



# Effects of an over-the-counter herbal weight management product (Zotrim<sup>®</sup>) on weight and waist circumference in a sample of overweight women: a consumer study

Effects of Zotrim  
on weight

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## Abstract

**Purpose** – Aims to carry out a consumer intervention study to evaluate the impact of an over-the-counter herbal weight management product (Zotrim<sup>®</sup>) on weight and waist circumference.

**Design/methodology/approach** – Overweight women were recruited using local media and 61 passed initial screening to begin a four-week intervention using a free sample of Zotrim at a dosage corresponding to manufacturers' recommendations. A total of 56 subjects completed the study, but data on all 61 were included in the "intention to treat" analysis.

**Findings** – There was a self-reported mean weight loss of 1.79 kg (0.45 kg per week) at week 4. Data on perceived hunger and fullness from three sets of questionnaires suggested that subjects felt less hungry between meals and fuller after meals at weeks 1 and 4 compared with base-line. This is likely to have impacted on energy intake and may account for the weight loss. Average weight loss as a percentage of baseline was 2.3 per cent, but this masked a broad range, suggesting that some subjects benefited more than others. Taking into account adjusted guidelines for clinically significant weight loss, 23 per cent of subjects achieved this cut-off, suggesting that their risk of chronic disease had reduced. Similarly, waist circumference (an independent measure of disease risk) decreased by an average of 4.3 cm during the four-week period. This reduced the number of subjects exceeding SIGN guidelines for central obesity from 93 per cent to 83 per cent.

**Originality/value** – Adds to the body of knowledge by proving that Zotrim can aid weight loss and help reduce waist circumference.

**Keywords** Obesity, Health education, Medicines, Body regions

**Paper type** Research paper

## Introduction

Much research has focussed on the aetiology of obesity but relatively little on options for treatment. The Health Committee report (2004) highlighted not only the inadequate resources for weight management offered by the National Health Service, but the shortage of effective, evidence-based options. Systematic reviews of treatment and

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prevention programmes (Health Development Agency, 2003; Avenell *et al.*, 2004) suggest that low fat diets are as effective as calorie reduced diets, although the more extreme very low calorie diets (typically less than 1000 kcal per day) induce greater weight loss. Approved drug treatments in the UK are sibutramine and orlistat which can induce a significant weight loss after 12 months (Avenell *et al.*, 2004), although weight seems to increase after this time despite continuation of the drugs (Torgerson *et al.*, 2004). Adding exercise increases the efficacy of diets (Health Development Agency, 2003), while combination programmes of diet, exercise and behavioural therapy appear to give the best weight loss results (Avenell *et al.*, 2003), although the number of published studies is small.

Table I summarises mean weight changes and weekly rates of weight loss following various interventions for weight management. While the outcome of these options looks encouraging, albeit modest in terms of weight loss, there are downsides including weight regain (particularly when interventions come to an end), poor compliance, insufficient access to therapies in primary care, and the risk of side effects from drug treatments.

Increasing numbers of consumers are now purchasing over-the-counter weight management remedies. However, the scientific evidence for most is sparse (Pittler and Ernst, 2004). One exception is the YGD formulation (now called Zotrim, Natures Remedies) which has been tested in a clinical trial (Anderson and Fogh, 2001) and a consumer study (Ruxton, 2004). Andersen and Fogh randomised 47 healthy overweight subjects to receive either YGD or a placebo. The results demonstrated a statistically significant weight loss of 5.1 kg over the 45-day period (0.8 kg per week) for YGD

Treatment	Comparison	Weight change at 12 months	Rate of weight loss (kg/week)
Orlistat (Xenical) <sup>a</sup>	Drug plus lifestyle changes vs placebo plus lifestyle	-10.6 kg with drug vs -6.2 kg for placebo	0.2
Orlistat (Xenical) <sup>b</sup>	Drug plus diet vs placebo plus diet (mean of 8 studies reported)	-5.9 kg with drug vs -3.0 kg with placebo	0.1
Sibutramine (Reductil) <sup>b</sup>	Drug plus diet vs placebo plus diet (mean of 4 studies reported)	-5.1 kg with drug vs -0.8 kg with placebo	0.1
Low fat or 600 kcal deficit diet <sup>b</sup>	Diet vs control (mean of 13 studies reported)	-4.5 kg with diet vs +0.6 kg with control	0.1
Low calorie diet <sup>b</sup>	Diet vs control (mean of 2 studies reported)	-5.7 kg with diet vs +0.4 kg with control	0.1
Very low calorie diet <sup>b</sup>	Diet vs control (1 study reported)	-11.1 kg with diet vs +2.3 kg with control	0.2
Low fat or 600 kcal deficit diet plus exercise <sup>b</sup>	Diet and exercise vs control (mean of 4 studies reported)	5.9 kg with diet/ex vs +0.8 kg with control	0.1
Diet plus behavioural therapy <sup>b</sup>	Diet and behavioural therapy vs control (mean of 3 studies reported)	-7.3 kg with diet/therapy vs +0.6 kg with control	0.1

