Maintaining a healthy weight and preventing excess weight gain in children and adults.

Cost effectiveness considerations from a population modelling viewpoint.

Introduction

The Centre for Public Health at NICE is developing a Public Health Guideline on Maintaining a Healthy Weight and preventing excess weight gain. The focus of the guideline is on individually modifiable factors that may help maintain a healthy weight and prevent excess weight gain. It will replace the current section 1.1.1 of the Obesity guideline.

NICE made the decision not to commission a cost effective review, or *de novo* economic analysis for this guideline for the following reasons:

- The scope for the guideline is on individual factors and not specific interventions delivered by the public sector
- NICE has produced a range of guidance around obesity and evaluated the cost effectiveness of a range of interventions which can support the cost effectiveness case for this work
- The recommendations are an update of advice/support that should already be occurring. They are therefore unlikely to have any significant impact on costs for providers or commissioners of services in this area.

This paper has been produced by the Centre for Public Health at NICE and details relevant evidence and learning from previous cost effectiveness work that NICE has done of relevance to this guideline. This paper was considered by the PHAC developing the guideline and informed the cost effectiveness considerations detailed in the guideline.

Key points:

- Previous NICE economic modelling can be applied to the maintenance of a healthy weight and prevention of excess weight gain.

- Changes in average population BMI over time are comparatively small but are collectively enough to make a large proportion of the population overweight or obese. Reductions in average BMI from lifestyle weight management trials are also small, but compared with the small weight gains at population level, they are not insignificant. Lifetime weight gains for adults are around 3 or 4 BMI 'points' and the average effect of weight management interventions is a reduction of about 1 BMI point.
- Most weight loss trials are short-term but the main benefits of maintaining a healthy weight and preventing weight gain are long-term. Trials show that initial weight loss reduces to much lower levels after 12 months. Thus there is no reliable evidence about what really matters: whether weight loss can be maintained over the long run. (See Figure 3 at the end of this paper for a reasonable likelihood that there remains a small effect over time periods longer than a year.) Cost effectiveness is based on the lifetime health gains for obese and overweight people becoming slimmer and remaining slimmer than they otherwise would be. It is therefore not known whether weight management interventions are on average cost effective, unless they are on average very cheap. In the face of this, the reason why NICE has recommended weight loss interventions is because only *very* small weight reduction in the long term (i.e. remaining below people's without-intervention weight trajectory) is required for cost effectiveness for most programmes, and on balance, it is judged to be more likely than not that such very small gains will accrue. It is most unlikely that new information will change this position, unless it is in the form of long-term follow-up of large short-term trials. *De novo* modelling would not help.
- What we do know by inference from the existing evidence is that it is cost effective at a population level for an intervention for people of a healthy weight not to become overweight or obese, or for people who are overweight or obese not to become more so. This is provided that the cost of the intervention is not more than £100 to £500 per head, the cost range depending on age, sex and the level of BMI. Thus *de novo* modelling is not needed.

- There are equity considerations, particularly for children. Children from the highest socioeconomic decile households on average are becoming less obese, but children from the nine lower deciles more obese. The difference is marked.

Introduction

NICE has previously undertaken economic modelling which is directly applicable to the maintenance of healthy weight and prevention of weight gain in adults. The key modelling reports were undertaken for the following public health guidance:

- Lifestyle weight management in adults (PH53, 2014)
- Lifestyle weight management in children and young people (PH47, 2013)
- Prevention of type 2 diabetes in adults (PH35, 2011)

The reports describe in more detail how the modelling work was undertaken. Lifestyle weight management in children also describes the complexity of assessing child BMI, overweight and obesity, and the impact of lifestyle interventions.

Short-term trials, long-term outcomes and cost effectiveness of interventions

Weight losses for adults in trials average about 2.6 kg across trials (12 months post intervention, $p<0.05$). This is relatively small, and varies between trials from around zero to about 7.5 kg. Some of the average weight loss had been regained when followed up for longer than 12 months. Follow-up data longer 12-18 months is limited.

