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Insights into the mechanisms and context of real-world falls: A framework analysis

Naser Taleshi

n.taleshi@exeter.ac.uk

University of Exeter

Genevieve K.R. Williams

University of Exeter

Sophie Parker

University of Exeter

Jochen Klenk

Robert Bosch Hospital

Clemens Becker

Robert Bosch Hospital

Lars Schwickert

Robert Bosch Hospital

Lorenzo Chiari

University of Bologna

Luca Palmerini

University of Bologna

William R. Young

University of Exeter

Sarah E. Lamb

University of Exeter

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Insights into the mechanisms and context of real-world falls: A framework analysis

Naser Taleshi[1*], Genevieve K.R. Williams[1], Sophie Parker[1], Jochen Klenk[2], Clemens Becker[2], Lars Schwickert[2], Lorenzo Chiari[3], Luca Palmerini[3], William R. Young[1], Sarah E. Lamb[1]

[1]Department of Public Health and Sport Sciences, University of Exeter, St Luke's Campus, Heavitree Road, Exeter, EX1 2LU, UK.
[2]Department of Clinical Gerontology, Robert Bosch Hospital, Auerbachstraße 110, Stuttgart, 70376, Germany.
[3]Department of Electrical, Electronic, and Information Engineering, University of Bologna, Viale del Risorgimento 2, Bologna, 40136, Italy.

*Corresponding author(s). E-mail(s): n.taleshi@exeter.ac.uk;

Abstract

Background: Short narrative reports (SNR) are often recorded immediately after fall events. SNRs have not been used to study falls, most likely because they have unknown structure and consistency. We aimed to investigate SNRs provided alongside verified real world falls, to determine whether they can provide useful insight into the mechanism of falls in two settings: community-dwelling (CD) and geriatric rehabilitation (GR) settings.

Methods: We analysed 270 SNRs of real-world falls, captured immediately after each event. The SNRs included a narrative description from the individual or a bystander, and prompts for specific information (e.g. fall direction, pre-fall activity). We developed a framework to analyse the SNRs and identify core sub-themes that were consistently reported, and then compared key themes (transitions and object interactions) across the CD and GR groups.

Results: We extracted four core sub-themes for the framework: initial status, intended status, interacting object, and fall direction. Of the 270 falls, 211 (78%) were sufficiently detailed to chart complete fall scenarios. Objects were

involved in 82% (173/211) of these falls. Falls were frequently reported to occur during transitions between sitting, standing, and walking, and often reported to involve interaction with objects such as static seats, mobility aids, and static furniture. CD participants reported more diverse fall circumstances (47 unique scenarios), often involving standing up from or sitting down on static seats, walking without object involvement, or navigating near static furniture. GR participants reported more walking-related falls involving mobility aids, but fewer varied scenarios (22 scenarios).

Conclusions: The SNRs can provide consistent, and potentially important insights into real-world fall circumstances. Our analysis highlights how specific activities and object interactions may contribute to loss of balance, particularly during common daily transitions; this supports group-specific prevention strategies for CD and GR populations.

Keywords: Real-World Falls, Short Narrative Reports, Framework Analysis

1 Introduction

Falls are a leading cause of injury, hospitalisation, and loss of independence in older adults (Peel 2011; Cumming et al. 2000). Falls account for approximately 684,000 deaths each year globally, with the majority occurring in people over 60 years of age (World Health Organization 2021). Studies have investigated risk factors that contribute to falls, and categorised risk as intrinsic, behavioural, and environmental (Tromp et al. 2001; Robinovitch et al. 2013). Most risk factor studies use a prospective cohort design, collecting data on pre-defined risk factors at baseline and asking participants to report falls retrospectively at fixed time-points during follow up (e.g. Deandrea et al. (2010)). Occasionally cohort studies use prospective fall diaries, where participants alert the study office when a fall occurs. Typically, a brief structured interview follows on a few weeks after the fall. Studies of real-time fall events are remarkably rare. Video analysis has been used successfully in long-term care environments and nursing homes to capture some sequences of the fall events (Choi et al. 2015; Holliday et al. 1990; Komisar and Robinovitch 2021). Video facilitates observation of interactions between objects and people, but data on movement intention and

sensory experiences during the fall are lacking. The scope of surveillance is curtailed by privacy concerns. An alternative, but unstudied source of data is brief narrative and contextual reports taken from people who fall, or those who observe them, recorded directly after the events, for example, accident and incident reports collected in hospital settings. These reports are often collected in various settings and are a combination of structured and unstructured data. Here we analysed the narrative and contextual reports of 270 confirmed real-world falls. Our aim was to characterise the data reported in SNRs and to determine whether these reports could provide a framework for understanding the mechanisms and environmental context of real-world falls from the perspective of the faller or a bystander, as recorded at the time of the fall. Based on this characterisation we also compared fall scenarios between CD and GR settings.

