Reviewer’s report

Title: Fall incidents unraveled: An observational video-based real life fall events study

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Reviewer: Yijian Yang

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General Comments:

The submitted paper provides important evidence regarding falls in private areas using video capture. This supplies additional information to a recent article published in the Lancet that focuses on falls occurred in common areas (e.g., dining room, hallway, and lounge) (Robinovitch et al., 2013). In this submitted paper, the authors reported fall characteristics observed from the video footage in assisted living (ALR) and residential care (RCR). The observation process was based on the fall classification system suggested by Noury et al. (2008). The analysis from video-captured falls provided detailed and objective evidence on the four phases of falls. However, the paper at this stage has some limitations and need to be revised.

Major Compulsory Revisions:

1. The authors stated that their aim was to provide an analysis and description of video-based real-life falls and to evaluate the classification system for falls suggested by Noury et al. The last aim is not very clear, as this study only included three participants with 26 falls captured on videos. This should not be considered as a “gold standard” to evaluate another system. It may be clearer to state the aim as: to use the fall classification system suggested by Noury et al to examine the circumstances and stages of real-life falls in three participants in ALR and RCR.

2. Some fall characteristics were missing. For example, what was the cause leading to imbalance (e.g., trip, slip, incorrect weight shifting, loss of support with external objects) (Robinovitch et al., 2013; Overstall et al., 1997; Topper et al., 1993; Berg et al., 1997)? Did the individual execute any protective responses (e.g., stepping, grasping, hand arresting) (Maki & McIlroy 2006; Hsiao & Robinovitch, 1998)? Did the fall result in an impact to key body sites (e.g., head, hip, hand, etc) (Nevitt & Cummings, 1993; Greenspan et al., 1994, Feldman & Robinovitch, 2007)? This information is important for future fall and injury prevention. In this study, falls captured on video were analyzed using the classification by Noury et al. However, it is possible to acquire more information through the video analysis.

3. Another interesting question is whether falls occurred in private areas are similar as falls in common areas (Robinovitch et al., 2013). If not, how different
are they? The sample size may be an issue for comparing these results, while it would be valuable to observe those variables of interest and consider the results on context from the study by Robinovitch et al (2013).

4. The small sample size of this study makes it difficult to generalize the results. This study only included three participants with 26 falls captured on videos from two different settings (two from ALR and one from RCR). This should be considered as a “case study”. Due to the small sample, the findings (e.g., fall direction, impact body sites) may be different from when including a larger sample, and may not represent all falls in ALR and RCR settings (due to the variability of resident characteristics). The manuscript needs to present the results and interpretation on an individual participant basis.

Specific Comments:
Minor Essential Revisions:

5. Abstract: The method section did not provide any information about how they analyzed the video footage, and who was involved in the analysis. Please clarify by adding this information.

In the results section, the “impact site” was missing. Participants mainly fell backward (62%). Did they land backwards too? Since there was not statistical test of validation, it would be clearer to state that the results are consistent with fall classification by Noury instead of “validate”. The sentence - “postfall phase was not typically characterized by an inactive participant” was not clear. Please clarify.

The conclusions need to be specific. It is important to indicate that the falls all occurred in the private areas of the assisted living and residential care settings.

6. Introduction: The authors stated that the aim of this study was to provide a thorough analysis and description of video-based real-life fall events consisting four phases. However, the authors emphasized the consequences of not being able to get up after a fall (post falls and recovery phases) in the second and third paragraphs. Information regarding pre-fall and critical phases is missing in the introduction. Please include more references about the importance of observing the other two phases – pre-fall and critical phases in this introduction.

In the second paragraph, the authors referenced that “20 to 80% of older persons who fall are not able to get up unaided”. This range is quite large and probably includes older adults in the community and residential care. Is the sequence less common in residential care than the community? Please explain and separate the two if possible.

In the third paragraph, the authors stated “To detect falls and validate the camera system...” Presumably, the long term goal is to automatically detect falls (through processing of video footage), but this was not done yet. The authors then adopted the theory-based classification system by Noury to observe the fall process. Since this is a video-based observational study, it would be more
appropriate to reference and discuss the study by Robinovitch et al (2013) before mentioning Noury. The Robinovitch’s study is largely comparable with Noury, with the exception that no analysis on the “post-fall” stage.

Later, the authors also mentioned to use video approach to validate the classification system by Noury. The concept of “validation” is problematic. How could it be wrong? (e.g., how could a fall not follow each of these stages)? It would be clearer to state “to use the Noury model to examine the circumstances and stages of real-life falls”.

The authors referenced Robinovitch’s study at the end of the introduction. The environmental and situational context may be different between falls in common areas and bedrooms, but the falls may be similar (e.g., following the same 4 stages). Thus, analysis of the current results within the context of Robinovitch’s study is essential.

7. Methods: The authors did not mention the inclusion criteria of participants and the reasons of only selecting three participants. This relates to concerns about the generality. Were there any other potential participants who were excluded from the study (e.g., due to the inability of doing physical or cognitive testing)? In addition, Participants in this study all completed the TUGT and two participants had high MMSE scores. This may not represent the general population in ALR and RCR where most people have impaired physical and cognitive function. Perhaps this is due to the small sample and selection bias.

