Chapter 1
The Metabolic Syndrome

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Abstract
Cardiovascular risk factors have a tendency to co-aggregate. One of the
most well studied of these co-aggregations is the overlap between insulin resistance,
obesity, hypertension and dyslipidaemia, now labelled as metabolic syndrome.

Although metabolic syndrome is multifactorial, there is a growing belief that
visceral obesity may play an important role in the development of the syndrome.
More recently, adipocyte hypertrophy is also getting much attention.

Susceptibility to the metabolic syndrome encompasses genetic factors and envi-
ronmental conditions during early life, including intra-uterine time. Environmental
factors, namely related with lifestyles – oscillation between work and rest, sleeping
time, quality and quantity of food and meal schedule, social organization, level
of stress and physical activity, play a paramount role in its causation and pro-
gressive development of superimposing vicious cycles. The consequences of the
syndrome are many, with relevance to cardiovascular disease and diabetes. The pro-
portion of affected people in the present world, together with the diverse nature of

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associating/causative factors, warrants a highly committed multidisciplinary effort from the whole society to deal with the problem.

**Keywords** Cardiovascular disease · Diabetes · Lifestyle · Metabolic syndrome · Stress

### 1.1 Concept and Components of the Metabolic Syndrome

Cardiovascular diseases are the leading cause of death worldwide, accounting for half of all deaths in middle age and one-third of all deaths in old age in most developed countries (World Health Organization 2007).

Cardiovascular risk factors have a tendency to co-aggregate across individuals and societies. One of the most well studied of these co-aggregations, difficult to disentangle, is the overlap between insulin resistance, obesity, hypertension and dyslipidaemia (Ogden et al. 2007; Rana et al. 2007; Shoelson et al. 2007). It has been recognized for several decades that individuals with insulin resistance often have hypertension, obesity and/or dyslipidaemia, and this cluster is also related with type 2 diabetes (Wingard et al. 1983). This risk factor clustering and its association with insulin resistance led to the proposal of a unique pathophysiological entity (Stern and Haffner 1986) now labelled as metabolic syndrome.

The metabolic syndrome, recognized as a major cause of type 2 diabetes and cardiovascular diseases, has become one of the major public health challenges worldwide (Eckel et al. 2005; Caterson et al. 2004; Galassi et al. 2006). The concept of a clinical entity composed by a constellation of metabolic disturbances was first proposed more than eighty years ago by Kylin, who described a cluster of hypertension, hyperglycaemia and gout (Kylin 1923). In 1947 Vague suggested that a particular obesity phenotype, then called android or male-type obesity, was associated with the metabolic disturbances seen in diabetes and cardiovascular diseases (Vague 1947). The concept of syndrome X was labelled by Reaven in (1988), but the term metabolic syndrome, now well-established, is currently considered a better description of the situation.

The diversity of features associated with this condition and the study of the problem by different associations led to a variety of definitions. All share the inclusion of the main features – glucose intolerance, obesity, hypertension and dyslipidaemia, but differ in details and criteria. The most widely recognized definitions of the metabolic syndrome are those from the World Health Organization (WHO) (World Health Organization 1999), the European Group of Insulin Resistance (EGIR) (Balkau and Charles 1999), the National Cholesterol Education Program, Adult Treatment Panel III (ATP III) (Expert Pannel on Detection Evaluation and Treatment of High Blood Cholesterol in Adults 2001), the International Diabetes Federation (IDF) (Alberti et al. 2006), and the American Heart Association and the National Heart, Lung and Blood Institute (AHA/NHLBI) (Grundy et al. 2005).