From this evidence it is not possible to say unconditionally whether weight management interventions are cost effective, because cost effectiveness considers lifetime outcomes measured in terms of quality of life and life expectancy. Within the length of the trial follow-ups (generally 12-18 months) there is no accurate way of knowing whether weight loss caused by an intervention in the trial will allow people to live longer (apart from people who have died within the follow-up period). In addition, the small average weight loss will have very little effect on the quality of life within that year, and will only generally become noticeable if the person develops conditions such as diabetes, cardio-vascular disease or lack of mobility, much later in life.

What is more, the lack of long-term data cannot be remedied overnight. For a trial that ended 10 years ago, not only must we have kept in touch with everyone in the trial who had, or did not have, the intervention, but we must wait a *further* 20 (or more) years to see what has happened in a 30 (or more) year period since the trial. For the enormous variability that would occur over that time, the numbers required for statistical significance would be extremely large, and almost certainty larger than would have been in any trial ever carried out. Not only did we not have RCT-based long-term outcomes data to gauge cost effectiveness when the previous guidances were written, but we almost certainly *never* will.

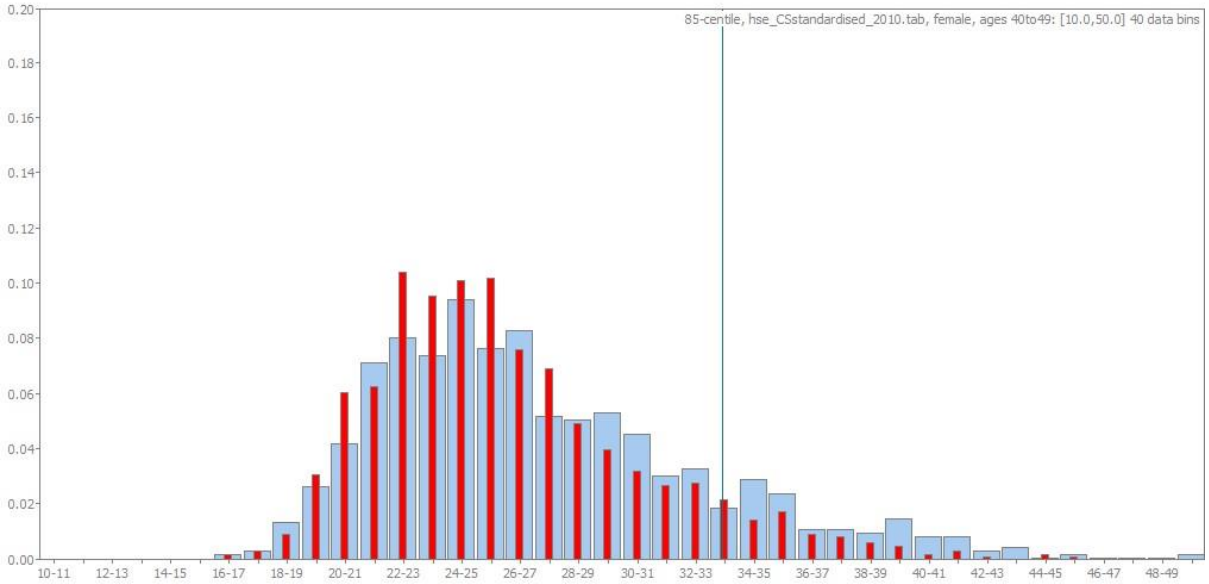
All NICE's statements about cost effectiveness have therefore been conditional on the assumption that some small amount of weight loss in the trials can be maintained for long periods. Figure 3 at the end of this paper would appear to show a reasonable likelihood that a small weight reduction will be maintained in the long term. Where initial weight loss has been large, modelling for PH53 shows that maintenance of weight reduction need be only some 3 to 5 years for older people, but much longer for younger people: over 20 years. For small initial weight loss, the maintenance for younger people of this lower weight has to be effectively for the whole of life. In the face of the average BMI trajectory of a representative group of people increasing as they age, an intervention that allows them to remain on the same average BMI for long time periods will be cost effective, even when the group's average BMI is initially above 25. (This is provided that the per-person cost of the intervention is no higher than the range of £100 to £500, depending on age.)

Small amount of weight lost but small incremental weight gains over time.

