

Review

## Dicer and Dementia: From the Molecular Level to a Possible Role in Memory Care Activities

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### Epigenetics

For more than a decade, there has been increasing interest in epigenetics as a key factor in the molecular mechanisms of health and disease, including cognitive wellbeing [1,2,3,4,5]. It has been said that that if the genome is the cell's cookbook with genes being the recipes, epigenetic markers are sticky-notes telling the chef which recipes to prepare when, where, and how much [1]. For example: it is not good, when you are expecting a dinner party of 50 people, to prepare 5 servings of food; nor is it good when you are expecting 50 people to prepare 5,000 servings of food. Thus there is a need for sticky-notes (epigenetics) to inform the chef (cell) about the guest list (physiological requirements). There has also been an increasing recognition of the awe-inspiring complexity of epigenetic mechanisms that fine-tune gene expression and how these mechanisms are influenced by the environment [2,3,6,7]. One of the components involved in this multifaceted process is Dicer – a factor in the post-transcriptional regulation of gene expression [8].

### Dementia

Worldwide prevalence of dementia is expected to triple by the year 2050 [9]. However, if preventive health measures succeed in delaying the average age of the onset of dementia by five years, this trajectory could be greatly stemmed [10]. Wellness programs focusing on environmental factors, nutrition, exercise, stress-management, spiritual wellness, and cognitively engaging activities are being promoted as ways to support brain health [11,12, 13,14,15,16,17,18,19,20,21]. These interventions may operate via manifold pathways [2,22,23,24,25,26,27]. This article will look at recent discoveries which hint that Dicer might play a role in brain health and look at memory care from this perspective.

### Dicer and Dementia

Returning to the dinner party analogy, Dicer is one of the epigenetic factors which regulate how many servings of food are prepared (level of gene expression). Thus cells need to have the correct amount of Dicer in order for the dinner party to be a success (healthy phenotype). But what happens when the chef's notes get mixed up over time? Epigenetic drift is believed to contribute to age-related degenerative processes [2,28].

Recently attention has been turning to Dicer [29,30]. Maintaining healthy levels of Dicer might be part of the key to extraordinary aging and a long and healthy life [31].

Evidence points to Dicer as being central to cognitive functioning and that reduced levels of Dicer play a role in the development of dementia. Dicer, through its role in regulating miRNAs levels, is believed to be a key factor in neuronal plasticity and memory [31,32,33]. Dicer is involved in neurogenesis [34,35]. Dicer supports dopaminergic neuron maintenance [36]. Dicer bolsters axonal integrity [37]. Dicer modulates the stress response [38].

Declining levels of Dicer in the brain may contribute to age-related cognitive issues [39]. Reduced levels of Dicer might be a factor in tau hyperphosphorylation – thus may be involved in the molecular pathophysiology of Alzheimer's disease [39]. In addition, there are also hints that reduced levels of Dicer might contribute to the development of amyloid plaques [40]. Declining levels of Dicer might also play a role in chronic inflammation – a possible contributing factor in Alzheimer's disease [41,42,43,44].

This raises the question as what environmental / lifestyle / nutritional / pharmaceutical methods could be employed to help older adults maintain healthy levels of Dicer in their brains?

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## Dicer, Environmental Enrichment, and Memory Care

Environmental enrichment (giving lab animals toys to explore) promotes brain health and has been used to model of cognitively stimulating human activities such as reading [45]. This animal model hints that cognitive activity helps to support Dicer levels in the brain [46]. Could this be part of the complex network of molecular mechanisms linking a cognitively active lifestyle to a reduced risk of memory loss and dementia? [11,47]. Cognitively engaging activities, such as reading, are recommended for supporting brain-wellness and memory care during aging [11]. Spiritual wellness may help to reduce inflammation and may also help to promote brain health [21,48,49,50].

## Memory Care and the Activities Profession

Activities professionals are leading the way developing new and innovative cognitively engaging activities for mature adults [51]. Retirement communities employ activities professionals to provide meaningful opportunities for elders to express their creativity and to stimulate their minds. Activities departments are also involved in spiritual wellness programs. With the increasing recognition of the needs of house-bound elders, activities professionals may now receive certification as home care providers [52]. In the future, therapeutic activities could also become a standard part of telemedicine practice [11]. In addition, entrepreneurs – many of whom have training and experience as activities professionals – are developing memory care / brain exercise products / gerontechnology products for our aging society [51]. This indicates a rapidly expanding role for well-trained activities professionals on a healthcare team. It also points to a role for educators in providing continuing education materials that enable activities professionals to remain current in the field. In addition, with the increasing need for gerontechnology, college programs in technology ought to plan to hire more educators in this discipline.

## Other Areas of Study

What other factors might influence brain levels of Dicer? Could the cognitive burden associated with severe asthma be due to intermittent hypoxia down regulating Dicer? [53,54,55]. What about issues concerning other tissues? Could age-related decreases in Dicer levels play a role in the elderly's susceptibility to pressure ulcers? [56,57]. What interventions – pharmaceutical or nutritional – might support healthy Dicer levels in various tissues? What other environmental factors should we be looking at? [58].

## Methodology

Eclectic methodology was employed in this speculative paper. Utilizing an element of informed intuition as one of the facets of scientific investigation draws upon the paradigm exemplified by the work of George Washington Carver [59,60,61]. Intuitive, freeform PubMed surfing and other reading was used to search for possible connections between items. Prior

familiarity with numerous topics from many years of freeform PubMed surfing and study helped to inform the search. Seeking to maintain an attitude of gratitude despite major roadblocks lent the tenacity needed to build a knowledge base over many years. (1 Thessalonians 5:17)

## Final Considerations

More investigations are needed on topics emerging from the intersection of lifestyle and epigenetics. This calls for a multidisciplinary approach that includes both epidemiology and molecular biology.

## Conflict of Interest Statement

Dr. Ross has experience in long-term care activities. She is the Founder of the Delaware Gerontology Institute, LLC ([www.DEGerontology.com](http://www.DEGerontology.com)) and designs products for elder care activities. Dr. Ross has studied both epidemiology and molecular biology and is an enthusiastic PubMed surfer geek.

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