

## Short Report: Treatment

# Population response to information on reversibility of Type 2 diabetes

S. Steven, E. L. Lim and R. Taylor

Magnetic Resonance Centre, Institute of Cellular Medicine, Newcastle University, Newcastle upon Tyne, UK

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### Abstract

**Aims** Following publication of the Counterpoint Study (on the reversibility of Type 2 diabetes using a very low energy diet), the extent of public interest prompted the authors to make available, on a website, general information about reversing diabetes. Shortly thereafter, individuals began to feed back their personal experiences of attempting to reverse their diabetes. We have collated this information on the effects of energy restriction in motivated individuals with Type 2 diabetes that has been achieved outside a research setting.

**Methods** Emails, letters and telephone communications received between July 2011 and September 2012 were evaluated ( $n = 77$ : 66 men, 11 women). Median diabetes duration was 5.5 years (3 months–28 years). Reversal of diabetes was defined as achieving fasting capillary blood glucose  $< 6.1$  mmol/l and/or, if available, HbA<sub>1c</sub> less than 43 mmol/mol (6.1%) off treatment.

**Results** Self-reported weight fell from  $96.7 \pm 17.5$  kg at baseline to  $81.9 \pm 14.8$  kg after weight loss ( $P < 0.001$ ). Self-reported fasting blood glucose levels fell from 8.3 mmol/l (5.9–33.0) to 5.5 mmol/l (4.0–10.0) after the weight loss period ( $P < 0.001$ ). Diabetes reversal was considered to have occurred in 61% of the population. Reversal of diabetes was observed in 80, 63 and 53% of those with  $> 20$ , 10–20 and  $< 10$  kg weight loss, respectively. There was a significant correlation between degree of weight loss and reported fasting glucose levels (Rs  $-0.38$ ,  $P = 0.006$ ). Reversal rates according to diabetes duration were: short ( $< 4$  years) = 73%, medium (4–8 years) = 56% and long ( $> 8$  years) = 43%.

**Conclusion** These data demonstrate that intentional weight loss achieved at home by health-motivated individuals can reverse Type 2 diabetes. Diabetes reversal should be a goal in the management of Type 2 diabetes.

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### Introduction

Publication about reversibility of Type 2 diabetes using a very low energy diet (the Counterpoint study [1]) was followed by over 1000 enquiries from people with diabetes. The overwhelming sentiment expressed was profound relief at the possibility that the condition was not inevitably permanent. The extent of public interest prompted the authors to make available on a website general information about reversing diabetes, both for people with Type 2 diabetes and healthcare professionals [2]. In this, it is explained that a very low energy diet was chosen in the research study to mimic the effects of gastric bypass surgery. However, steady but substantial weight loss achieved by reducing portion size was recommended as the preferred method. The focus was on the need to achieve substantial

and sustainable weight loss through the best approach for that individual. All individuals were advised to discuss their plans for energy restriction with their own doctor, particularly with a view to adjusting anti-diabetic medication. A separate document with information for doctors was available. No alterations to habitual physical activity levels were advised. Within a few months individuals began to feed back their personal experiences of attempting to reverse their diabetes. We have collated this information, which provides a unique demonstration of what is achievable by energy restriction in motivated individuals outside a research setting.

### Methods

Emails, letters and telephone communications between July 2011 and September 2012 were evaluated ( $n = 77$ ). Information on diabetes history, the nature of the diet undertaken, intentional weight loss achieved and improvement in glucose

Correspondence to: Sarah Steven. E-mail: sarah.steven@ncl.ac.uk

control was collected. Reversal of diabetes was defined as achieving a reported fasting capillary blood glucose less than 6.1 mmol/l and/or, if available, HbA<sub>1c</sub> less than 43 mmol/mol (6.1%) off any anti-diabetic treatment. Plasma glucose levels were converted to whole blood glucose levels by dividing by a factor of 1.11 [3]. Results are expressed as mean  $\pm$  SD or median and range when not normally distributed. Paired *t*-test, Mann–Whitney *U*-test and Spearman rank sum were carried out (Minitab 15 Software; www.minitab.com).