**Table I.**  
Expected weight loss from obesity treatments

**Notes:**

<sup>a</sup>Torgerson *et al.* (2004); <sup>b</sup>Avenell *et al.* (2004)

compared with 0.3kg for the placebo. No advice on diet or exercise was given to subjects. A follow-up of 22 subjects in the YGD group at 12 month revealed that the initial weight loss was maintained. YGD is likely to induce weight loss by impacting on satiety. A parallel study by Andersen and Fogh (2001) using ultrasound revealed that the rate of gastric emptying in seven volunteers was affected following consumption of YGD vs a placebo. Gastric emptying after YGD was 53 per cent slower than after the placebo. A shorter time to fullness has also been reported by subjects after consuming YGD (Andersen, 2002).

The weight loss results of Anderson and Fogh (2001) were supported by previous consumer study (Ruxton, 2004). Forty-eight women given a free trial of Zotrim for 28 days demonstrated a mean weight loss was 2.3 kg (0.6 kg per week). These studies, the clinical and the consumer, provide evidence that the formulation is effective for weight management and can be useful in the field. However, weight on its own is not a good predictor of disease risk. Studies suggest that waist circumference, independent of body mass index (BMI), predicts the risk of chronic diseases such as diabetes and cardio-vascular disease (Zhu *et al.*, 2004; Janssen *et al.*, 2004). Previous studies have not evaluated how Zotrim might impact on measures other than weight and BMI, thus the aim of our study was to look at the effect of one month's supply of Zotrim on weight, waist circumference and waist-to-hip ratio in free-living subjects.

### Subjects, recruitment and study design

Articles in local newspapers in Fife and Buckinghamshire were used to recruit subjects for a consumer study on weight management. The articles called for overweight women aged over 18 years who were healthy and not currently pregnant or breastfeeding. The study was restricted to women in order to keep the sample as homogenous as possible. The first 115 responding to the articles were sent a recruitment pack, containing an information sheet, a tape measure, screening questionnaire and consent form, by the study dietitian (FH).

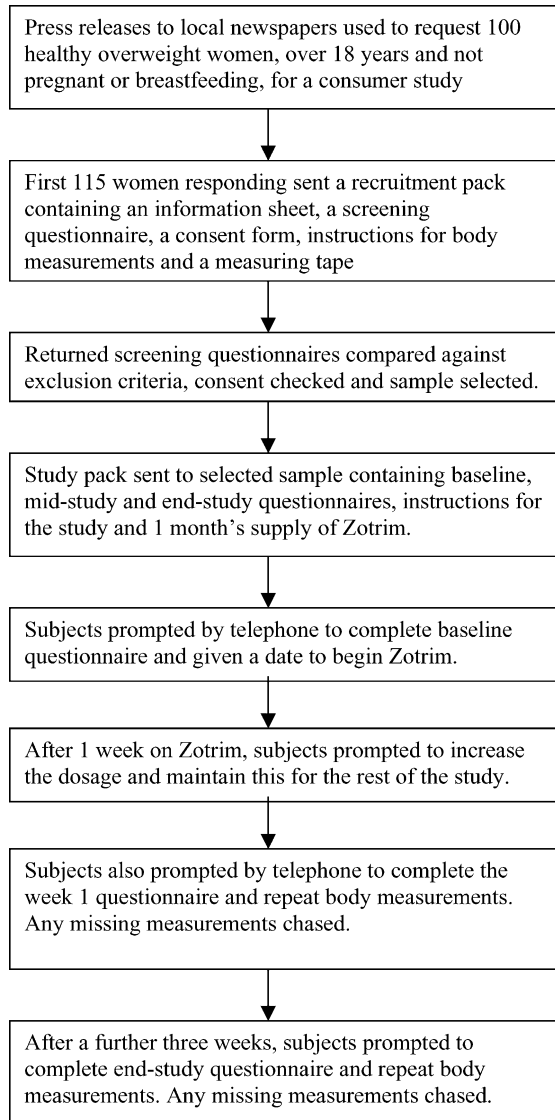
Exclusion criteria were applied to all women returning the screening questionnaire. There were: BMI below 25 or above 35; poor reported health or multiple medical conditions; reported sensitivity to caffeine; thyroid disease; gastro-intestinal disease; pregnant or breast-feeding; poor motivation or unwillingness to take Zotrim; lack of signature on consent form; being male; aged under 18 years or over 70 years; no access to scales. Women with diabetes mellitus were included but were advised that the risk of hypoglycaemia could increase during the study (if they reduced their consumption of food). The selected sample was sent further instructions and a 4-week supply of Zotrim.

