Title:

Global warming: is weight loss a solution?

Anna Gryka, MSc, research student, Centre for Obesity Research and Epidemiology, Robert Gordon University, Aberdeen UK

Iain Broom, Professor of metabolic medicine, DSc, Centre for Obesity Research and Epidemiology, Robert Gordon University, Aberdeen UK

Catherine Rolland, PhD, lecturer, Centre for Obesity Research and Epidemiology, Robert Gordon University, Aberdeen UK

Correspondence and requests for materials should be addressed to :

Dr Catherine Rolland

Email: c.rolland@rgu.ac.uk

Telephone: 01224 262893

Fax: 01224 262828

Address: Centre for Obesity Research and Epidemiology
Robert Gordon University
St Andrew Street
Aberdeen
AB25 1HG
UK

Abstract

The current climate change has been most likely caused by the increased greenhouse gas emissions. We have looked at the major greenhouse gas, carbon dioxide (CO_2), and estimated the reduction in the CO_2 emissions that would occur with the theoretical global weight loss. The calculations were based on our previous weight loss study, investigating the effects of a low-carbohydrate diet on body weight, body composition and resting metabolic rate of obese volunteers with type 2 diabetes. At 6 months we observed decreases in weight, fat mass, fat free mass and CO_2 production. We estimated that a 10 kg weight loss of all obese and overweight people would result in a decrease of 49.560 Mt of CO_2 per year, which would equal to 0.2 % of the CO_2 emitted globally in 2007. This reduction could help meet the CO_2 emission reduction targets and unquestionably would be of a great benefit to the global health.

Key words: Global warming Carbon dioxide Obesity

Introduction

Climate change resulting from the mean rise in temperature over the last 100 years has been widely discussed.[1] It has been accepted by the majority of scientists that the change is being caused by the anthropogenic increase in greenhouse gas emissions. Greenhouse gases in the atmosphere impair the earth's cooling processes which results in the global rise in temperature. [1] The major greenhouse gas is carbon dioxide (CO_2) which mostly comes from burning of fossil fuels (gas, oil, coal and other solid fuels). Other sources of CO_2 emissions include iron and steel production, cement manufacture, solid waste combustion, or petrochemical production. In 2007, burning of fossil fuels and cement manufacture caused emission of 30649.36 Mt CO_2 globally.[2] Across the world, fossil fuels are combusted to provide energy to generate electricity, for transport, business, agriculture and industry. If the current emissions are not reduced, the global temperature may rise by 2 to 7°C by the end of the century depending on the models used.[3] This in turn may cause the extinction of many species, irreversible changes in the ecosystems and environmental disasters like storms, wildfires, droughts or floods. Such prognoses bring governments to set targets for the reduction of CO_2 production and support the search for alternative energy sources.

Humans, apart from indirectly producing CO_2 through the use of fossil fuels and the industry, also produce CO_2 during respiration. Consequently, global CO_2 emissions depend on the size of the population. In addition, due to the fact that CO_2 production is proportionate to body mass, heavier individuals produce more (based on our data, for every kg of body mass lost, RMR dropped by about 18 kcal/d and there was a 1%

reduction in CO_2 produced). The post-industrial changes to human lifestyle and diet have resulted in an obesity epidemic. Although the knowledge of obesity mechanisms is quickly expanding and novel obesity treatments are being developed, the situation on a world population level has not improved. With the countless unsuccessful efforts to tackle the obesity problem, it is more and more evident that the global modification of today's lifestyles and environments may be the only possible solution to the obesity epidemic.

In light of the growing literature on the link between obesity, type 2 diabetes, coronary artery diseases and climate change [4-8] we thought it would be interesting to discuss the effect of the global reduction of body mass, in particular of those individuals who are obese and overweight on worldwide CO_2 emissions. It is clear that an omnipresent weight loss of all obese and overweight population is as improbable in the short term as global warming is inevitable if no action is taken. However, it is essential to model the effect of population weight loss on CO_2 emissions. We have assumed a 10 kg weight loss based on our observations as well as other studies using a low carbohydrate diet for a 6 month period. [9]

Methods

The calculations in the current paper are based on an observed decrease of resting metabolic rate (RMR) that occurred with weight loss in our recent study. The intervention involved 6 months on a low-carbohydrate, high-protein diet and included 25 obese volunteers (13 females, 12 males) with poorly controlled ($HBA_{1c} > 7.5\%$) type 2 diabetes

(T2DM) (ISRCTN20400186). CO_2 production and body composition were assessed at baseline and 6 months. The CO_2 production was measured using the Quark RMR (Cosmed, Rome, Italy). Body composition was measured by air-displacement plethysmography (Bod Pod, Life Measurement Inc., Concord, California, USA). The majority of the variables were not normally distributed, hence the Wilcoxon signed ranks test was used to investigate 6-month changes in weight, fat mass (FM), fat free mass (FFM) and CO_2 production. Analyses were performed with SPSS, version 17.0 (SPSS Inc., Chicago, Illinois, USA).

