

**ABSTRACT**

There is little doubt that the benefits of regular exercise far outweigh its risks. Prior to embarking on physical activities, patients should undergo a pre-participation screening, as most cases of obesity is accompanied by comorbidities and risk factors for acute myocardial infarction and stroke. With an adequate pre-participation screening, the risks can be managed. Weight management is challenging for most individuals. One of the reasons is that it requires a multi-pronged approach, including dietary restriction, discretionary exercise, and increased incidental daily activities, in order to achieve an overall energy deficit. The latter two are both complementary physical activities, and are not exactly the same. Discretionary exercise is associated with a higher heart rate, thus inducing fitness benefits, but is difficult to sustain for more than an hour each day; whereas incidental activities are associated with a lower heart rate (that is insufficient to increase aerobic fitness) but is more sustainable. The appropriate discretionary exercise prescription for weight loss should (1) primarily involve cardiovascular (aerobic) activities, (2) have a total exercise volume of 200-300 min per week or  $>2000 \text{ kcal} \cdot \text{wk}^{-1}$ , and (3) an intensity of 55-70% of maximal heart rate. Cross-training should be encouraged to minimise overuse injuries. Resistance training is advantageous but should be done in addition to (rather than in place of) aerobic activities. Incidental daily physical activities should also be encouraged, with the use of pedometers for example. A daily step count of 10,000 would be an appropriate target for adults to attain health benefits.

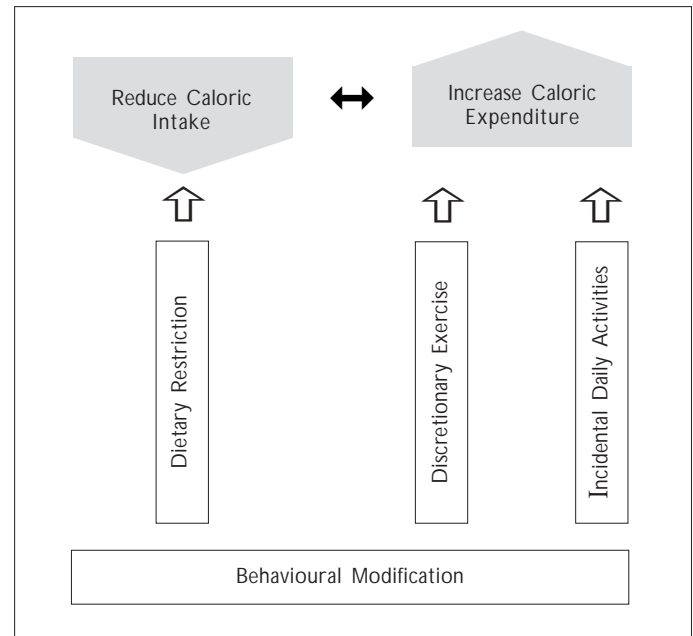
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**INTRODUCTION**

Discretionary exercise refers to the structured exercise that you intentionally set out to do, as opposed to incidental activities of daily living, such as walking to one's car and doing household chores. Discretionary exercise forms the second pillar of a rounded weight-loss programme (see below)<sup>1</sup> which is aimed at achieving a total daily energy deficit of 500 - 1,000 kcal.

Between dietary restriction and discretionary exercise, the former is generally more effective for weight loss. However, although discretionary exercise on its own is less effective than dietary restriction, it offers many benefits independent of weight loss that dietary restriction by itself does not offer. Furthermore, it has been shown that people who develop the

Figure 1. Rounded weight-loss programme



habit of regular exercise are more likely to maintain their weight loss. Of course, combining dietary restriction, discretionary exercise, and activities of daily living is the most effective way to lose weight and maintain the weight loss (Figure 1).

The benefits of exercise are numerous<sup>1</sup>:

- κ Overall, exercise improves functional capacity (through increases in cardio-respiratory fitness), making activities of daily living easier and more enjoyable.
- κ There is consistent evidence that endurance training is associated with:
  - lower fasting and glucose-stimulated insulin levels,
  - improved glucose tolerance,
  - improved insulin sensitivity.
- κ Light to moderate aerobic training is effective in lowering blood pressure.
- κ Endurance training increases plasma HDL (good cholesterol) and lowers TG.
- κ Endurance training has been shown to induce significant loss of intra-abdominal fat even if there is minimal change in body weight. For example, a 25% drop in intra-abdominal fat was found in older men who lost only 2.5kg.
- κ Decreased mortality and morbidity from coronary artery disease, cardiovascular diseases, colon cancer, type 2 diabetes.
- κ Resistance training improves strength via increased neuromuscular adaptation and increased muscle mass. A two- to three-fold increase in muscle strength can be achieved in three to four months in older adults.

- κ If one loses weight through dieting alone, 25-30 % of the weight loss will be from lean body mass while 70-75 % will be from body fat; if one loses weight through both diet and exercise, then the weight loss from body fat increases to 85-90 %.
- κ During the weight loss phase (i.e. negative energy balance), resistance training minimises the loss of muscle mass that usually accompanies weight loss, thereby minimising the drop in basal metabolic rate. As older adults are prone to losing muscle mass as part of the normal ageing process, resistance training may be a more important adjunct to weight loss interventions compared to young adults.
- κ Heavy resistance training helps to increase bone mineral density.
- κ Decreased anxiety and depression; Enhanced feelings of well-being.

### PRE-PARTICIPATION SCREENING

As there are numerous co-morbidities that accompany obesity, it is unlikely that the obese have an isolated weight problem. Exercise is integral in the management of many of these conditions, and with a customised exercise programme that takes into consideration the individual's comorbidities, the benefits of exercise outweighs the risks.

It is therefore important to identify these comorbidities so that the appropriate modifications can be incorporated into the exercise prescription. The Physical Activity Readiness Questionnaire (PAR-Q)<sup>2</sup> is useful in identifying those who would benefit from being assessed by their doctors before embarking on an exercise programme.

The objectives of pre-participation screening in an obese individual are therefore to identify:

- κ Comorbidities for subsequent management
- κ Risk factors for cardiovascular disease and causes of sudden death
- κ Primary causes of obesity
- κ Musculoskeletal conditions that may hinder physical activity

Pre-participation screening should include a minimum of history, physical examination, and resting ECG. Additional tests, e.g. blood investigations, exercise stress test, echocardiography should be ordered if indicated<sup>3</sup>.

### EXERCISE PRESCRIPTION FOR WEIGHT LOSS

The American College of Sports Medicine's (ACSM) recommendation to 20-60 minutes of aerobic activity three to five days of the week at 55-90% of maximum heart rate ( $HR_{max}$ ) is largely aimed at improving cardio-respiratory fitness and reducing cardiovascular disease<sup>4</sup>. Unfortunately, for weight loss, this is insufficient. The ACSM recommendation for weight loss<sup>5</sup> is substantially longer:

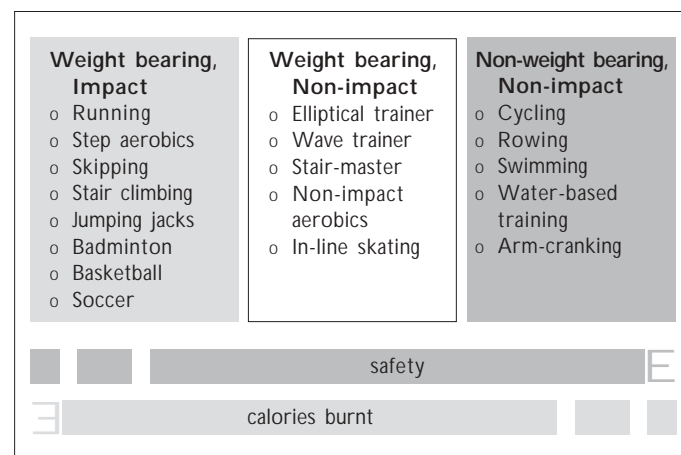
- κ Primarily Cardiovascular (aerobic) activities

- κ 200-300 min per week or >2000 kcal-wk<sup>-1</sup>
- κ 55-70% of maximal heart rate.

