Author's response to reviews

Title: Risk factors for recurrent injurious falls that require hospitalization for older adults with dementia: a population based study

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Reviewer 1

The authors carried out a retrospective analysis of admission records of over 32,000 dementia patients who had severe injurious falls. Appropriate analysis was done. The study showed increased risk in female subjects and age association.

Q   Although a retrospective data analysis, the authors did not include the injuries sustained. Subdural haematoma is a known cause of dementia following even trivial trauma, it would have been appropriate to mention this in the discussion.

R   To be classified as a case with dementia in this study, a participant must have had a hospitalisation with a principal diagnosis or co-morbid condition as 'dementia' prior to the injury occurring. Therefore, this should not pose an issue. As well, the focus of the paper was not about the cause of the dementia.

We have not included the type of the injury sustained as this was beyond the scope of this current paper. This paper is specifically assessing risk factors for recurrent falls regardless of the type of injury sustained in the fall.

Q   There was no mention of how dementia was diagnosed - the instruments and disease severity. It would have been useful if there was some information on the duration of dementia - acute vs. chronic disease. These issues point to the challenges of retrospective analysis for a condition like falls in the elderly. The authors alluded to the fact that there were no records of medications which are known to add to the risk of falling in older individuals.

R   Dementia was ascertained only by hospitalisation records, not by formal assessment. However if dementia was recorded in their hospital records then we are confident that they had dementia as they would have to be diagnosed by a clinician. Unfortunately it is a limitation of the data linkage that information on duration and severity of dementia and medication usage is not available. This has been described in the limitations section of the discussion (p12) "Unfortunately it was not possible to determine any concurrent use of medications that may have contributed to the fall as this information was not available in the WADLS" and (p.13) "Another limitation of the study is that we were not able to determine the exact onset of dementia or the severity of the disease which would likely impact on recurrent injurious falls risk."

Reviewer 2

This is an interesting study using population linked information from hospital admission and death registry to evaluate fall-related injuries that required hospitalization. Importantly, the study addresses the under-studied, though very vulnerable, patient population of older adults with dementia. I feel there are some deficiencies in the reporting of the methods to fully understand the study processes, including the assumption of the index hospital admission as the time of new diagnosis and the actual fall outcome of interest.

Q   Major Concerns: Abstract - conclusions. "screening for falls history at the time of dementia diagnosis" is not substantiated with this study as it is not substantiated that the index admission is the time of diagnosis.

R   Agreed. This statement has been changed to: "Screening those with dementia for injurious falls history could help to identify those most at risk of recurrent injurious falls" (p.2)

Q   Was end of follow-up always related to death or the end of the time frame of study interest? Could people move out of the area and then how would this information be captured?

R   Inclusion criteria stipulated that they were residents of WA at the time of their hospital admission. This has been added to the paper (p.5) "Cases were aged 60+ years and residents of Western Australia with a hospital record in the HMDS….." It was not known if residents moved out of the State. However, since the modelling only included those who had at least one injurious fall and were hospitalized for it in WA, this issue would have minimal effect on the results.

Q   Page 4, line 1-10. Please provide references to support the statements in the first and third sentences.

R   Thank you, references have been added (p.4).

Q	I am not entirely clear of the methodology after the selection of all hospital admissions of any cause with a dementia diagnosis. My understanding is that the hospital records were searched for each person for all admissions with an injury and fall coding after the time point they are identified with the index admission to hospital for any cause. So then people would have had to have 2 or more admissions for a fall-related injury to be identified as a faller after the index admission? Or was it anyone who had any fall-related injury admission? This is not well described in the methods and needs clarification.

R	The Conditional Stratified Cox Proportional Hazards model uses only those who had one fall or more (i.e. ≥ 1) in the modelling. Such a model is interested in the risk of having a 2nd fall after an initial fall. This has been made clearer and the following information has been added to the statistical analysis section of the methods on p 7: "The model included all those with dementia who had one or more injurious falls to determine risk factors for subsequent injurious falls after the first injurious fall had occurred."