- *At a population level,* lifestyle weight management programmes for adults (as stated above) cause small average losses of weight – about 2.6 kg for the average of the programmes in the academic literature
- The following BMI distributions (see Figure 1) for the years 1995 and 2010 for women in the UK between the ages of 40 and 49 (which are representative of other age ranges for both men and women) show that BMI has increased by about 1 BMI point for BMI up to about 25 or 27, and by about 2 points above

the 25 to 27 level. This averages about 1.5 BMI points (about 4kg) over 15 years, or about 0.1 BMI point per year. This is only about 0.3 kg/0.7lb per year. This gradual weight creep has been enough to cause the 'obesity epidemic'. It would appear to be of the order of 3 points of BMI over a 30-year period, or about 8 kg/1¼ stone.

Figure 1 BMI distribution for UK females aged 40-49



UK females aged 40-49, BMI distributions in 1995 (red) and 2010 (blue)

Source: *Martin Brown et al (UKHF) cost effectiveness report for NICE on weight management for adults, 2013 (for PH53)*

- A 2.6 kg decline in weight will not undo the effect of the average increases in weight seen in the distributions such as the above (if these can be extrapolated at the same rate beyond 15 years) – even if interventions maintain the weight loss for the rest of life.
- Nevertheless, the increased morbidity and premature mortality caused by overweight and obesity are very expensive for the health services to treat, so even a small reduction in, or maintenance of, the population's current obesity and overweight profile would be cost effective long term.

Key findings from modelling of lifestyle weight management programmes in adults

What NICE did was to look at some “What-if?” scenarios. For example,

- “What if the weight lost in the trial was never regained at all?” and
- “What if it was put straight back on?”

It was found that if only very small amounts of weight (such as 1 kg) were lost and weight remained below where it would otherwise have been expected to be, then the intervention would be cost effective (provided that it did not cost more than about £100 per head to provide). (PH53 *Weight management for adults*). The initial cost, however, would in most cases not be recuperated for at least 20 years. (PH35 *Preventing type 2 diabetes – population and community approaches).* (This may be important for local governments contemplating investment in obesity interventions.)

But if weight went straight back on, the intervention would not be cost effective. (PH53)

Here are two scenarios which deal with weight lost by a lifestyle intervention (e.g. a commercial or NHS weight management scheme). We then show how it can apply to not losing initial weight, but instead, remaining at the same weight for many years.
The first scenario: An overweight or obese woman of age 40 loses 1kg at a weight management class. She then has weight creep at the rate of 0.3 kg per year (the same as she would have had without first having lost 1kg), but manages to remain 1kg below where (on average) she would have been without the weight management class. If she can maintain this 1kg differential until she is at least 60, and as long as the weight management class did not cost more than £100, on average it will be just cost effective for her to have gone to the class. That is the kind of scenario that was modelled.
In the second scenario, the woman does not go to the weight management class, but by some means (it is not asked how she does it, but suppose that it also costs £100) she manages to stay the same weight for 20 more years until she is 60. For the first 3 years, she is heavier than if she had been to the class, lost 1kg and underwent weight creep at 0.3kg per year. But from about 4 months into the fourth year and thereafter, she is now lighter than she was in scenario 1.

Over 20 years at the rate of 0.3kg per year, she would have gained 6kg with no intervention. In scenario 1 she would have gained 5 kg, allowing for the initial weight loss of 1kg. In scenario 2, she gains zero. If scenario 1 is borderline cost effective compared with doing nothing, then scenario 2 will be much more cost effective under the assumptions made. In fact, if she had not had the scenario 1 intervention but had gained 0.1kg per year for 20 years (instead of the zero in scenario 2) it is highly likely that it would still be cost effective, because her weight in 20 years would be only 2kg above baseline. In scenario 1, where she was 5kg above baseline after 20 years, the intervention was borderline cost effective. In comparison, the low-weight-gain trajectory intervention will outperform the intervention in scenario 1, and for the same cost must automatically be cost effective.

If consideration of costs and benefits is restricted to 3 years, there would be the same intervention costs as for a long-term consideration, but now in scenario 1 (where she was lighter than in scenario 2 for the first 3 years) she does better than scenario 2. But even in scenario 1, she gains almost no health benefits in the first 3 years, because these come mainly towards the end of life. So we need to consider the longer term before an intervention becomes cost effective. So scenario 1 is not cost effective if we consider only 3 years, and neither will scenario 2 be, as she is heavier in the first 3 years in the second scenario. A three-year period is important in this context because it is the length of the local government electoral cycle.