Regular telephone calls from the study dietitian were used to prompt subjects to complete the questionnaires at week 1 and week 4, and to take anthropometric measurements at the correct time. Figure 1 gives an overview of the study design.

### Materials and methods

#### *Details of the product*

Zotrim is a commercially available herbal food supplement containing the active ingredients yerba maté (leaves of *Ilex paraguayensis*), guarana (seeds of *Paullinia cupana*) and damiana (leaves of *Turnera diffusa* var. *aphrodisiaca*). All are extracts of South American herbs which have a history of use in traditional culture. Subjects were asked to take two tablets 15 minutes before meals for seven days. At this point, they were prompted by telephone to increase the dose to three tablets 15 minutes before



**Figure 1.**  
Study design overview

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meals for the remainder of the study. These instructions were in line with the manufacturer's guidance.

#### *Anthropometric measurements*

Subjects were asked to provide weight (kg or lb), height (m or feet), waist circumference (cm) and hip circumference (cm) at Screening. These data were used as the baseline measurements if no changes had occurred between screening and baseline. All measurements were repeated at week 1 and week 4. Full written instructions were given on how to take the measurements and the study dietitian checked comprehension by telephone. Data were converted to metric where necessary.

### *Questionnaires*

Four questionnaires were used. The screening questionnaire focussed on information relevant to the exclusion criteria i.e. health related. The baseline questionnaire had three sections: ratings of hunger and fullness around the main meals using a 10 point scale; questions on number and type of snacks consumed; statements on perceived control over eating to which subjects were asked to respond with “agree”, “disagree” or “neutral”. These three sections were repeated in the questionnaires at week 1 and week 4. Additional questions were added to cover compliance with Zotrim, perceived changes to eating habits and any reported side effects or benefits experienced during the study.

### *Statistical analyses*

All data were entered into Stata (StataCorp) and analysed. Anthropometric measurements at baseline and at 4 weeks were compared using paired *t*-tests. Ratings for hunger and fullness were analysed using Wilcoxon Sign Rank tests.

## **Results**

### *Subjects and compliance*

115 women responded to the media articles and 105 were sent screening questionnaires. Of these, 88 returned their questionnaires and 61 were started on the consumer study with 56 completing all stages. All data from the 61 starters were included to enable an “intention to treat” analysis. Thus, the sample size for the results varies between 56 and 61 depending on the availability of data.

Mean baseline weight was 77.9 kg (60.9 kg to 97.7 kg) and mean BMI was 29.4 kg/m<sup>2</sup> (25.1 kg/m<sup>2</sup> to 35 kg/m<sup>2</sup>). Mean baseline waist circumference was 93.7 cm (68 cm to 114 cm), while mean waist-to-hip ratio was 0.86 (0.67 to 1.1). 57 women (93 per cent) had a waist circumference in excess of the 80 cm SIGN (1996) guidelines cut-off for central obesity.

Reported compliance with Zotrim was good. At week 1, 64 per cent had taken all tablets as instructed and no-one had missed more than a couple of occasions. By week 4, full compliance had gone down to 44 per cent but only 25 per cent had missed more than a couple of occasions. Reasons for lack of compliance included illness, holidays and forgetfulness.

