

REVIEW ARTICLE

Cognitive reserve and cognitive rehabilitation

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Abstract

Many societies including Japan are struggling with the problem of elderly dementia people. Japanese Government policy is to make the symbiotic society in which the elderly dementia people can live their lives safely and peacefully in the place they choose. Another goal of our society is to establish effective means of dementia prevention, in which the concept of cognitive reserve can play an important role. Osaka Kawasaki Rehabilitation University has a plan of launching graduate school of cognitive rehabilitation in which the University's research and service will be devoted to prevention of dementia and symbiotic life of the demented people in the community.

INTRODUCTION

Amyloid deposition, neurofibrillary tangles, and neuronal loss are regarded as pathological hallmarks of Alzheimer's disease. It is also true that all of these three can be observed in the brain of healthy elderly people, if not as many as in Alzheimer's disease brain. In fact, it is known that some people who presented with the pathology of Alzheimer's disease by postmortem study did not show cognitive decline until death. Amyloid deposition and neurofibrillary tangles may not be correlated well with cognitive decline of subjects (Stern, 2003; Scarmeas, 2003).

COGNITIVE RESERVE

There has been a concept of "brain reserve" (BR) for understanding the cognitive function and living capacity of children with intellectual disabilities. As is well known, a certain level of development is expected in cognitive and living function through appropriate training and nurturing, and the effect of training is considered to be regulated by "brain reserve" that depends on brain size, number of nerve cells, number of synapses, and others. Compared with a passive concept of "brain reserve," "cognitive reserve" in the elderly has been proposed, that might be regulated by neural network, types of neural circuits involved, and the newly mobilized neural circuits, implying more active role on cognitive function (Stern, 2018).

Cognitive reserve is the ability to maintain cognitive function by antagonizing deteriorating factors caused by brain aging and pathological process,

which modifies effect of intracerebral pathology on clinical symptoms to maintain cognitive function. Cognitive reserve is influenced by psychosocial factors including intelligence (IQ), educational history, work experience, hobbies, and social participation (Nucci, 2012). The biological entity of cognitive reserve is, however, little elucidated (Figure 1).

Cognitive decline in the elderly progresses gradually with age. A person with high cognitive reserve can resist the pathological process to some extent to prevent its functional decline, but once the functional decline begins, cognitive function declines more rapidly than those with lower cognitive reserve. People with high cognitive reserve have a longer time to develop dementia than those with low cognitive reserve, but the rate of cognitive decline after developing dementia is faster. In other words, cognitive reserve can delay the onset of cognitive decline (Figure 2).

SUCCESSFUL AGING AND COGNITIVE RESERVE

Elderly people usually show wide individual differences in physical, mental, and social conditions. Everyone, born as a similar baby alike, experiences different kind of family structure, home environment, education, job experience, and so on throughout life, and difference in each stage of life accumulates in his (her) old age, as a result of various biological, psychological, and social experience. Given this diversity of older people, it is not enough to simply dichotomize the elderly people into normal or ill. Though dementia can be regarded as representative