2 Methods

2.1 The context: framework analysis of the FARSEEING fall dataset

The FARSEEING study was a multi-centre project that collected a large repository of real-world falls from older adults across five sites in Germany and one in New Zealand. All falls were verified using body-worn inertial measurement units (IMUs), and accompanied by a short structured contextual report and unstructured narrative report of the fall event provided by the person who fell or an immediate witness to the fall (e.g., caregiver). The methodology has been described in detail elsewhere (Klenk et al. 2016). Structured contextual data were (age, sex, primary medical condition (if any), setting, assistive device use, fall location, pre-fall activity, and time of fall, etc). Participants who fell, or the immediate carer were asked to provide the SNR by describing how the fall occurred. In this paper, we studied only narrative reports, and did not draw on any specific data from the IMUs other than to know a fall had occurred.

In this study, Framework Analysis (FA) was applied to the narrative reports to determine if, and what themes emerged as consistently reported common fall circumstances. A framework was developed and applied across all narratives. FA involved six stages: familiarisation, initial inductive coding, developing a working analytical framework, applying the analytical framework, charting and matrix construction, interpretation and quantitative summary (Gale et al. 2013; Smith and Firth 2011). In the initial coding three researchers from different disciplinary backgrounds, independently open-coded a subset of 150 narratives. Reports were annotated and emerging themes were labelled and described. This early inductive coding helped generate a preliminary framework which was then applied to the full set of 270 narratives. Ambiguities in the narrative were supplemented by cross-referencing structured metadata on fall direction and pre-fall activity. If a fall direction was not clearly stated in either source, it was marked as Unknown (UNK). Cases with no clearly identifiable object or insufficient narrative detail on interacting objects were coded as No Object / could not tell (CNT). Each researcher coded independently, and any discrepancies were resolved through discussion to ensure consensus and consistency across all coded data.

Coded data were transformed into a binary matrix using MATLAB (The MathWorks Inc. 2021). This FA step, known as charting, organises qualitative codes into a systematic format. We generated Sankey diagrams to illustrate the common themes or fall scenarios and descriptive statistics such as postural transition frequencies. Sankey diagrams facilitated visual depiction of the temporal alignment of the fall report, ultimately allowing a reconstruction of the reported fall. To estimate whether major themes in the data occurred more than by chance, we applied a one-sample proportion z-test for each stage of the reconstructed fall event. We assumed a uniform probability distribution across all observed transition types and calculated the expected proportion for each FA-stage. For each estimate, we report a z-score, p-value, 95% confidence interval and Cohen's h effect size (Cohen 2016). We explored whether scenarios varied

across community-dwelling and rehabilitation groups. We calculated odds ratios (OR) to compare observed vs. expected frequencies. The statistical results are exploratory and not intended to provide definitive inferences. Given the large number of transitions tested and the assumption that each scenario was equally likely under a uniform model, we interpreted p-values < 0.05 as indicative rather than conclusive. Our interpretation focused on transitions with large deviations from expectation or clear group differences.

2.2 The process of carrying out framework analysis

Figure 1 provides an overview of our six-stage FA process which illustrates how we progressed from an initial dataset of 270 unstructured fall reports to a structured visual and statistical summary. Stage 1 involved familiarisation with the data through open-ended reading. In Stage 2, three researchers independently open-coded a subset of narratives to identify recurring themes. Stage 3 developed a working framework with four core sub-themes: Initial Status, Intended Status, Interacting Object, and Fall Direction, along with 13 object classes defined. In Stage 4, the framework was applied to all 270 narratives, resulting in 211 cases retained after excluding those with insufficient detail. Stage 5 charted 211 coded data into a binary matrix, organising the data into a more manageable format and facilitating data analysis in the next stage. Finally, Stage 6 combined statistical analysis and visualisation (Sankey diagrams) to identify common themes and setting-specific differences.