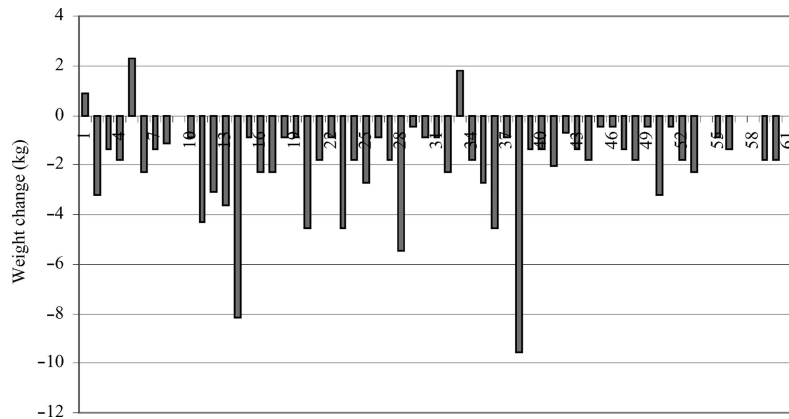
### *Weight and BMI*

Mean weight loss was 0.7 kg (CI +/-0.31) at week 1, and 1.79 kg (CI +/-0.65) at week 4, both statistically significant at  $p < 0.0001$  when compared with baseline. The range of weight loss was broad (+2.27 kg to -9.55 kg), suggesting that some subjects responded better than others to the intervention. Figure 2 shows the spread of individual weight change between baseline and week 4.

The overall mean rate of weight loss was 0.45 kg per week, although the rate between baseline and week 1 (0.7 kg) was greater than between week 1 and week 4 (0.37 kg). Mean weight loss at week 4 was 2.3 per cent of baseline but this masked a broad range of +2.7 per cent to -12 per cent.

Mean BMI reduced by 0.27 at week 1 and by 0.68 by week 4. All changes were statistically significant at  $p < 0.0001$ .

**Figure 2.**  
Spread of weight change  
between baseline and  
week 4 (kg)

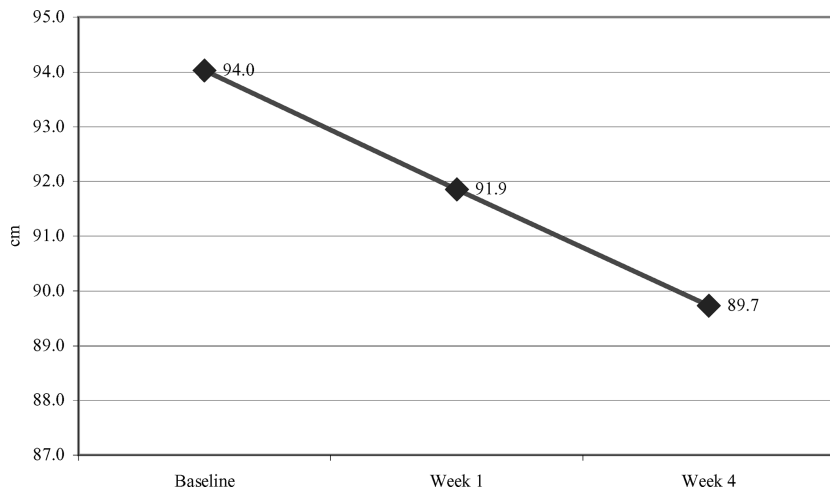


*Waist and hip circumferences*

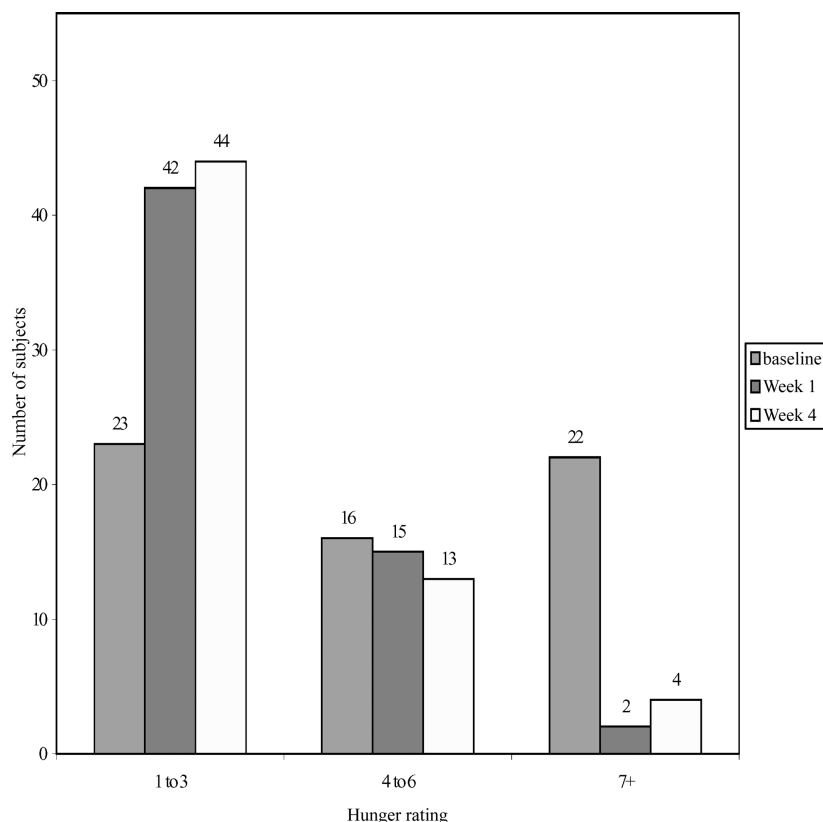
As Figure 3 shows, mean waist circumference reduced by 1.8 cm at week 1 ( $p < 0.001$ ), and by 4.3 cm by week 4, compared with baseline ( $p < 0.0001$ ). The range of overall waist circumference change was +3 cm to -11 cm at week 2, and +8 cm to -17 cm at week 4. The reductions brought 10 (17 per cent) subjects below the SIGN guideline cut-off for central obesity. Similar reductions were seen for hip circumference. At week 1, the mean reduction was 1.3 cm ( $p < 0.001$ ), while at week 4, it was 3.2 cm ( $p < 0.0001$ ). Waist-to-hip ratio remained stable throughout the study at around 0.85.

