Allostasis and the Three Essentials for Health Care: A Reflective Article

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Abstract

The concept of allostasis has emerged as a key theoretical framework for understanding the body's adaptation processes in response to environmental challenges. Building upon the evolution of the homeostasis paradigm, this article reflects on how chronic stress, resulting from unhealthy lifestyles, can trigger allostatic overload with pathophysiological consequences such as chronic inflammation, neuroendocrine dysfunction, and behavioral impairment, thereby contributing to the development of non-communicable diseases and mental disorders. In this context, regular physical activity, a healthy diet, and good sleep quality are proposed as three essential habits for health care. These behaviors act as positive modulators of allostatic load, support physiological recalibration processes, and serve as fundamental pillars in any health promotion strategy. Finally, the article advocates for the integration of these three essentials into public policies and clinical practices, recognizing their structural role in sustaining both individual and collective health.

Keywords: allostasis, physical activity, healthy diet, sleep quality .

Based on the findings of Claude Bernard in 1865, Walter Bradford Cannon coined the term ***homeostasis*** to refer to the maintenance of acceptable ranges of physiological variables through mechanisms that preserve stability. This requires sensors that recognize discrepancies between detected values and previously established acceptable values, in order to activate the

action of effectors that reduce these discrepancies, configuring a negative feedback system (1). Although Cannon stated that there is a wide variety of emergency situations such as intense pain, bleeding or hypoglycemia, among others, it is now recognized that even in a state of rest and in activities of daily living, apparently stable states are altered and this generates coordinated response actions by different effector systems (2).

One of the concepts that emerges strongly in this context is ***stress***, understood as a perceived threat—either consciously or unconsciously—that poses a risk to homeostasis (3,4), triggering a response whose specificity depends on the type of challenge affecting homeostasis, how the organism perceives the stressor, and its capacity to cope with it (5).

Although the concept of homeostasis refers to a constant state of physiological variables, advances in health-related sciences have shown that the values considered acceptable are subject to interindividual variability inherent to the human population. For this reason, in 1988 it was proposed that stability could be achieved through dynamic adjustments in the acceptable ranges of these variables, giving rise to the concept of allostasis (6). Thus, the concept of allostasis was born.

To maintain or restore homeostasis, certain levels of physiological activity are required to enable the organism to sustain stability through change. In other words, the goal is to promote adaptive processes in response to environmental challenges (7,8). Adaptations resulting from allostatic responses to stressors are mediated by genetic, developmental, and experiential factors, and are initially effective, as they contribute to the organism's well-being and long-term survival (2). However, the prolonged, continuous, or intermittent activation of allostatic response effectors may lead to maladaptive recalibrations, which eventually wear down bodily systems, resulting in what is known as allostatic load (4).

The development of the stress–disease cascade model (9) has provided a useful theoretical framework for understanding how adaptive allostasis progresses toward maladaptive allostatic states, then toward allostatic load, and ultimately to allostatic overload. In this final stage, molecular and cellular changes occur as a result of accumulated damage and premature aging, which in turn promote the development of disease (10).

The 21st century faces a significant challenge from non-communicable diseases, which are responsible for nearly 18 million deaths worldwide before the age of 70 (11), as well as from mental disorders, which affected 970

million people globally in 2019 (12). These conditions often share a common etiology linked to chronic disruption in physiological regulation. This is because the systems responsible for responding to environmental challenges and lifestyle habits remain persistently activated due to repeated exposure to stress, which—if not properly managed—can lead to tissue damage, chronic inflammation, neuroendocrine alterations, and impaired behavioral self-regulation (13–15).

Recognizing that the most prevalent diseases today develop in organ systems worn down by prolonged exposure to stress resulting from unhealthy lifestyles, it becomes essential to identify practices that serve as positive modulators of physiological stress responses and promote adaptive recalibrations. Regular physical activity, a healthy diet, and good sleep quality are three essential lifestyle habits for maintaining health—not only due to their role in disease prevention, but also because of their direct impact on the internal regulatory mechanisms that sustain the organism's dynamic stability.

Regular physical activity plays a crucial role in modulating physiological responses to stress and in the development of adaptive allostatic processes. Recent studies indicate that higher levels of daily physical activity are associated with lower levels of physiological stress accumulation in the body. Furthermore, physical activity has been shown to reduce systemic inflammation and improve the functioning of the hypothalamic–pituitary–adrenal (HPA) axis, thereby contributing to better stress regulation (16–18).

When nutrition provides sufficient energy, is high in fiber, includes all macronutrients, is low in ultra-processed foods, contains healthy fats, is low in added sugars, includes a diverse range of foods throughout the day and week, and is adapted to cultural preferences, it has favorable effects on stress regulation, contributes to the reduction of systemic inflammation, and facilitates allostasis (19–22).

The third essential factor—equally important—is deep, continuous, restorative sleep aligned with circadian rhythms. When sleep is deprived, the body enters a state of chronic activation of the stress response system, characterized by heightened reactivity of the HPA axis to everyday stimuli. This hyperactivity is associated with persistently elevated cortisol levels, which contribute to disruptions in emotional regulation, a lowered pain threshold, and increased susceptibility to mood disorders (23–25).

In a world where chronic stress and unhealthy lifestyles gradually ero-

de the physiological foundations of human health, allostasis emerges as a robust theoretical framework for redefining healthcare. Regular physical activity, healthy eating, and good sleep quality should no longer be regarded as mere individual recommendations, but rather as structural components of any strategy aimed at health promotion and disease prevention. Investing in their promotion, ensuring equitable access, and integrating them into school, workplace, community, and clinical settings is not merely a technical option—it is a strategic, ethical, and necessary decision that should guide the development of public policies recognizing that caring for the body's dynamic balance is also caring for the sustainability of health systems, social productivity, and human dignity.

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