



## Perspective Article

# Physical Resilience: A novel approach for healthy aging

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## Abstract

Population aging is evident globally. The traditional model of care based on disease management is not sufficient to develop a generation of functional older adult population. The construct of Physical Resilience (PR) holds great potential to make the agenda of healthy aging a reality if we were to properly understand it and develop intervention strategies to maintain PR through life. There are several difficulties and challenges with this novel construct that need to be resolved through research, so as to foster its vast possibilities to maintain functional ability in old age.

**Keywords:** Aging, Functional ability, Healthy aging, Resilience

Aging is a gradual loss of physiological integrity which leads to multisystem functional impairment making an organism vulnerable to death<sup>1</sup>. In the 21<sup>st</sup> century, we have made tremendous progress in eliminating and treating many diseases leading to a dramatic increase in population aging that has never been experienced before<sup>2</sup>. However, not everyone can expect to live this extended lifespan in a robust and functional state. We need new approaches to identify individuals who are vulnerable to functional decline, so that we may develop suitable interventions strategies to avoid care dependency in old age.

In everyday medical practice, we see patients who despite having no underlying conditions recover poorly from a certain disease or a medical procedure. Whereas some patients although comparatively older or with a history of chronic diseases may even recover very well from a similar procedure. Such ability of an individual to recover or bounce back effectively (i.e., regain their functional ability) upon facing a stressor is referred to as physical resilience (PR)<sup>3,4</sup>. PR is a novel construct, although the concept of resilience has been widely used in various sectors from engineering to human health. The concept of PR differs from that of resilience as there is a need for a triad of stressor, system, and state to quantify PR<sup>5</sup>. For example, if we consider hip fracture as a stressor, the systems involved are the musculoskeletal and neurological systems, and the state is mobility. PR may be influenced largely by the underlying physiologic reserve of different systems and other factors including genetics,

disease, psychosocial factors and health behaviors. Whereas resilience is a term broadly used to describe the ability of an organism to resist or respond to a challenge<sup>6</sup> without any specific focus on the involved system. Resilience, in general, may be dominated by the psychosocial aspects of an organism while encountering a stressor<sup>7</sup>.

## PR, functional ability and healthy aging

PR is of interest to aging researchers and geriatricians as this construct particularly focuses on the recovery of functions. Function centered approach is now considered as the core of geriatrics<sup>8</sup>, as so, concepts such as PR may hold great potential to make “healthy aging” a reality. Healthy aging is the process of maintaining optimum functional ability leading to well-being in old age, i.e., older individuals

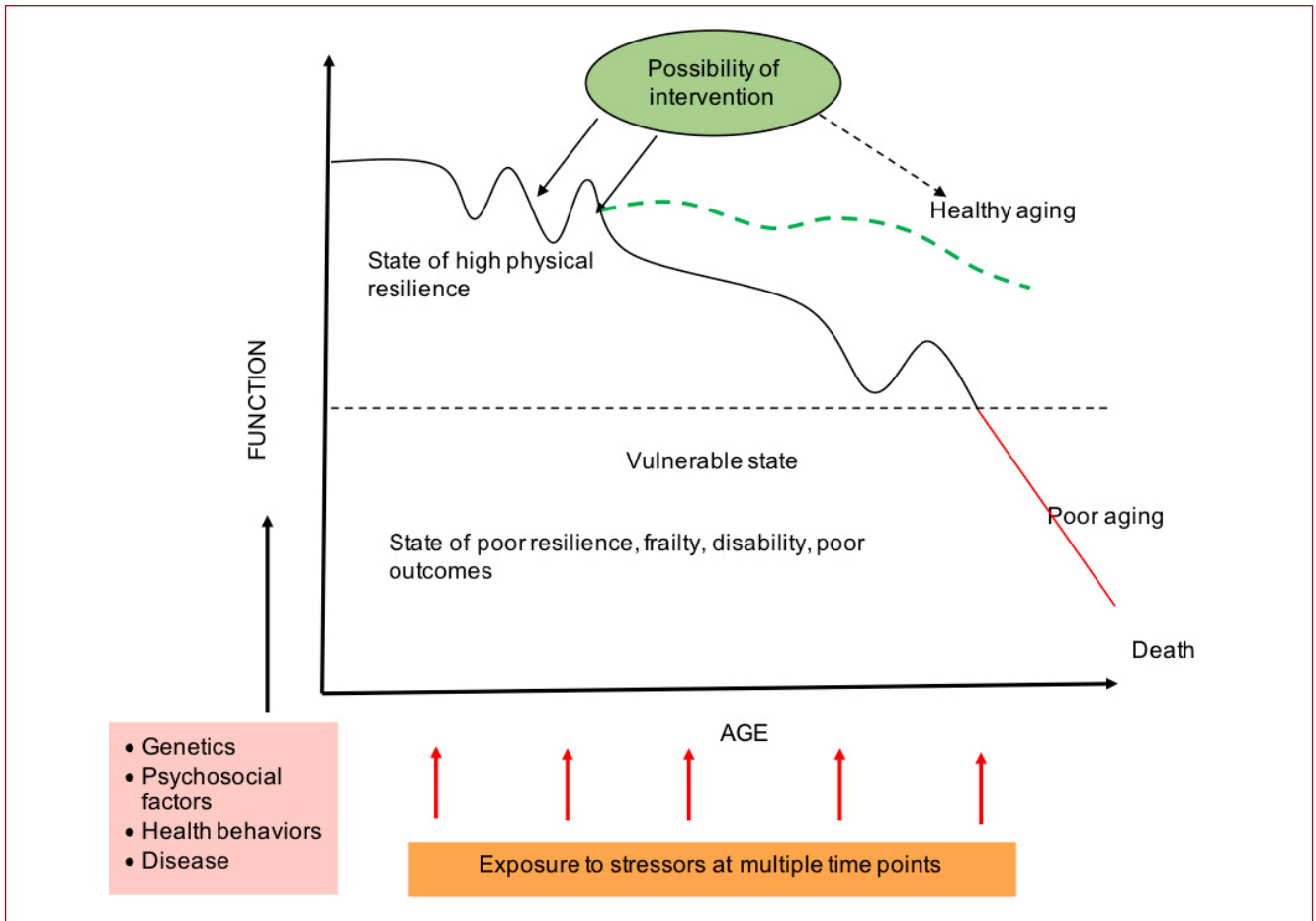
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**Figure 1.** Functional decline, physical resilience, and healthy aging.

