Stress, brain and eating behavior

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ABSTRACT

The brain occupies a special hierarchical position in human energy metabolism. If cerebral homeostasis is threatened, the brain behaves in a "selfish" manner by competing for energy resources with the body. Need, supply, and demand are terms used in the field of economics and logistics. The stress response and the adaptation of the stress response influence our eating behavior is a central question in brain research and medicine.

Keywords: Physical exercise, Neurosurgery, Spine, Stress, Eating behavior.

TEXT

The brain occupies a special hierarchical position in human energy metabolism. If cerebral homeostasis is threatened, the brain behaves in a "selfish" manner by competing for energy resources with the body.[1-11] Peters and al.[1] demonstrated that stressed brains use a mechanism referred to as "cerebral insulin suppression" to limit glucose fluxes into peripheral tissue and to enhance cerebral glucose supply. Furthermore, psychosocial stress elicits a marked increase in eating behavior in the post-stress phase. According to the "Selfish Brain" theory, cerebral energy homeostasis has highest priority in human energy metabolism.[12] The pathologist Marie Krieger was the first to provide evidence that the brain behaves in a "selfish" manner.[13] She showed that the human brain mass is preserved during inanition, while all the organs of the body such as heart, liver, spleen, kidneys, and pancreas lose about 40% of their mass.[13] Exercising is used as a non-pharmacological treatment in many chronic diseases.[14-22] Exercise has been shown to have beneficial effects on brain functions in humans and animals and, therefore, exercise is particularly important for brain rehabilitation and remodeling.[23-35] The stress response and the adaptation of the stress response influence our eating behavior is a central question in brain research and medicine.[36-42] Highlighting recent advances and showing the close links between eating behavior, the stress system, and neurometabolism can be of enormous interest.[43-47] In the last two years, the mechanisms of brain pull have been better understood due to major scientific contributions. The brain pull functions to demand energy from the body. Two brain-pull mechanisms have been detected so far: first, allocative brain-pull mechanisms, which activate the SNS and the HPA axis to favor glucose allocation to the brain, as well as astrocytic mechanisms, which enhance glucose transport via GLUT1 through the blood-brain barrier.[36] Need, supply, and demand are terms used in the field of economics and logistics. We applied supply-chain principles and laws to further characterize the central and peripheral energy metabolism.[48-52] The supply-chain of the brain – with the central nervous system as the final consumer – describes the energy fluxes from the remote environment to the near environment, through the body, towards the brain. The supply-chain is branched, that means, it is possible to store energy in the side buffers like fat tissue, muscle, and liver. It is a general principle in economic supply-chains that the flux is determined by the supplier (push-component) and by the receiver (pull-component). In other words, the fluxes are regulated by supply and demand. In this connection, the "brain-pull" functions to demand energy from the body.[48] Therefore, continuous observation with daily clinical practice by physicians and surgeons, continuous scientific research and further discoveries can improve the knowledge of this topic.[53-62] These main findings presented in this human study indicate that the brain's need, supply, and demand are increased by stress. On this basis, these findings had been predicted by the "Selfish Brain" theory. Overweight and obesity are growing problems, with more attention recently, to the role of stress in the starting and maintaining process of these clinical problems. However, the mechanisms are not yet known and well-understood; and ecological momentary analyses like the daily variations between stress and eating are far less studied. Emotional eating is highly prevalent and is assumed to be an important mechanism, as a maladaptive emotion regulation (ER) strategy, in starting and maintaining the vicious cycle of (pediatric) obesity.[62] Debeuf et al.[59] stress the importance of looking into the daily relationship between stress and eating behavior parameters, as both are related with change over and within days. The activation-induced increase in cerebral lactate efflux measured over the same time period accounted for only a small fraction of the activation-induced excess glucose uptake. These data confirm earlier reports that brain activation can induce resetting of the cerebral oxygen/glucose consumption ratio and indicate that the resetting persists for a long period after cerebral activation has been terminated and physiologic stress indicators returned to baseline values. Activation-induced resetting of the cerebral oxygen/glucose uptake ratio is not necessarily accounted for by increased lactate production from nonoxidative glucose metabolism.[62] More research is needed to draw firm conclusion on the moderating role of ER strategies and emotional eating.

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