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Longevity and successful ageing: implications from the oldest old and centenarians

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ABSTRACT

Sociologists, physiologists, and psychologists have proposed differing models of successful ageing. However, none of the previous models to describe successful ageing appear appropriate for adaptation to the long and unstable period of extreme old age. New theories are thus required. Empirical findings relating to successful ageing are applied in the context of centenarians and the oldest old, and a new framework for understanding successful ageing emphasising psychological development in old age and age-related differences in functional status is proposed.

Key words: Adaptation, psychological; Aged, 80 and over; Aging; Longevity

INTRODUCTION

Various disciplines have proposed their own models for successful ageing, but such models may not be appropriate for extended longevity, as different elderly age groups have different problems. This paper introduces the conditions associated with longevity and the oldest-old, and then reviews some representative models of successful ageing and their limitations. A new model for successful ageing, with greater emphasis on psychological aspects, is proposed. The young old, old old, oldest old, and centenarian groups are defined as 65-74 years, 75-84 years, over 85 years, and over 100 years, respectively.

LONGEVITY IN CONTEMPORARY SOCIETY

The average lifespan of populations in developed countries is at an all-time high. In Japan, it was 79.6 years for men and 86.4 years for women in 2009, compared to 50.1 and 54.0 years, respectively, in 1947. Taking into account the infant mortality rate, life expectancy in the 40-year-old age-group has been extended 1.5 fold (26.9 to 40.5 years for men, and 30.4 to 46.9 years for women) between 1947 and 2009. For the elderly aged 65 years during the same period, life expectancy has doubled, and half of all men and women who are currently 65 years old will live to an estimated 83.6 and 88.6 years, respectively.

Active or healthy life expectancy that considers quality of life (QOL) is more important than life expectancy alone. A US longitudinal study initiated in 1982 reported that active life expectancy has increased in later birth cohorts, and that this trend is expected to be consistent even in older age-groups such as the oldest old. A Danish study has also reported similar trend in centenarians. In Japan, a longitudinal study demonstrated higher functional levels in later birth cohorts of elderly. In terms of functional ability, male and female participants were 7.5 and 10 years ‘younger’ in terms of function in 2002, respectively, than those surveyed in 1992. These findings support the compression of morbidity theory, which predicts that the longer a person stays alive, the shorter the period of disability becomes.

In the oldest old, however, the risks related to ill health and disability are higher. In 2008, among hospital inpatients in Japan, 2% were in the young old age-group and 9% in the oldest-old age-group, whereas the prevalence of dementia was <5% and >25%, respectively. An epidemiological study reported a much higher prevalence of dementia (48%) in the oldest old. A study conducted in the Tokyo metropolitan area (participation rate, 78%) reported that 42% of the oldest old required others to take care of them. The prospect of physical and cognitive decline is a big challenge for the oldest old. An increasing proportion of bedridden Japanese centenarians has been reported. It is unclear whether the compression of morbidity model is applicable to the oldest old, as no precise data are available to test this model in this context.

Although there has been considerable improvement in the health status of the young old, this situation may not be applicable to the oldest old. There is no evidence...
that the oldest old can maintain their health as they did in younger old age.

SUCCESSFUL AGEING

Ageing is characterised by loss of physical function, social relationships, and cognitive function. In the 1960s, social gerontologists debated 2 opposing theories of successful ageing.8 The disengagement theory suggested that gradual disengagement from social life and an increasing focus on the inner self is a natural process of human ageing, because physical and mental decline is inevitable.8 Conversely, the activity theory argued that maintaining a middle-aged lifestyle (i.e. remaining active) into old age is important for the elderly.8 The former theory emphasised passive acceptance of ageing, whereas the latter emphasised the active avoidance of ageing. Both theories have some merit for explaining successful human ageing,9 but neither has been directly tested. Subsequently, the continuity theory was put forward, advocating a combination of both the disengagement and activity theories, and that continuous selection of either theory based on individual preference is the path to successful ageing.9

In recent years, different theories of successful ageing have been proposed from both the medical and psychological fields. Research frameworks for studies on successful ageing have classified these theories as: biomedical, psychosocial, a combination of both, and laypersons’ views.10 The laypersons’ view model is the simplest, with avoidance of disease, disability, and dementia. This is reflected in the custom of many elderly people in Japan visiting temples or shrines to pray for a pin pin korori (PPK) life, which means to die suddenly after being very healthy.