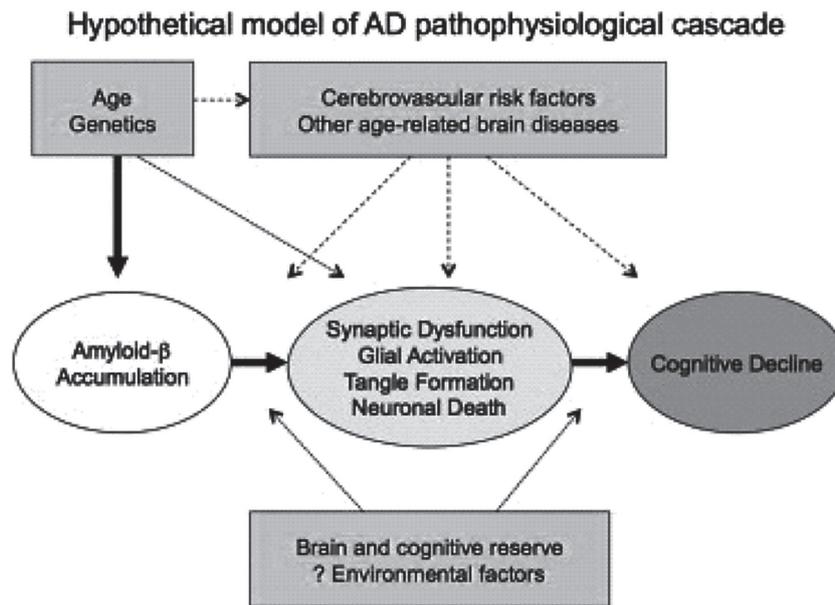


Figure 1. Alzheimer pathophysiological cascade and cognitive reserve hypothesis

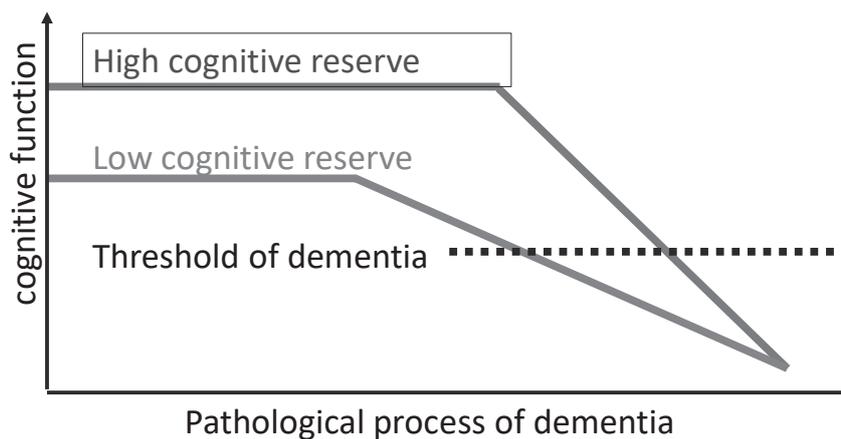


Figure 2. Cognitive reserve and onset of dementia

of unsuccessful aging, the actual elderly people can be positioned somewhere in the spectrum from “unsuccessful aging” to “successful aging.” “Successful aging” has been proposed as a term to describe the desirable elderly in contrast to dementia (Butler, 1974).

The factors which enable the elderly to enjoy successful aging have been discussed to be arranged in a hierarchical model consisting of (a) physical health, (b) normal cognitive function, (c) life satisfaction (well-being), and (d) social activity. Physical health(a) is the most basic requirement of successful aging, meaning not suffering from physical illness. In addition, cognitive function (b) is an important

requirement for managing social life. In addition to healthy functioning body and mind, proper cognitive function can be maintained. Life satisfaction and well-being(c) is necessary to realize the above, and it has been thought that social participation and social activities (d) might be possible only when the above three factors, (a), (b), and (c), are implemented (Figure 3).

LIFE SATISFACTION AND SOCIAL ACTIVITIES AS COGNITIVE RESERVE

Cognitive function (b) was considered as a necessary condition for life satisfaction (c), and the

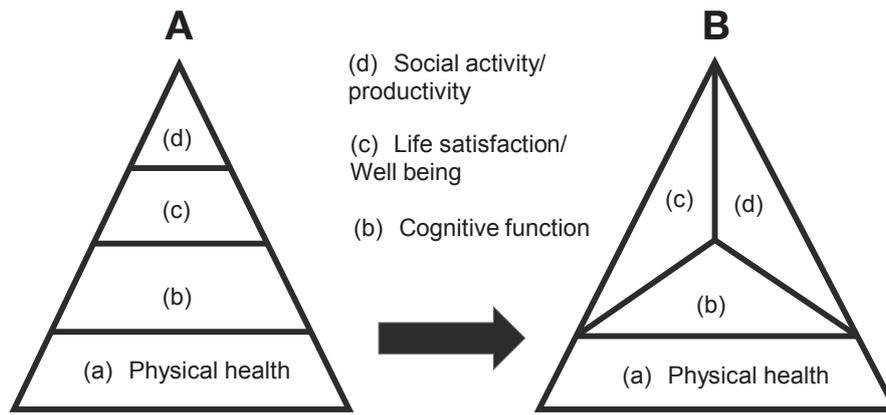


Figure 3. Interrelationship among cognitive function, well-being, and social activity. Above (a) physical health, which is a *sine qua non* for (b), (c), and (d).

latter was considered as a requirement for social activities (d) in the old hierarchical model. However, recent studies have shown that cognitive function (b), life satisfaction (well-being) (c), and social activity/ social productivity (d) are interrelated each other, not necessarily in a simple hierarchical structure. Experience of life satisfaction is shown to help maintain cognitive function, and it is also important to participate in society and continue social activities for cognitive function. Considering these interactions, it is better to think that cognitive function, life satisfaction, and social activities influence each other as shown on the right side of Figure 3 (Takeda, 2016).

