The link between behavioral factors and disease is not well-defined. Although connections between a fight-flight reaction to environmental stress and hypertension have been much discussed, a potential disease association to a defeat-type of reaction has been much less considered. This is characterized by an elevated activity of the hypothalamo-pituitary-adrenal (HPA) axis, which is difficult to measure over a sufficiently long period of time. There is now considerable evidence that the characteristic peripheral endocrine abnormalities following a chronic HPA axis activation is directing storage fat to central, visceral adipose tissue depots. This evidence comes from detailed molecular and cellular studies, clinical observation, and intervention trials, as well as from statistical associations between visceral fat accumulation and HPA axis activation in a number of conditions. Central fat accumulation, measured conveniently as the waist/hip circumference ratio (WHR), is therefore probably a surrogate measurement for a chronic or repeated activation of the HPA axis. The WHR consequently provides a possibility to examine connections between environmental factors resulting in a hyperactive HPA axis, which is a consequence of a defeat-type of reaction to perceived stress.

Such statistical associations have been examined in several population samples. The WHR has been found to be linked to a number of psychosocial and socioeconomic handicaps among both men and women, as well as to traits of psychiatric disease and use of alcohol and tobacco. Measurements of moderate obesity without WHR elevation often show reverse relations. It is suggested that measurements of central fat distribution such as the WHR may be used as a surrogate for chronic or repeated HPA axis activation, a consequence of a defeat-type of reaction to perceived environmental stress. This may provide a novel, convenient method to trace adverse bodily consequences of environmental stress leading to disease. This is also suggested by the fact that the WHR is now an established, unusually powerful risk factor for several prevalent diseases, which were previously suggested to have links to psychosocial and socioeconomic handicaps.
Key words: stress, cortisol, behavior, psychosocial factors, socioeconomic factors, central fat accumulation

REACTIONS TO PERCEIVED ENVIRONMENTAL THREAT ("STRESS")

Different species of mammals, as well as animals at lower developmental levels, transfer perception from the environment to bodily reactions. The senses register various noxious or threatening events and immediately, unconsciously orchestrate a series of defense mechanisms to counteract the perceived threat against the individual. Such reactions are necessary for survival and are therefore common for most species. The center for the coordination of such reactions, the hypothalamus, is localized to the lower part of the brain and is similar in both primitive animals and highly developed primates, including humans. It is essentially independent of the degree of sophistication of the superior cortical parts of the brain.

The counteracting mechanisms are of different natures, including adaptations of circulation, muscular contractions, and metabolism, mediated via nervous or endocrine reactions, tailored to meet the perceived threat or stress, and are often combined.

Several types of reactions to perceived stress are known. The most generalized and well-known are the fight-flight and the depressive reactions, described by authors such as Henry (Henry & Stephens, 1977). In the fight-flight reaction the organism is adapting mental, circulatory, and muscular systems to an alert or alarm situation with readiness for defense by fight and/or flight. This is supported by metabolic adaptations to meet the immediate need of energy from both carbohydrate and lipid sources in the form of glucose, from glycogenolysis, and from free fatty acids (FFA) from triglyceride stores. This is mediated mainly via activation of the central sympathetic nervous system. The endocrine counterparts are elevation of catecholamine secretion, and when the situation is under control, increased secretion of sex steroid hormones.

When the environmental stress is perceived as overwhelming, the fight-flight reaction becomes meaningless or impossible, and is replaced by a situation of defeat. The individual is now placed in a situation of helplessness and responds with a depressive reaction. With a sufficiently developed central nervous system, this is seen as mental depression. There is no need for muscular defense, and the circulatory adaptations are not those of the alert fight-flight reactions. The organism is instead adapting for survival purposes by saving available energy stores and making them more easily accessible for utilization. In terms of armed conflict, the fight-flight reaction is attack or retreat, whereas the defeat reaction is more similar to being subjected to a siege. The endocrine reaction is then characterized by adaptations of the hypothalamo-pituitary-adrenal (HPA) axis, which becomes hyperactive. Probably mainly as a consequence of this, both the growth hormone (GH) and hypothalamo-pituitary-gonadal axes are inhibited. These are teleologi-