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

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ABSTRACT:

2 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
4 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
6 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
8 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
10 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
12 (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
14 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
16 physical activity, as well as reduce levels of overweight/obesity and other associated
chronic hypokinetic conditions.

18

INTRODUCTION:

20 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)
22 have doubled between 1986 and 2000, whilst severe (BMI>40) and super obesity
(BMI>50) have increased 4-to-5 fold,¹ along with an alarming threefold increase in
24 childhood overweight/obesity.² Although some evidence suggests that obesity levels in
US children and adolescents may have plateaued and adult prevalence is slowing, the
26 levels of overweight/obesity represent 66% of the US population.³ Some have projected

that 86% of the USA adults could become overweight/obese by 2030, with an associated
28 estimated total health cost of just under one trillion US dollars.⁴ In the UK the data are
just as alarming, with adult overweight/obesity rates at 62%⁵ with 90% of children
30 predicted to be overweight/obese by 2050 with an associated total projected health care
cost of GBP50 billion.⁶

32

As adiposity is primarily a balance between energy intake and energy output, then dietary
34 restriction and regular physical exercise have been intuitively accepted as vital in a
successful weight management programme. Although many short-term programs (<6
36 months) appear successful, insufficient studies have examined the issue of poor long-term
maintenance. Indeed, the long-term success of most weight management programmes
38 has been disappointing, with only 30% successfully maintaining a loss >10% of body
weight for over 5 years.⁷ This target of achieving and maintaining a >10% loss of initial
40 body mass comes from recommendations from the 2001 American College of Sports
Medicine (ACSM) Position Stand⁸ and the 1998 National Heart, Lung and Blood
42 Institute report⁹ as being the minimum amount needed to realize long-term health
benefits.⁸ However, a number of recent studies have shown significant improvements in
44 chronic disease risk factors when weight reductions have been much lower, with some
benefits following only 2-3% reductions in weight.¹⁰ Indeed, a comprehensive review of
46 the physical activity research evidence that supports weight reduction/maintenance
strategies is provided by the most recent 2009 ACSM Position Stand¹⁰ and provides an
48 excellent resource.

50 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.¹¹

52 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
54 reduction programme, and therefore need to understand the consequential effects on
health. This review aims to compliment some recent national initiatives targeting an
56 increase in community physical activity to help reduce the prevalence of
overweight/obesity such as the “Change4Life” campaign in the UK
58 (www.nhs.uk/change4life),¹² and the “Exercise is Medicine” campaign in the USA
(www.exerciseismedicine.org),¹³ by providing a concise and precise summary of
60 evidence-based guidelines that can be applied during preventive counselling to
appropriate clients.

62

EXERCISE ALONE TO REDUCE WEIGHT:

64 Evidence from several meta-analyses^{14, 15} show that weight reduction programs based
purely on increasing levels of physical activity alone are not very successful. For
66 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,¹⁶ it
68 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
70 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.¹⁷ Thus the
72 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
74 caloric restrictions, whilst >150 min/week may result in a modest loss of 2-3kg.¹⁰ In
comparison, prescribing substantially higher physical activity goals (65-75 min/day) does
76 appear to promote significantly greater weight loss,^{18, 19} and the Institute of Medicine now
recommends 60 min/day for the control of body weight.²⁰ The ACSM also suggested that
78 accumulating 225-420 min/week may needed necessary for sustained weight loss (5-

7.5kg),¹⁰ although they have noted that recommending these levels would present a
80 significant challenge for health professionals.⁸

82 **DIET ALONE TO REDUCE WEIGHT:**

When compared to exercise alone, dietary restriction can have a dramatic effect on short-
84 term weight loss with one meta-analysis²¹ 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.¹⁵

86 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
88 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
90 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
92 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
94 not over longer periods.²² It is also suggested the high protein diets may help reduce the
appetite and enhance satiety more successfully than high carbohydrate diets.²³ Some
96 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.²⁴ Fat
98 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
100 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
102 extensively.²⁴ Caloric restriction is often felt to be more manageable for many of the
overweight than adhering to an exercise programme.²⁵ It should be noted that care
104 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,
106 the appropriate action may require a referral to a qualified dietician.¹⁰

108 **EXERCISE PLUS DIET TO REDUCE WEIGHT:**

Although evidence is somewhat conflicting on the early benefits of adding exercise to
110 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
112 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
114 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
116 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
118 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
120 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
122 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
124 minimizing the loss of FFM when compared to endurance (aerobic) training, although
further research was needed in this area.

126

Although it is clear that an appropriate exercise regime produces clinically significant
128 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
130 physical activity contributing the remainder (~20%).

