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# Metabolic Syndrome

Discussion paper prepared for

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Prepared by:

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Dr. David Fitchett received his medical degree in 1970 and completed post-graduate training in cardiology at Cambridge University in Britain. In 1978, he joined the Faculty of Medicine at McGill University where he became Director, Cardiology Intensive Care Unit and Medical Director Cardiac Transplantation. In 1997, he was appointed to the Division of Cardiology at St Michael's Hospital in Toronto, where he was Director of the Cardiac Intensive Care Unit for 11 years. His areas of interest are in acute coronary syndromes and in the prevention of cardiovascular disease in patients with cardiometabolic disease (including diabetes). He has published widely in these areas. Dr. Fitchett is currently a Staff Cardiologist at St Michael's Hospital and Associate Professor of Medicine at the University of Toronto.

This medical discussion paper will be useful to those seeking general information about the medical issue involved. It is intended to provide a broad and general overview of a medical topic that is frequently considered in Tribunal appeals.

Each medical discussion paper is written by a recognized expert in the field, who has been recommended by the Tribunal's medical counsellors. Each author is asked to present a balanced view of the current medical knowledge on the topic. Discussion papers are not peer reviewed. They are written to be understood by lay individuals.

Discussion papers do not necessarily represent the views of the Tribunal. A vice-chair or panel may consider and rely on the medical information provided in the discussion paper, but the Tribunal is not bound by an opinion expressed in a discussion paper in any particular case. Every Tribunal decision must be based on the facts of the particular appeal. Tribunal adjudicators recognize that It is always open to the parties to an appeal to rely on or to distinguish a medical discussion paper, and to challenge it with alternative evidence: see *Kamara v. Ontario (Workplace Safety and Insurance Appeals Tribunal)* [2009] O.J. No. 2080 (Ont Div Court).

### METABOLIC SYNDROME: A Marker of Increased Risk for Diabetes and Coronary Heart Disease

Metabolic syndrome is one of several patterns of increased risk for both diabetes and coronary heart disease. It is not a disease, but is a cluster of risk factors that occur commonly together and are associated with a 2-3 fold increased risk for heart attack or stroke(1) and a 5 fold risk for progressing to diabetes, if not already present. Classical risk factors for coronary heart disease and stroke include increased cholesterol, high blood pressure, smoking, and diabetes. Metabolic syndrome, as an additional risk is an important concept, because of the rising prevalence of obesity related cardiovascular disease and diabetes. Abdominal obesity is central to metabolic syndrome, and definitions of metabolic syndrome have generally included abdominal obesity as one component. The most recent definition of metabolic syndrome (table 1) requires abdominal obesity with other secondary components such as high blood pressure, high blood triglycerides, low HDL cholesterol and abnormal sugar metabolism.

Table 1: International Diabetes Federation Definition of Metabolic Syndrome 2004

<b>Central adiposity (waist circumference)</b>		
	<b>Men</b>	<b>Women</b>
• Euroid*	>94 cm	> 80 cm
• South Asian**	>90 cm	> 80 cm
• Chinese	>90 cm	> 80 cm
• Japanese	>85 cm	> 90 cm

**PLUS 2 or more of the following:**

- Triglycerides  $\geq 1.7$  mmol/L
- HDL  $< 0.9$  mmol/L (men) or  $< 1.1$  mmol/L (women)
- Blood pressure (systolic  $\geq 130$  mm Hg or diastolic  $\geq 85$  mm Hg) or antihypertensive treatment
- Fasting plasma glucose  $\geq 5.6$  mmol/L OR pre-existing diabetes OR impaired glucose tolerance

