neuromuscular Facilitation (PNF)

STATIC
1. most recommended
2. slowly stretching a muscle to the point of mild discomfort & then holding that position for an extended amount of time (usually 10 - 30 seconds). The risk of injury is low; requires little time and assistance, and is quite effective.

BALLISTIC
1. uses momentum created by repetitive bouncing movements to produce muscle stretch. Do not perform ballistic (bouncing) stretching! This type of stretch can lead to muscle soreness and injury.

Propriorecptive Neuromuscular Facilitation (PNF)

1. Combination of alternating contraction and relaxation of both agonist and antagonist muscles.
2. Research supports PNF stretching produces largest improvements in flexibility, but this technique typically causes some degree of muscle soreness. PNF typically requires a partner and is time consuming.

PROPER BIOMECHANICS

1. can aid in improving and maintaining range of motion (ROM) in a joint or series of joints
2. flexibility exercises should be performed in a slow, controlled manner with a gradual progression to greater ROM.

FLEXIBILITY PROGRAM GUIDELINES

Frequency: at least 3 times a week
Intensity: to a position of mild discomfort
Duration: 10 to 30 seconds for each stretch
Repetitions: 3 to 5 for each stretch
Type: static, with major emphasis on the lower back and thigh area

Stretching exercises can be effectively in the warm-up and /or cool down periods that come before and follow the aerobic conditioning phase of an exercise program.

It is recommended that an active warm-up is performed before vigorous stretching exercises.

Reference:

American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

Injury Prevention - General

Most types of physical activities are considered beneficial because moderate exercise is an important element for general well being. The potential risk for musculoskeletal injury increases for all levels of participant with increasing physical activity, intensity, and duration of training. The incidence and severity of exercise-related musculoskeletal injuries can be reduced by understanding the associated risks, preventive measures, and care of the injury.

The injuries most frequently associated with fitness related activities are overuse syndromes.

With the increased interest in resistance and aerobic training, there has been an increase in the frequency and severity of musculoskeletal injuries, both from acute and overuse trauma.

Pollock et al. found that , with beginning jogger/runners who trained 30 minutes a day for 1, 3, or 5 days per week, 1 day of rest between exercise days may help prevent running related injury. As functional capacity improves, frequency can be increased or the jogging alternated with lower impact modes of exercise.

Training errors are another cause of injury. Training errors are reported in 60-80% of injuries to runners and are commonly caused by exceeding limits of duration or intensity, high rates of progression, and excessive hill running.

<u>Intrinsic Risk Factors Associated with Musculoskeletal Injury:</u>

- Bony alignment abnormalities
- Leg length discrepancy
- Muscle weakness and imbalance
- Restricted range of motion
- Joint laxity
- Body composition
- Previous injury
- Previous physical activity
- Gender
- Predisposing musculoskeletal disease

- Performing warming-up exercises
- Performing stretching exercises

Extrinsic Risk Factors Associated with Musculoskeletal Injury and Sport:

Excessive load on the body
- Type of movement
- Speed of movement
- Number of repetitions
- Footwear
- Surface

Training errors
- Excessive distances
- Fast progression
- High intensity
- Running on hills
- Poor technique
- Monotonous or asymmetric training
- Fatigue

Adverse environmental conditions
- Darkness
- Heat/cold
- Humidity
- Altitude
- Wind

Faulty equipment

Flexibility:

Flexibility (range of motion) is influenced by body and soft tissue structures surrounding the joint. Decreased flexibility is an intrinsic risk factor for musculoskeletal injury. Stretching exercises, performed as part of an exercise-specific training program to increase flexibility, are an important aspect of a training program. They should be performed before and after an exercise session. Increased flexibility decreases the incidence of musculoskeletal injury, minimizes or eliminates muscle soreness, and contributes to improved performance.

Warm-up and Cool-down:

The cardiovascular, respiratory, and neuromuscular systems can be put in a state of readiness for vigorous activity through warm-up exercises. Muscle that is not properly warmed is susceptible to injury.

Increased muscle temperature improves elasticity of intramuscular connective tissue, increases metabolism, and increases potential magnitude and speed of contraction.

Warm-up decreases risk of injury.

Other Risk Factors for Injury:

- Age is not associated with risk of exercise-related injury.
- Past exercise injury and poor physical fitness are associated with risk of musculoskeletal injury.
- Low body fat and certain characteristics of body stature may be risk factors

Pre-Participation Screening: Exercise professionals should be encouraged to use health/fitness screening prior to initiating exercise programs.