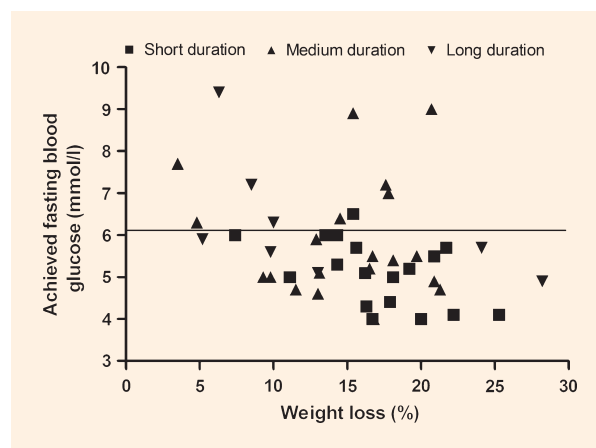
## Results

The respondents (66 men, 11 women,  $56.4 \pm 9.7$  years) had median diabetes duration of 5.5 years (3 months to 28 years). Duration was further categorized as short (< 4 years)  $n = 30$ ; medium (4–8 years)  $n = 25$ ; long duration (> 8 years)  $n = 14$ . Prior to undertaking energy restriction, diabetes treatments were: metformin (36); sulphonylurea (13); diet alone (10); insulin (6); glucagon-like peptide 1 (GLP-1) agonist (3); thiazolidinedione (3); dipeptidyl peptidase-4 inhibitor (2). Proprietary liquid meal replacements were used by 38 individuals and energy intake was restricted without the use of special products in 34 individuals. Support from a healthcare practitioner during the diet was reported by 27 people and 25 felt that they had a negative response to request for support. The median diet duration was 8 weeks (1–104).

Self-reported weight fell from  $96.7 \pm 17.5$  kg at baseline and was  $81.9 \pm 14.8$  kg after weight loss ( $P < 0.001$ ). Self-reported fasting blood glucose levels fell from 8.3 mmol/l (5.9–33.0) to 5.5 mmol/l (4.0–10.0) after the weight-loss period ( $P < 0.001$ ). Pre- and post-diet HbA<sub>1c</sub> was available in 20 subjects and fell from 58 mmol/mol (40–115) [7.5% (5.8–12.7)] to 45 mmol/mol (26–57) [6.3% (4.5–7.4)] ( $P < 0.001$ ). Diabetes reversal was considered to have occurred in 61% of the population. In the non-reversal group, improvements sufficient to allow discontinuation of anti-diabetic medications occurred in five individuals.

Reversal of diabetes was observed in 80% of those with > 20 kg weight loss, 63% of those with weight loss 10–20 kg and in 53% of those with < 10 kg weight loss. The mean weight loss in individuals who reported diabetes reversal was  $16.0 \pm 6.9$  kg, and was  $12.8 \pm 4.9$  kg in those who did not achieve reversal of diabetes. There was a significant correlation between degree of weight loss (%) and reported fasting glucose levels ( $R_s -0.38$ ,  $P = 0.006$ ) (see Fig. 1). Of those achieving loss of > 20% of body weight, only three people did not achieve reversal of diabetes. The reversal rates in the short, medium and long duration groups were 73, 56 and 43%, respectively, and in those losing > 15 kg in weight the reversal rates were 82, 64 and 75%, respectively.

Longer-term data from eight of these individuals are available, indicating a sustained benefit on blood glucose levels following cessation of tight energy restriction. These



**FIGURE 1** Self-reported fasting blood glucose levels at the end of the diet period in relation to the degree of achieved weight loss. The solid line at 6.1 mmol/l represents the diagnostic cut-off for diabetes reversal.

individuals, all male, undertook an 8-week period of energy restriction, with four individuals using a meal replacement product. Sustained reversal of diabetes was confirmed by HbA<sub>1c</sub> in six individuals and by oral glucose tolerance test in two individuals. Details on glycaemic control and weight change for these individuals are shown in Table 1.

