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Title: Exercise and diet in weight management: updating what works.

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ABSTRACT:
The world is facing major problems associated with the rapid increase in levels of overweight and obesity. Solving this problem via appropriate modifications to exercise habits and/or diet appears easy, but in practice it is inordinately difficult and only a small percentage manage to maintain their weight loss over the long-term. However, a number of strategies can be employed to increase the chances of success. Medical doctors, dieticians, and other allied health professionals are potentially well placed to provide guidance to those at risk of overweight/obesity. This review is aimed at supporting major initiatives targeting an increase in community physical activity to help reduce the prevalence of overweight/obesity, such as the “Change4Life” campaign in the UK (www.nhs.uk/change4life), and the “Exercise is Medicine” campaign in the USA (www.exerciseismedicine.org). By providing a concise summary of the evidence-based research that can be easily understood by a wide range of health professionals, this review hopes to provide a useful document that can be used to enhance preventive counselling by promoting appropriate changes in lifestyle that will ultimately increase levels of physical activity, as well as reduce levels of overweight/obesity and other associated chronic hypokinetic conditions.

INTRODUCTION:
Obesity prevalence has been increasing rapidly in nearly all nations, to the extent it is now considered a global epidemic. In the USA the obesity prevalence rates (BMI>30) have doubled between 1986 and 2000, whilst severe (BMI>40) and super obesity (BMI>50) have increased 4-to-5 fold, along with an alarming threefold increase in childhood overweight/obesity. Although some evidence suggests that obesity levels in US children and adolescents may have plateaued and adult prevalence is slowing, the levels of overweight/obesity represent 66% of the US population. Some have projected
that 86% of the USA adults could become overweight/obese by 2030, with an associated
estimated total health cost of just under one trillion US dollars.\textsuperscript{4} In the UK the data are
just as alarming, with adult overweight/obesity rates at 62%\textsuperscript{5} with 90% of children
predicted to be overweight/obese by 2050 with an associated total projected health care
cost of GBP50 billion.\textsuperscript{6}

As adiposity is primarily a balance between energy intake and energy output, then dietary
restriction and regular physical exercise have been intuitively accepted as vital in a
successful weight management programme. Although many short-term programs (<6
months) appear successful, insufficient studies have examined the issue of poor long-term
maintenance. Indeed, the long-term success of most weight management programmes
has been disappointing, with only 30% successfully maintaining a loss >10% of body
weight for over 5 years.\textsuperscript{7} This target of achieving and maintaining a >10% loss of initial
body mass comes from recommendations from the 2001 American College of Sports
Medicine (ACSM) Position Stand\textsuperscript{8} and the 1998 National Heart, Lung and Blood
Institute report\textsuperscript{9} as being the minimum amount needed to realize long-term health
benefits.\textsuperscript{8} However, a number of recent studies have shown significant improvements in
chronic disease risk factors when weight reductions have been much lower, with some
benefits following only 2-3% reductions in weight.\textsuperscript{10} Indeed, a comprehensive review of
the physical activity research evidence that supports weight reduction/maintenance
strategies is provided by the most recent 2009 ACSM Position Stand\textsuperscript{10} and provides an
excellent resource.

There is good evidence to suggest that medical doctors and other health care
professionals are in the best position to give preventive counselling to their clients.\textsuperscript{11}

However, these health professionals need to be aware also of the various methods that
can be adopted when considering prescribing a physical activity enhancement or a weight reduction programme, and therefore need to understand the consequential effects on health. This review aims to compliment some recent national initiatives targeting an increase in community physical activity to help reduce the prevalence of overweight/obesity such as the “Change4Life” campaign in the UK (www.nhs.uk/change4life), and the “Exercise is Medicine” campaign in the USA (www.exerciseismedicine.org), by providing a concise and precise summary of evidence-based guidelines that can be applied during preventive counselling to appropriate clients.

EXERCISE ALONE TO REDUCE WEIGHT:

Evidence from several meta-analyses show that weight reduction programs based purely on increasing levels of physical activity alone are not very successful. For example, a typical loss of only ~0.3 to 1.3kg over 16 weeks intervention. Although other reviews have concluded that exercise alone can produce “modest” weight losses, it would appear that the typical 30 min/day of mild-moderate activities (e.g., walking) undertaken by many of the overweight may not last long enough to consume a significant amount of energy. In fact, Professor Bouchard estimated it could take up to 2 years for a sedentary obese person to treat their condition through exercise alone. Thus the traditional ACSM activity recommendations of accumulating 150 min/week of moderate exercise is likely to have a minimal effect on weight loss unless it is combined with caloric restrictions, whilst >150 min/week may result in a modest loss of 2-3kg. In comparison, prescribing substantially higher physical activity goals (65-75 min/day) does appear to promote significantly greater weight loss, and the Institute of Medicine now recommends 60 min/day for the control of body weight. The ACSM also suggested that accumulating 225-420 min/week may needed necessary for sustained weight loss (5-
Although they have noted that recommending these levels would present a significant challenge for health professionals. 