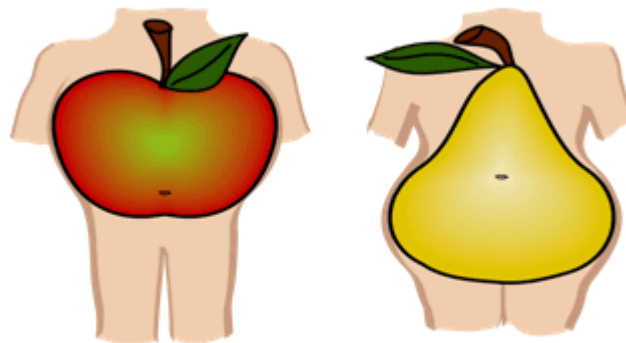
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### Abdominal Obesity and Risk for Cardiovascular Disease and Diabetes

Body mass index (BMI) is a measure of body fat based on height and weight that applies to adult men and women. Overweight (body mass index (BMI) 25-30) and obesity (BMI > 30) are independent risk factors for cardiovascular disease and mortality(2;3). Measures of abdominal obesity, such as waist circumference predict cardiovascular risk and the development of diabetes better than BMI alone. Dr Jean Vague first described the association between abdominal obesity (apple shaped (figure 1)) with cardiovascular disease and diabetes. In contrast, pear-shaped or lower body female obesity has a much lower risk for either condition. The metabolic syndrome results from an interaction between genetic susceptibility and lifestyle, and is frequently expressed when a susceptible individual gains weight (figure 2). It has been estimated that 20%-40% (or more in some populations) of people have the genetic susceptibility. Consequently the number of individuals with metabolic syndrome

Figure 1: Central Abdominal Obesity as compared to Lower Body Obesity



Adapted from Kingma J, Franco, Blvd (1667) 902-906-906

is huge. In the US today, it is estimated that almost half the population over 60 years of age meet criteria for metabolic syndrome. The prevalence of obesity increased by 61% between 1991 to 2000, and is projected to increase a further 80% over the next 20 years (International Obesity Task Force Report 2003), such that 45% of the US population will be obese (not just overweight) by the year 2025. In Canada a Stats Canada report from 2005 stated that 23% of Canadians are obese compared to 14% 25 years beforehand. Teenage obesity

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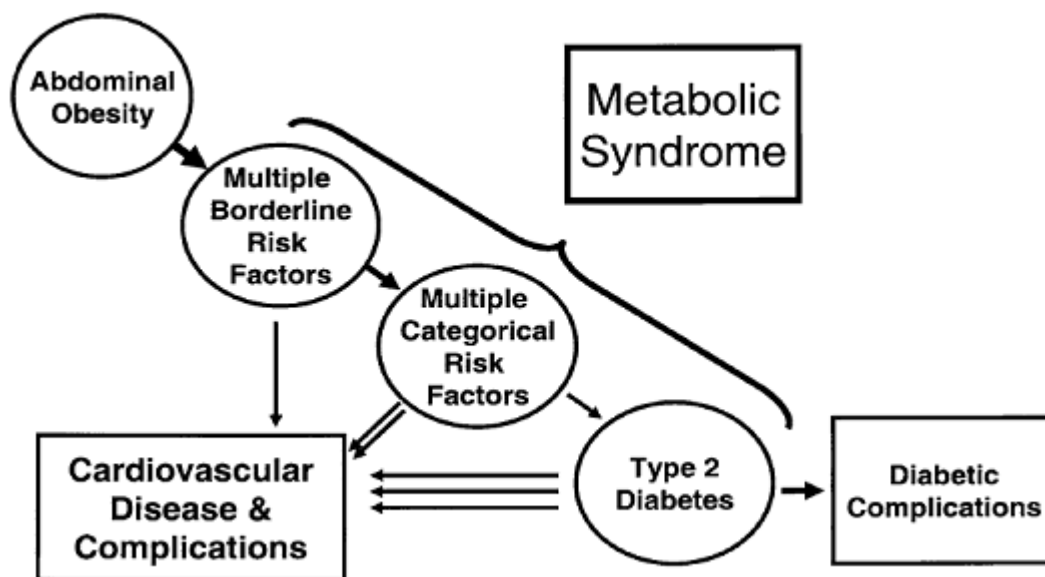
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doubled from 14 to 29% between 1978 and 2004. As the prevalence of diabetes is related to the prevalence of obesity, it is likely that the prevalence of metabolic syndrome will follow the same relationship. The consequences of this enormous increase in metabolic syndrome and the development of coronary heart disease and diabetes will be huge public health challenge.