Basic Physical Fitness and Training:

A well rounded exercise program involves warm-up and cool-down, muscular strength and endurance exercise, flexibility training, and aerobic conditioning. Proper training techniques require attention to basic principles of specificity of exercise, overload, progressive resistance, and progression. Each program must be based on mode of activity, intensity, duration, and frequency. In addition, proper equipment (clothing and shoes) plays an important role in safe participation.

Injury Recognition:

The exercise professional is often asked for advice or clinical opinion about an injury or need for referral. Examination is beyond the knowledge and clinical skill base of exercise professionals and should be performed by a physician or health care professional specifically trained in injury examination.

General Injury Classifications: Muscle Injuries, Joint Injuries, and Bone Injuries

Physiology of Injured Tissue:

When forces exceed limits of the tissues, injury results. At the time of injury, mechanical trauma produces damage to cells. Because damaged cells cannot transport or process oxygen, nutrients, waste, and metabolites, they become necrotic (dead).

The immediate response to injury is decreased blood flow to the area.
Proper treatment to control extent and amount of tissue damage and edema (swelling) includes Rest, Ice, Compression, Elevation, and Stabilization.

The Healing Process:

There are three phases of soft-tissue healing: Inflammation, repair, and remodeling.

- Inflammatory Phase: The reaction to tissue injury is inflammation. Signs and symptoms of inflammation include redness, local heat, swelling, pain, and loss of function. The purpose of inflammation is to localize injury, protect tissues from further damage, rid tissue of injurious agents and dead cells, and to prepare for the repair phase.
- Repair Phase: The repair process begins within the initial hours after injury and is dependent upon resolution of the inflammatory phase, scar formation and repair of injured tissue occurs. Most soft tissues (muscle, tendon, connective tissue) do not have the ability to regenerate the exact, specific tissue that was damaged, so healing occurs with formation of scar tissue.
- Remodeling Phase: The remodeling phase overlaps with the repair phase because while some scar tissue is being formed, other scar tissue is being remodeled. The remodeling process involves realignment of collagen fibers so that scar tissue becomes stronger according to the forces to which it is subjected. Strength of scar tissue continues to increase for 3 months to 1 year following injury. It is not uncommon for ligaments to take a year or longer to become completely remodeled.

Treatment for Exercise-Related Injuries:

Standard treatment procedures are divided into initial treatment (initial first aid) and follow-up treatment. Initial treatment should be administered for the first 24 – 72 hours depending on severity of injury. The purpose of this procedure is to limit the amount of secondary injury, control swelling, and aid physiology of the inflammatory response.

- Rest: Rest allows time to control the effects of trauma and to avoid additional tissue damage.
- Ice: Application of ice is the first step on initial treatment. Ice, or some form of cold application, lowers the temperature of tissue reducing the metabolism of healthy cells. This

controls swelling. Cold applications are beneficial for reducing pain and muscle spasm that accompany musculoskeletal injury.

- Compression: Compression controls edema and prevents fluid from accumulating in the injured area. Compression is accomplished with an elastic wrap.
- Elevation: Elevation of an injured area above the level of the heart (when possible) limits swelling. Controlling swelling associated with injury also decreases tissue damage resulting in a smaller area of damaged tissue to be repaired.

Follow- Up Procedures:

Follow-up treatment should be directed by a sports medicine professional or a physician. Procedures that follow initial treatment are designed to allow return to the highest level of functional activity in the shortest time. Application of heat and cold are often prescribed after initial treatment is completed. Heat should not be applied during the acute inflammatory phase. While both heat and cold application are beneficial, exercise is the most important follow-up treatment procedure. Exercise is the most effective method to increase blood flow to an injured area, therefore, ice and heat should always be combined with exercise.

Reference:
American College of Sports Medicine. (1998). ***ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*** **(3rd ed.). Baltimore: Williams and Wilkins.**

Obese individuals are at an increased relative risk for orthopedic injury, may require that intensity of exercise be maintained at or below the intensity recommended for improvement of aerobic (cardiorespiratory) endurance. Non weight bearing activities (and/or rotation of exercise modalities) may be necessary and frequent modifications in frequency and duration may also be required.

The risk of orthopedic injury may be increased with the latter; however, programs emphasizing low to moderate intensity exercise with a longer training duration are recommended for most individuals

The risk of injury associated with high impact activities or high intensity weight training must also be weighed when selecting exercise modalities, especially for the novice exerciser or an obese individual. It may be desirable to engage in several different activities to reduce repetitive orthopedic stresses & involve a greater # of muscle groups.