3 Results

3.1 A narrative-informed framework for real-world falls

The framework was applied to all 270 narratives; however, 59 were excluded between Stages 2 and 3 for lacking at least two core sub-themes (21 from the original 97 GR falls (∼21.6%), 36 from 163 CD falls (∼22.1%), and 2 from assisted living). This left

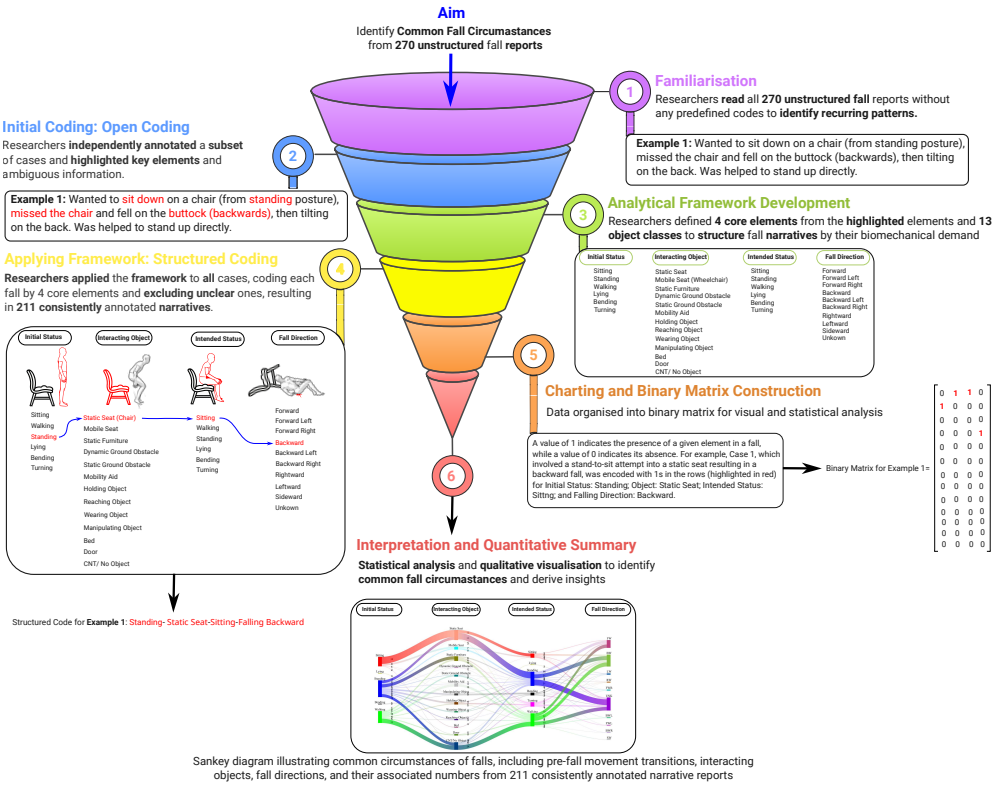


Fig. 1 Overview of the six-stage analytical process used to transform 270 unstructured fall reports into structured descriptive information. The funnel structure illustrates the progressive refinement: from initial open-ended familiarisation to framework development, structured coding, matrix construction, and interpretation. Example 1 shows how a single narrative was analysed using agreed definitions for the four core sub-themes: Initial Status, Interacting Object, Intended Status, and Fall Direction. The process led to a qualitative visualisation (Sankey diagram) and statistical analysis across the dataset of 211 coded cases.

211 coded fall events verified from 98 individuals (mean age 71.0 ± 11.8 years; 127 from CD, 76 from GR patients, and 8 from assisted living or nursing homes) for final analysis. Among 211 included cases, 173 had valid timestamps, with a mean reporting delay of 24 min after the fall and 75% of reports made within 15 min, indicating minimal recall delay and high contextual reliability. Stages 5 and 6 involved charting these coded data into a binary matrix and applying statistical and visual analyses (Sankey diagrams) to identify common themes and setting-specific differences.

Table 1 provides summary data for participants included in our analysis, and descriptive statistics on fall characteristics across 211 verified events.