Many biomedical theories have suggested that avoiding physical or psychological decline and disability, and extending life expectancy are the basis of successful ageing. The Rowe and Kahn model reported that successful ageing is based on 3 main factors: avoidance of disease and disability, maintenance of mental and physical function, and continuous active involvement in life.11,12 The model has a hierarchical structure in which maintenance of good health enables activities in other dimensions. The model also added psychosocial factors to the biomedical model of successful ageing. In this context, the model may be categorised as a subtype of the activity theory. The Rowe and Kahn model also affirmed that everyone has the opportunity to maintain these 3 components of successful ageing by improving their lifestyle.

Nonetheless, maintaining health and functional ability may not be the only way to ensure successful ageing. A study reported that 50.3% of elderly people aged 65 to 99 years evaluated themselves as being ‘successful agers’, even though only 18.8% fulfilled the Rowe and Kahn criteria.13 In addition, 36.8% of the elderly evaluated themselves as not successful by the Rowe and Kahn criteria, even though they did fulfil those criteria. The study reported by myself and colleagues in 2008 also had similar findings.14 We classified people aged 65 to 84 years (n=1231) into 4 groups using the cluster analysis technique, based on level of physical function, presence of disease, and level of psychological well-being. Among the 4 groups, 2 showed higher psychological well-being. One of the higher groups (19.5%) performed at a higher functional level and had a higher degree of psychological well-being, which is consistent with the biomedical model of successful ageing. The other higher group (37.1%) consisted of people who had some type of disease but showed higher psychological well-being, indicating that the presence of disease is not perceived as a factor detrimental to successful ageing by elderly people themselves.

SUCCESSFUL AGEING IN THE OLDEST OLD

The Berlin Aging Study of the oldest old has reported that the oldest old have inferior learning ability, lower life satisfaction, and a decline in positive affect. This state is referred to as ‘psychological mortality’, and helping the oldest old to maintain their dignity is a large burden for developed countries.15 Recent studies have added new evidence suggesting that there is a paradoxical relationship between physical health and psychological well-being in centenarians and the oldest old.16-20

In the Tokyo Centenarian Study,21 304 centenarians were classified into 4 phenotypes based on 3 functional dimensions: sensory loss, physical function, and cognitive function. Only 5 (2%) of the centenarians were classified as ‘exceptional’, with all of their functions graded as excellent, whereas 56 (18%) were classified as ‘normal’, exhibiting retention of fine cognitive and physical function. 167 (55%) were classified as ‘frail’, exhibiting impairment of either cognitive or physical function, and the remaining 76 (25%) were classified as ‘fragile’, exhibiting deterioration of both physical and cognitive function.21 Only 20% of centenarians met the criteria for successful ageing, in terms of either the biomedical or Rowe and Kahn models. Interestingly, centenarians who were physically frail but cognitively intact showed the same level of subjective well-being as the normal group, based on the Philadelphia Geriatric Center Morale Scale.22 Subjective well-being in this frail group was higher than in individuals in early old age and old age with physiological limitation.17,22 The number of participants was small because of cognitive decline, and this affected reliability.

To replicate findings that had showed dissociation between physical function and subjective well-being in centenarians, we studied 235 community-dwelling oldest old aged 85 to 103 years.5,24,25 42% of the participants were dependent on others for some sort of care. Although the level of depressive mood was higher in the dependent group, the level of subjective well-being was not different
between the dependent and the independent groups. We also compared objective physical functions (grip strength, presence of illness, and instrumental activities of daily living) and subjective evaluations (subjective health and well-being) between the young old, old old, and oldest old. The results showed a significant decline according to age with regard to objective measures; however, this trend was not evident and was stable in subjective measures between the old old and the oldest old. Furthermore, regression analysis indicated that the influence of physical function on the subjective measures was significant in the young old and the old old; however, these relationships were not observed in the oldest old. Consistent findings have also been reported in western countries. Researchers are now investigating the psychological mechanism behind this phenomenon.