Thus, extrapolating to the population as a whole, an additional scenario – of weight maintenance – should be added to the arsenal of desirable weight management end-points that currently consist of weight loss alone. This also applies to children, as described below.

Key findings from lifestyle weight management in children

The economic evaluation of lifestyle weight management interventions for children is more complicated than for adults, because to achieve a healthy weight, overweight and obese children do not necessarily have to lose weight but may be able to simply maintain weight while growing taller (i.e. “grow into a healthy weight”). In some cases, they may put on weight at a slow rate and still achieve a healthy weight in future by growing sufficiently quickly in compensation. Being overweight or obese at

the end of growth in height, however, requires a loss in weight to achieve a healthy weight.

Economic modelling (for PH47) estimated that interventions for overweight children costing £100 per head would usually be cost effective from a public sector perspective. This would be the case if a group of overweight children moved to a lower average weight trajectory and this was maintained for life. (This is true for a weight loss of as little as 0.5%). Therefore, by inverse logic, interventions that prevent a child moving onto a 0.5% higher average weight trajectory (or greater) for life would also be cost effective.

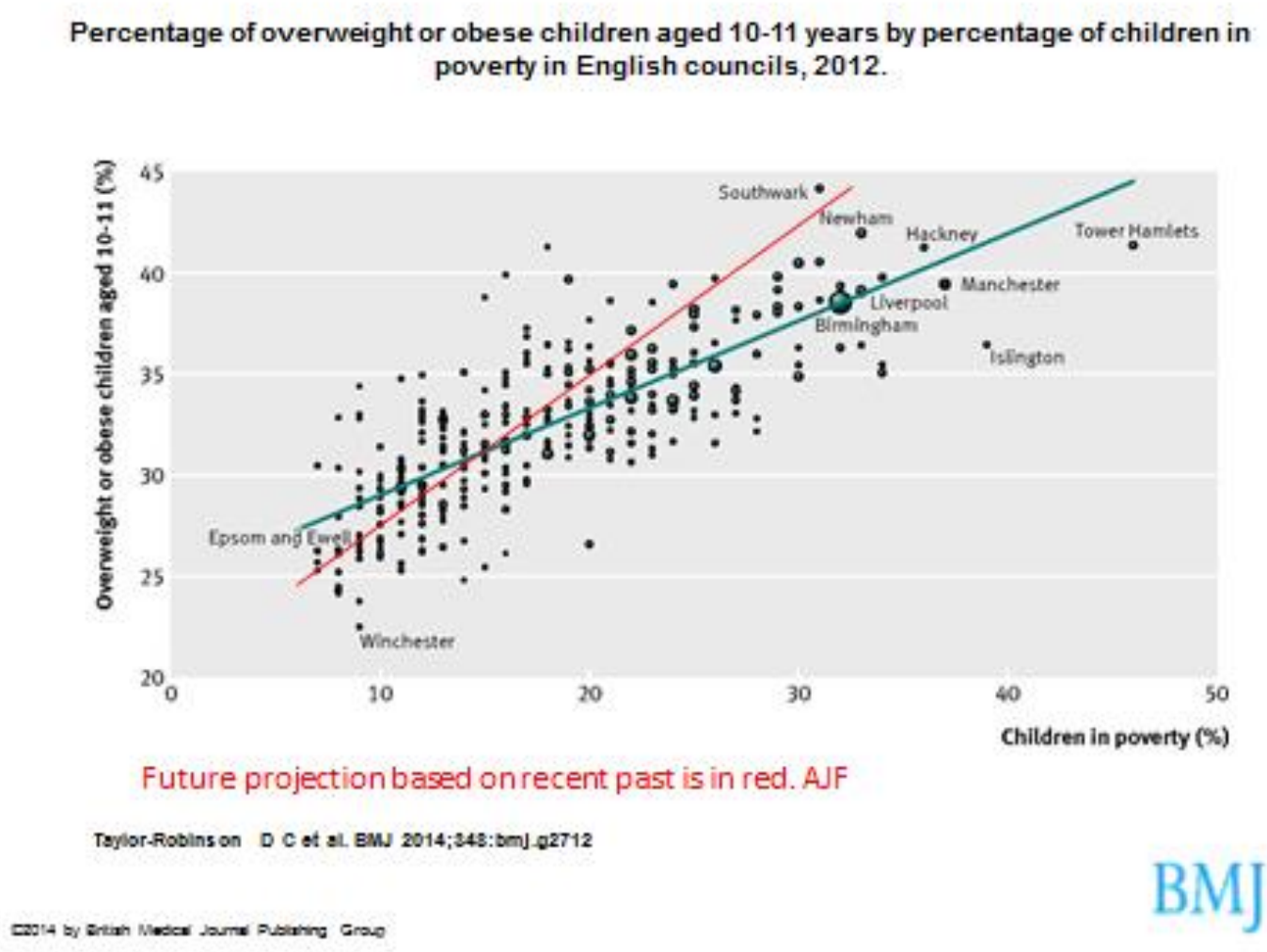
Key findings from population and community interventions to prevent type 2 diabetes (PH35)