Results and calculations

The dietary composition of participants on a low-carbohydrate / high-protein diet is outlined in Table 1. As expected, the total energy of the diet was significantly lower during the study than at baseline. According to our recommendations, the total amount of carbohydrate, both as grams per day and as a percent of daily total energy, was lower during the study than at baseline. Additionally, the amount of protein increased from 22% to about 30% of total energy levels but did not change when expressed in grams per day.

After 6 months of the weight loss programme, we observed a decrease in weight, fat mass (FM), fat free mass (FFM) and CO_2 production (Table 2). Six-month change in CO_2 production was positively correlated with changes in weight ($r = 0.506$; $P = 0.0.12$) and FM ($r = 0.517$; $P = 0.011$). The majority of weight lost was attributed to a decrease in FFM (Table 2), reflecting the higher protein content of the diet which was about 30% of energy intake (Table 1). Weight loss achieved by implementing a normal- or a low-protein diet (i.e. 10-15% of energy), could perhaps induce a higher loss of FFM than a high-protein diet. Consequently, such a diet would cause an even bigger drop in RMR and CO_2 production, but would not be beneficial to the health of the individual losing weight.

On the basis of the current data, for every 1 kg of body mass lost, the CO_2 production would decrease 3.2 ml/min. Therefore, an individual who lost 10 kg would produce 32 ml of CO_2 less every minute. This would equal to 16812 l (33.04 kg) of CO_2 less in a year, compared to what would be produced without weight loss. In 2008, the global number of obese and overweight adults over 20 years old was 1.5 billion. [10] If all those individuals lost 10 kg and sustained it for a year, the reduction in CO_2 emissions would be 49.56 Mt CO_2 /year. This would equate to 0.2% of CO_2 emitted globally in 2007 by burning of fossil fuels and the manufacture of cement.[2] Analogously, a 5 kg weight loss of all overweight and obese people would reduce global CO_2 emissions by only 0.1%.

Discussion

Our calculations have shown that a 10kg weight loss of all overweight and obese people would translate into a 0.2 % reduction in the global CO_2 emissions. This percentage seems small; however, we have looked at personal production only. Had we accounted for additional reductions in CO_2 emissions that would likely accompany weight loss, for example decreases in transport costs, and smaller amounts of food consumed as suggested by Edwards and Roberts, [11] the total estimated decreases in CO_2 production would have been greater. It could also be argued that the decrease in CO_2 production which accompanies weight loss would mimic the benefits of decreasing global population.

The theoretical global weight loss would also be of great health benefit; halving the risks of developing T2DM and obesity-related cancers, improving glycaemic control in those with T2DM, and finally improving blood pressure and lipid profiles.[12] Such changes would bring the significant reductions of healthcare costs and also improvements in general quality of life.

The targets for CO_2 emissions, as specified in the Kyoto Protocol Reference Manual, vary for different countries and regions of the world. The UK Low Carbon Transition Plan suggests lowering the emissions by 18% from the 2008 levels, or 95.9 Mt CO_2 / year, by 2020.[13] A 10 kg weight loss of all overweight and obese in the UK would account for over 1% of the CO_2 emission reduction target by 2020. [14-16]

This estimation was only possible when a number of assumptions were made. Firstly, we assumed that weight loss in overweight people would result in the same change in FM and CO_2 production as in the obese. Secondly, we assumed that obese and overweight but otherwise healthy people would show the same change in CO_2 production with weight loss as did obese people with type 2 diabetes. Finally, it has been shown that people with type 2 diabetes have higher RMR than those without [17] and therefore our calculations may be slightly overestimated. However, if significant loss of FFM occurred with weight loss (as may be the case with normal- or low-protein diets), the decrease in RMR could have been higher, in which case the current estimations would underestimate it. Present calculations were not designed to accurately reflect potential impact of global weight loss on climate disruption, but to signal an opportunity for addressing individual, global and environmental benefits of weight loss.

Health and climate change issues seem to be closely related in the perspective of our future. We agree with Wilkinson et al (2010) who stated that policies to reduce carbon emissions and climate change will improve health and well-being.[18] The opposite should also be true; tackling lifestyle-related health problems should have a positive effect on the environment. Universal moderate weight loss of the overweight and obese would result in an equivocal influence on the world carbon emissions with possible effects on climate disruption. Nevertheless, this relatively small amount could help to meet the CO_2 emission reduction targets and unarguably would be of a great benefit to the human's health. Moreover, the shift from seeing weight loss as beneficial for an individual's health to also being beneficial for the planet may change attitudes toward healthy lifestyle. If such benefits were persuasive to governments across the world, a significant impact on global warming might be achieved as a consequence.

Acknowledgements We thank A. Stewart for reading of the manuscript and critical comments. The study of low-carbohydrate diet was supported by the Go Lower company.

Conflict of interest: The authors declare no conflict of interest.

References

1. HM Government. *Climate change.* HM Government, 2009. http://www.direct.gov.uk/en/Environmentandgreenerliving/Thewiderenvironment/Climatechange/index.htm.

2. The World Bank. World Development Indicators. CO2 emissions (kt). [Online]. Available: http://data.worldbank.org Last updated 04/10/2010; Printed: 20/04/2011.