Reference:

American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

Endurance activities that require running and jumping are considered high impact types of activity and generally cause significantly more debilitating injuries to beginning as well as a long term exercisers than do low impact and non weight bearing type activities.

Beginning joggers have increased foot, leg, and knee injuries when training is performed more than 3 times a week week and longer than 30 minutes duration per exercise session. High intensity interval training (run - walk) compared to continuous jogging training was also associated with a higher incidence of injury. Thus, caution should be taken when recommending the type of activity and exercise prescription for the beginning exerciser.

Orthopedic injuries as related to overuse increase linearly in runners/joggers when performing these activities.

For injury prevention, it is important to select different types of activities and remember the effect the quantity and quality of exercise has an impact on injuries.

Significant increases in VO2max (the greatest amount of oxygen that can used by the body during intense exercise) have been shown with 10 - 15 min of high intensity training. Thus, if total body mass and fat weight reduction are not considerations, then shorter duration, higher intensity programs may be recommended for healthy individual at low risk for cardiovascular disease and orthopedic injury.

The important factor is to design a program for the individual to provide the proper amount of physical activity to attain maximal benefit at the lowest risk.

Reference:

American college of Sports Medicine. (1990). The Recommended Quantity and Quality for Developing and Maintaining Cardiorespiratory and Muscular Fitness In Healthy Adults. *Med Sci Sports Exercise.* 22.2, pp. 265 - 274.

A lack of time is the most common sited barrier to participation in physical activity, and injury is a common reason for stopping regular activity.

Reference:

Physical Activity and Public Health: A Recommendation From the Centers for Disease Control and Prevention and the American College of Sports Medicine. (01 February 1995*). Journal of the American Medical Association,* 273.5.

Environmental Considerations: Heat

Of the many environmental factors that can impact on safe and effective exercise, none is potentially life and health threatening as heat stress.

Heat stress is the combination of environmental conditions, metabolic rate, and clothing that increases core temperature.

Clothing:
Clothing further restricts maximum rate of evaporative cooling. If clothing is placed between skin and environment, the result is decreased cooling ability through evaporation of sweat. To minimize the effect of clothing, the following are important:

- The covered surface area should be as small as is reasonable
- The fabric should be light weight, open weave (or other material freely allowing water vapor to pass through.
- Trapped air spaces from multiple layers should be minimized
- The construction should be loose with openings to allow air easy movement around and through the clothing.

Heat Related Disorders:
The normal response to heat stress includes elevated core temperature, increased heart rate, and water loss due to sweating. Left unchecked, however, these responses may lead to heat related disorders, as well as psychomoter and cognitive performance decrements. The disorders of particular importance during exercise are the following:

- heat cramps
- heat syncope
- dehydration
- heat exhaustion
- heat stroke

Heat Cramps: Heat cramps are most likely to occur during or after sustained exercise with profuse sweating. Cramps usually appear in fatigued calf or abdominal muscles.

Heat Syncope: Heat syncope may result from dehydration or excessive pooling of blood in peripheral vascular beds. This may cause "black – out" symptoms. Recovery is relatively quick

and most are generally aware of the occurrence. Adequate hydration and avoiding prolonged standing or rapid transition to an upright posture can reduce head syncope.

Dehydration and Heat Exaustion: Dehydration and heat exhaustion are more likely to occur to the unacclimated and in those who ignore hydration practices or early warning signs.

Heat Stroke: Heat stroke is a medical emergency and the least suspicion that it may be present justifies an immediate and aggressive response. The risk for heat stroke is greatest among those who abuse alcohol or drugs, who are highly motivated and ignore symptoms of heat exhaustion, or who are heat intolerant (i.e., do not acclimate).

Personal Protective Practices to Reduce Risk for Heat Disorder:

- Seek relief from heat stress exposure with sensation of extreme discomfort, lightheadedness, nausea, headache, loss of coordination, or weakness.
- Maintain adequate hydration by drinking small amounts of water at frequent intervals (A weight loss of 2% of body weight in 1 day is evidence of dehydration.)
- Maintain a healthy lifestyle through sound diet, adequate sleep, and avoiding drug abuse.
- Avoid heat stress exposure and exercise during acute illness (eg, fever, nausea, vomiting, diarrhea).
- Seek medical advice if diagnosed with a chronic disease (disease or treatment may reduce heat tolerance
- Reduce expectations if no recent exercise in warm or hot environments

Reference:
American College of Sports Medicine. (1998). ***ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*** **(3rd ed.). Baltimore: Williams and Wilkins.**

Heat stress guidelines are aimed at preventing body temperature from rising excessively during physical exertion and are based upon accurate assessment of the following:

1. exercise intensity
2. environmental conditions (either indoor or outdoor)

Exercise and the environment: Important factors

1. temperature
2. humidity
3. air movement
4. solar radiation

Wet bulb globe temperature (WBGT) = temperature, humidity, solar radiation, and wind velocity & this represents a composite measure of the impact of the environment on exercising subjects.

