The obesity epidemic: both energy intake and physical activity contribute

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Recent data from Australia, the United States and Europe show increased self-reported energy intake associated with obesity, in contrast to earlier suggestions that the obesity epidemic has occurred despite minimal or no increase in per capita energy intake from food. The effect of increased energy intake is compounded by sedentary lifestyles. Both physical activity and nutrition must be addressed to reduce the prevalence of obesity and improve the health of Australians. **(MJA 2004; 181: 489-491)**

During the past decade, several authors from the United States and the United Kingdom have suggested that the obesity epidemic has occurred despite minimal or no increase in per capita energy intake and/or energy from the food supply.[1,2] This has been described as the "American paradox",[2] and cited as evidence that the obesity epidemic is due to decreased physical activity and not to changes in eating patterns.[3]

There are dangers inherent in this viewpoint. According to the International Obesity Taskforce (IOTF), the food industry seeks to focus on inactivity and promote sports to divert attention from the role of foods and drinks.[4,5] The IOTF asserts that the causes of the obesity epidemic are twofold: an abundance of energy-dense foods and drinks, leading to a pervasive "passive over-consumption" of energy; and an environment that limits opportunities for physical activity, leading to an almost universal sedentary state.[4]

Energy intake

Trends in energy consumption are difficult to establish because of a variety of measurement issues. People under-report their energy intake, and higher BMI is associated with a greater degree of under-reporting.[6] This introduces a systematic bias, resulting in the paradoxical observation that obese individuals appear to eat less than lean people. Techniques have been developed to reduce this bias by excluding the most blatant under-reporters.

The Australian Food and Nutrition Monitoring Unit undertook a bridging study to compare the food and nutrient intake data from the 1983 and 1995 Australian national nutrition surveys and the 1985 Australian Council for Health, Physical Education and Recreation (ACHPER) study.[7] For these studies, energy intake was estimated from 24-hour intake and food frequency data, collected by dietitians at in-home interviews. After adjusting for differences in the food composition databases and demographic changes in the Australian population, the study found that mean energy consumption of Australian adults living in capital cities increased significantly by around 3%–4% (about 350 kJ/day) between 1983 and 1995.[7] Between 1985 and 1995, mean energy intake increased greatly and significantly by 11% for girls and 15% for boys aged 10–15 years. The major source of increased energy intake was carbohydrate. Absolute fat intake did not increase among children, and declined slightly among adults.[7] Fat as a percentage of energy decreased because of the increase in energy intake.

An energy imbalance of 3%–4% in adults (about 350 kJ/day, equivalent to a slice of bread, or 30 minutes of sitting instead of brisk walking) would produce weight gain of about 1 kg per year until equilibrium is again reached, when the higher energy expenditure at a higher body mass equals energy intake.

The Australian intake data are supported by recent data from the US. A significant increase in total energy intake between 1971 and 2000, particularly from carbohydrate, has been reported in the US, based on intake data from the National Health and Nutrition Examination Survey (NHANES).[8] Data on food supply in the US and Europe also indicate that energy supply has increased.[9,10]

In Europe, data from the MONICA study indicate that per capita energy supply correlates with prevalence of obesity.[10] In that study, trends in total energy supply per capita explained 41% of the between-population trends in BMI. Energy supply combined with prevalence of ex-smokers (who are more likely to be overweight) explained 69% of the between-country differences in change of prevalence of overweight.

An economic analysis of factors underlying the trends in obesity in the US found that the per capita increase in the numbers of restaurants accounted for 61% of the increase in BMI and 65% of the increase in the percentage of the population who are obese.[11]

Energy expenditure

Although it is not possible to measure energy expenditure at a population level, it has been suggested that population Total Daily Energy Expenditure (see Box) has declined.[1,2,12] However, all of these reviews rely on the argument, based on the UK data,[1] that energy intake has not increased and therefore energy expenditure must have decreased.