Q	Also please be consistent with the terminology throughout the paper for the outcome, for example on page 9, line 46 - the discussion references recurrent falls and the abstract and methods talk about "recurrent injurious falls".

R	The terminology has been made consistent throughout the paper, using "recurrent injurious falls".

Q	Is there information on the type of residence the person was living, such as community-dwelling or nursing home. I assume there may be a different threshold for seeking medical care across living residence, either more likely to go to hospital or conversely if there is medical staff on site that can treat something that another centre without onsite medical staff may not be able to treat then the threshold is lower to send the person to hospital.

R	Unfortunately this information was not available in the data and has been added as a limitation to the Discussion on p 14. "The WADLS data also did not capture lifestyle factors, the type of residence the person was living in and physical activity levels, which may all influence falls risk."

Q	Page 5, line 36-44. Not sure the distinction for participant exclusion based on dementia of drug, alcohol or HIV and yet include Creutzfeld-Jakob disease. I am also uncertain about the "non-specific dementia" category and the possibility that it includes the conditions that were specifically excluded.

R	Non-specific dementia does not include conditions that were specifically excluded. This category included unspecified dementia (such as presenile and senile dementia) and dementia in other specified diseases (such as Lewy body disease, multiple sclerosis etc).

Q	Page 5, line 44-49. The exclusion of people with an admission that includes a diagnosis of dementia prior to the time frame of interest is not clear. Also please clarify the wording, "previous hospital record for dementia" - does this mean a primary diagnosis or

admission reason being dementia rather than a person having any admission with an accompanying diagnosis of dementia. Please clarify whether the intent was to assume an admission that corresponded to "dementia" being a relevant co-morbidity as timing for the provision of a new diagnosis of dementia, stated within the abstract "screening for falls history at the time of dementia diagnosis". How can one presume that the person did not receive a dementia diagnosis at some time prior to the index hospital admission? This needs to be more elaboration of the limitations of this assumption in the discussion

R   Those who had a hospital admission that included dementia as a principal diagnosis or a co-morbid condition prior to the timeframe of interest were excluded. This has been clarified on p.5. "…each participant's hospital records were searched from 1970 onwards to identify those with a previous hospital record that included dementia as a principal diagnosis or a co-morbid condition and were excluded from the analysis."

We acknowledge that a limitation of using linked hospitalisation data is that the date of dementia diagnosis cannot be specified. We do not presume that a person did not receive a dementia diagnosis at some point prior to the index hospital admission, but the index admission is used as the best available estimate of dementia onset. This limitation has been clarified in the discussion (p.13). "While the index hospital admission was used as the best available estimate of dementia onset, it cannot be presumed that participants did not receive a dementia diagnosis prior to this"

This methodology has also been used in previous data linkage studies by other authors examining dementia. Zilkens et al., 2013. Earlier age of dementia onset and shorter survival times in dementia patients with diabetes. American Journal of Epidemiology, 177(11): 1246-54.

Q   Is it possible to provide a summary of the types of injuries that were sustained by the people? This information would be informative as previous research for falls in the general population of older adults have provided a summary of the types of injuries.

R   As mentioned previously this was beyond the scope of this paper. This paper is specifically assessing risk factors for recurrent falls regardless of the type of injury sustained in the fall.

Q   There may also be social reasons for one person being admitted to hospital and another person being discharged home after the same type of injurious fall. In the discussion, page 13 line 46-48, it would be important to know what kind injuries were present for these people to give a context to this statement or justify why the information was not collected. There needs to be more discussion of possible limitations to this in the discussion.

R   Agreed. This has been better clarified and the following information added to the discussion (p. 14). "Finally, it should be noted that the data analyzed from the WADLS represented only the more severe cases of falls that required hospitalization for more than twenty-four hours." It should also be acknowledged that having a diagnosis of dementia may have increased the need for hospitalization in the event of a fall due to social reasons, rather than the injury, especially if a person was living alone."