Cognitive reserve is a concept advocated from the viewpoint that cognitive function may be maintained by maintaining wellbeing and social activities by improving lifestyle. The idea is to cultivate sufficient cognitive reserve to prevent dementia by maintaining cognitive function even if Alzheimer’s pathology occurs in the brain.

COGNITIVE REHABILITATION

The term “cognitive rehabilitation” may not yet be widely recognized in the society, but we are going to promote the concept underlining cognitive rehabilitation through activities of our university. We believe that the “cognitive rehabilitation” is an important concept of our institution, which can represent the mission of the institution and we will stimulate our research activity to expand the value and usefulness of “cognitive rehabilitation” for the development of the field of rehabilitation. We propose that the term “cognitive rehabilitation” should include the following triple meanings described below (Figure 4).

Rehabilitation of brain function

First, the term “cognitive rehabilitation” means the rehabilitation of cognitive and other brain functions. The field of physical therapy has been expanding including several subspecialties such as locomotor disorders and internal disorders as the target subject of rehabilitation. Along with development of brain science and neuroscience, rehabilitation of the brain function has become a new target area of physical therapy. The Japanese Association of Physical Therapy launched the subspecialty of mental and psychological rehabilitation which aims the promotion of rehabilitation to the mental and brain function.

We expect to transform the brain function of subjects who suffer from malfunction and dysfunction of the brain due to CNS disorders through

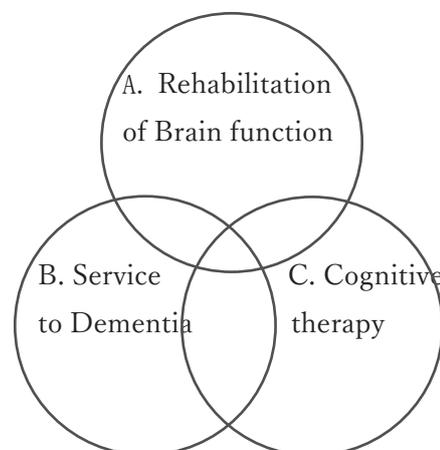


Figure 4. “Cognitive rehabilitation” is coined to represent triple meanings, as shown in the figure. Although it has not been widely recognized, we expect to spread it widely in the society through the activities of Osaka Kawasaki Rehabilitation University.

“Cognitive Rehabilitation.” Recent advance in brain science and neuroscience has made it possible to understand the mechanism underlining some dysfunction of brain circuits, which, in turn, enables us to develop strategy to transform inadequate behavior, affection and cognition of the subject. We have an ambition that Osaka Kawasaki University will be one of active research centers of “cognitive rehabilitation in Japan in near future. Our effort in this field will be applied not only to the development of clinical service of cognitive rehabilitation but also to understanding of the underlining mechanism of cognitive function through advanced technology and research tools.

Service to dementia people

The direct message perceived by the lay people from “cognitive rehabilitation” may be dementia and rehabilitation. We of course think that “cognitive rehabilitation” in our institution should cover the service to the elderly dementia people in our community. Our service to the community will also include the rehabilitation to the people with cognitive dysfunction throughout life cycle, including developmental disorders, traumatic brain disorders, and neurocognitive disorders. Considering the high number of elderly people in the community, it will be a direct goal of our rehabilitation services to develop knowledge and skills for effective rehabilitation for people with dementia. We expect our research and service to the elderly people will promote the symbiotic community between dementia and cognitive normal elderly people in this area. Another goal of cognitive rehabilitation is the prevention of cognitive decline of the elderly people dwelling in this community.

Cognitive behavioral therapy (behavioral transform through cognitive improvement)

Furthermore, all rehabilitation service should aim for the highest effectiveness and usefulness of the service, and we should devise theories and techniques to foster awareness and motivation of the target subjects for rehabilitation in order to maximize the effect of rehabilitation service. We expect the effective work on the cognitive function of the subject in charge of rehabilitation service is to change the cognition and behavior of the subject. Treatment aiming for correcting cognitive distortions leading to the behavior modification is now established in the clinical practice of psychiatry and psychosomatic medicine as cognitive therapy or cognitive behavioral therapy. However, attempts to utilize cognitive behavior modification have not been developed in the field of rehabilitation. “Cognitive rehabilitation” aims to improve the effect of rehabilitation by studying the cognitive function of the subjects, which aims to develop effective rehabilitation technology for the behavioral modification through improvement of cognitive function.

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