**DIET ALONE TO REDUCE WEIGHT:**

When compared to exercise alone, dietary restriction can have a dramatic effect on short-term weight loss with one meta-analysis revealing a 11kg loss over 15 weeks (cf. exercise alone ~1kg), and up to 18kg over 6 months when on a very-low-energy diet.

Yet it was noted in both reviews that most participants had regained over one-third of this weight loss after one year. Although caloric restriction alone can result in weight reduction, it is notoriously difficult since caloric restriction is well known to cause a simultaneous reduction on resting metabolic rate (RMR), which is normally linked to a fall in fat-free mass (FFM). The solution is to try to avoid a reduction in FFM and this appears difficult without an accompanying exercise regime. Preventing a loss in FFM might explain why high-protein hypocaloric diets may facilitate greater weight loss in the overweight/obese when compared to high-carbohydrate/low-fat diets over 6 months, but not over longer periods. It is also suggested the high protein diets may help reduce the appetite and enhance satiety more successfully than high carbohydrate diets. Some positive effects have been reported from very low-carbohydrate diets on weight reduction, although the long term benefits and dangers are not fully known yet. Fat restriction is clearly implicated as being important for weight maintenance, as data from the National Weight Control Registry (NWCR) in America shows that those who maintained an impressive average weight loss of nearly 14 kg over 5.5 years, were found to be consuming a low-fat diet (<25% of energy as fat), and were also exercising extensively. Caloric restriction is often felt to be more manageable for many of the overweight than adhering to an exercise programme. It should be noted that care clearly needs to be taken when giving nutritional advice to overweight and obese
individuals, and as some health professionals may not have adequate nutritional expertise, the appropriate action may require a referral to a qualified dietician.10

EXERCISE PLUS DIET TO REDUCE WEIGHT:

Although evidence is somewhat conflicting on the early benefits of adding exercise to diet restriction in reducing weight, the longer-term combined benefits of exercise plus diet appear to be well supported. The conclusion from a 2005 systematic review26 that diet and exercise resulted in 20% greater initial weight loss than diet alone contrasts with a 1999 review16 that exercise does not significantly increase the initial weight loss beyond that achieved by dietary restriction alone. These inconsistent findings may reflect variations in the degree of caloric restriction used, as very-low-energy diets have been shown in a 2007 meta-analysis15 to produce dramatic short-term weight loss, followed by substantial weight regain. Over longer periods (>1 yr), the benefit of adding exercise to dietary restrictions seems unequivocal,9, 15, 23, 26, 27 whilst the addition of behaviour therapy (such as Problem Solving Therapy), peer support, and regular contact with a therapist able to produce further benefits,28 as can weight-loss medications.15, 29 However, one review23 noted that the combined effects of strength and endurance exercise on weight reduction were less than expected and may be due to the insufficient volume of exercise accumulated, with the strength training possibly having an important role in minimizing the loss of FFM when compared to endurance (aerobic) training, although further research was needed in this area.

Although it is clear that an appropriate exercise regime produces clinically significant benefits in weight loss when used in conjunction with caloric restriction, the dominant contributor is typically likely to be dietary (~80% of the weight loss), with enhanced physical activity contributing the remainder (~20%).
DOES RESISTANCE TRAINING HELP WEIGHT LOSS?

Resistance training has gained popularity as an adjunct to weight loss programmes, even though recent reviews concluded that insufficient evidence exists to support a significant role in successful long-term weight management. Yet it is known that resting metabolic rate contributes about 60-70% of our daily energy expenditure and that FFM is the main contributor to resting metabolism. Hence any intervention or diet that maintains, or even increases, the body’s fat free mass via resistance training regimes, could potentially play an important role in weight management. Although there appears to be little consistent research evidence to date that shows resistance training has a dramatic effect on increasing FFM or increasing metabolic rate. Although evidence suggests resistance exercises may produce a modest increase in FFM and a reduction in CVD risk factors for some individuals that is independent of weight loss. If nothing else, the resistance exercises may provide an element of variation in the exercise regime and ideally these exercises will increase the functional capacity of overweight individuals so that they are more likely to adhere to an enhanced physical activity regime.

