

Can calorie restriction prolong life?

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During the last 20 years we have begun to lead less physically active lives and started to eat energy richer foods. These changes have led to an epidemic of being overweight, which is life shortening. Can this be controlled by calorie restriction and will it lead to prolongation of life?

There is much published evidence showing that calorie restriction (i.e. reduced energy intake) will extend the life of rats and many short-lived lower animals.^{1,2} This is a robust effect, confirmed repeatedly since its discovery in rats in 1935, and it is large. In the rat a 40% calorie restriction throughout life will extend both the mean and maximum life durations by 40%.

Will calorie restriction extend human life? It is very likely to do so, but it will be hard to prove. Such proof would require the restriction of energy intake of at least 100 people for over 100 years, starting in childhood. Today, there is almost no chance of organising such a trial. However, because of the current overweight epidemic, it is more likely that a medium term (10 to 20 years') study of the effects of energy restriction in overweight subjects could be undertaken in the near future.

We do know that calorie restriction reduces body weight, blood pressure and cholesterol, which are risk factors for cardiovascular disease in humans,^{3,5} and for this reason alone it should extend human life. There is, however, much conjecture about the prospects for retarding ageing and prolonging life by dietary restriction.⁶

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Calorie restricted populations

There are many populations of people in Africa and Asia who are energy restricted but have short life expectancies because they are restricted also in essential nutrients, such as proteins, minerals and vitamins. A calorie restriction is needed without malnutrition. In this regard, people living on the islands of Okinawa, south of Tokyo, are consuming 40% fewer calories than the average American.⁷ They are short in stature and live four years longer than Americans, due mainly to their lower mortality from heart disease and cancer. When Okinawans migrate to the USA they acquire both the lifestyle and mortality of the Americans. It is likely that aspects of the lifestyle of the Okinawans (their low energy intake; diet of whole grains, vegetables, fruit, soy and omega-3 rich fish; exercise levels; and philosophy of life) are responsible for their reduced mortality and longer life. Thus, calorie restriction is but one of a number of factors that may be extending the life of these people.

Trials of calorie restriction

During World War II most European populations were semi-starved and reported to have diminished cardiovascular disease as a consequence. In the late 1940s the six-month Minnesota starvation study of Keys and colleagues investigated the effects of a severe reduction of 30% in food and calorie intake resembling that of some European countries just after World

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Figure. A healthy diet should be encouraged from early childhood.

War II.³ This diet lowered body weight and both systolic and diastolic blood pressures, which increased when food restriction stopped. At the end of the study the subjects were showing clearly the effects of malnutrition, such as lethargy, mental confusion, physical weakness and peripheral oedema.

In the 1990s two significant studies in healthy adults showed that long term 20% calorie restriction without malnutrition reduced some risk factors for cardiovascular disease. Ten weeks of 20% calorie restriction lowered body weight and blood pressure and improved the lipid profile in a Dutch study.⁴ The most comprehensive study of calorie restriction in a human population was carried out in the USA over two years in eight healthy non-obese non-smoking adults who were subjected to 20% calorie restriction.⁵ Their diet comprised 25 varieties of vegetables plus fruits, nuts, grains and legumes with small amounts of dairy, eggs and meat. Longitudinal studies revealed 20% or greater reductions in body weight, blood pressure, white cell count, insulin, blood sugar, cholesterol and most other variables studied. Low body temperature, a sign of increased life expectancy, was also observed. All subjects remained healthy throughout the study. Thus it is clear that long term human calorie restriction can retard many age-related changes, but to date there is no direct evidence that calorie restriction will extend life.

GETTY IMAGES

The overweight epidemic

During the last 20 years a more sedentary lifestyle coupled with overeating in most countries has resulted in an epidemic of overweight and obesity, which are life shortening.^{8,9} In countries like Australia and the USA more than half the adult population and a quarter of children are now overweight. Being overweight increases the risk of cardiovascular disease, type 2 diabetes, hypertension, stroke, dyslipidaemia and some cancers, and as a result reduces life expectancy.^{8,9} Signs of these changes are evident in childhood.

Life-long calorie restriction to delay age-related diseases

Life-long calorie restriction should delay the onset of the killer diseases of man in middle and old age. Since rodent studies clearly show that the effect of calorie restriction is greatest if started early in life,¹ the change to a healthier lifestyle of eating low calorie foods (low energy, high fruit and vegetable diets) and performing more physical exercise should be started in childhood. The healthy lifestyle established in childhood should then be maintained throughout life to delay the onset of cardiovascular disease, diabetes and some cancers in middle and old age.

Unfortunately there are many environmental factors that influence our choice of foods and our exercise routine. These include the television advertising of high-energy foods, high prices for vegetables and fruit, low prices for high-energy processed foods, growth in the availability and use of labour saving devices, increased use of cars and more time spent viewing television.^{8,10} It will be very difficult to reduce our energy intake with all the promotion pushing us to consume more high-energy processed foods and remain physically inactive.⁸

What can the doctor do?

'Prevention' is the key word. The medical profession must slow the epidemic of overeating and becoming overweight

by education, early detection and appropriate treatment.^{8,10} GPs should:

- advise most patients to reduce their intake of high-energy foods (e.g. fast foods and sweet soft drinks) while maintaining normal nutrition (including eating more fruit and vegetables)
- refer patients to a dietitian where appropriate
- advise increased physical activity.

These principles should be applied also to slow down the increasing incidence of overweight children.

Risk factors for chronic diseases should be screened in young people. Practice nurses can help to educate patients to manage risk factors and achieve treatment targets. Leaflets describing the dangers of being overweight and how to reduce calorie intake should be distributed to all patients.

In recent papers, Catford and Caterson⁸ and Campbell¹⁰ say that it is time for the medical profession to take the lead in advocating prevention of overeating and being overweight. However, success will come only from a co-operative effort from all segments of society, including public health programs and government legislation to restrict the advertising of high-energy fast foods.¹⁰ The effect of eating high-energy processed foods can be likened to that of smoking cigarettes. They both increase the risk of cardiovascular disease and cancer, and shorten life.

Conclusion

Because of our sedentary lifestyle, most of us now overeat. This leads to people being overweight and having an early onset of the chronic diseases of ageing, and it shortens life expectancy.

A two-year study of healthy adults clearly showed that energy restriction will reduce body weight, blood pressure and cholesterol, risk factors for cardiovascular disease, the major cause of death in later years. It is well known that long-term calorie restriction extends the life of many lower animals and is more effective if

started early in life. Thus, a healthy lifestyle of reduced energy intake and increased physical activity developed in childhood and maintained throughout life should delay the onset of the diseases of old age and prolong life. MT

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