However, not all patients with increased waist circumference have features of metabolic syndrome. Furthermore type 2 diabetes can develop in individuals without abdominal obesity and with the other metabolic abnormalities and high blood pressure. Consequently the optimal definition of metabolic syndrome has remained controversial. The IDF (International Diabetes Federation) definition shown in table 1 is perhaps the most useful as it emphasizes the role of abdominal obesity, which is a therapeutic target. Weight loss and increased physical activity have been shown to substantially reduce the risk for diabetes.

Metabolic syndrome can be considered to be a "pre-diabetic state". It is well recognized that individuals who develop diabetes are at a substantial risk for cardiovascular disease long before the blood sugar levels are high enough to make a diagnosis of diabetes. People with pre-diabetes (abnormal blood sugar either fasting or after a standard dose of glucose) have a 50% greater chance of developing coronary disease than individuals with normal blood sugars. By the time diabetes is diagnosed coronary disease is established in a significant number of individuals. Subjects in the Nurses Health Study who subsequently developed diabetes had a 3.7 fold greater risk for heart attack prior to the

Figure 2: Progression and Outcomes of the Metabolic Syndrome



## Metabolic Syndrome

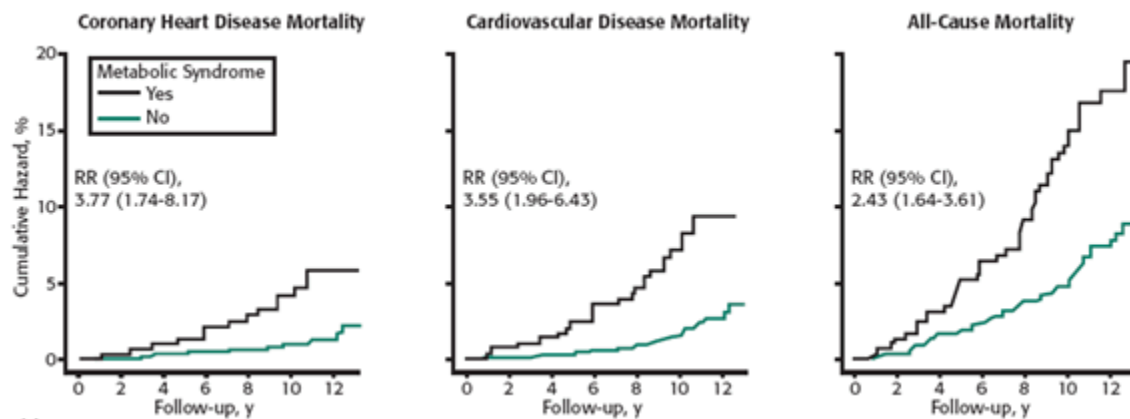
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diagnosis of diabetes and 4.6 fold greater risk after the diagnosis of diabetes than subjects who did not develop diabetes(4). Consequently the time for intervention is early and before high risk individuals have developed additional risk factors such as hypertension. This is especially relevant with the current epidemic of childhood obesity and the associated increase in the prevalence of type 2 diabetes in young people.

## Cardiovascular Risk and Metabolic Syndrome

The presence of metabolic syndrome is associated with a 2-4 fold increased risk of coronary heart disease and cardiovascular disease, independent from the presence of diabetes (figure 3). The risk is higher the greater the number of metabolic syndrome components present.