*Perceived hunger*

The 10 point rating scale for reported hunger at mid-morning, mid-afternoon and late evening was collapsed into three groups for ease of analysis. These were scale 1 to 3 “a little hungry”, scale four to six “quite hungry”, and scale seven to ten “very hungry”. Figure 4 shows how hunger mid-morning changed over the study. More women reported feeling less hungry at both week 1 ( $p < 0.0001$ ) and week 4 ( $p < 0.0001$ )



**Figure 3.**  
Mean change in waist  
circumference (cm)



**Notes:** Key to rating scale: 1 to 3 “a little hungry”, 4 to 6 “quite hungry”, 7 to 10 “very hungry”

**Figure 4.**  
Number of subjects  
reporting various levels of  
mid-morning hunger at  
baseline, week 1 and  
week 4

compared with baseline. There was no significant difference in hunger between weeks 1 and 4. At the end of the study, 42 women said they were less hungry, eight said they felt the same and 11 said they were more hungry. The median score was five at the beginning of the study, decreasing to three at weeks 1 and 4. There was a similar pattern for the hunger ratings reported for mid-afternoon and late in the evening.

#### *Perceived fullness*

The ten point rating scale for reported fullness after breakfast, after lunch and after the evening meal was collapsed into three groups for ease of analysis. These were scale one to four “not full”, scale five to seven “quite full”, and scale eight to ten “very full”. Figure 5 shows how fullness after lunch changed over the study. More women reported feeling fuller at both week 1 ( $p < 0.005$ ) and week 4 ( $p < 0.05$ ) compared with baseline. There was no significant difference in hunger between weeks 1 and 4. At the end of the study, 29 women said they were more full, ten said they felt the same and 18 said they were less full after lunch. The median score was seven at the beginning of the study, then eight at both weeks 1 and 4. There was a similar pattern for the hunger ratings reported after breakfast, however, the effect appeared to be greater after the evening meal with 33 women reporting that they were fuller, 12 saying they felt the same and 15 saying they were less full.

*Reported snacking*

Subjects were asked how many snacks they ate between main meals, and during the evening. Figure 6 shows consumption of snacks following the evening meal. Subjects were more likely to snack in the evening than at any other time with many subjects having two or more snacks. Compared with baseline measures, subjects reported fewer snacks in the evening at week 1 ( $p > 0.05$ ) and at week 4 ( $p < 0.005$ ). There was no significant change in the number of snacks eaten between weeks 1 and 4. At the end of the study, 25 women said they ate fewer snacks, 28 said they ate the same number and eight said they ate more snacks in the evening.

Results were similar for reported snacking between breakfast and lunch, and between lunch and the evening meal. The reductions in snacking at these times of the day were more statistically significant than the evening reductions.