BENEFITS OF REGULAR DAILY ACTIVITY:

There is a notion that although relatively small habitual doses of moderate exercise may not be effective in treating an overweight or obese individual, these daily doses may be sufficient to prevent weight gain, providing one’s diet is satisfactory. It has been estimated that the average American gains almost 1kg/year due to an excess energy intake that could be offset in 90% of the population by increasing daily energy expenditure by only 50kcal/day. It has been similarly estimated that walking an extra 800m/day (equivalent to walking an extra 1,000 steps/day, equating to about 50kcal), would prevent this weight gain. Walking an extra 0.8-1.0km/day should be attainable for...
most people by taking stairs, a lunch-time stroll, or walking a little further to the next
public transport station. This form of exercise is cheap, routinely available, and can be
accumulated either in 1-2 larger bouts, or convenient multiple short bouts throughout the
day (e.g., before/during/after work) that often removes two of the largest activity barriers
of needing to change clothing or to find a large epoch of time in our busy days. Multiple
daily bouts of moderate activity even as short at 6 minutes have been shown to have
potential health benefits.\textsuperscript{31} From a behavioural standpoint these short and mild
interventions using small increases in daily walking are likely to be effective.\textsuperscript{10, 24}

\textbf{INTENSITY OF EXERCISE FOR WEIGHT LOSS:}

There appears to be lack of understanding by many individuals, including health
professionals, as to the most appropriate level of exercise intensity needed to promote
reasonable weight loss. Because low intensity exercise (eg. walking), is known to
metabolize a high percentage of fat, it is mistakenly assumed that this type of exercise is
the most ideal exercise for those wishing to lose weight. As a large number of
overweight and sedentary individuals may not have the capacity to exercise at a higher
intensity, then initiating their exercise regime by walking is a safe and sensible practice.
However, walking results in relatively small amounts of fat being oxidized due to the low
metabolic demand of the exercise. In comparison, the exercise intensity that corresponds
to the highest rate of fat use is around 60-70\% of maximum oxygen uptake.\textsuperscript{32} This
corresponds to about 70-80\% of maximum heart rate and equates to a “moderate-to-hard”
exercise intensity (and not the light-to-moderate work rates often recommended and
traditionally posted on cardiovascular exercise equipment in gyms). Higher intensity
exercise not only burns more calories, it also increases thyroxine release, which increases
cellular metabolism even during the recovery phase from exercise. Although a light
exercise regime is likely to be more appropriate for those overweight/sedentary
individuals beginning an exercise programme, the aim should be to gradually increase the
work rate to moderate-to-hard levels as their capacity/ability allows, providing it does not
compromise their health or compliance to the programme. Indeed, a 2007 Cochrane
Collaboration\textsuperscript{27} concluded that vigorous exercise is more effective in causing weight loss
than either moderate or light activity, but only when diet was not restricted. There is
insufficient evidence on whether high intensity interval training (HIIT) might have a
successful role in weight management programs. Although it does appear to elevate
metabolism for a considerable time after the exercise ceases, most individuals find this
HIIT exercise to be rather unappealing. However, 3-4 lower-level bouts of intermittent
exercise each lasting 10-15 minutes may be beneficial for those who dislike continuous
exercise or consider continuous exercise as a barrier to their exercise regime.\textsuperscript{8}

**SUCCESSFUL STRATEGIES FOR LONG TERM WEIGHT LOSS:**

Long-term weight loss is difficult to achieve, with most individuals typically regain 70-
80\% of the lost weight, although there are a number of strategies that may aid long-term
loss.\textsuperscript{33} A defining factor according to the NWCR is whether the individual experienced a
significant emotional, medical or lifestyle “triggering” event that initiated their successful
weight loss regime.\textsuperscript{33} Other suggestions include recommending that the customary
dietary advice and exercise prescription needs to be extended with frequent follow-ups
from health professionals, with these types of contact being weekly or bi-weekly and of
any type (meeting, phone message, email, letter). Providing patients with behavioural
therapy, such as relapse-prevention training, and other types of both professional and peer
support, especially problem-based therapy groups may also help.\textsuperscript{8, 19, 33} There is some
evidence of greater long-term successful weight loss in those individuals who have the
ability to accrue 80 min/day of moderate activity or 35 min/day of vigorous activity.\textsuperscript{16}

One study showed substantial long-term weight loss was produced by walking >120
min/day, but it is likely many overweight individuals would find it difficult to comply with these demands on a regular basis. Although developing an active lifestyle appears helpful in losing weight, adhering to a regular exercise programme appears to be critical in maintaining the lost weight, to the extent that recent recommendations from the ACSM suggest that 60-90 minutes of moderate exercise a day is necessary to prevent weight gain. Furthermore, some evidence from the NWCR indicates the incorporation of at least 25% of exercise being of vigorous intensity is advantageous in the maintenance of long-term weight loss.