Previous modelling has also shown that *very* low-cost public health interventions (costing less than £10 per head), for an average weight loss of 1kg per head (and returning to the pre-intervention weight trajectory after 3 years or longer), are likely to be cost effective. These are unlikely to be face-to-face interventions other than brief advice (as their cost would not allow for enough time to have a sufficient effect) but rather some means of mass communication, such as TV, internet or a tax on sweet or fatty foods or drinks (that obviously has to apply to the whole population).

Equity considerations

- The children from the lowest socioeconomic decile of families are on average the most obese.
- The gradient is monotonic (i.e. the lowest decile is the most obese, then the next-lowest decile is the next-most obese, etc, all the way up to the highest decile).
- But the highest-decile of children are becoming ***less*** obese over time, while the lowest 9 deciles are becoming ***more*** obese.
- So the obesity gradient is increasing.
- This has been happening since 2005 (NOO 2011, now on the Public Health England website)
- Figure 2 below shows the same things more succinctly.

Figure 2: Overweight and obese children versus children in poverty



Conclusions

- We know a lot about the size of the weight increases that have led to the ‘obesity epidemic’. At a population level, they are reasonably small per year, but mount up over the decades.
- We know that on average, life-style weight management schemes are effective after 12 months, but that their effect tends to wear off after that. If the wearing-off effect is not total, the interventions are likely to be cost effective.
- The length of time that weight-loss can be kept off is crucial for cost effectiveness estimation. Weight loss that is regained quickly will not usually be cost effective.
- For adults, previous modelling shows that at least a 1kg per head weight loss among overweight or obese adults, if maintained for life, is likely to be cost

effective, provided that the cost per person of intervening is less than £100. This suggests that preventing at least a 1kg weight gain for the same cost will also be cost effective.

- What we do not know, and would find it exceedingly difficult to determine, is what kind of intervention is better than another to keep weight off. Doing further modelling will not help, because there are no new data that will bear on the problem. It is also recognised that weight maintenance, like weight loss, is a multi-component issue and should be approached as such. What works for one person or one group of people will not for another and it is a combination of approaches that is likely to be the most effective.
- Thus NICE has not carried out any *de novo* modelling for this piece of guidance.
- The scope for this work concerns modifiable behaviours that may help children and adults maintain a healthy weight or prevent weight gain. It is not about recommending interventions *per se*, but of providing recommendations to allow members of the general population to modify their own behaviour and for health professionals to provide advice and guidance whilst carrying out their day to day roles. Doing this could thus be considered cost neutral (or at worst very cheap), so the guidance is very likely to be cost effective
- The most encouraging thing about recent childhood obesity is that among the highest socioeconomic groups, obesity has levelled off and appears to be declining. But that implies that the disparities between rich and poor are increasing. (See slope of the red line added to the BMJ graph above.) Thus, from an equalities perspective, enabling those from lower socio-economic groups to level off their trajectory is also important.