### Mode of Activity

As the objective is to burn calories, it is best to choose activities that use large muscle groups (since they consume more calories than small muscles) which can be maintained continuously, and is rhythmical and aerobic in nature, e.g. brisk walking, jogging, stationary cycling, rowing, elliptical trainers, swimming, and skating.

Figure 2. Aerobic activities divided into three groups



Aerobic activities can be divided into three groups<sup>1</sup> (Figure 2):

As we move from the leftmost group to the right, the activities become less injurious but they burn fewer calories.

As the exercise duration for weight loss is rather long, it is advisable to pick at least two different aerobic activities to reduce the risk of overuse injuries. This is termed as cross training. If the subject had previously been sedentary and is quite overweight, then pick two activities from the list of non-weight bearing, non-impact activities. As fitness improves and weight loss is evident, substitute one of the activities for another from the weight-bearing, non-impact group, and so on.

Table 1 compares the calories burnt for every 30 minutes of each activity for a given bodyweight<sup>6</sup>:

### Exercise Duration

For most, the goal is to burn 400 kcal per day, or 2,800 kcal per week<sup>1</sup>. This works out to around five hours for most individuals, assuming you can burn 560 kcal per hour. Few individuals, especially if overweight, can tolerate more than 60 minutes of cardiovascular exercise per day, so in order to accumulate a total of five hours, one needs to set aside at least five days for cardiovascular exercise, i.e. 560 kcal per session. If the individual chooses to exercise six times a week instead, then each session needs to be only 50 minutes (470 kcal per session) in order to accumulate a total of 5 hours (or

Table 1. Calories burnt for every 30 minutes of each activity

Gym activities	Body weight (kg)						
	50	60	70	80	90	100	
Aerobics: moderate	149	177	206	234	263	291	
Bicycling: 16 km/h	163	195	226	258	289	321	
Bicycling: 21 km/h	238	283	329	375	421	466	
Calisthenics	119	143	166	190	214	238	
Weight lifting: bodybuilding, vigorous effort	158	189	221	252	284	315	
Weight lifting: light workout	79	95	110	126	142	158	
Circuit training: average	211	253	296	338	380	422	
Rowing: light	149	177	206	234	263	291	
Rowing: moderate	230	275	319	363	407	452	
Running: 8 km/h	195	232	270	307	345	382	
Running: 10 km/h	260	310	360	410	460	510	
Running: 12 km/h	319	381	442	504	565	627	
Elliptical trainer / Ski machine: general	184	221	257	294	331	368	
Stair-treadmill ergometer: general	236	284	330	378	425	473	
Stretching, Hatha yoga	106	127	148	169	190	211	
Walking: normal 4 km/h	79	95	110	126	142	158	
Walking: brisk 6 km/h	111	132	154	174	196	217	
Walking: brisk 7 km/h	149	177	206	234	263	291	
<b>Sports activities</b>							
Badminton	119	143	166	190	214	238	
Basketball game	211	253	296	338	380	422	
Bicycling: mountain	224	269	314	359	404	449	
Billiards	66	79	92	106	119	132	
Bowling	79	95	111	127	143	158	
Dancing	145	174	203	232	261	290	
Martial arts, kickboxing	264	317	370	422	475	528	
Rollerblading	185	222	259	296	333	370	
Rope jumping	264	317	370	422	475	528	
Running: cross-country	238	285	333	380	428	475	
Soccer	185	222	259	296	333	370	
Swimming 25 m/min	123	146	170	193	217	240	
Swimming 40 m/min	178	213	247	281	315	350	
Tai chi	106	127	148	169	190	211	
Tennis	185	222	259	296	333	370	
Volleyball	79	95	111	127	143	158	

2,800 kcal) per week.

Do not embark on five hours of exercise per week immediately. This can be done progressively, over 1-3 months. Commence the exercise programme at a comfortable and realistic frequency and duration, e.g. twice a week, 20 minutes per session, depending on the current level of physical activity. Increase the frequency or duration each week or every two weeks, until the targets set above are achieved.