132 **DOES RESISTANCE TRAINING HELP WEIGHT LOSS?**

Resistance training has gained popularity as an adjunct to weight loss programmes, even
134 though recent reviews concluded that insufficient evidence exists to support a significant
role in successful long-term weight management.^{10, 24} Yet it is known that resting
136 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
138 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
140 to be little consistent research evidence to date that shows resistance training has a
dramatic effect on increasing FFM or increasing metabolic rate.²³ Although evidence
142 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.¹⁰ If nothing
144 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
146 so that they are more likely to adhere to an enhanced physical activity regime.^{8, 24}

148 **BENEFITS OF REGULAR DAILY ACTIVITY:**

There is a notion that although relatively small habitual doses of moderate exercise may
150 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
152 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
154 expenditure by only 50kcal/day.³⁰ It has been similarly estimated that walking an extra
800m/day (equivalent to walking an extra 1,000 steps/day, equating to about 50kcal),
156 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
158 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
160 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
162 daily bouts of moderate activity even as short as 6 minutes have been shown to have
potential health benefits.³¹ From a behavioural standpoint these short and mild
164 interventions using small increases in daily walking are likely to be effective.^{10, 24}

166 **INTENSITY OF EXERCISE FOR WEIGHT LOSS:**

There appears to be lack of understanding by many individuals, including health
168 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
170 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
172 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.
174 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
176 to the highest rate of fat use is around 60-70% of maximum oxygen uptake.³² This
corresponds to about 70-80% of maximum heart rate and equates to a “moderate-to-hard”
178 exercise intensity (and not the light-to-moderate work rates often recommended and
traditionally posted on cardiovascular exercise equipment in gyms). Higher intensity
180 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
182 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
184 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
186 Collaboration²⁷ 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
188 insufficient evidence on whether high intensity interval training (HIIT) might have a
successful role in weight management programs. Although it does appear to elevate
190 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
192 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.⁸

194

SUCCESSFUL STRATEGIES FOR LONG TERM WEIGHT LOSS:

196 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
198 loss.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
200 weight loss regime.³³ Other suggestions include recommending that the customary
dietary advice and exercise prescription needs to be extended with frequent follow-ups
202 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
204 therapy, such as relapse-prevention training, and other types of both professional and peer
support, especially problem-based therapy groups may also help.^{8, 19, 33} There is some
206 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.¹⁶
208 One study showed substantial long-term weight loss was produced by walking >120

min/day,³⁴ but it is likely many overweight individuals would find it difficult to comply
210 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
212 in maintaining the lost weight,^{10, 24, 25, 33} to the extent that recent recommendations from
the ACSM suggest that 60-90 minutes of moderate exercise a day is necessary to prevent
214 weight gain.^{10, 35} Furthermore, some evidence from the NWCR indicates the
incorporation of at least 25% of exercise being of vigorous intensity is advantageous in
216 the maintenance of long-term weight loss.⁸

218 **RATE OF WEIGHT LOSS:**

Health professionals typically recommend a slow and steady weight loss plan even
220 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
222 (1 to 5 year) weight loss,²⁴ although this conclusion is not supported by the 2001 ACSM
Position Stand.⁸ One potential reason for why a greater initial weight loss may be
224 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
226 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
228 changes. Emphasis on central adiposity using a reduction in waist circumference as a
target may prove more appropriate.

230

FITNESS AND ACTIVITY EFFECTS ON ALL-CAUSE MORTALITY:

232 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
234 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
236 20-30%.³⁶ However, by increasing their fitness score from being unfit (lowest 20th
percentile) to being moderately fit (20-60th percentile), using a combination of structured
238 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
240 60-70%.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
242 on reducing cardiovascular risk factors than simply increasing physical activity levels,³⁷
which again stresses the extra benefits of developing an ability to train regularly using
244 MVPA.

246 **INTERNATIONAL EXERCISE RECOMMENDATIONS:**

Wide variations exist in the exercise volume needed to promote weight loss. Although
248 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
250 loss,¹⁰ whilst the Institute of Medicine recommends 60 min/day for the control of body
weight.²⁰ Yet others have shown that even more (75-120 min/day) may be better for
252 long-term weight loss.^{16, 34} Whether such levels are realistically achievable in busy and
congested urban environments is yet unknown. Patients may require education as to how
254 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
256 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
258 role when dealing with overweight individuals. The “Green Prescription” provided from
the family physician of the type advocated by studies in several countries³⁸⁻⁴⁰ should

260 therefore be extended to be a part of a standardized proactive national health campaign in
many countries.

262

METABOLIC FITNESS:

264 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”
266 in order to improve health risk, as there is evidence this can improve independent of a
clinically significant reduction in weight²⁷ and via a standard exercise program.³⁵ The
268 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
270 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
272 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
274 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
276 therefore needed to find ways of altering the environment that encourage behaviours that
prevent the development of obesity.³⁰

278

SUMMARY:

280 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
282 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
284 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

286 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
288 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
290 improvement in metabolic fitness may be of prime health importance, and easier to
achieve, than a significant reduction in weight.

292

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