are able to do what they value the most<sup>9</sup>. While discussing the functional ability of older individuals, a distinction should be made between PR and frailty. PR is sometimes thought to be the opposite of frailty, as the latter is defined as a state of poor functional ability and increased vulnerability to stressors<sup>10</sup>. During the aging process, PR may be observed throughout the life course whereas frailty syndrome appears in old age. Moreover, it should also be noted that the concept of frailty is largely driven by health deficits and limitations while PR captures the life-long accumulation of positive health attributes. The construct of PR appears to be more closely related to the construct of Intrinsic capacity (IC)<sup>5</sup> recently introduced by the World Health Organization (WHO). IC is a construct that may be thought as the evolution of the frailty, but driven by positive health attributes or physiologic reserves instead of the health deficits.

### **A better understanding of PR may contribute to healthy aging**

It is clear that while a person is in a resilient state, they may not have many poor adverse outcomes as a result of

exposure to stressors. But with an increase in age, they suffer from various geriatric conditions. Such increased susceptibility to disease or adverse events in old age is due to the inability of the exposed system to compensate for the loss. For instance, stroke is a condition with a higher risk of mortality and disability in old age and various factors such as genetics, lifestyle factors, environment, etc. may contribute to a stroke which are already present in mid-life, so why does this condition affect severely in old age? As said before, it is because due to the inability of the system to compensate, which is the loss of resilience. The same individual's system had been compensating for the loss while he/she was young and resilient. At this point, there may be very little possibility of interventions that would make the individual robust or even help them to regain their function. In this state of vulnerability, the cascade of frailty comes into play making the person disabled and dependent. However, if we were able to fully understand the construct of PR (i.e., the interplay between stressor, system and state and associated biological/physiological changes) we may be able to identify the resilient from non-resilient even before

there is an involvement of actual stressor. We could make suitable clinical decisions based on the resiliency status of an aging individual. Such as whether a certain medical procedure may be of benefit to the person or estimate the likelihood of recovery. If the individual was likely to have a poor recovery, a better understanding of PR may enable us to design pre and post-stressor rehabilitation strategies to diminish the adverse effect of a therapeutic stressor. We may be able to develop targeted care models to reduce the burden of disability. Instead of intervening when it's too late, we could apply preventive strategies when the aging cascade is still further uphill. PR studies may enable us to identify biomarkers of resiliency which may be potential targets for interventions. All of these fore-mentioned strategies may slow the process of functional decline such as frailty and help in attaining healthy aging.

### Advancing further on PR

In order to consider the construct of PR to be of more frequent use in aging research, simple methods of measurements may be needed, as quantifying PR is a difficult task<sup>6</sup>.

Currently, the most clinically relevant method to measure PR is the assessment of trajectories of recovery from a stressor<sup>6</sup>. Undoubtedly, this method is difficult to implement as there is a need for well-defined stressors and requires assessment of pre and post-stressor functional status which is very difficult in an acute clinical setting.

There is a possibility of making use of simple pre-stressor physical functional measures to determine PR, but again assessing them would be impractical in a real-world scenario. Self-reported functional measures may be potentially useful to overcome this difficulty; however, such an approach needs to be validated. It should also be noted that there is still a lack of standards to validate such new measures of PR, although an approach such as stimulus-response modeling may be used to characterize PR<sup>11</sup>, this approach may not be always applicable, given the few numbers of available validated tests. Hence, new methods for the validation of PR may be needed. Another possibility is the validation of such pre-stressor measures in pre-existing longitudinal cohorts (potentially linked with data from clinical settings) which has a wide array of functional records from early life that may allow us to understand the trajectory of recovery in the face of stressors at multiple time points.

Future work in PR should explore the impact of a stressor on systems that may not be directly linked to that stressor. Such studies would allow us to determine whether the systems compensate each other where possible. If so, we could develop intervention strategies to strengthen the non-resilient systems by strengthening other systems that may compensate for that particular system which may have a huge implication for healthy aging. Possibility of strengthening the systems by raising the underlying physiologic reserves to optimize PR should be investigated. Concepts such as "Mithridatism" may be confirmed in the context of PR by perturbing a system with small-scale

stressors so that it could result in beneficial outcomes while facing a bigger stressor in the future<sup>6</sup>. If found to be beneficial, this approach may enable us to develop a new generation of super functional older adults with higher level of PR. Indeed, to effectively conduct new studies on PR and develop intervention strategies to promote PR better understanding of the mechanism of PR is needed.

More importantly, it should be carefully understood that only treating geriatric syndromes in old age may not be the appropriate answer to healthy aging. Healthy aging requires a life course approach and improving physical resilience may attenuate the cascade of aging and associated adverse outcomes such as frailty and disability.

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