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The skinny on fat

The World Health Organization (WHO) projects that by 2015, 700 million adults will be obese (http://www.who.int/en/). The prevalence of adults in the U.S. who are obese is still high, with about one-third of adults obese in 2007–2008, although new data suggest that the rate of increase for obesity in the U.S. in recent decades may be slowing (1). Studies have shown that being overweight or obese is associated with many diseases, many life threatening. Overall and abdominal obesity are associated with increased prevalence of periodontal disease (2). We are now finding that where the fat lies in the body may have significant impact on its pathogenic properties. This article will review some of the new findings in the area of fat and obesity.

Individuals tend to store fat in specific locations, and have been described as either apple or pear shaped to describe if the fat lies in the mid-section versus the abdomen or hips. Accumulation of fat in the abdominal area is associated with insulin resistance, diabetes, lipid disorders and atherosclerosis (3). There are many ways to provide an estimate of body fat such as body mass index (BMI), skinfolds, bioelectrical impedance and underwater weighing. However, these methods do not address the distribution of fat. A simple measure of waist circumference or the waist-to-hip ratio has great value in determining risk for heart attack and stroke (4).

Epidemiological studies indicate that being overweight or obese is associated with increased cancer risk. The most dramatic effect of obesity on cancer risk has been noted for a common form of liver cancer called hepatocellular carcinoma or HCC (5). Modelling the effect of obesity in mice, researchers have demonstrated that obesity is tumour-promoting and have obtained evidence that this effect depends on induction of low-grade, chronic inflammation. Obesity-promoted HCC development was reliant on enhanced production of the tumour helper cytokines IL-6 and TNF, which cause hepatic inflammation and activation of the oncogenic transcription factor STAT3. The chronic inflammatory response caused by obesity and enhanced production of IL-6 and TNF may also increase the risk of other cancers, according to the study authors. The key role of TNF is in the regulation of immune cells, but its deregulated production may cause diseases such as rheumatoid arthritis or Crohn's disease (5). Paradoxically while TNF was also tested for its ability to *destroy* cancer cells, its chronic production was found to actually *increase* tumour development (5).

Leukaemia cells, like other cancers, are dependent on glucose to generate their energy, but new research shows for the first time that these cells also rely on fatty acid metabolism to grow and to evade cell death (6). Inhibiting fatty acid oxidation makes leukaemia cells vulnerable to drugs that force them to commit suicide, or apoptosis. The study suggests that mitochondrial function and resistance to apoptosis in leukaemia cells are intimately linked with the entry of fatty acids into mitochondria. The results also imply that leukaemia cells are addicted to fatty acids for the function of the Krebs cycle and the prevention of cell death (6). The conclusions of this study may translate to new methods of controlling leukaemia and cancer cell metabolism by therapeutically targeting fatty acid oxidation. The authors are collaborating to develop drugs based on their research results.

Prevention and treatment

It appears that, given the prevalence of obesity in the Western and developing worlds, even a modest increase in cancer risk represents a major public health problem. Weight loss measures may be a way to combat this problem, as even modest weight loss can result in significant reductions in visceral fat and substantially improve health (7). As well, anti-TNF drugs, currently used in the treatment of chronic inflammatory diseases, may be used to prevent HCC development in obese men who suffer from chronic liver disease (5). New studies show that overweight and obese people using alli® (orlistat 60 mg) with a reduced calorie, lower-fat diet can significantly reduce weight, visceral fat, and waist circumference and may reduce their risk of type 2 diabetes, hypertension, heart disease, and stroke (8, 9). Alli® is a USA FDA-approved over-the-counter (OTC) weight loss aid that, according to their website, is clinically proven to boost weight loss by 50% and significantly reduce excess visceral fat. Working in the digestive tract, alli® prevents about 25% of the fat that a person eats from being absorbed (http://www.allihcp.com/default.aspx).

Researchers have discovered a molecular mechanism that controls energy expenditure in muscles and helps determine body weight, which could lead to a new medical approach in treating obesity (10). The energy-saving mechanism is controlled by ATP-sensitive potassium (KATP) channels. ATP, or adenosine triphosphate, is the energy currency utilized by cells in the body. These particular channels can sense ATP pools and regulate heart and skeletal muscle performance accordingly (10). Animals lacking this energy-saving mechanism burn more stored energy by dissipating more heat when at rest or when normally active. As in humans, excess energy from food is stored as glycogen or fat that could be converted into ATP according to energy demand. Eliminating the KATP channel forces the body to use energy less efficiently, consuming more and storing less gaining low weight, even when on a high-calorie Western diet (10). While mechanisms that preserve energy are naturally protective, such as in the event of food shortage or environmental stress, they promote obesity in a sedentary society. The study findings suggest that therapeutic targeting of the KATP channel function, specifically in muscle, could offer a new option for obese patients with lower capacity for exercise (10).