Probably the most important environmental question with which an exercise professional may be confronted is how to deal with environment below ceiling limits but above the NIOSH recommended heat stress alert. This area represents environmental conditions in which exercise can still be performed, but with an increased risk to the participant. In such cases, the following actions are recommended

1. Change in the environment. If the exercise area cannot be cooled to an appropriate WBGT requirements and/or.
2. For this session, decrease the exercise intensity like cooling the environment, lowering the intensity represents another way of staying within acceptable temperature/intensity zone. Ways to accomplish this, while still getting a training effect include slowing the pace of exercise appropriately or making the exercise intermittent by adding rest cycles. Perhaps the most useful guide is the proper use of target heart rate (unchanged from cool conditions). Exercise heart rate is increased about 1 beat/min for every degree centigrade above 25`c and 2 beats/min for every mmHg above 20 mm Hg water vapor pressure.

One of the best means of decreasing risk of exercise program participants developing heat illness is through a gradual acclimation to exercise in hot environments.

Has been established that as much as 25% of apparently healthy population may be heat intolerant in the unacclimated state, with that number decreasing to about 2% after thorough acclimation.

The best method of acclimation is to aerobically exercise in a hot environment. The first of such session may last as little as 10 - 15 minutes for safety reasons, and gradually increase in duration to a full exercise session. It takes most healthy people 10 - 14 days to fully acclimate, although illness and alcohol consumption have been shown to slow this process.

Along with heat acclimation, adequate hydration is the key to preventing untoward effects of exercise when the temp and or humidity are high.

Progressive dehydration occurs during exercise when sweating is profuse. As little as a 2% reduction in body weight during exercise can result in impaired temperature regulation.

Furthermore, a 4% decrease in body weight translates into a 6% decrease in maximal aerobic capacity and a 12% reduction in exercise time.

Exercise programs should be structured around fluid availability so that participants can drink before, during, and after exercise.

Participants should be encouraged to drink as much water as physically possible (minimally 2 cups) 15 to 20 min. prior to exercise, 1 cup of water every 15 minutes during exercise, and nor water than thirst dictates after exercise.

Each pound of weight lost should be replaced with 16 oz of fluid.

Fluid should be cold (45` - 55` F) & palatable and with a few exceptions, water is the replacement drink of choice.

Is little need to replace electrolytes lost during most brief exercise sessions since these small decrements are typically replenished when the next meal is eaten.

Unless the exercise bout lasts in excess of 60 - 90 minutes there is little advantage in supplementing carbohydrates during exercise.

SPECIAL CONSIDERATIONS FOR HEAT ILLNESS

1. hypertension: alters control of skin blood flow
2. diabetes - neuropathies may affect sweating and/or skin blood flow
3. aging - alters peripheral cardio and sweating responses
4. various drug regimens (including diuretics, b-blockers, a-agonists, & vasodilators
5. alcohol use - causes vasodilatation and enhances dehydration
6. obesity
7. history or heat illness and acclimating to heat

GUIDELINES FOR FITNESS FACILITY STANDARDIZED HEAT STRESS MANAGEMENT PLAN

1. increased medical screening and surveillance of participants
2. evaluation of all aspects of the thermal environment using WBGT
3. approved decision making flow chart based on proposed standards such a NIOSH,

ACGIH, and tailored to your clientele & exercise setting.

4. gradual acclimation policy for participants
5. provision of cold, palatable fluids and plan for increasing fluid intake before, during, and after exercise (structured drink breaks for entire group).
6. participant education, including early signs and symptoms of heat illness (chills, lightheadedness, dizziness, piloerection, nausea, etc.)
7. emergency procedures of heat illness incorporated into an overall emergency plan for the facility.

Reference:

American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

Environmental Considerations: Cold

Cold stress is the combination of environment, metabolic rate and clothing that results in heat loss from the core as a whole or from localized areas.

Cold related disorders include hypothermia and varying degrees of local tissue damage.

Control of cold stress is accomplished through managing risk factors.

