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Probiotics and resilience: relevance to 21st century consumers

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ABSTRACT

Resilience enables an individual to remain stable while exposed to and or to recover faster from a stressor. Recent advances in probiotic clinical trials have revealed that probiotics may help boost mood and cognitive function and lower stress and anxiety. This opinion article presents thoughts on evaluating clinically acceptable markers of resilience and focuses on probiotics as a potential effective intervention to promote resilience. Biomarker characteristics for identifying clinical relevance of a probiotic intervention for resilience via a Global Index is proposed.

Resilience is defined as thriving in the face of or the capacity to maintain homeostasis under adversity (1). Certainly, resilience has emerged as an important factor in navigating 21st century life in North America. Resilience enables an individual to remain stable while exposed to and or to recover faster from a stressor. The hypothalamic pituitary axis (HPA) is key in controlling the response to psychological stress and metabolic health (2). This re-directs us to "stress system resilience" in relationship to metabolism and the recognition of provision for maintenance of function despite perturbation. Adaptable psychological interventions have been considered in improving well-being and resilience in older adults (3).

Since human resilience, resistance and the ability to achieve homeostasis is a neurocognitive phenomenon, the ability of probiotics to influence the gut-brain axis to modulate emotion processing, emotion regulation and cognition control is not unexpected (Figure 1). The concept of resilience has been applied to the human gut ecosystem (4). While perturbations occur with illness and intake of antibiotics during child hood, the gut microbiota reaches a relatively stable functionality. Repeated stressors affect the colonizing microbiota however, research suggests that colonizing bacteria have the ability to recover from perturbations. The speed at which this recovery occurs is an indication of an individual's resilience. Since nutrition is an external challenge that can perturb normal physiological function or disrupt the gut ecosystem, food can be considered to have a beneficial effect if it can increase the resilience of the consumer to the challenge.

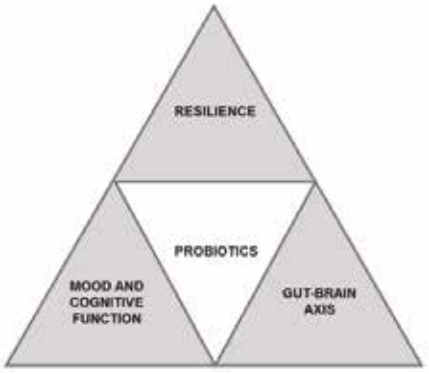

Figure 1. Probiotic intervention for resilience. Probiotics improve resilience by influencing gut-brain axis and modulating emotional processing and cognition control.

Recent advances in probiotic clinical trials have revealed that probiotics may help boost mood and cognitive function and lower stress and anxiety in patients with Alzheimer's Disease and fibromyalgia. Probiotics modulate gut microbiota composition imbalance by increasing favourable bacterial populations, improving gut epithelium barrier function and regulating cytokine production.

The current opinion article will focus on probiotics as a potential effective intervention to promote resilience.

Alpha-1 anti-trypsin, zonulin, p-GPL2, dual sugar and PEG permeability markers have been validated as markers of improved gut integrity (5). However, clinically acceptable markers of resilience are lacking (6). A statistical approach to measuring improved health has been previously proposed (7), according to which if a probiotic supplement minimizes the variation or fluctuation around the mean for a given biomarker, even in the absence of change in the mean, this could reflect improved health, with the assumption that the biomarker is physiologically relevant to health. Characteristics of a valuable biomarker would include: fluctuations of biomarker levels over time occur in response to stressors; tight control of the biomarker is physiologically advantageous. Such biomarkers may be used as the outcome measure in a gold standard randomized clinical trial, set up to test the hypothesis that consumption of the probiotic results in lower fluctuations in levels of the biomarker compared to the control. Importantly, intra-individual variation in biomarker levels will provide sufficient data to show efficacy of the probiotic and will therefore require small sample sizes compared to a study that tests probiotic supplementation to be associated with fewer healthy persons falling sick vs. a control.

Testing for an increase of positive emotions or an improvement in the ability to regulate positive emotions is essential. The emotional face Stroop paradigm, which assesses probiotic-induced differences in cognitive control when provided with emotional distractors, has been reported. fMRI showed a probiotic-induced decrease in amygdala activity suggesting that probiotic consumption resulted in participants experiencing less emotional conflicts

compared to the placebo group (8). Probiotic supplementation functions as a non-invasive strategy to prevent depressive feelings in healthy individuals and improve psychological wellbeing as measured by changes in mood, personality dimensions, and quality of sleep.

To gain advantage of a clinical trial that examines the effect of probiotics on resilience, it is important to identify several end-points and use an explorative statistical approach. For example, the study design may incorporate collection of fecal samples to determine the effect of microbial components. The primary outcome measure could be the change in a psychological profile assessed using a validated tool which provides an index of cognitive vulnerability to depression. Secondary outcomes should measure mood, sleep quality, temperament, coping strategies and mental wellbeing, components of a global index for probiotics.

Conducting clinical trials in resilience will enable the understanding of a new concept in which probiotics serve as the intervention. By ensuring a diverse and complex ecosystem, the gut microbiota plays a central role in health. While the traditional approach to studying probiotics has been to determine the recovery of the microbiota from perturbations, our current opinion is that the speed at which a person recovers from sickness or from stressors and returns to a state of health is equally important. Though it is not a novel concept, resilience in clinical trials does not depend on the measurement of a single biomarker but should be approached holistically through the measurement of a global index.

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