Figure 3: Coronary heart disease mortality, cardiovascular mortality, and all-cause mortality in men with and without the metabolic syndrome(5)



## Identification of Metabolic Syndrome

Evaluation of risk for heart attack and stroke should include the identification of the classical risk factors (age, gender, family history of premature cardiovascular disease, hypertension, high LDL (Low-density lipoprotein) cholesterol, low HDL cholesterol, diabetes and smoking history). In addition, identification of features of metabolic syndrome should be part of the general assessment. Measurement of waist circumference is recognized as an important component of the physical examination. For adult patients that are either overweight (BMI > 25 kg/m<sup>2</sup>) or obese (> 30 kg/m<sup>2</sup>) or who have a waist circumference exceeding the limits associated with metabolic syndrome (ethnic criteria shown in table 1) fasting blood sugar, and triglycerides should be measured.

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### Management of Cardiovascular Risk

Healthy lifestyle that includes weight reduction, increased physical activity and a heart-healthy diet) should be promoted for all individuals. Informing the patient of the threat of diabetes and cardiovascular disease will often motivate change. Weight reduction should for a 10% weight loss. Such a weight loss will result in a 50% reduction of intra-abdominal fat(6). However even smaller weight losses (~6.5%) can result in substantial reductions of blood glucose, triglycerides, total cholesterol and blood pressure.(7) Increased physical activity should be encouraged with at least 30 minutes of moderate intensity activity each day. A recent study in subjects with metabolic syndrome shows that a small amount of moderate intensity exercise (equivalent to walking approximately 19 km/week) was better than either inactivity or a small amount of high level intense exercise (8). This study supports the recommendation for patients at risk to participate in 30 minutes walking daily. Complete smoking cessation should be encouraged in all patients. Dietary advice should not only target weight loss but also improve the consumption of "heart-healthy" foods and avoidance of highly processed, energy dense food of poor nutritional value.

### Impact of Metabolic Syndrome on Employment and Disability

Metabolic syndrome is closely related to obesity. Consequently the impact of metabolic syndrome on cardiovascular disease and diabetes cannot be isolated from the overall impact of obesity on a wide range of medical conditions. Obesity is associated with a wide range of medical conditions that include diabetes, gall bladder disease, cardiovascular disease (including hypertension, stroke and heart attack, some types of cancer, arthritis, and back pain). Metabolic Syndrome causes chronic disability as a result of the clinical manifestations of cardiovascular disease, heart failure and angina, from vascular dementia and from catastrophic sudden strokes. Cardiovascular disease kills, and is the major cause of premature death in most countries. In addition it is also a major source of chronic disability.

Obesity is not only a hazard to the individual, but also to care givers. Lifting or moving obese patients is a major cause of disability for nursing staff. Obese individuals are at increased risk during an emergency as they may not be able to escape fire through emergency exits. When involved in a motor vehicle accident an obese individual is twice as likely to die as a lean individual, not only because of the increased forces due to the heavy weight and the relative inefficacy of seat belts, but also due to underlying health problems, and difficulties extracting the individual from the wreckage.

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Obesity can lead to discrimination, lower self-esteem and less job opportunities. Obese workers may be misconceived as less intelligent, lacking personal discipline, lazy and less productive. Obese individuals are 15-20% less likely to be employed than the non-obese.

Obese individuals are more likely to be involved in work related injuries of all types. In a recent study(9) of 7690 workers, of whom 29% had work related injuries of any type over a 2 year period. 85% of those injured were either overweight or obese.

Sedentary occupations are associated with a greater incidence of obesity and consequently metabolic syndrome. Individuals with musculo-skeletal injuries (particularly with back pain) are at high risk of increasing obesity. However obesity also contributes to back, hip and knee pain. Thus injury in an obese individual may exacerbate obesity and the development of both diabetes and eventual cardiovascular complications. Consequently obesity and metabolic syndrome can delay the return to work after an injury. In addition obesity is associated with a greater degree of workplace absenteeism and health care costs(10).

## Conclusions

Metabolic syndrome with associated abdominal obesity is a major cause for coronary heart disease and stroke. Cardiovascular disease results in substantial disability and sick leave as well as being the largest cause of mortality during the most productive years. Obesity is also associated with a wide range of conditions that further cause disability and work-place absenteeism.

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