*Additional perceived effects of Zotrim*

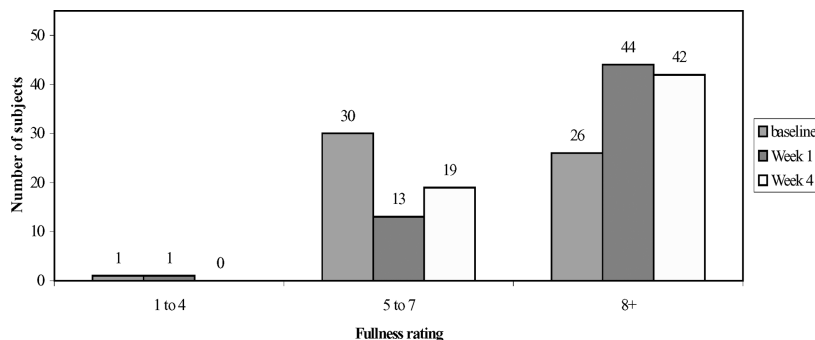
In order to probe for positive or negative effects associated with taking Zotrim, subjects were asked how they felt at weeks 1 and 4. After a week, 20 subjects reported feeling better, 30 said they felt the same, and 9 said they felt worse. After 4 weeks, the numbers changed to 25 (better), 29 (same) and 5 (worse).

Reasons for positive or negative responses were recorded. Subjects could offer more than one explanation. Reasons for a negative response at week 1 ( $n = 9$ ) and week 4 ( $n = 5$ ) were feeling unwell or tired, and experiencing a change in bowel habit. Feelings of sleeplessness and bloating were reported by two subjects at week 1, but not week 4.

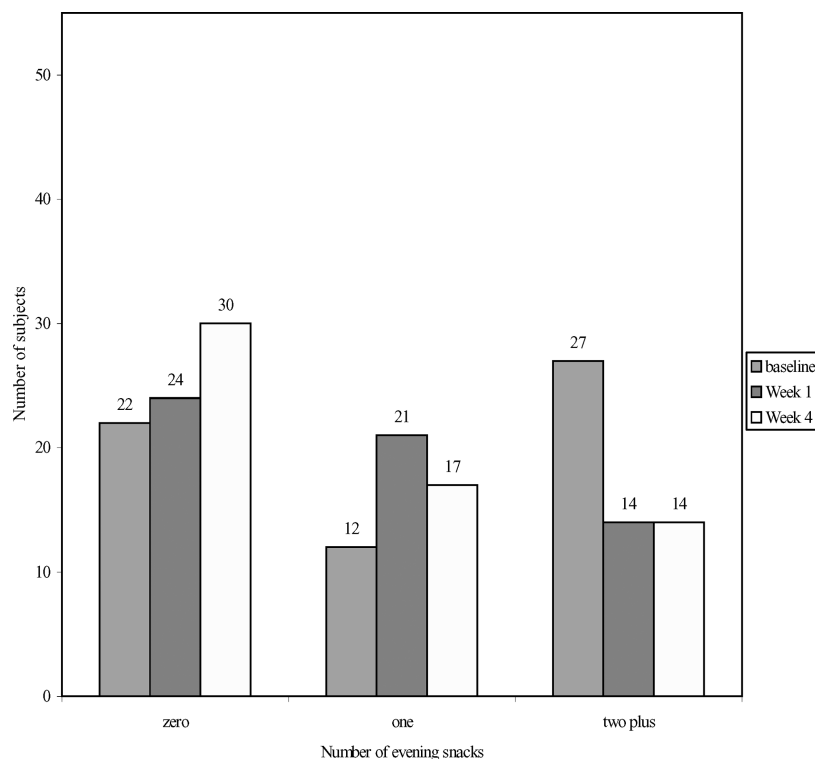
The main reason for a positive response at weeks 1 and 4 was a sense of greater energy ( $n = 11$  both times). Other comments included feeling less hunger and increased well-being, eating more healthily and feeling positive about weight loss ( $n = 12$  at week 1;  $n = 16$  at week 4).

**Discussion**

This consumer study demonstrates statistically significant weight loss and changes in body shape over a 4-week period. Subjects were not asked to take a commercially available weight management remedy as per manufacturer's instructions but not to make any changes to their diet or physical activity regime. While not intended as a scientifically rigorous study, i.e. there was no control group, the work nevertheless fulfils the objective of providing additional evidence in an uncontrolled setting to support the 45-day randomised, placebo-controlled trial of Anderson and Fogh (2001).



