Physical Activity and Health

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A gain in body weight results from a long-term imbalance between energy intake and energy expenditure. Apart from genetic factors, likely causes of overweight are reduced physical activity, excess energy intake, or both. Under conditions of energy need, the body metabolizes all available fuels and diet composition has no impact on the amount or rate of weight loss. In contrast, when energy is consumed in excess, it is disposed of according to an oxidative hierarchy. Whereas excess carbohydrate and protein promote their own oxidation, dietary fat does not. As a result, increased fat intake, typically associated with a consumption of a varied and energy-dense diet, can lead to increased fat storage. Physical activity can restore energy balance and so prevent weight gain. Though carbohydrate is an important fuel for exercise, its body stores are small in comparison to those of fat and protein. Carbohydrate consumption during intensive exercise, whether in liquid or solid form, optimizes exercise performance by virtue of sparing glycogen stores. In contrast, low intensity aerobic exercise increases the oxidation of fat and so contributes to weight control. Aerobic exercise can be maintained for long periods of time, in trained individuals, with fat oxidation proportionally increasing with time. As physical activity moves the energy equation in the direction of greater energy need, diet composition plays a lesser role. An exercise prescription together with a balanced diet is the key to shaping health habits, especially for adolescents.

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The development of obesity among children, adolescents, and adults is the combined outcome of a genetic predisposition, excess energy intake, and insufficient energy expenditure[1,2]. Studies on the development of human obesity have tended to emphasise potential genetic mechanisms as well as the macronutrient composition of the obese diet.

Population-based studies have addressed shifts in health and eating habits in the course of the nutrition transition and their relationship to the growing prevalence of childhood obesity worldwide[1]. Economic development in different parts of the world has been associated with a common transition from a staple carbohydrate-based diet to a more diverse eating pattern characterised by an increased proportion of milk, meat, dairy products and more vegetables and fruit. The emerging global diet is more energy-dense, more palatable, more varied, as well as higher in dietary sugars and fats.

Whereas much research on human obesity has focused on genetic and food intake variables, physical activity remains a neglected part of the energy equation. Yet, in every case, the nutrition transition has been associated with other marks of growing prosperity, notably urbanisation, motorized transport, and a more efficient food supply. As a result, growing exposure to energy-dense foods has been associated with declining physical activity and ever-lower levels of energy expenditure. While limiting energy intakes is a recognised component of dietary guideline, the benefits of physical activity have not always been made clear. Exploring the connections between changing dietary habits, physical activity and health is the focus of this review.

Energy Balance Equation

A gain in body weight results from a long-term imbalance between energy intake and energy expenditure. Apart from genetic factors, likely causes of overweight are overeating, inactivity or both. For inactive persons, diet composition can play an important role[2]. When food energy is consumed in excess, it is disposed of according to an oxidative hierarchy. Whereas excess carbohydrate and protein promote their own oxidation, dietary fat does not. As a result, carbohydrate and protein balance are maintained. In contrast, increased fat intake, typically associated with a consumption of a varied and energy dense diet, does not promote its own oxidation and leads to increased fat storage.

Epidemiological studies support a connection between high fat intake and obesity. Dietary fat, the most concentrated source of calories, promotes energy intakes, either by failing to suppress appetite, or by increasing the overall palatability of the diet[3]. High fat diets also reduce the thermic effect of food, that is the amount of food energy that is dissipated as heat. Studies conducted with 9- and 10- year old children[4] found a significant relationship between body fat and fat intakes, calculated as percent total energy. In contrast, body fat and carbohydrate consumption were inversely linked, even when sex, total energy intake, physical fitness and parental body mass were taken into account.

The fat content of the diet becomes less important under conditions of energy need. When energy intake is severely restricted, the body metabolises all available fuels equally, so that diet composition has no impact on the amount or the rate of weight loss. Expending more energy through increased

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physical activity is another way to create energy need. Greater energy expenditure can restore energy balance and so prevent weight gain, even with an energy-dense diet.

A sedentary lifestyle interacts with the fat content of the habitual diet. In a series of studies[5], measured energy intakes and energy expenditure, the latter measured either in respiratory chambers or using the doubly labelled water technique, of male participants consuming three different diets. The data showed that for low-activity participants positive energy balance was achieved for a diet containing no more than 25% of energy from fat. In contrast, highly active participants reached a positive energy balance on a diet containing as much as 54% of energy from fat. In other words, high levels of energy expenditure permit the consumption of a high-fat diet without the danger of weight gain[5]. It is the combination of inactivity and a high-fat diet that is most detrimental to health.

