The obesity epidemic in the US: impact upon coronary heart disease

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Introduction

The US is currently experiencing an epidemic of obesity which will impact upon rates of coronary heart disease (CHD) for decades to come. Overall rates of overweight and obesity, measured by a body mass index (BMI) of >25 and 30kg/m^2 respectively, stood at 65% and 32% in 2001.[1]

The impact of obesity on rates of CHD in a population is both direct and indirect. Obesity per se is a well-recognised independent risk factor for the development of CHD but also works through its mechanistic association with hypertension, hyperlipidaemia, insulin resistance and inflammation.[1] Rates of obesity are far higher in a population of patients with established CHD than in the general population. Data from two cardiac rehabilitation programmes in the US in Vermont and Boston, Massachusetts, have documented rates of overweight (BMI>25) from 75% to 88% and rates of obesity (BMI>30) from 36% to 53% in cohorts of patients with recently diagnosed CHD.[2] Yet, from a treatment point of view, clinicians and cardiac rehabilitation specialists have not yet succeeded in developing a systematic approach to the treatment of obese patients with CHD.

Table 1. Caloric intake and rates of obesity in the US

	1971	2000
Caloric intake (men) kcal/day	2,450	2,618
Caloric intake (women) kcal/day	1,542	1,877
Rates of obesity BMI>30kg/m^2	14.5%	30.9%

(Adapted from Wright et al[3])

Mechanisms of obesity

In the general population, and in the population with CHD, obesity occurs when there is a mismatch between caloric intake and caloric expenditure. In the general US population from 1971 to 2000, there was an increase in daily caloric intake of 335kcal/day for women and 168kcal/day for men[3] (see Table 1). Not only has there not been a concomitant increase in caloric expenditure to match the increased intake but rather, physical activity energy expenditure, the variable component of daily energy expenditure, has decreased, as we have engineered physical activity out of our daily lives.

Effects of obesity on coronary risk

Obesity exerts its effect on coronary risk, primarily through its aetiologic importance on the pathophysiology of the insulin resistance syndrome, also termed 'metabolic syndrome'. This is a cluster of risk factors related primarily to central or abdominal obesity (see Table 2). The National Cholesterol Education Panel Adult Treatment Panel III classification of metabolic syndrome requires the presence of any three of the following for its diagnosis:

- abdominal obesity (waist >102cm in men, 88cm in women);
- triglycerides >150mg/dl;
- HDL cholesterol <40mg/dl in men, <50mg/dl in women;
- high blood pressure (<130 systolic or >85 diastolic);
- or a fasting glucose of >110mg/dl.[4]

Table 2. Insulin resistance (metabolic) syndrome

Central obesity
Insulin resistance
Glucose intolerance/type 2 diabetes
Hypertension
Hypertriglyceridaemia/low HDL cholesterol
Small dense LDL cholesterol particles
Procoagulant state
Microalbuminurea

Metabolic syndrome also influences the development of CHD by its association with a procoagulant state, small dense low density lipoproteins, microalbuminurea and a generalised state of inflammation reflected by an increase in C-reactive protein.[5] The prevalence of metabolic syndrome in the general American

population is 24%, with a prevalence of over 40% in men and women in their 60s and 70s.[6] Thus, by age 60, almost half of the American population has a 'toxic' form of obesity that places them at a markedly increased risk for the development of atherosclerotic cardiovascular disease.

The data from the cardiac rehabilitation centre are yet more compelling as Milani et al found a 58% prevalence of metabolic syndrome in attendees with CHD.[7]

Lifestyle approaches to obesity in CHD patients

Cardiac rehabilitation/secondary prevention centres are an optimal site for the development of behaviourally-based programmes to initiate exercise and nutrition programmes to treat obesity in patients with CHD. Yet, overall, cardiac rehabilitation has been quite ineffective in producing substantial weight loss in coronary patients. In data from our own institution, we found that a three month programme of exercise three times per week, without a focused nutrition-behaviour component, was associated with only 0.5kg of weight loss overall.[8] Milani et al similarly found in a cohort of 136 patients with CHD and metabolic syndrome that a three month programme of exercise was associated with only 1kg of weight loss, although there were slight improvements in body fat (-1%), waist circumference (-2cm), C-reactive protein and blood pressure.[7]

We recently instituted a behaviourally-based weight loss programme in association with our cardiac rehabilitation programme. It is based upon theories of behaviour change not dissimilar from smoking cessation programmes and alcohol abstinence programmes.[9,10] In brief, patients are given a daily calorie goal that estimates a 500kcal/day deficit compared with weight maintenance nutritional requirements. Patients keep records of food intake and count calories using a pocket guide with guidance from a nurse coordinator during weekly meetings. Related topics such as stimulus control, dealing with high stress situations and relapse prevention are discussed at weekly 'troubleshooting' sessions.

In an initial cohort of 27 patients, we found that a mean weight loss of 5kg in this programme was associated with improvements in lipid levels and a 4cm decrease in waist circumference after a total of 11 weekly sessions.[11] There was a positive correlation between the number of sessions attended and the amount of weight loss. We have been disappointed, however, at the number of overweight patients in cardiac rehabilitation who have been uninterested in participating in this no additional cost programme that is part of our overall approach to secondary prevention.

As many overweight patients referred to cardiac rehabilitation seem unwilling or unready to participate in a behaviourally-based weight reduction programme, we have also taken the path of optimising the exercise component of cardiac rehabilitation as an adjunct to dietary restriction. Studies of classic cardiac rehabilitation exercise programmes have documented a surprisingly low exercise-related energy expenditure for thrice-weekly exercise programmes. Studies by Schairer et al[12] and Savage et al[13] documented that CHD patients in cardiac rehabilitation burn 720-800kcal/week during their supervised exercise sessions. In an effort to maximise weekly exercise-related energy expenditure, we performed a preliminary study in 21 obese CHD patients with a mean age of 62 years of age.[14] The study intervention consisted of relatively low intensity daily walking which gradually increased to 45 minutes and more of daily exercise. Dietary intake was kept stable. The exercise intervention was associated with an increase in daily physical activity energy expenditure from 800kcal/week to 2,600kcal/week; thus, we were able to increase weekly energy expenditure by 1,800kcal without any associated morbidity. This four month intervention resulted in 4.6kg of weight loss and associated metabolic benefits, without any alteration of dietary intake (see Table 3).

Table 3. High caloric exercise in obese coronary patients.

	Pre-intervention	Post-intervention	p value
Weight (kg)	94.7	90.1	<0.0001
BMI (kg/m^2)	31.0	29.8	<0.0001
Waist (cm)	109.0	103.6	<0.0001
Fat mass (kg)	27.0	23.4	<0.0001
Triglycerides (mg/dl)	233	177	0.04
Cholesterol/HDL-C	5.6	4.8	0.03
Insulin (IU)	13	10	0.03

(Adapted from Savage et al[14])

Summary

The obesity epidemic in the US is related to a mismatch between caloric intake and energy expenditure in a complex socio-cultural environment. The prevalence of obesity continues to increase in the US both in adults and in children and similar trends are being seen around the world.

While the prevention of obesity will require a multipronged public policy approach, the medical community will be called upon to treat the consequences of obesity for decades to come. Cardiac rehabilitation and secondary prevention programmes are faced with a markedly increased prevalence of patients with obesity and CHD.

It is our challenge to develop a medical approach that evolves from just treating the consequences of obesity with lipid drugs, blood pressure drugs and hypoglycaemic agents towards an approach that treats the primary disorder with lifestyle treatment programmes.

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