**Figure 5.** Number of subjects reporting various levels of post-lunch fullness at baseline, week 1 and week 4



**Figure 6.**  
Number of subjects  
reporting snack  
consumption in the  
evening at baseline,  
week 1 and week 4

Although the methodology and duration of the studies differ, it is useful to compare our 28-day study with the results of Anderson and Fogh. Using a one-sample t-test, weight loss in the clinical trial was found to be significantly greater than in the present study. This is an indication that the samples differed and one obvious distinction is the inclusion of men in the clinical trial. A recent study found that men were more successful at losing weight than women (Truby *et al.*, 2004), while another showed that men were better at maintaining resting energy expenditure while dieting (Volek *et al.*, 2004). A second difference is that subjects in the clinical trial were recruited from a weight management clinic (suggesting a commitment to losing weight and perhaps greater dietary knowledge), while those recruited for the consumer study were recruited from the general population.

A third difference is the duration – the clinical study was 17 days longer than the consumer study and the rate of weight loss increased from 0.52 kg per week in the first ten days to 0.79 kg per week for the entire study. In contrast, the rate of weight loss in our study decreased from 0.7 kg per week in the first seven days to 0.37 kg per week thereafter. This is more typical of weight management and yet still seems to exceed the rates of weight loss reported for other therapies (0.1 to 0.2 kg per week, see Table I), although it is acknowledged that these studies were conducted over 12 months.

Given the changes in reported hunger, satiety and snacking, it is reasonable to assume that the weight changes in our study occurred because subjects were able to eat

less and maintain this over the 4-week period. It could be assumed that subjects deliberately ate less because they knew they were receiving weight management therapy and being monitored. However, it is interesting to note that the weight change in the placebo group of the Anderson and Fogh clinical study – also a group aware of being monitored and believing that they may have been given an active therapy for weight loss – was only 0.3 kg over 45 days. This suggests that the weight loss in both studies was genuine.

While statistically significant weight loss is important, guidelines for weight management place emphasis on the achievement of a clinically significant weight loss, i.e. one that lowers the risk of chronic disease. The National Obesity Forum (NOF, 2004) suggests a figure of 10 per cent of baseline body weight over 12 weeks for clinical significance. When this criterion is applied to our 4-week study, the pro-rata weight loss goal is 3.3 per cent. Fourteen subjects in our study (23 per cent) achieved a weight loss of 3.3 per cent of baseline or more, while a further ten (16 per cent) achieved a weight loss of 2.3 per cent to 3.2 per cent. Only three subjects gained weight over the 4 weeks with a mean gain of 2 kg.

The use of Zotrim compares well with conventional therapies such as reduced calorie diets and exercise, particularly since our subjects were not asked to make any changes to either diet or physical activity. Apart from the 12-month studies summarised in Table I, which report an average rate of weight loss of 0.1 kg to 0.2 kg per week, there is evidence from short-term interventions. Drummond *et al.* (2004) used a 770kcal deficit diet in 76 men and reported a weight loss of 5.2 per cent baseline after 12 weeks (pro rata 1.7 per cent over 4 weeks). This is lower than the 2.3 per cent found in our consumer study. Another study which used a 600kcal deficit diet over 8 weeks in 68 adults reported a mean weight loss of 3.0 kg (pro rata 1.5 kg over 4 weeks). This, again, is lower than the 1.79 kg found in our consumer study.

A key component of this study was to evaluate how Zotrim impacted on waist circumference, since this is an independent determinant of disease risk. Mean waist reduction was 4.3 cm which lowered the proportion of women exceeding the SIGN (1996) cut-off for central obesity from 93 per cent at baseline to 83 per cent at 4 weeks. The reduction in waist circumference compared well with that reported by other studies. Wien *et al.* (2004) achieved a 14 per cent reduction in waist circumference over 24 weeks in 65 adults using a low calorie formula diet enriched with almonds. The pro rata reduction of 2.3 per cent over 4 weeks is lower than the 4.5 per cent reduction in waist circumference seen in our study. Similarly, a 6-week high carbohydrate dietary intervention in 63 men achieved a 2.6 cm (2.7 per cent) reduction in waist circumference (Archer *et al.*, 2003), while a 12-week energy restricted dietary intervention in 51 men achieved a 8.1 cm reduction in waist circumference (Ash *et al.*, 2003). The pro rata reductions in these two studies would be 1.7 cm and 2.7 cm respectively, compared with the 4.3 cm in our study. Zotrim appeared to have a greater impact on waist circumference than the therapies reported in these studies.

### Conclusion

This consumer study provides further evidence that an over-the-counter herbal weight management product (Zotrim) can help induce a statistically significant mean weight loss in a sample of overweight free-living women. The product also had

a significant impact on waist circumference, an independent determinant of chronic disease risk. Both the weight and waist circumference changes over 4 weeks compare favourably with longer-term conventional weight management therapies.