## Discussion

The data suggest that very significant improvements in blood glucose levels can be made by energy restriction undertaken by motivated individuals in their usual environment. This is possible with minimal or no support from a healthcare practitioner. It is still widely believed that long-duration Type 2 diabetes results in an inevitable and irreversible decline in insulin secretion, with the inevitable requirement for insulin therapy after an average of 10 years [4]. Six individuals with long-duration disease (9–28 years) reported reversal of diabetes. This is in keeping with observations following bariatric surgery, that some individuals will achieve normalization of blood glucose levels, even although remission rates decrease when disease duration is more than 10 years [5]. Although the use of very low energy diets tends to be followed by weight regain, some people are able to avoid this [6,7] and our data confirm this. Modification of dietary fat content may have a beneficial effect following intentional weight loss [8]. Further work is needed to define the optimum method for maintaining normal glucose tolerance after the return to normal eating.

The study population represents a group of individuals motivated to regain their health, and this is an important point. The crucial factor which differentiates this dietary intervention from previous attempts is the clearly identified goal of becoming free of Type 2 diabetes. The distinction between the treatment of a potentially curable disease and

**Table 1** Sustained benefit on weight and blood glucose levels following a period of energy restriction in eight individuals

Subject	Time since diet period	Reported glycaemic control at this time	Diabetes duration	Weight $\Delta$ during diet (kg)	Weight $\Delta$ following diet (kg)
1	8 months	HbA <sub>1c</sub> 40 mmol/mol (5.8%)	4 months	-7.3	+3
2	7 months	HbA <sub>1c</sub> 36 mmol/mol (5.4%)	3 years	-30.4	-12.4
3	5 months	HbA <sub>1c</sub> 35 mmol/mol (5.4%)	1 year	-18	+5
4	5 months	HbA <sub>1c</sub> 39 mmol/mol (5.7%)	3 years	-20.4	+2.2
5	5 months	HbA <sub>1c</sub> 33 mmol/mol (5.2%)	6 months	-17	+7.5
6	5 months	HbA <sub>1c</sub> 38 mmol/mol (5.6%)	8 months	-25.4	+5.4
7	3 months	Oral glucose tolerance test Fasting plasma glucose 6.1 mmol/l 2-h plasma glucose 6.3 mmol/l	4 years	-17.5	+2.5
8	3 months	Oral glucose tolerance test Fasting plasma glucose 5.1 mmol/l 2-h plasma glucose 6.0 mmol/l	6 months	-18	-3

that of a chronic progressive condition was made eloquently by one individual, who contrasted the often reported battle to 'bear' a life-threatening disease such as cancer with the learned helplessness induced by advice that diabetes was inevitably progressive. The responses clearly show that this minority of health-motivated people strongly resent being told that there is nothing that can be done to escape from Type 2 diabetes and that they must take medication. The overwhelming impression gained by doctors from their routine clinical practice is that people with Type 2 diabetes rarely succeed in losing weight, and the critical point that there is a subgroup who are strongly motivated by desire to regain health has not been widely recognized. Some doctors do know that occasionally people do reverse their diabetes, but this is not acknowledged by clinical guidelines [9]. The pathophysiological basis for this has previously been described [10].

Observations in uncontrolled free-living populations make this study unique and reflect the prospects for what can be achieved beyond the research environment. However, the limitations inherent to this study design must be acknowledged. Firstly, there will have been self-referral bias, with the observations demonstrating proof of principle rather than any estimate of likely reversal rates. The precision of the diagnosis of Type 2 diabetes is uncertain. The inclusion of individuals with maturity-onset diabetes of youth or slow-onset Type 1 diabetes would result in an underestimation of rates of diabetes reversal using a very low energy diet. The significant degree of heterogeneity in the intervention must also be acknowledged, including the degree of energy restriction (particularly in those who did not use a meal replacement product) and the length of diet period undertaken. Finally, diabetes reversal was mostly based on self-reported, unverified measurements of glycaemic control in the form of capillary blood glucose results, fasting plasma glucose results, HbA<sub>1c</sub> or oral glucose tolerance tests.

These data demonstrate that intentional weight loss achieved at home by health-motivated individuals can reverse Type 2 diabetes. Diabetes reversal should be a goal in the management of Type 2 diabetes in these individuals. The durability of the effect on glucose metabolism requires further study. Long-term avoidance of weight gain must be the top priority after reversal of diabetes, and the dietary regimen best able to achieve this must now be established.

#### Funding sources

None.

#### Competing interests

None declared.

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