PSYCHOLOGICAL WELL-BEING

The paradoxical findings discussed in the previous section may be a result of divergent reference values and domains of concern for successful ageing in individuals. Life satisfaction, the meaning of life, economic background, personal achievement, sense of humour, and spirituality are important factors for successful ageing, along with health, according to lay people’s perceptions. Psychological factors are more important for successful ageing than expected. It has been proposed that a new domain of positive spirituality be added to the Rowe and Kahn model.

Among theories of successful ageing, the fundamental differences between psychological models and biomedical models are that (1) psychological models focus on the ageing process itself and attempt to clarify the mechanism that enables elderly people to adapt and maintain psychological well-being, and that (2) conversely, biomedical models focus on the consequences of the ageing process and evaluate individual status over a short period of time.

Models of psychological well-being can be classified into 2 domains—the logical model and the non-logical intuitive model—based on the psychological mechanism behind the adaptation process. A representative logical model known as the selection, optimisation, compensation (SOC) model has been advocated by German psychologists. This model is applicable to a wide age range, from the young to the elderly. According to this model, people do not passively accept losses in life; rather, they actively cope with loss by using SOC strategies. Being capable of using these strategies is related to emotional well-being and life satisfaction. Selection means choosing those life goals to which an individual commits by allocating personal resources. Two types of selection have been hypothesised. Elective selection means selection of new goals as investments for the future, and this tends to be done more by young people. Loss-based selection means selection of downgraded goals because of current or future loss of capacity caused by functional decline. Optimisation means sophistication of ability, allocation, or adjustment of resources and regulation of motivation to accomplish goals. Compensation means that an aged person will draw on a compensatory resource, such as assistive devices or new strategies. As a consequence, individuals can maintain a certain level of performance.

Although the SOC model can be adapted to any stage of life, use of loss-based selection is not optimal for younger individuals because it may reduce opportunities for future development by limiting personal aims. For elderly people, redefinition of goals is an effective strategy when facing unavoidable losses. A correlation has been noted between a self-evaluated SOC strategy questionnaire score and subjective well-being across a wide age range from the young to the elderly. The advantage of the SOC model is that it focuses on the adaptation process and its mechanism. This model considers the dynamics of changes in biomedical, social, and psychological dimensions. However, few studies have supported this model empirically. One study reported that middle-aged adults use SOC strategies more frequently and effectively than the young or the elderly, suggesting a need for cognitive resources in order for the SOC mechanism to function successfully.

The socio-emotional selectivity theory is also a good example of a logical model. This theory hypothesises that people of any age focus on emotional euthymia rather than stressful situations (such as seeking new information or knowledge) when they realise that their life expectancy is limited. As a consequence, they focus more on and select information that brings ‘positivity effect’. The positivity effect is larger in individuals with higher working memory and executive function capacity. Both logical models indicate the need for cognitive resources in order to maintain psychological and emotional well-being, suggesting that intentional logical thought is necessary for the successful operation of adaptive approaches to ageing.

The non-logical model provides meaningful insights into the psychological well-being of the elderly, especially the oldest old. In the lifespan psychosocial developmental theory, 8 developmental stages are hypothesised. At the final stage (wisdom), elderly people reconsider and reconstruct their lives, and bring them psychological health. This 8-stage model was subsequently considered insufficient as a lifespan theory, and a new psychological developmental stage that enables acceptance of physical frailty was proposed. The theory of gerotranscendence may be a good candidate for explaining this additional 9th stage, although the theory has not been finalised.