### Exercise Intensity

Exercise intensity refers to how hard one exercises. It is usually prescribed as a percentage of your maximum heart rate ( $HR_{max}$ ), where:

$$HR_{max} = 220 - \text{age}$$

For example, if a 30 year old wishes to exercise at 70% of maximum heart rate, then the exercise heart rate would be 70% of  $(220 - 30) = 133$  beats per minute.

For the purpose of weight loss, there is little evidence to support the need to exercise beyond an intensity of 70% of maximum heart rate. Duration is more important than intensity. If the subject is unfit, start with a low intensity, e.g. 55% of  $HR_{max}$ , and increase progressively from there.

Why is 70% the recommended exercise intensity? At higher intensities, one fatigues very quickly, and premature termination of exercise curtails the total calories burnt. Low exercise intensities are easy to tolerate for long periods, but the low rate of energy expenditure necessitates very long exercise durations in order to burn a substantial number of calories. Hence, there is an optimal balance where the intensity is high enough to burn calories at a decent rate, but low enough for one to last the distance. For most, that optimal intensity is about 70%.

### Progression

One is not expected to immediately engage in five hours of cardiovascular activities at 70% of  $HR_{max}$  immediately. Start slow and build up gradually. For example, if the subject were previously sedentary, then start by brisk walking at an exercise heart rate of 55% of  $HR_{max}$  three days a week, 20 minutes per session, and progress from there.

Progress by keeping the exercise intensity low and increasing the exercise duration / distance by about 10% per week. Once the desired frequency and exercise duration are reached, then start increasing the intensity.

### Timing of Exercise

Does it matter what time of the day one exercises? It would be most conducive to pick a cool, less polluted period, e.g. early mornings, especially if exercising outdoors. But the overriding factor is convenience – we'd be happy to find the time to exercise, let alone be picky about the time of the day. Those who have regular, dependable lunch hours may find it most convenient to exercise during lunch. Some prefer to exercise after work as they use the exercise time to unwind. Some finish work at different times each day and finish late

most days, so they may prefer exercising early in the morning, when the time is their own. Most have difficulty falling asleep within two hours after exercise (due to elevated adrenaline levels), so exercising late in the evening, close to bed time may not be ideal. The bottom line is: Choose the time of the day that fits in best with the individual's schedule, such that the total exercise time is maximised.

Another consideration is the timing of the exercise session in relation to meals. If exercising after going without food for several hours, the subject may feel too faint and lethargic to exercise at the desired intensity and duration, thus limiting the total calories expended. But if exercising soon after a meal, a bloated stomach may make it hard to exert physically. Generally, the most comfortable time to exercise is about two hours after a main meal.

Comfort aside, does the timing of the exercise session in relation to a meal affect fat-burning? For example, if one exercises on an empty stomach, does one burn more body fat? At moderate exercise intensities, the preferred fuel is carbohydrate, and when that runs out, the body will have no choice but to depend almost entirely on the fat store. The body has got about 2,000 kcal worth of carbohydrate stored up and when that is about to be used up, the subject feels like he has 'hit the wall,' and will rely heavily on fat utilisation, which is slow-release. It usually takes about 90-120 minutes of moderate to high intensity exercise (i.e. at 70-75 % of maximal aerobic capacity) before hitting the wall. However, when in a chronic energy deficit, one tends to hit the wall earlier. Aiming to hit the wall during routine exercise is not wise, as it is not sustainable and thus, the total energy expenditure is not optimal over a long period.

Appetite is suppressed during and immediately after exercise, especially with moderate- to high-intensity exercise. We can take advantage of this. For example, if the subject notices that he or she has a voracious appetite during dinner time, then advice the subject to go for a good workout just before dinner, to suppress the intake during dinner. However, bear in mind that about an hour after exercise, the appetite not only returns, but is also increased, so going for supper an hour or more after a workout is not a good idea.