Q   Coding for the comorbidity variable needs further justification. Why is someone with 1 comorbidity seen as being equivalent to someone who might have 17 comorbidities? Yet, why are different comorbidities seen as equivalent in disease burden and a simple sum is used to give a summary value (page 6,line 58)? On page 6, it is stated that an unweighted comorbidity score was assigned based on the cumulative number of comorbidities, yet comorbidity is presented as a dichotomy in Table 1 and would appear to be a dichotomy in the regression analysis. Can you please clarify.

R   This method of coding for the comorbidity variable was selected as it is the way that comorbidity has been classified for previous linked data studies undertaken in WA which has been developed by Holman et al (1999). In addition, in our experience when undertaking regression analysis it is easier for interpretation to classify comorbidity as dichotomous.

Q   Could you clarify if the hospital records reviewed included emergency room visits or only people who were admitted to stay in the hospital? Was there a time frame required for admission duration, for example the person had to be in hospital for 24 hours or something. Some fall-related injuries could be treated solely in an emergency room visit (e.g., wrist fracture not requiring surgery) versus a hip fracture requiring a hemiarthroplasty.

R   Thank you. This has been clarified in the methods section (p. 6). "The hospital records include only those who were admitted to hospital for more than twenty-four hours and do not include those who visited an Emergency Department only."

Q   Also is it possible to provide information on length of hospital contact, such as emergency room visit without admission or hospital admission for x number of days. Again there may be social reasons for one person being admitted and another not to be admitted after an injurious fall that have nothing to do with the injury directly. Please provide clarification.

R   Emergency Department visits are not included in the data. However we have alluded to this issue in the Discussion (p.14) "It should also be acknowledged that having a diagnosis of dementia may have increased the need for hospitalization in the event of a fall due to social reasons, rather than the injury, especially if a person was living alone".

Q   Page 6, line 34-39. What if there wasn't a previous hospitalization?

R   Co-morbid conditions were obtained from previous hospitalisation records as well as the index hospital admission records. This has been clarified on p 6. "A comorbid health condition was classified as having one or more of the following 17 conditions described by Holman et al. (1999) recorded during a hospital admission as a main diagnosis or a comorbidity in the five year period prior to and including the index hospital admission."

Q   Table 1 needs to be cited in the text.

R   Added (p.8).

Q   Page 10, line 7. The statement relating to the importance of these findings at time of diagnosis is not supported and the methodology as written cannot accurately determine time of diagnosis. At some time between one hospital admission and an admission with dementia listed as a medical condition, a diagnosis occurred. So unless there is additional information that was not included in the methods to corroborate the index admission as the time of being newly diagnosed with dementia, then this speaks beyond the data. Please clarify.

R   Thank you. The time of diagnosis is simply a best available estimate (see above), though our findings suggest it is important to screen anyone with dementia for a history of falls. We have clarified these statements in the abstract (see above) and main text (p 10) "This finding suggests that it is essential to screen all those with dementia for injurious falls history in order to identify those most at risk of recurrent injurious falls."

Q   Table 1. In the headings for falls (no falls, 1 fall, 2 or more falls), are these 1 injurious fall and 2 or more injurious falls? Please amend wording for precision of information and consistency with in manuscript. Also the title of the table is not very informative as written, more detail is required.

R   Thank you. Falls has been amended to "injurious falls" in the table. The title has been amended to "Characteristics of 32,519 Western Australian dementia patients by number of injurious falls observed, 2001-2013"

Q   Table 2. Is "fall in previous year" any fall type? Please clarify in text. Are the variables listed in Table 2, the only variables that were included in the adjusted analyses? How was this subset of variables selected?

R   Fall in the previous year did include any injurious fall type. Fall has been amended to "injurious fall" in the table and results section (p.9). The variables listed in table 2 are the only variables included in the model as this is the only information provided by the linked databases. These were also the variables of interest based upon the literature reviewed in the Background section.

Q   Minor Concerns. Please review the manuscript for some errors in grammar.

R   Thank you, manuscript has been reviewed.

Editorial requests

R   Thank you. All editorial requests have been met. The dataset on which the conclusions of the paper rely cannot be deposited in a publicly available repositories due to confidentiality restrictions on data obtained from the Western Australian Data Linkage System.