

Alzheimer's Disease prevalence, costs, and prevention for military personnel and veterans[☆]

Leslie Sibener^a, Ibrahim Zaganjor^a, Heather M. Snyder^a, Lisa J. Bain^b, Robert Egge^c,
Maria C. Carrillo^{a,*}

^aMedical and Scientific Relations Division, Alzheimer's Association, Chicago, IL, USA

^bIndependent Science Writer, Philadelphia, PA, USA

^cPublic Policy and Advocacy Division, Alzheimer's Association, Washington, DC, USA

Abstract

By 2050, more than 13 million Americans of all ages are estimated to be living with Alzheimer's disease (AD), and the aggregate costs of care will swell to approximately \$1.2 trillion. The rapidly climbing number of those affected with AD includes a growing population of aging military veterans affected who may have an added risk for the disease as a consequence of traumatic brain injury, posttraumatic stress disorder, and/or service-related injuries. The increasing number of individuals, the long duration of disability, and the rising cost of care for AD and other dementia to our society are important public health challenges facing many older adults. These challenges are further compounded by a burgeoning military veteran population that is much younger, with an increased risk of AD and other dementia, and who may experience decades-long periods of disability and care. This outlook underscores the critical need for investments in research at the federal and international levels to accelerate the pace of progress in developing breakthrough discoveries that will change the trajectory of AD and related dementia.
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Alzheimer's disease; Military medicine; Traumatic brain injury; Posttraumatic stress disorder; Healthcare costs

1. Introduction

Alzheimer's disease (AD) affects more than 5 million Americans of all ages, and this number is projected to nearly triple to more than 13 million by 2050 [1]. The prevalence among US veterans is 563,786 individuals, similar to the overall population, and is likewise expected to increase dramatically in the coming decades [2–5]. Yet, there are concerns that the number of at-risk veterans extends beyond the issues of population aging. Notably, the prevalence of dementia in veterans is predicted to rise as a result of an increasing incidence of traumatic brain injury (TBI) and posttraumatic stress disorder (PTSD) [2].

Since March 2003, more than 2.3 million soldiers were deployed to the Iraq-Afghanistan war zones [3], and among these service members, nearly 300,000 veterans between 2000 and 2013 have been diagnosed with TBI [4] and more than 83,000 with newly diagnosed PTSD [5]. As a result of greatly improved military health and battlefield survival from these signature acute injuries, there is now a paradox that veterans will be at a greater risk of developing chronic neurodegenerative diseases such as AD and dementia [2].

2. Costs of dementia care

The aggregate cost of care for older adult individuals affected by AD and other dementia is estimated to be approximately \$203 billion in direct and indirect expenses [6]. Medicare and Medicaid cover approximately 70% of these costs, but out-of-pocket expenses account for \$34 billion or 17% of this total. Moreover, in 2008, the total per-person payments from all sources of health care and

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L.S. and I.Z. contributed equally to this work.

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*Corresponding author. Tel.: +1-312-335-5722.

E-mail address: mcarrillo@alz.org

long-term care, including private insurance and out-of-pocket payments, were three times greater for Medicare beneficiaries with a form of dementia than for other Medicare beneficiaries when matched for age [7].

These costs reflect that people living with AD and other dementia have more than three times the number of hospital stays per year than other individuals of the same or similar age [7]. Furthermore, they reflect the high costs associated with long-term care services. For example, in 2012, the national average cost for a private room in a nursing home was \$90,520 per year and the average cost of an adult day center was \$70 per day [8]. These figures do not take into account the number of or the dollar value of hours of unpaid care provided by nonprofessional and family caregivers. In 2012, the total value of unpaid care provided by such individuals was approximately \$216 billion [6].

Dementia care is expensive today, and such related expenditures are projected to increase dramatically. It is estimated that aggregate payments for health care, long-term care, and hospice will increase from the current \$203 billion to \$1.2 trillion by 2050 [6]. However, what remains unknown is how these costs will be affected by present and future veterans who may be diagnosed with neurodegenerative illnesses at an earlier than expected time points, possibly in their fifth or even fourth decade of life.