Based on new evidence that children and adolescents can be effectively treated for obesity, the U.S. Preventive Services Task Force recommends that clinicians screen children ages 6 to 18 years for obesity and refer them to programs to improve their weight status (11). This grade B*[2] recommendation recommends that clinicians screen children aged 6 years and older for obesity and offer them or refer them to comprehensive, intensive behavioural interventions to promote improvement in weight status. Interventions may include behavioural interventions alone, or combined pharmacologic and behavioural interventions. The task force reviewed 20 clinical trials of behavioural and pharmacologic interventions for obesity and found comprehensive, moderate to high intensity programs are effective at helping children improve their BMI (11). Comprehensive programs included three components: counselling for weight loss or healthy diet, counselling for physical activity or a physical activity program, or behavioural management techniques such as goal setting and self monitoring.

A science advisory was issued which reviewed and placed into context the potential health implications of overweight as distinct from obesity (12). Clarity on this issue is particularly important given the substantial proportion of the population in the overweight range. Although the advisory discusses the important issue of the BMI–total mortality relationship, it also broadens the topic to include other important considerations, such as outcomes above and beyond total mortality (12). The study mentions that the relationship between BMI in the overweight range and total mortality risk is controversial. There is evidence of an adverse relationship in some studies but not in others (12). It is critical to consider the overall risk status of patients regardless of BMI, with the realization that those with cardiovascular disease (CVD) risk factors, such as type 2 diabetes mellitus and systemic hypertension, are at particularly increased risk from excess weight and may well benefit from weight loss intervention as part of their treatment (13, 14).

Relation to oral health

The tridirectional relationship between periodontitis, diabetes, and obesity suggests that the dental visit may offer a largely untapped opportunity to screen for undiagnosed diabetes (15). To better examine this potential opportunity, data from the National Health and Nutrition Examination Survey (NHANES) 2003–2004 were used to determine if a larger proportion of patients with periodontal disease as compared with those without periodontitis would be recommended for screening according to American Diabetes Association (ADA) guidelines (15). The data were also used to determine whether at-risk individuals with periodontitis visited a dental professional recently, so that they could avail themselves of this opportunity for screening, if offered. As almost all individuals with periodontitis would have been recommended for diabetes screening, and many at-risk persons with periodontal disease recently visited a dental office, the data suggest that the dental visit provides an important potential venue for this screening (15).

There is increasing evidence of a relationship between periodontitis and several nutrition-linked chronic conditions, such as obesity, dyslipidemia and metabolic syndrome, with an accepted bidirectional influence between periodontal disease and each condition. An association between several dietary factors and the progression of periodontitis is relevant to this relationship (16). Thus, omega-3 fatty acids, vitamin C, lactic acid foods, soy products and a diet rich in vegetables and fresh food appear to be favourable for better periodontal health, whereas a lipid-rich diet may be detrimental to periodontal tissues (16).

New research shows that not all fat is equal. White fat, commonly known as bad fat, is how the body stores excess energy that accumulates when the body consumes more calories than needed. Brown fat actually burns excess energy to generate heat, such as in newborns and hibernating animals. New studies show that most adults have unexpectedly large and active

*http://www.ahrq.gov/clinic/3rduspstf/ratings.htm

deposits of this calorie-burning type of fat that biologists once thought disappeared after infancy. The persistence of brown fat suggests a potential new strategy to fight obesity. In addition to eating less and exercising more, people may one day be able to stimulate their bodies to dispose of stored energy, in the form of ordinary fat, purely as heat. According to an author of one study, the discovery is like finding a new organ (17). Brown fat's single physiological purpose is to expend energy, and is activated by temperature changes in the environment. In a baby, when the environment is cold, brown fat quickly begins producing heat, generated by mitochondria. Brown fat is an ideal target for drugs or other measures designed to make it more active. Some animal studies have looked at a pigment in brown seaweed, Fucoxanthin, as a potential anti-obesity agent (http://www.nutraingredients.com/Research/Brown-seaweed-extract-could-fight-obesity).

The prevention and treatment of overweight and obesity on a population-wide basis is a difficult task. Population-based strategies that improve social and physical environmental frameworks for healthful eating and physical activity are complementary to clinical preventive strategies and to treatment programs for those who are already obese. Better efforts to provide environmental interventions may lead to improved health and to future decreases in the prevalence of obesity in the USA and worldwide. Oral healthcare professionals, such as dental hygienists and dentists, can play an important role in this area.

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