3. Met Office. *Climate change — your essential guide.* Report No.: 09/0050. Met Office, 2009.

4. Faergeman O. Climate change and preventive medicine. *Eur J Cardiovasc Prev Rehabil 2007*, **14**: 726-729.

5. Shea, K.M. Climate change: public health crisis or opportunity. *J Public Health Manag Pract* 2008; **14:** 415-417.

6. Delpeuch F, Maire B, Monnier E, Holdsworth M. Globesity. A Planet out of Control? 2009. London: Earthscan.

7. Mawle A. Climate change, human health, and unsustainable development. *J Public Health Policy* 2010; **31:** 272-277.

8. Egger G, Swinburn B. Planet Obesity. We Are Eating Ourselves and the Planet to Death. 2010. Crows Nest, Allen & Unwin.

9. Hession M, Rolland C, Kulkarni U, Wise A., Broom, J. Systematic review of randomized controlled trials of low-carbohydrate vs. low-fat/low-calorie diets in the management of obesity and its comorbidities. *Obes Rev* 2009; **10**: 36-50.

10. World Health Organization, 2011, Obesity and Overweight. Fact sheet No 311. [Online]. Available: http://www.who.int/mediacentre/factsheets/fs311/en/index.html Printed: 12/21/2011.

11. Edwards P, Roberts I. Population adiposity and climate change. *Int J Epidemiol* 2009; **38**: 1137-40.

12. Turner H, Wass J. *Oxford Handbook of Endocrinology and Diabetes.* Oxford University Press, 2002.

13. HM Government. The UK low carbon transition plan. National strategy for climate and energy. HM Government, 2009.

14. Office for National Statistics. News Release: UK population approaches 62 million. Crown Copyright, 2010.

15. The Scottish Government. *Scottish Health Survey 2008*. The Scottish Government, 2009.

16. The NHS Information Centre. *Health Survey for England 2008. Volume 1: Physical activity and fitness.* 2009.

17. Bitz C, Toubro S, Larsen TM, Harder H, Rennie KL, Jebb SA, et al. Increased 24-h energy expenditure in type 2 diabetes. *Diab Care* 2004; **27**: 2416-21.

18. Wilkinson RG, Pickett KE, De Vogli R. Equality, sustainability, and quality of life

Table 1. Changes in diet composition during the low-carbohydrate / high-protein weight loss programme (n=25).

	Baseline	6 months	Change	P-value [a]
Energy				
kcal	1845 ± 74	1194 ± 21	-594 ± 600	0.001
Carbohydrate				
g/day	164 ± 69	50 ± 25	-108 ± 74.1	< 0.001
% total energy	41 ± 9	22 ± 11	-17.8 ± 12.0	< 0.001
Protein				
g/day	87 ± 33	79 ± 28	-5.3 ± 32.2	0.882
% total energy	22 ± 7	30 ± 8	7.9 ± 7.5	< 0.001
Fat				
g/day	80 ± 44	68 ± 20	-16.4 ± 37.1	0.573
% total energy	38.5	50.0	10.0 ± 13.9	0.015

Values are expressed as mean ± standard deviation. [a]Significance level of the difference between baseline and 6 months, Wilcoxon signed ranks test.

Table 2. Changes in weight, fat mass, fat free mass, resting metabolic rate and CO_2 production, during the low-carbohydrate / high-protein weight loss programme (n=25).

	Baseline	**6 months**	**Change**	**P-value** [a]
Weight (kg)				
Males (n=12)	117.7 ± 19.5	108.0 ± 20.9	-9.7 ± 6.4	0.001
Females (n=13)	104.6 ± 22.2	94.2 ± 22.1	-10.4 ± 7.8	< 0.001
Total	110.9 ± 21.6	100.8 ± 22.2	-10.1 ± 7.0	<0.001
FM (kg)				
males	50.3 ± 13.0	41.1± 12.9	-9.2 ± 5.2	< 0.001
females	54.1 ± 17.6	45.7 ± 19.8	-8.8 ± 7.8	0.001
Total	52.4 ± 15.7	43.4 ± 16.5	-9.0 ± 6.5	< 0.001
FFM (kg)				
males	67.3 ± 11.8	67.0 ± 12.0	-0.3 ± 1.7	0.266
females	50.5 ± 7.4	49.3 ± 7.3	-1.6 ± 1.4	< 0.001
Total	59.0 ± 12.8	58.1 ± 13.3	-0.9 ± 1.7	0.001
RMR (kcal/d)				
males	2267 ± 451	2033 ± 420	-234 ± 181	0.001
females	1845 ± 428	1572 ± 345	-274 ± 306	0.002
Total	2048 ± 81	1793 ± 442	-254 ± 250	< 0.001
CO_2 production (ml/min)				
males	258 ± 56	220 ± 45	-37 ± 33	0.001
females	201 ± 47	173 ± 42	-27 ± 37	0.013
Total	226 ± 58	195 ± 50	-31 ± 34	< 0.001

Values are expressed as mean ± standard deviation. Abbreviations: FM, fat mass; FFM, fat free mass; RMR, resting metabolic rate; m, male; f, female. [a]Significance level of the difference between baseline and 6 months, Wilcoxon signed ranks test.