Veterans with dementia incur elevated health-care costs. They are more likely to require hospitalization and their hospital stays tend to be substantially longer than those without dementia [5]. In addition, possible risk factors for dementia such as TBI and PTSD are also linked to substantially increased health-care expenses. For example, one study found that the median annual health-care costs for veterans diagnosed with TBI are four times higher than those for veterans without TBI and are even higher for veterans experiencing both TBI and PTSD or pain [9]. Psychiatric visits are also much more common among veterans with dementia [2].

The annual cost of informal care provided to elderly community-dwelling individuals with dementia, including veterans, averaged approximately \$18,385 per individual according to a study conducted in 1998 [10]. These informal costs, as well as the costs associated with nursing home and home health care, are expected to increase dramatically for veterans in the coming decade in line with expected increases in the general population [11]. It is unknown if veterans today or in the future will experience increased care-related costs due to battle-related injuries (e.g., TBI and PTSD) or whether the Veterans Health Administration system will enable better care management for concomitant diseases described in greater detail in Section 3.

3. Are veterans at an increased risk of AD?

Military personnel and veterans are subject to the same risk factors of AD as the general population, in addition to potential exposure to other factors that may further increase their risk. In the general population, there are hints in litera-

ture of possible factors that increase an individual's risk of AD, including age, family history, and heart health. These factors are outlined in greater detail in the following paragraph. More research into how these factors may affect veterans or military personnel is needed.

Age is the greatest risk factor for AD, with the incidence of AD dementia doubling every 5 to 6 years after the age of 65 years [12]. Genetic factors may also increase the risk of developing AD. The apolipoprotein E $\epsilon 4$ (*APOE* $\epsilon 4$) allele is the strongest genetic predictor of risk for AD. Individuals who inherit two copies of this allele have a 12- to 15-fold increased risk of developing AD and an earlier age of onset than individuals with other allelic forms of the *APOE* gene [13]. Furthermore, TBI recovery and outcomes have been connected to the possible genetic areas of interest, including *APOE* $\epsilon 4$ (described previously). TBI in the presence of *APOE* $\epsilon 4$ allele is associated with poorer health outcomes in adults and is linked to increased mortality after ischemic stroke and cardiopulmonary arrest [14,15]. Other genes have also been linked to an increased risk of disease, including genes involved in the processing of the AD precursor protein and pathways involved in the immune response and inflammation, lipid transport, synaptic function, and other important physiologic processes that are involved in AD pathogenesis [16]. The influence of genetics is also reflected in the fact that individuals with a parent or sibling with AD are more likely to develop AD than those who do not have a first-degree relative with AD [17].

Cardiovascular risk factors also raise the risk of dementia. For example, in a study of 678 Catholic nuns, stroke emerged as the greatest risk factor for subsequent dementia [18], and other studies have linked an increase in dementia incidence to hypertension [19], diabetes and insulin resistance [20], obesity [21], and atherosclerosis [22].

Depression has also shown to increase the risk of dementia [23], as do TBI and PTSD [2]. In addition, lifestyle factors including physical activity, smoking, diet, level of education, and social and cognitive engagement and socio-demographic factors such as race, gender, and socioeconomic status may potentially be related to an increased risk of dementia [24,25]. These factors impact the general population; research regarding how these factors may impact veterans and military personnel specifically is needed to understand the potential risk to these groups.

In addition to the factors described in the above sections, veterans may be at an increased risk for AD because of both the demographics of the veteran population, compared with the general population, and the risks related to combat injuries. Veterans are, on average, older than nonveterans [26]. In Veterans aged 30 to 64 years, there is a higher proportion of African-Americans compared to the overall US population (16% -17% African American veterans compared with 13% in the US population), and the incidence of AD in African-Americans is about twice that of Caucasian individuals [27]. Veterans may also be affected by socioeconomic factors such as lower incomes or unemployment [28].

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