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Crash characteristics of older pedestrian fatalities: Dementia pathology may be related to ‘at risk’ traffic situations

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Abstract

Older people are over represented among pedestrian casualties, and cognitive decline is an often cited possible contributory factor. Cognitive decline and dementia are intimately associated, however the role dementia might play in older pedestrian crashes has received little attention. This study describes crash characteristics for 52 fatally injured older pedestrians in the Sydney metropolitan area. It investigates the relationship between the extent of neurofibrillary tangles (NFT), a hallmark of Alzheimer’s disease in the brain, and particular crash situations. The results demonstrate crash characteristics that are similar to that reported in other studies of older pedestrians. Furthermore, the results suggest that cognitive decline associated with dementia related neuropathology may be associated with specific crash situations. Compared to older pedestrians with no, or low NFT, those with moderate to high NFT were more likely to be: at least partially responsible for the incident; injured while in low complexity situations; involved in impacts with reversing vehicles; impacted in near lanes of traffic; and struck by a vehicle off road. While described as trends only ($p < 0.2$), these findings highlight areas of concern for older pedestrians and suggest potential targets for engineering and behaviour-based countermeasures aimed at reducing casualty numbers among older pedestrians.

Keywords: Pedestrian; Elderly; Alzheimer’s disease; Cognition; Neurofibrillary tangle; Autopsy

1. Introduction

Older people (i.e. those over the age of 65 years) make up less than 13% of the population yet account for about 32% of all pedestrian deaths (ATSB, 2002a). While there has been an overall decrease in pedestrian deaths per capita in recent years, the rate of decline varies by age. For older pedestrians, the decline has been significantly less. There are a number of factors that may contribute to this including the fact that they do not survive their injuries as well as younger people. The mortality rates for people over 65 years exceed those for younger people for comparative injury severity (McCoy et al., 1989). More older pedestrians die (44.6%) as a result of their injuries compared to 10.4% of younger pedestrians (Sklar et al., 1989).

Changing demographics are such that there are relatively more older people than previously in the community, and this may also influence the exposure of older pedestrians. Unless a proactive approach to this problem is adopted, the numbers of older pedestrians killed and injured can only be expected to grow given the rapid ageing of the population. At the turn of the 19th century, 4% of the Australian population was over 65 years of age. By 1998, the percentage of older people had risen to 12.2%, and by 2051 it is estimated to reach 24.2% (ABS, 1999a). In NSW alone, there will be approximately 1.8 million older people by 2041, which reflects a 144% increase since 1995 (Henderson and Jorm, 1998). These increases in the aged population are common to most western countries and Australia shows trends similar to that seen in Canada, the USA, and New Zealand (ABS, 1999b); European countries, including the UK, show slightly higher levels.

Exposure of older pedestrians is also influenced by the fact that walking is the primary mode of transport among many of these road users. Keall (1995) reported that the percentage of travel time spent walking is highest for people over 65 years.

To develop effective countermeasures for reducing older pedestrian casualty numbers, there is a need to better understand the causative factors for these crash types. Studies investigating these factors in the past often cite cognitive decline as having

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a possible contributory role (Fildes and Corben, 1994; OECD, 2001; Rouse, 2002; Oxley, 2002; ATSB, 2002a). A potential contributory role for cognitive decline in the behaviour of older pedestrians has also been demonstrated in comparisons of road crossing behaviour between older and younger people (Oxley et al., 1997, 2001). However, there has been little formal study of associations between cognitive decline and older pedestrians.

Cognitive ability is known to decrease as part of neurodegenerative disease such as Alzheimer's disease. In Australia, approximately 6% of people over the age of 65 years and nearly 25% of people over 85 years have diagnosed dementia (Henderson and Jorm, 1998). Alzheimer's disease (AD) accounts for about 60% of these cases. Additionally, there are many people diagnosed with mild cognitive impairment (MCI), who are functionally affected but do not meet criteria for dementia (Busse et al., 2003; Fisk et al., 2003; Graham et al., 1997; Ritchie et al., 2001). Mild cognitive impairment and Alzheimer's disease affect brain functions such as complex attentional processes, secondary memory, accessing of word knowledge, visuospatial ability and some forms of abstract reasoning and problem solving, some of which will be vital for safe pedestrian behaviour.