### Resistance Training

Resistance training (weight training) increases muscle mass, and this leads to an increased metabolic rate. It also increases strength and power, thereby reducing the risk of injuries and makes functional tasks easier to perform. For these reasons, it would seem desirable to add resistance exercise to your training program.

However, many forget that in an effective weight loss programme, the body is in an energy deficit (i.e. negative energy balance), leading to a catabolic state. A negative energy balance is a pre-requisite for weight loss. In such a state, it is difficult to build anything, including muscle. Whereas resistance training during weight loss has been shown to reduce the muscle loss that frequently accompanies weight loss, it is unlikely to increase muscle mass<sup>7</sup>.

Competitive bodybuilders realise this, and that is why they do not attempt to bulk up and cut fat concurrently. Instead, they organise their training into a bulking phase and a cutting phase. During the bulking phase, bodybuilders do high volumes of resistance training and consume carbohydrate- and protein-rich diets to increase muscle mass. Inevitably, they will put on fat as well, as their bodies are in an anabolic (building) phase. Next, they go into a cutting phase, where they usually include cardiovascular activities and embark on a very low-fat, low-carbohydrate diet to create an energy deficit, thereby losing fat (to give the ribbed, well-cut look) and inevitably some muscle mass as well. By repeating cycles of bulking and cutting phases, bodybuilders progressively increase muscle mass while reducing body fat over time.

Since gaining enough muscle mass to significantly increase resting metabolic rate is not realistically achievable, one would be better off focusing on cardiovascular exercise to lose fat. Furthermore, cardiovascular activities tend to burn much more calories than resistance training. Aerobic exercise should be the mainstay of a weight loss programme. If one has the time, go ahead and do resistance training, but do not do so at the expense of cardiovascular training.

Resistance training does have its benefits, as described above. A good time to commence resistance training is when the subject is nearing or has achieved the weight loss target, and is embarking on weight maintenance phase.

### INCIDENTAL DAILY ACTIVITIES

To complement discretionary exercise, incidental daily physical activities should also be encouraged<sup>1</sup>, with the use of pedometers for example. A daily step count of 10,000 would be an appropriate target for adults to attain health benefits. This translates to an energy expenditure of 300-400 kcal. The stepometer is very useful for quantifying daily activities and applying concrete targets.

Ways to increase daily activities include using the stairs instead of the escalator or elevator, alighting one bus-stop early and walking the rest of the way, parking at far end of car park and walking, mopping the floor, washing and waxing the car, actively playing with one's children, doing sit ups during

TV commercials, and walking walk to a colleague's desk instead of using the phone or email.

### CONCLUSIONS

Weight loss requires a negative energy balance, which is best achieved through dietary restriction, discretionary exercise, and increased daily activities. Discretionary exercise is a main pillar for weight loss, and should (1) primarily involve cardiovascular (aerobic) activities, (2) have a total exercise volume of 200-300 min per week or >2000 kcal·wk<sup>-1</sup>, and (3) an intensity of 55-70% of maximal heart rate. The benefits of exercise far outweighs its risks, and to minimise the risks further, a pre-participation screen should be conducted; cross training should be encouraged; the modality, volume, and intensity should be tailored to the individual, and the volume and intensity should be increased progressively. Resistance training can be used to supplement, but not substitute cardiovascular activities in an individual attempting to lose weight.

### REFERENCES

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### LEARNING POINTS

- o Weight loss requires a negative energy balance, aiming for a total energy deficit of 500 – 1,000 kcal per day.
- o The energy deficit is achieved via all three pillars of dietary restriction, discretionary exercise, and increased incidental daily activities.
- o The benefits of exercise far outweigh the risks, but cautionary measures such as pre-participation screening should be conducted to manage the risks.
- o The exercise prescription for weight loss should (1) primarily involve cardiovascular (aerobic) activities, (2) have a total exercise volume of 200-300 min per week or >2000 kcal·wk<sup>-1</sup>, and (3) an intensity of 55-70% of maximal heart rate.
- o The exercise programme should be tailored to the individual, incorporate cross training, and be increased progressively.
- o A daily step count target of 10,000 steps has been shown to be associated with various health benefits.