Table 1 Participants ($n = 98$) and Fall Characteristics ($N = 211$ falls)

Category	Details (No., %)
Participants ($n = 98$)	Male 47 (48.1) / Female 51 (51.9) Age (mean (SD)): 71.0 (11.8) Height (mean (SD)): 169.9 (9.8) Weight (mean (SD)): 75.8 (15.7)
Fall setting ($N = 211$)	CD 127 (60.2), GR 76 (36.0), Other 8 (3.8)
Fall location ($N = 211$)	Indoor 182 (86.3), Outdoor 12 (5.7), Unknown 17 (8.1)
Pre-fall activity Reported ($N = 211$ falls)	Walking 61 (28.9), Sit-to-stand 45 (21.3), Standing 37 (17.5), Transfers 6 (2.8), Bending 5 (2.4), Turning 5 (2.4), Sitting down 4 (1.9), Lying 3 (1.4), Sitting 4 (1.9), Other 7 (3.3), Unknown 34 (16.1)
Assistive device ($N = 211$)	Yes 32 (15.2), No 78 (36.9), Unknown 101 (47.9)
Fall direction ($N = 211$)	Backward 71 (33.6), Forward 54 (25.6), Sideways 16 (7.6), Unknown 70 (33.2)
Time to report	Average: 24 min, 75th percentile: within 15 min

The framework captured four key sub-themes that were reported consistently across the narratives analysed: Initial Status, Interacting Object, Intended Status, and Fall Direction. Initial status describes the person's reported posture or movement just before interacting with an object (e.g., standing, walking, bending). The interacting object refers to any environmental object reported to be involved in the fall (e.g., chair, walker, carpet). Intended status indicates what the person was reported to be trying to do at the time (e.g., sit, continue walking, stand), and fall direction captures the direction in which the fall was reported to occur.

Sub-themes: The initial and intended status were reported in all 211 narratives analysed. Initially (before interacting with object), participants most commonly reported standing (90/211), followed by walking (64/211) and sitting (51/211). From these initial postures, participants often reported intending to transfer to standing posture (76/211), walking (70/211), turning (24/211), or sitting down (23/211). Of

the 211 falls included, 82% reported an interaction with an identifiable object and 18% of falls occurred without a reported object or with ambiguous object interaction (CNT). The narratives referenced 73 distinct objects. We grouped them into 13 object classes (see stage 3 in Fig. 1 and Table 2) that list the ergonomic codes to describe the type of human interaction occurring with the object. Static seats (e.g., chairs, toilets) were reported in a quarter of fall cases, exclusively during sit-to-stand (SiTS) or stand-to-sit (STSi) transitions. Static furniture (e.g., beds, tables, cabinets) were reported in ∼12% of fall cases, typically when participants were initiating walking from a standing position near the object or navigating around it. Mobility aids (e.g., walkers, wheelchairs) were reported in 9% of falls, either as a support device or as a source of instability. Finally, 141/211 of falls reported had known directions where backward falls (including backward (BW), backward-right (BWR) and backward-left (BWL); 71/211) were the most common outcome reported, followed by forward falls (forward (FW), forward-left (FWL), forward-right (FWR) and forward-side (FWS); 54/211), 16 sideway falls (leftward (LW), rightward (RW), sideward (SW) and with a substantial proportion of fall directions being unknown (70/211).

Themes (the sequence of events): Themes were created by linking the four subthemes in sequence to reconstruct full pre-fall transitions. These movement pathways are visualised in Fig. 2, which highlights the most common scenarios across all 211 cases.

Overall, the most frequent theme (transition) reported was standing up from a static seat, observed in 35 cases (16.6%, $Z = 14.75$, $p < 0.001$, $h = 0.55$) which typically involved BW falls. Falls during walking without object interaction or with an unidentified object, were reported in 22 cases (10.4%), also significantly exceeding the expected rate ($Z = 8.49$, $p < 0.001$, $h = 0.37$) and often resulting in BW and FW falls. Sitting down onto a static seat was reported in 14 falls (6.6%; $Z = 4.63$, $p < 0.001$, $h = 0.23$). These typically involved a report of missing a seat or losing

Table 2 Object classes and interactions reported in 270 short narrative reports of falls