We have previously examined the brains of a sample of older people who died in pedestrian accidents in the Sydney metropolitan area and found that they have increased neurofibrillary tangles (NFT), one of the neuropathological hallmarks of Alzheimer's disease, compared to older people who died of other causes (Gorrie et al., 2006). In the current study, we have examined the crash characteristics of the same sample and tried to identify which particular traffic situations have a higher risk for older people with possible cognitive impairment, as indicated by high levels of NFT pathology.

2. Methods

2.1. Study design

This study examines crash characteristics of fatally injured older pedestrians in the Sydney metropolitan area. The first part of the study describes the characteristics of these older pedestrian crashes. The second part examines possible associations between crash characteristics and the level of dementia pathology as previously determined for these pedestrians (Gorrie et al., 2006).

2.2. Subjects

Subjects comprised 52 pedestrians (24M:28F) aged between 65 and 93 years (mean 77.7 ± 7.3 years) who died following a vehicle–pedestrian crash between 1997 and 2003 in the Sydney metropolitan area. All subjects underwent a coronial post-mortem examination at the Department of Forensic Medicine, Central Sydney Laboratory Services as required under the NSW Coroner's Act (NSW Coroner's Act, 1980).

The Human Research Ethics Committee of the University of New South Wales and the Human Ethics Committee of the Central Sydney Area Health Service approved the study.

The New South Wales State Coroner granted permission to access death investigation records.

2.3. Crash investigation

2.3.1. Crash characteristics

General information about the crash was initially determined from the brief narrative on the post-mortem report supplied by the attending police at the time of death. Further detailed documentation was obtained by examining the legal brief prepared for the NSW State Coroner. The Coroner's brief contained police and witness statements, photographs of the crash scene and diagrams of the crash location compiled by trained accident investigation officers. Data were recorded for the type of crash, the time and day, the weather and natural lighting at the time, the type of critical event leading up to the accident and any extenuating circumstances. Where possible, the crash site was visited and a scene plan illustrating the main features of the location was compiled.

2.3.2. Responsibility for the crash

From the data collected, cases were classified into those where responsibility for the crash was attributed to the driver of the striking vehicle and those where responsibility was attributed to the pedestrian. Responsibility for the crash was attributed to the driver of the vehicle if they were charged with an indictable offence, lost control of the vehicle, struck a pedestrian on a marked zebra crossing, or if a specific negligent action of the driver was determined to be contributory to the crash. The pedestrian was deemed to be responsible if they walked, ran or fell into the path of a vehicle and none of the above criteria applied or if they disobeyed a red 'don't walk' signal at a crossing controlled by traffic lights.

Responsibility was attributed to both parties in impacts involving reversing vehicles, in crashes where the actions of both the driver and the pedestrian was considered to contribute equally to the crash or where a clear determination could not be made. Factors such as weather, lighting, visibility and traffic conditions were taken into account when making these determinations.

2.3.3. Complexity of the crash scene

Two independent assessors were given a summary of the crash and asked to rank crossing location as low, moderate or high complexity based on the overall location, conditions and circumstances of the crash scene. For example, a two way suburban street with light traffic flow and good visibility would have been ranked as low complexity whereas a busy intersection or a location with multiple lanes of traffic would have been ranked as high complexity. There was good intra-rater reliability for complexity categorisation (Kappa = 0.83).

2.4. Neuropathology

The full neuropathological assessment of these subjects has been described previously (Gorrie et al., 2006). Briefly, following fixation in formalin, the brain of each pedestrian subject was