Objective analysis of Total Daily Energy Expenditure and Activity Energy Expenditure in free-living individuals is possible using doubly-labelled water techniques. A large review of objective studies of energy expenditure found that Resting Energy Expenditure, Activity Energy Expenditure and Total Daily Energy Expenditure are all substantially and progressively higher with obesity. For BMI categories ranging from < 25 to > 35 kg/m^2, Total Daily Energy Expenditure ranges from 9.5 to 13.5 MJ/day for women and from 12.9 to 17.5 MJ/day for men.[13] This contradicts the popular view that obesity is due to "low metabolism" and is maintained despite a low level of food intake. After adjustment for body size, energy expenditure of obese individuals is similar to that of lean individuals.

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Energy expenditure terminology

Total Daily Energy Expenditure is the amount of energy expended by an individual in one day. This is made up of Resting Energy Expenditure and Activity Energy Expenditure.

Resting Energy Expenditure is the energy expended by the body in the resting state to maintain itself and digest food. This is made up of Basal Metabolic Rate (energy expended in the rested and fasted state) plus the Thermic Effect of Food (the energy used in digesting food — estimated at ~10% of Total Energy Expenditure).

Activity Energy Expenditure is the energy expended by the body in movement, and is the only aspect of energy expenditure that is under conscious control. Activity Energy Expenditure makes up 20%–40% of Total Energy Expenditure, depending on activity level.

Physical Activity Level is expressed as the ratio of Total Daily Energy Expenditure divided by Basal Metabolic Rate.

Population body mass has increased, so population per capita Total Daily Energy Expenditure must have increased. Clearly, energy intake must also have increased to maintain energy balance. The recent studies quoted above, based on both food supply and self-reported intake data in the US, Australia and Europe, confirm this.

Physical activity

At an individual level, physical activity is clearly important for weight control. Physical activity is an effective adjunct to dietary management for weight loss and maintenance.[14] However, at a population level, measurement of physical activity relies on self-report and suffers from methodological difficulties similar to those for determining nutrition. Prospective observational population studies of the effect on body weight of physical activity measured at baseline are few and the results are inconsistent.[15-17] Physical inactivity appears to be both a cause and a consequence of obesity.

Many studies have shown that television viewing is associated with obesity, although this is independent of physical activity level.[18] However, it is very clear that a sedentary lifestyle is almost universal in developed societies, and that this is related to physical, technological and economic environmental conditions.[19]

In Australia, population surveys suggest that the proportion of the population reporting undertaking 30 minutes of moderate physical activity daily has declined from 62% in 1997 to 57% in 2000.[20] However, there is now consensus that 45–60 minutes of moderate physical activity may be required for some people to prevent weight gain in the current environment of abundant energy-dense food.[15,17]

Relative contributions to obesity

Two longitudinal studies using objective measures of energy expenditure have attempted to determine the relative contribution of energy intake and expenditure to subsequent risk of obesity. In the first study, involving infants, measured energy intake determined weight gain between 3 months and 12 months, but measured energy expenditure did not.[21] The other study showed that, among Pima Indian adults, baseline total energy intake (calculated from energy expenditure measured by using doubly-labelled water) is a predictor of weight gain over 4 months or more.[22] However, baseline Activity Energy Expenditure and physical activity were not related to weight gain. As in many other studies, the physical activity level was lower in obese subjects, and the authors concluded that this was secondary to obesity.

Conclusion

An increase in energy supply and consumption has made a major contribution to the obesity epidemic. It is probable that population physical activity level has also decreased, as both a cause and a consequence of the obesity epidemic. There are many other benefits of physical activity and healthy eating besides weight management, and both physical activity and nutrition must be addressed together to improve the health of all Australians.

This requires multistrategy interventions across a range of sectors, including food producers, manufacturers, wholesalers, retailers, restaurateurs, caterers, transporters, advertisers, urban planners, employers, sporting associations, the fitness industry, community groups, the media, and policymakers at all levels of government, in addition to interventions in schools.

A national, coordinated, systematic approach to monitoring overweight and obesity, dietary intake and physical activity is essential to both inform and evaluate interventions. Key evidence-based interventions to address childhood obesity through improved nutrition and increased physical activity are outlined in the National Obesity Taskforce report *Healthy weight 2008 — Australia's future*.[23]

Competing interests

None identified.

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