Figure 3

From: Weight regain after behavioural weight management programmes

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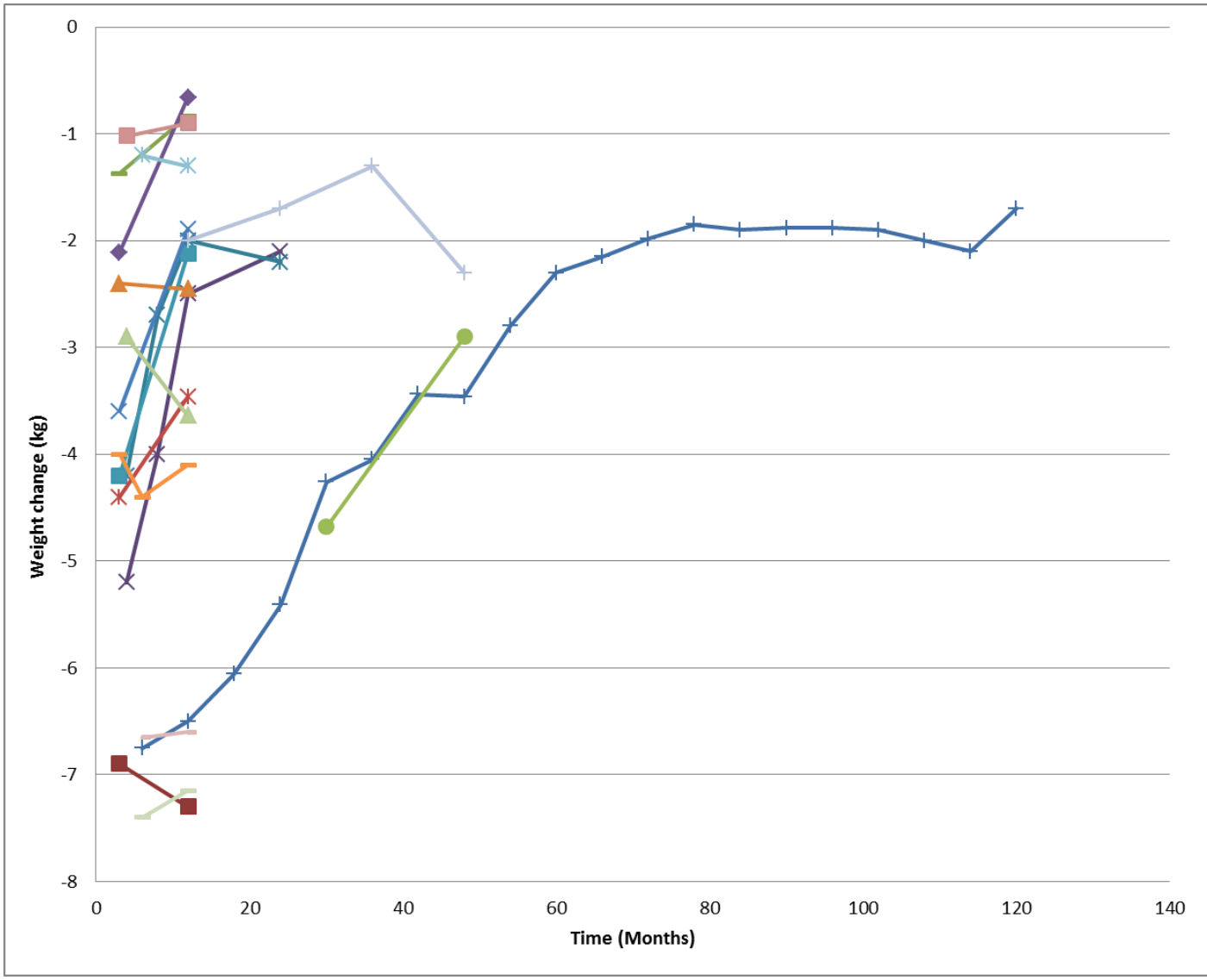
Review 1c (for NICE PH53: weight management for adults)

Johns D, Hartmann-Boyce J, Aveyard P, Onakpoya I, Jebb S, Phillips D, Ogden J, Summerbell C, Perera R
03/04/2013

Figure 3. Weight regain in BWMP interventions following the end of the programme but during low contact follow-up



This shows clear evidence of the wearing-off effect of weight loss (from a number of trials) but some evidence that a long-term effect remains. None of the trials shows an

adverse long-term effect of dieting, but this might be mainly because very few trials went for long enough for the graphs to go above the zero weight-gain line.

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