Physical Activity

Energy expended in the course of physical activity varies with the duration and intensity of exercise, and is affected further by body weight and fitness level. According to some reports, enhanced energy expenditure can continue even after exercise; high intensity weight-lifting was reported to elevate energy expenditure above baseline for several hours.

Most of the energy needed for sustained exercise is provided by the body fat stores. Though carbohydrate is an important fuel for exercise, its body stores are small in comparison to those of fat and protein. Carbohydrate consumption during intensive exercise, whether in liquid or solid form, optimizes exercise performance by virtue of sparing glycogen stores. Soft drinks and energy bars have become popular with athletes and are used to promote peak performance.

In contrast to high-intensity efforts, low intensity aerobic exercise increases the oxidation of fat and so contributes to long-term weight control. Aerobic exercise can be maintained for long periods of time, in trained individuals, with fat oxidation proportionately increasing with time. As sustained physical activity moves the energy equation in the direction of greater energy need, the fat content of the diet becomes less important. Cross country skiers and other endurance athletes regularly consume energy-dense diets without any risk of gaining weight. For optima health, any shift toward a high energy diet ought to be compensated for by a corresponding increase in physical activity.

Children and Physical Activity

Levels of physical activity among children in the US and other developed nations are low[6]. Increased physical activity is associated with higher energy intakes, coupled with lower body fat and a higher proportion of fat-free mass[7]. A recent study among 10 year old French children examined eating habits of active verses inactive boys and girls[8]. Activity patterns were determined by questionnaire completed by the parents and the child. The questions assessed daily activity (walking, running, cycling, skating) weekly activity (sports participation) or occasional activity (during holidays). On the average, the low activity group engaged in 11.6 h of activity per week , as opposed to 19.4 h for the active group. Boys were more active (15.3 h/wk) than girls (12.5h/wk).

More active children had higher energy intakes[8]. The 200 kcal difference was accounted for by a gain in carbohydrate intakes, including sucrose. Active children consumed more energy at breakfast and in the afternoon. Energy intakes at lunch and dinner were similar for the two groups. As in other studies, increase in physical activity was associated with lower percentage of energy from fat. Additional benefits of physical activity, apart from direct effects of exercise, might be related to a shift in eating habits toward energy-providing carbohydrate foods[8,9].

Physical Activity and Health

The traditional diet in the Gulf countries, consisting of rice, bread, milk, dates, vegetables and fish is gradually giving way to a diet containing more meat, dairy products, and other energy dense foods. The nutrition transition, both in the Gulf and elsewhere, has been associated with a corresponding shift in disease patterns, away from infectious disease and toward a greater prevalence of chronic illness, obesity and diabetes. Improved diet and better quality of life, together with better health services, have contributed to a major increase in life expectancy in the Gulf region[10].

However, low physical activity levels pose a problem for adolescent health. Cars, television, growing urbanisation and absence of exercise programmes in schools all contribute to an epidemic of inactivity. Public health policies and other initiatives, so often focused on dietary intakes, ought to take physical activity into account.

REFERENCES

1. Drewnowski A, Popkin B. The nutrition transition: new trends in the global diet. Nutr Rev 1997;55:31-43.
2. Ravussin E, Tataranni A. Dietary fat and human obesity.J Am Diet Assoc 1997;97:S42-S46.
3. Drewnowski A. Why do we like fat? J Am Diet Assoc 1997;97:S58-S62.
4. Tucker LA, Seljaas GT, Hager RL. Body fat percentage of children varies according to their diet composition.J Am Diet Assoc 1997;97:981-6.
5. Stubbs RJ, Harbron CG, Murgatroyd PR, et al.Covert manipulation of dietary fat and energy density:effect on substrate flux and food intake in men eating and libitum. Am J Clin Nutr 1995;62:316-29.
6. Schlicker SA, Borra ST, Regan C. The weight and fitness status of United States children.Nutr Rev 1994;52:11-17.
7. Davies PSW, Gregory J, White A. Physical activity and body fatness in pre-school children. Int J Obesity 1995;19;S6-S10.
8. Deheeger M, Rolland-Cachera MF, Fontvieille AM.Physical activity and body composition in 10 year old French children; linkage with nutritional intake? Int J Obesity 1997;21:372-9.
9. Trmeblay A, Almeras N. Exercise, macronutrient preferences and food intake. Int J Obesity 1995;19:S97-S101.
10. Musaiger AO. Diet-related chronic disease in the Arab Gulf states; the need for action. Ecol Food Nutr 1994;32:91-94. increase in physical activity.