Hypothermia:

- Symptoms: chills, fatigue or drowsiness, pain in the extremities
- Signs: euphoria, slurred speech, slow, weak pulse, shivering, collapse and /or unconsiousness, body core temperature below 95 degrees F.
- First Aid: move to warm area and remove wet clothing, modest external warming, drink warm, carbohydrate –containing fluids, transport to hospital.

Frostbite:

- Symptoms: burning sensation at first, coldness, numbness, tingling
- Signs: skin color white or grayish yellow to reddish violet to black, blisters, response to touch depends on depth of freezing.
- First Aid: move to warm area and remove wet clothing, external warming (e.g., warm water), drink warm, carbohydrate-containing fluids if conscious, treat as a burn, do not rub affected area, transport to hospital.

Frostnip:

- Symptoms: possible itching or pain
- Signs: skin turns white
- First Aid: similar to frostbite

Trench Foot:

- Symptoms: severe pain, tingling, itching
- Signs: edema, blisters, response to touch depends on depth of freezing
- First Aid: similar to frostbite

Personal Protective Practices to Reduce the Risk for Cold Disorders:

- Seek relief from cold stress exposure with sensation of extreme discomfort especially in extremities, fatigue or weakness, or loss of coordination.
- Frequently drink warm, non-caffeinated fluids containing carbohydrates.
- Anticipate, wear, and adjust (as necessary) proper clothing.
- Change wet clothing immediately, especially if the air temperature is below 36 degrees F.
- Plan exercise to avoid fatigue at a location removed from a warm recovery station.
- Maintain a healthy lifestyle through sound diet, adequate sleep, and avoiding drug abuse.
- Seek medical advice for repeated or unusual intolerance to cold, such as repeated episodes of frostnip, appearances of welts, or severe shivering. Medical approval for exercise at below – 11 degrees is recommended.

Reference:
American College of Sports Medicine. (1998). ***ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*** **(3rd ed.). Baltimore: Williams and Wilkins.**

In most circumstances, cold represents less of an immediate health risk for exercising clients or patients. This is because most people dress appropriately (or even overdress) for outdoor exercise in cold weather and because aerobic exercise itself generates large amounts of heat.

Reference:
American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

Environmental Considerations: Acute Altitude Exposure & Air Pollution

Training and Altitude:

Considerable evidence exists that altitude training is beneficial in preparation for competition at altitude, therefore many athletes spend considerable resources training at altitude. However, the value of this training for increasing performance at sea level is controversial. The lack of consensus may be attributed to differences in duration of exposure to altitude, elevations of training, and initial fitness levels. Recent studies indicate that, under specific conditions, intermittent altitude exposure might have some beneficial effects for sea-level performance.

Above 3,000 meters, the negative effects of prolonged exposure to hypoxia outweigh the potential positive training effects of exposure to hypoxia.

Muscular strength or muscular endurance seem unaffected during acute exposure to altitude. However, subtle neuropsychological effects associated with acute mountain sickness can occur at altitudes of 3,000 meters within 6 hours of exposure.

Above 4,500 meters, the deterioration for most mental functions may be considerable, although large inter-individual variation exists. These effects, may, in turn, affect muscular strength and endurance.

Acclimatization:

With prolonged stay at altitude (days to weeks), acclimatization occurs. This includes adjustments at the pulmonary, circulatory, and muscle tissue (cellular) level. Within 3 to 4 days, the increase in resting ventilatory rate at moderate altitude is stabilized at 40% above sea level values.

Red cell production increases within 2 weeks, leading to a 4 – 12% increase in hemoglobin.

As a result of these physiological adaptations with acclimatization, physical work capacity (VO2 Max … the rate that the body uses oxygen and endurance) at altitude improves and, at moderate altitude, may nearly reach sea level values with adequate acclimatization time.

Generally, about 2 – 3 weeks are needed to adapt to moderate altitude.

For each 600 meter increase, an additional week is required.

It should be noted that the adaptive changes are reversible on return to sea level and within a month after ending exposure, adaptation is lost.

Reference:
American College of Sports Medicine. (1998). ***ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*** **(3rd ed.). Baltimore: Williams and Wilkins.**

The most obvious change during physical activity at high altitude is an increased pulmonary ventilation which increases the feeling of breathlessness.

At an altitude of 4,000 ft., a sea level resident can expect about a 5% reduction in VO2max (the greatest amount of oxygen that can used by the body during intense exercise), which is typically accompanied by a similar decrease in physical work capacity.