Gerotranscendence is a theory of psychological development that is thought to develop during middle age and progress into old age. This theory hypothesises that...
gradual and natural changes in behaviour and thought according to age are an adaptive mechanism through which the elderly can maintain psychological well-being. Three major domains—social relationships, sense of self, and the way the universe is perceived, including both the materialistic and spiritual worlds—have been included in this model. With regard to social relationships, these are seen as changing from the wider and shallower relationships with others (characteristic of young people) to narrower and deeper relationships later in life, and an eventual departure from a social role. With regard to the sense of self, the theory proposes a decline in self-centred thought and selfishness as a person ages, and that it becomes easier for a person to accept the individual that he or she has become. According to the theory, a change in perception of the universe indicates a change in the sense of time and space from a fixed to a more flexible form, and ultimately to a feeling of existence in a different time and place; as a consequence, individuals can re-experience life events and become more intimately aware of their ancestors or dead relatives. Furthermore, the individual can feel the existence of a creator or universal order and a common connection with creation. This theory is influenced by Zen Buddhism and eastern philosophy, and emphasises a natural shift of thought from a realistic world view to a transcendental view. The elderly do not need to continue the same lifestyle and activity that they maintained when they were younger. In this context, the gerotranscendence theory can be seen as in keeping with disengagement theory. The most important characteristic of these theories is that they do not require logical thought and strategic control of cognition, unlike the SOC model or the socio-emotional selectivity model.

Non-logical theories are applicable to the oldest old because (1) cognitive capacity declines with age, and even the crystallised or pragmatic domains, which are ageing-resistant cognitive domains, decline in the oldest old; (2) the oldest old face an ontological situation that is difficult to resolve. Many of them need care from others because of their functional decline. For example, a 105-year-old woman who lived with her daughter (who was in her 60s) had been a hardworking person. She had started drawing in her late 70s, and had managed to improve her drawing ability over 10 years until a health problem had forced her to give up. She was still able to participate in our sub-study of a detailed cognitive assessment survey that involved the use of the Wechsler Adult Intelligence Scale-Revised test, which takes 2 hours to complete. Moreover, at the age of 102 years, she participated in a project to publish a book containing short autobiographical descriptions of centenarians. The final interview was conducted when she was 105 years old, at which time she was almost bedridden because of 2 strokes and needed total care by her daughter. Even in this situation, her psychological well-being was good. When she was asked, “Do you sometimes feel that life isn’t worth living?” she replied that “I can still talk and be a companion for my daughter, despite my condition”. Her mental state may be explained by the loss-based selection outlined in the SOC model, in that she found a new purpose (to be a companion to her daughter) by downgrading her purpose from a more complex role. Her mental state could also be explained in terms of socio-emotional selectivity theory, in that she focused on the positive side of her role (companion) rather than the negative side (care receiver). Being bedridden and completely dependent on her daughter must have been a significant psychological concern for her, but is likely typical of the ontological situation faced by the oldest old. This kind of situation is hard to resolve, even if higher cognitive resources are maintained and fully logical thought is possible. In this situation, a non-logical conception, as outlined in the gerotranscendence theory, may have enabled this woman to overcome the negative aspects of her problem and to evaluate her condition in a positive light.

NEW PERSPECTIVE ON SUCCESSFUL AGEING

Current theories of successful ageing and psychological well-being are applicable to a proportion of age ranges, but not the entire ageing process from 60 to 100 years old. A modified theory of successful ageing from a single overall model to a multiple shift model is proposed. Considering the better physical function of individuals in early old age, maintenance of health and functional capacity, as encapsulated in the PPK concept, must be a primary goal, because individuals in this age range are still socially active, and their situation has remained largely unchanged since their middle age. Subsequently, the Rowe and Kahn model becomes important in understanding successful ageing because people in early to middle old age face loss of their social role. In this second stage, logical psychological compensation strategies such as the SOC model or socio-emotional selectivity model appear appropriate, because cognitive resources are maintained and operational. In the final stage of life, when function and cognitive capacity have declined considerably such that intentional control
Asian countries have tended to apply gerontological theories developed by the West. Western culture stresses independence and autonomy. Ironically, if individuals live longer, the chance of being faced with the crisis of losing this independence and autonomy becomes higher. Trying to resolve this problem logically seems a difficult challenge for the individual, because the decline of function seen in the oldest old is not a reversible phenomenon. Therefore, some kind of emotional acceptance mechanism that is not based on logic seems inevitable.

For successful restructuring of ageing theories to meet the needs of our ageing society, we should focus on a broader range of research domains, from demography to psychology, and consider the potential and possibly complex interrelationships between these domains.

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