## References

- Andersen, T. and Fogh, J. (2001), "Weight loss and delayed gastric emptying following a South American herbal preparation in overweight patients", *Journal of Human Nutrition and Dietetics*, Vol. 14, pp. 243-50.
- Archer, W.R., Lamarche, B., Deriaz, O., Landry, N., Corneau, L., Despres, J.P., Bergeron, J., Couture, P. and Bergeron, N. (2003), "Variations in body composition and plasma lipids in response to a high-carbohydrate diet", *Obesity Research*, Vol. 11, pp. 978-86.
- Ash, S., Reeves, M.M., Yeo, S., Morrison, G., Carey, D. and Capra, S. (2003), "Effect of intensive dietetic interventions on weight and glycaemic control in overweight men with Type II diabetes: a randomised trial", *International Journal of Obesity*, Vol. 27, pp. 797-802.
- Avenell, A., Broom, J., Brown, T.J., Poobalan, A. *et al.* (2004), "Systematic review of the long-term effects and economic consequences of treatments for obesity and implications for health improvement", *Health Technology Assessment*, Vol. 8 No. 21.
- Drummond, S., Dixon, K., Griffin, J. and De Looy, A. (2004), "Weight loss on an energy-restricted, low-fat, sugar-containing diet in overweight sedentary men", *International Journal of Food Sciences and Nutrition*, Vol. 55, pp. 279-90.
- Health Development Agency (2003), "The management of obesity and overweight", *An Analysis of Reviews of Diet, Physical Activity and Behavioural Approaches*, HDA, London.
- House of Commons, Health Committee (2004), *Obesity*, Third report of session 2003-04, Vol. 1, The Stationery Office, London.
- Janssen, I., Katzmarzyk, P.T. and Ross, R. (2004), "Waist circumference and not body mass index explains obesity-related health risk", *American Journal of Clinical Nutrition*, Vol. 79, pp. 379-84.
- National Obesity Forum (2004), *Guidelines for Management of Adult Obesity and Overweight in Primary Care*, National Obesity Forum, London, available at: [www.nationalobesityforum.org.uk/](http://www.nationalobesityforum.org.uk/)
- Pittler, M.H. and Ernst, E. (2004), "Dietary supplements for body-weight reduction: a systematic review", *American Journal of Clinical Nutrition*, Vol. 79, pp. 529-36.
- Torgerson, J.S., Boldrin, M.N., Hauptman, J., Sjöström, L. (2004), "XENical in the prevention of diabetes in obese subjects (XENDOS study)", *Diabetes Care*, Vol. 27, pp. 155-61.
- Truby, H., Millward, D., Morgan, L., Fox, K., Livingstone, M.B., DeLooy, A. and Macdonald, I. (2004), "A randomised controlled trial of 4 different commercial weight loss programmes in the UK in obese adults: body composition changes over six months", *Asia Pacific Journal of Clinical Nutrition*, Vol. 13(Suppl), pp. S146.
- Ruxton, C.H.S. (2004), "Efficacy of Zotrim: a herbal weight loss preparation", *Nutrition & Food Science*, Vol. 34, pp. 25-28.
- Volek, J.S., Sharman, M.J., Gomez, A.L., Judelson, D.A., Rubin, M.R., Watson, G., Sokmen, B., Silvestre, R., French, D.N. and Kraemer, W.J. (2004), "Comparison of energy-restricted very low-carbohydrate and low-fat diets on weight loss and body composition in overweight men and women *Nutritional Metabolism*", Vol. 1 No. 1, pp. 13.

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Wien, M.A., Sabate, J.M., Ikle, D.N., Cole, S.E. and Kandeel, F.R. (2004), "Almonds vs complex carbohydrates in a weight reduction program", *International Journal of Obesity*, Vol. 27, pp. 1365-72.

Zhu, S., Heshka, S., Wang, Z., Shen, W., Allison, D.B., Ross, R. and Heymsfield, S.B. (2004), "Combination of BMI and waist circumference for identifying cardiovascular risk factors in whites", *Obesity Research*, Vol. 12, pp. 633-45.

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**Further reading**

Scottish Intercollegiate Guidelines Network (SIGN) (1996), *Obesity in Scotland. Integrating Prevention with Weight Management*, publication No. 8, SIGN, Edinburgh.

West, J.A., de Looy, A.E. (2001), "Weight loss in overweight subjects following low-sucrose or sucrose-containing diets", *International Journal of Obesity*, Vol. 25, pp. 1122-8.