For altitudes above 4,000 ft., a further progressive decline occurs. For a given absolute exercise intensity, HR is higher at moderate altitude, but target heart rate guidelines developed at lower altitudes are still valid & should be followed. Thus, as with conditions of high heat and humidity, exercise intensity or pace will be lowered accordingly.

Medical concerns at high altitude include the following:

1. Acute Mountain Sickness (AMS):

Acute Mountain Sickness is characterized by severe headache and often accompanied by nausea, vomiting, decreased appetite, weariness, and sleep disturbances. AMS begins 6 – 12 hours after arrival, usually peaks on the second or third day, and disappears on the fourth or fifth day. AMS normally appears above 2,500 meters and the frequency of AMS increases

with altitude and rate of ascent. Generally, above 3,000 m, 24 hours of acclimatization should be acquired for every 300m of altitude gain. Although AMS is self limiting, persistence of symptoms may require medical treatment. If AMS is not at least partially resolved within 2 – 3 days, descent is the only effective treatment.

2: High Altitude Pulmonary Edema (HAPE):

HAPE is a non-cardiac form of edema which, while rare, is potentially fatal. Prompt treatment with supplemental oxygen or descent to lower altitude is required. HAPE is considered a progression in the severity of AMS, associated with pulmonary edema. The onset may be subtle and symptoms include dyspnea, fatigue, chest pain, tachycardia, coughing, and cyanosis of lips and extremities. As HAPE progresses, affected individuals may cough frothy or blood-tinged sputum. This complication can be fatal if not treated promptly. Evacuation to lower altitude is essential.

3: High Altitude Cerebral Edema (HACE):

HACE may develop when the rate of ascent is too fast. The symptoms of HACE include severe headache, fatigue, vomiting, nausea, ataxia, and changes of mental status. The incidence of HACE is low (1%), but HACE is potentially fatal if untreated. In cases of symptoms of cerebral edema, direct medical care with immediate evacuation to low altitude and supplemental oxygen is recommended.

Preventing Altitude Sickness:

Preventing AMS is achieved by adjusting the amount and rate of ascent. Options include an interrupted ascent with time (days) to acclimatize at successive altitudes before reaching final elevation or limiting daily gain in altitude to 300 m or less. Initially, unacclimatized subjects should avoid vigorous exercise. Further, adequate hydration and a high carbohydrate diet may aid prevention.

References:

American College of Sports Medicine. (1998). ***ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*** **(3rd ed.). Baltimore: Williams and Wilkins.**

American College of Sports Medicine (1995*). ACSM's Guidelines for Exercise Testing and Prescription, (*5th ed.). Baltimore: Williams and Wilkins.

Air Pollution:

Air pollution can also affect exercise performance and health. Organizers of sporting events or exercisers are more frequently confronted with problems related to exercising in polluted air. Both large sporting events and daily activity are performed in major cities wihich are usually sites with the highest pollution levels. Additionally, with indoor training and sports events, the infiltration of outdoor air pollution may be significant. Furthermore, the indoor environment may actually add to the problem with specific indoor air pollutants emitted by the occupants, the activities and building materials.

Geographical distribution of outdoor pollution is strongly related to the presence of industry and population density. Automobiles, trucks, busses, aircraft, industrial sources, and combustion of fossil fuels are major sources for carbon monoxide, sulfur and nitrogen oxides, hydrocarbons and particles. Areas with equal production of pollutants do not necessarily have equally polluted air or smog because climate and topography play major roles. River and mountain valleys generally have greater smog levels than hill tops and plains. High temperature and humidity typically promote smog.

Prevention of Air Pollution:

Avoidance of exposure is the primary method for preventing acute and long term adverse effects of outdoor pollutants. Timing and selection of optimal location for exercise and moderating intensity and duration are key factors. Knowledge of daily seasonal patterns and fluctuations is important when planning an event involving high intensity exercise. Avoiding periods and areas with heavy traffic can minimize CO exposure. Summer and early autumn afternoons are unfavorable for O3 exposure.

Information on air pollution can be acquired from local meteorological authorities which often provide a Pollutant Standards Index (PSI), developed by the Environmental Protection Agency.

The important factors for controlling exposure to indoor pollution include: selecting an optimal location for air intake, using low-emission building materials, regularly cleaning and use of "low dust" floor coverings, clean ventilation and air conditioning systems, and sufficiently high, fresh air ventilation rate.

Reference:

American College of Sports Medicine. (1998). ***ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*** **(3rd ed.). Baltimore: Williams and Wilkins.**

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