The video analysis was completed by two individual raters. I wonder how much disagreement between the two raters and the reason of disagreement, as this reflects the reliability of the analysis approach. If there is a lot of disagreement between two individual raters, a team approach with discussion during the analysis may be more appropriate.

The definition of the fall in this paper is out-of-date. This definition excludes some falls that are due to loss of consciousness or seizure, which can be the cause of falls in ALR or RCR. The recent definition by the Profane group (Hauer et al., 2006) defined a fall as “an unexpected event in which the resident comes to rest on the ground, floor, or lower lever”. It is more appropriate to use this most recent definition.

The current paper included the “fall direction” in the “critical phase”. It is unclear whether this refers to the initial direction after the imbalance or the landing direction up to the impact. Please clarify. Other fall characteristics such as “impact sites” also need to be included in this phase.

8. Results: In the “Prefall phase”, the authors mentioned that Participant A fell only once, but did not mention the number of falls by Participant B (n=10) and Participant C (n=15) (captured on video) when presenting the results of the activity at the time of falls.

The authors listed the activities at the time of falls, but the cause of falls was missing. For example, was a fall during walking caused by “tripping”? It is
possible that participant C in the Figure 2 was tripped by the carpet on the floor during walking. Determining the cause (biomechanical or environmental) of the fall will help prevent the future falls (e.g., modification of the environment). It will be valuable to provide “the cause of falls” in this manuscript.

In the “Critical phase”, the authors excluded 5 falls because “in three cases, residents B and C lost balance, but were able to hold on to an object (chair, door or table) for a short time, and fell with a delay to the ground”. This is considered as “balance recovery by grasping” and should be included in the critical phase, unless the fallers were able to re-establish a stable posture for a relatively long period of time and then lost balance again. In the latter situation, the falls need to be re-analyzed starting from the failure to maintain a stable posture during standing.

In the “Postfall phase”, the authors mentioned that “there were 17 (65%) falls in the living area, four (15%) in the sleeping area, three (12%) in the hall and two (8%) in the bathroom”. Where are the living area and hall in a private bedroom? Please clarify and perhaps indicate them from the Map in Figure 1.

Also, In this phase, by comparing the mean time of lying on the ground with a call alarm (11 minutes; n=14) to without a call alarm (28 minutes; n=5), the difference seemed large but not significant. This may be due to the small (and unequal) sample size, which needs to be clarified in the paper. Meanwhile, please specify the analysis before reporting the p-value (e.g., Mann-Whitney U-test).

Since there are only three participants in this study, and fall characteristics from multiple falls within each participant may be similar, it would be clearer to present the data separately for each individual.

9. Discussion: in the second paragraph, the authors found that “in more than half of the falls a walking aid was used. This differs from 21% reported in the study by Robinovitch et al”. This difference may be because of the small sample in this study (n=3, compared to n=130). In addition, all three participants in this study are mobility aid users. Please include this information in the discussion as this is one of the reasons causing the difference. The authors also need to include more meaningful discussion of cause and activity, compared to Robinovitch et al (2013).

In the fourth paragraph, the authors indicated that about 62% of falls were backward, which is different from other studies where participants mostly fell forwards [26] or sideways [31]. The authors suggested that this difference might be due to the retrospective self-reportage with a potential recall bias in those studies. On the other hand, it may be due to the different study population (community vs. residential care). Again, the small sample of participants with multiple falls also made it difficult to draw any conclusion, as same fallers may tend to fall similarly in terms of fall direction (or other mechanisms). In addition, fall direction may be defined differently in different studies. Please clarify the fall direction in this study.
Only 1-2% of falls caused hip fractures and hip fractures are determined by many factors. The authors made the assumption that “The direction of the fall might also partly explain the absence of hip fractures in our study, as sideward falls are independently associated with hip fractures”. This sentence is not appropriate due to the small sample in this study. On the other hand, fall direction can be changed due to the body rotation during descent. The authors need to consider the changes in fall direction between initiation and landing.

On page 14 the first paragraph, the authors mentioned “even in residential care facilities time on the ground is an important issue given its serious consequences.” Please provide the references to support this statement.

The authors also suggest separating the critical phase into two, but the two phases were not clearly described. These two phases may include a balance recovery phase after the imbalance, and descending phase after the failure to recover balance. Please be specific.

10. In Table 1, Please provide disease diagnoses that may be associated with falls (e.g., Hypertension, Cardiac Arrhythmia, Stroke, Alzheimer’s disease, etc) if the participant has any of those. The high-risk drugs include psychotropics, antidepressants, and diuretics. It would be better to specific which drug was used by each participant. “Fell in past year” is not specific. Please include the number of falls in the past year. In addition, the IADL ranges from 0-8, while the scores for three participants are 21, 27, and 26. Please clarify.

11. In Figure 2, Participant A fell sideway resulting in hip impact and Participant C fell forward impacting her head, despite both of them used their hands to arrest the fall. This information is missing in this paper. It is important to include the impact sites as an important variable in the “Critical phase”, as this information will guide the prevention of fall-related injuries.

**Level of interest:** An article of importance in its field

**Quality of written English:** Acceptable

**Statistical review:** Yes, and I have assessed the statistics in my report.

**Declaration of competing interests:**

I declare that I have no competing interests