RATE OF WEIGHT LOSS:

Health professionals typically recommend a slow and steady weight loss plan even though this lacks empirical support. In fact there is some research evidence suggesting that a greater rate of initial weight loss is positively associated with enhanced long-term (1 to 5 year) weight loss, although this conclusion is not supported by the 2001 ACSM Position Stand. One potential reason for why a greater initial weight loss may be advantageous, it that it may provide a greater psychological boost that encourages the participants to maintain compliance with the diet/activity regime. This may also be an important reason for trying to avoid the focus solely on body weight, which may not change considerably during early remodelling following the initiation of such lifestyle changes. Emphasis on central adiposity using a reduction in waist circumference as a target may prove more appropriate.

FITNESS AND ACTIVITY EFFECTS ON ALL-CAUSE MORTALITY:

It should be noted that there are separate, and independent, effects of improving both physical activity (a behaviour) and physical fitness (a set of attributes) on all-cause mortality. If sedentary individuals can become moderately active by achieving even the
lowest level of the recommendations below, then they can reduce their mortality risk by 20-30%.\textsuperscript{36} However, by increasing their fitness score from being unfit (lowest 20\textsuperscript{th} percentile) to being moderately fit (20-60\textsuperscript{th} percentile), using a combination of structured moderate-to-vigorous exercise (MVPA: training around 60-80\% of maximum heart rate to enhance aerobic power), then the reduction in all-cause mortality risk is a staggering 60-70\%.\textsuperscript{36} These benefits can be observed across all levels of obesity. Other empirical research has shown that improving aerobic power via MVPA activity has greater effects on reducing cardiovascular risk factors than simply increasing physical activity levels,\textsuperscript{37} which again stresses the extra benefits of developing an ability to train regularly using MVPA.

\textbf{INTERNATIONAL EXERCISE RECOMMENDATIONS:}

Wide variations exist in the exercise volume needed to promote weight loss. Although the ACSM currently suggest we accumulate 150 min/week of moderate activity for the maintenance of our health, they recommend 250-300 min/week for long-term weight loss,\textsuperscript{10} whilst the Institute of Medicine recommends 60 min/day for the control of body weight.\textsuperscript{20} Yet others have shown that even more (75-120 min/day) may be better for long-term weight loss.\textsuperscript{16, 34} Whether such levels are realistically achievable in busy and congested urban environments is yet unknown. Patients may require education as to how such interventions may be implemented and this remains a major challenge for health professionals. The fact that the NWCR felt that a significant lifestyle incident or triggering event is often necessary to precede successful weight loss, suggests beneficial changes may occur if family physicians/clinicians adopt a much more proactive initiating role when dealing with overweight individuals. The “Green Prescription” provided from the family physician of the type advocated by studies in several countries\textsuperscript{38-40} should
therefore be extended to be a part of a standardized proactive national health campaign in many countries.

**METABOLIC FITNESS:**

Given the difficulties in achieving successful long-term weight loss, some researchers now suggest switching the primary focus from weight loss to that of “metabolic fitness” in order to improve health risk, as there is evidence this can improve independent of a clinically significant reduction in weight \(^{27}\) and via a standard exercise program. \(^{35}\) The concept of enhancing metabolic fitness aims more at controlling hypertension, dyslipidaemia, and hyperglycaemia, as all of these are known to be strong risk factors for cardiovascular disease. It has been argued that the treatment of obesity should therefore be targeted at health gains, and not weight reduction; hence weight loss should perhaps be viewed as a secondary outcome, whilst achieving reductions in health risk should become the primary outcome. \(^{41,42}\) It is also clear that modernization has not only brought benefits to our lifestyles, but it has also re-engineered many aspects to make them toxic to our health by creating an obesogenic environment. Greater proactive public health efforts are therefore needed to find ways of altering the environment that encourage behaviours that prevent the development of obesity. \(^{30}\)

**SUMMARY:**

Successfully losing weight and maintaining the loss over a number of years is a serious lifestyle challenge. Achieving long-term weight loss via exercise alone is rare, whilst diet alone is better, but a combination of regular physical activity lasting upwards of 60 min/day and dietary restriction seems to be the most favoured, \(^{43}\) especially to maintain the loss. To be successful over the long-term requires a considerable effort by the individual and typically needs frequent support from family, peers, and health
professionals that have a range of behavioural strategies that can be customized to the individual’s requirements. Walking may be suitable when initiating a weight control programme, but higher levels of exercise should be appropriately introduced as the health benefits are substantially greater. For some, the prevention of weight gain and an improvement in metabolic fitness may be of prime health importance, and easier to achieve, than a significant reduction in weight.

REFERENCES:


