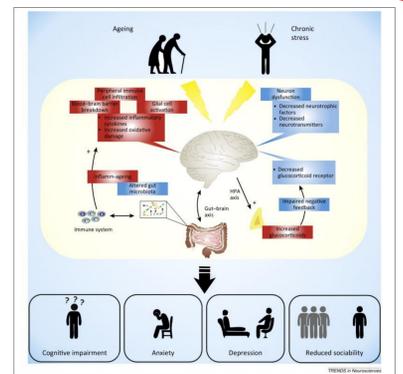


## 1. Introduction

In 2015, dementia cost the United States of America alone \$226 billion, and by 2050, this cost is projected to rise to \$1.1 trillion (1). An often underappreciated cost of dementia is the impact upon informal caregivers for dementia patients. Dementia caregiving is associated with heightened stress as well as increased depression (2). There is also emerging evidence that the chronic stress of dementia caregiving may impact upon central nervous system activity in informal caregivers (3); this may exacerbate the physiological effects of ageing (see **Figure 1**). The current study examined the cognitive neurobiology and mental well-being of dementia caregivers.



**Figure 1:** Chronic stress may exacerbate ageing's physiological impact (adapted from 4.)

## 2. Aims & Hypothesis

**Aims:** (1). Systematically evaluate the literature for evidence of the effects of dementia caregiving on biomarkers of stress, including HPA axis activity, inflammation and cognitive performance.

(2). Examine stress, depression and cognitive performance in an Irish cohort of dementia caregivers.

**Hypotheses:** We hypothesised that dementia caregiving would be associated with heightened biomarkers of stress and worsened mental health.

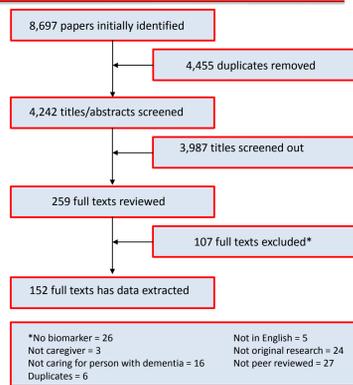
## 3. Methods

### Systematic review

**Systematic review:** We searched PsycINFO, ScienceDirect, Web of Knowledge, PubMed, Scopus and Cinahl for quantitative studies published in English that examined biomarkers of stress in dementia caregivers. Studies were assessed for inclusion in the systematic review (see Figure 2 for flowchart of study evaluation). We examined studies assessing biomarkers of stress in dementia caregivers, as well as interventions to reduce stress biomarkers.

The systematic review was registered on 28/05/2015 at the following link:

[http://www.crd.york.ac.uk/PROSPERO/display\\_record.asp?ID=CRD42015020828](http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42015020828)



**Figure 2:** Flowchart of articles examined

### Caregiver assessment

Family dementia caregivers (N = 30) were recruited via the Memory Clinic at St. Finbarr's Hospital, Cork. Caregivers were providing at least 10 hours of unpaid care per week to a relative with dementia. Controls (N = 12) were recruited from the community.

	Caregivers (N = 30)	Controls (N = 12)	P-value
Age	56.1 +/- 2	52.9 +/- 2.3	.36
Gender	20 females, 10 males	7 females, 5 males	.73
Relation to care recipient	20 children, 10 spouses	-	-
IQ (NART)	105 +/- 1.8	104.1 +/- 2.6	.78

**Table 1:** Participant characteristics (Values are mean +/- SEM)

Exclusion criteria were: serious health problems, taking a medication that would confound the aims of the study, participation in a trial involving experimental drugs in the last 30 days.

**Daily stress:** Daily stress was assessed using the Cohen Perceived Stress Scale.

Depression was assessed using the Beck Depression Inventory (BDI).

**Neurocognitive performance:** Participants completed the paired associates learning task (PAL), simple reaction time, spatial span and rapid visual information processing tests from the CANTAB platform (see **Figure 3**).



**Figure 3:** CANTAB: neurocognitive assessment.

## 5. Discussion & conclusions

- Dementia caregiving is associated with heightened cortisol levels and high self-reported stress levels, as well as poorer performance on tests of memory and sustained attention. This likely interacts with higher levels of depressive symptoms and may underpin a possible cognitive neurobiology of caregiving.
- A comprehensive physiological phenotyping of dementia caregivers is required to better understand the mechanisms of these effects.

## 6. Acknowledgements & Disclosure

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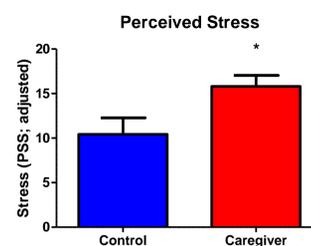
## 4. Results

### Systematic review

Papers assessed in the review indicated that dementia caregiving was associated with heightened perceived stress, as well as dysregulated cortisol output and immune system function. Risk of bias was generally low to moderate.

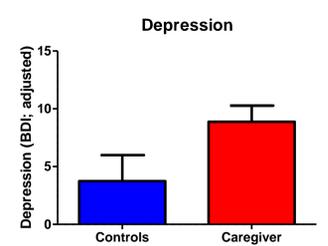
### Stress and mental health in caregivers

**Stress**  
Dementia caregivers reported significantly higher stress than non-caregivers,  $F(1, 35) = 5.69, p = .02, \eta_p^2 = .14$  (see **Figure 4**).



**Figure 4:** Perceived stress in caregiver and controls (means adjusted for age as a covariate).

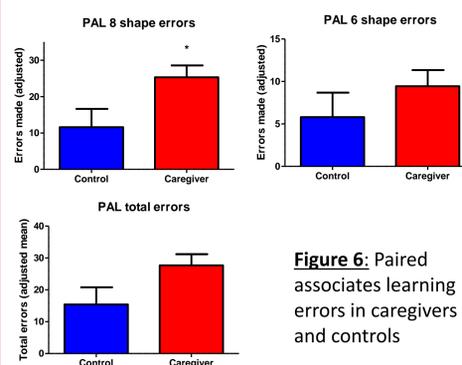
**Depression**  
Dementia caregivers reported higher depression than non-caregivers, a marginally significant effect,  $F(1, 32) = 3.72, p = .06, \eta_p^2 = .1$  (see **Figure 5**).



**Figure 5:** Depression in caregivers and controls.

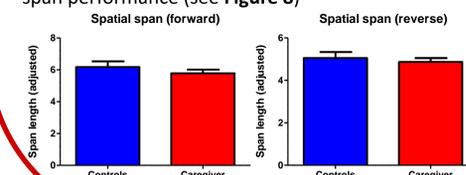
### Neurocognition

**Visuospatial Memory**  
Caregivers made significantly more errors on the Paired Associates Learning (PAL) test, 8 patterns:  $F(1, 37) = 5.18, p = .03, \eta_p^2 = .12$  (see **Figure 6**).



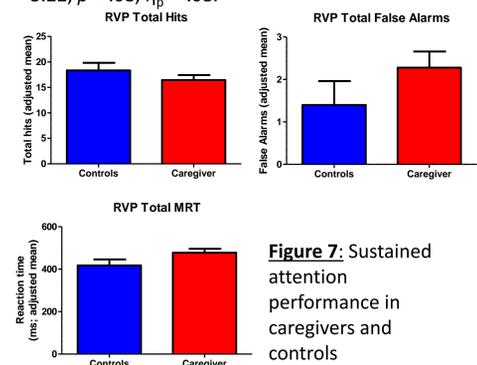
**Figure 6:** Paired associates learning errors in caregivers and controls

**Working memory**  
Caregivers and controls did not differ in spatial span performance (see **Figure 8**)



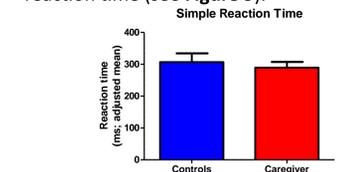
**Figure 8:** Spatial span performance in caregivers and controls

**Sustained Attention**  
Caregivers had fewer hits, more false alarms and slower reaction time on the Rapid Visual Information Processing (RVP) test (see **Figure 7**). Reaction time was marginally slower,  $F(1, 36) = 3.22, p = .08, \eta_p^2 = .08$ .



**Figure 7:** Sustained attention performance in caregivers and controls

**Simple reaction time**  
Caregivers did not differ from controls on simple reaction time (see **Figure 9**).



**Figure 9:** Simple reaction time performance in caregivers and controls

## 7. References

- <http://www.alz.org/facts/>
- Mahoney R, et al. Am J Geriatr Psychiatry 2005; 13: 795-801
- Correa MS, et al. Neurosci 2015; 286: 371-382
- Prenderville JA, et al. Trends Neurosci 2015; 38: 13-25