Object Classes	Objects / Environmental Factors Reported	Intended Actions
Static Seat	Armchair, Chair, Couch, Sofa, Stool, Car seat, Table, Bed, Toilet, Bath	Non-wheeled stationary seating supports during **Sit** ↔ **Stand** transitions.
Mobile Seat	Rollator, Wheelchair, Wheeled Walker, Walker	This object class included wheeled or moveable seating supports used during **Sit** ↔ **Stand** transitions.
Static Furniture	Bed, Chair, Table, Cupboard, Motorhome, Sofa, Wardrobe, Wash Basin, Staircase, Wall	Large stationary furniture or environmental factors encountered when **navigating** in the environment.
Dynamic Ground Obstacle	Bus, Treadmill	Moving structures that participants **moved on**.
Static Ground Obstacle	Snow Heap, Step, Uneven Ground, Ground obstacle, Carpet, Ground Footwear, Socks, Snow Obstacle	Stationary structures or obstacles that participants **moved over**.
Mobility Aid	Rollator, Walker, Walking Frame, Wheeled Walker, Handrail, Parallel Bars, Ladder	Support-related items that were used either as a **support device** or were identified as a source of instability when **moving**.
Holding Object	Bedlinen, Dishes, Ipad, Iron, Water Glass, Wood, Footstool	**Holding** and manual interaction involving hand or upper limb.
Reaching Object	Door Handle, Doorbell, Telephone, Washing, Drawer	**Reaching** and manual interaction involving hand or upper limb.
Wearing Object	Clothes, Hip Protector, Shoes, Towel	Clothing while **dressing** or manual interaction involving hand or upper limb.
Bending-Associated Object	Bottle, Object, Washing, Water Case, Mop, Cat food	Objects interacted with or manipulated when **bending over**.
Door	Door / Door Sill	**Passage** through door thresholds or sills.
Bed	Bed	**Lying down**.
Could Not Tell (CNT)	No Object Reported	During **any activity** with no clearly identifiable object or insufficient narrative detail.

balance while lowering the body, often resulting in BW or SW falls. The fourth most frequent theme (transition) was "walking with a mobility aid" (e.g., using a walker or rollator), reported in 13 falls (6.2%, $Z = 4.15$, $p < 0.001$, $h = 0.21$).

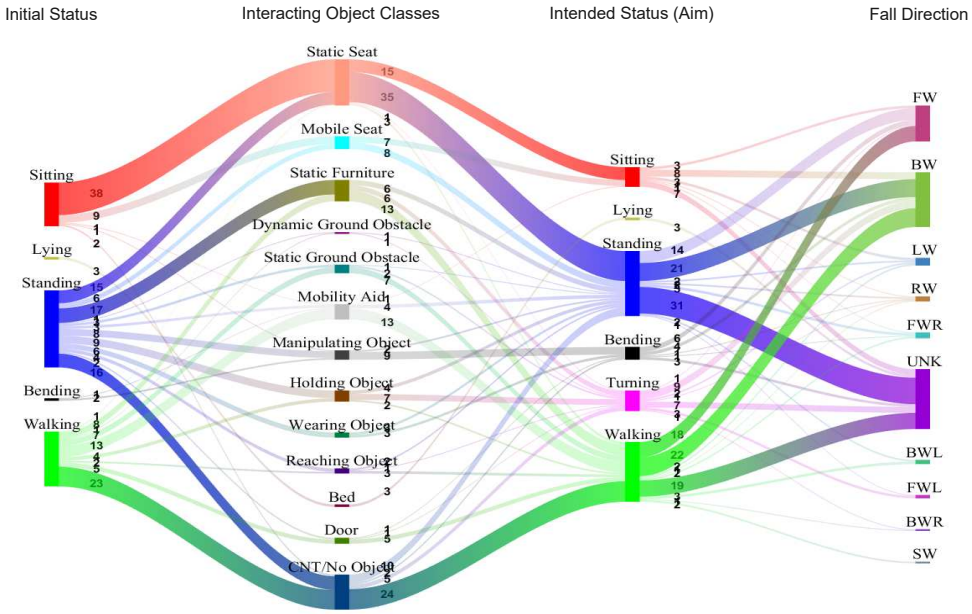


Fig. 2 Sankey diagram illustrating pre-fall movement transitions and their associated fall directions among 211 participants. Nodes represent key initial or intended postures and interactions with environmental object classes. Links between nodes depict movement transitions. The last column shows fall directions, highlighting that BW and FW falls were the most frequently reported.

CD group (127 falls) showed a great diversity in fall scenarios (47 unique object interactions). The most frequent was "standing up from a static seat," with 17 falls (13.7%), significantly higher than a uniform expected rate of 2.6 ($Z = 8.79$, $p < 0.001$, 95% CI: 8.2–20.7%, $h = 0.48$). "Walking without object interaction" reported in 10 falls (8.1%; $Z = 4.49$, $p < 0.001$, $h = 0.30$), and "sitting down onto a static seat" occurred 9 times (7.3%; $Z = 3.87$, $p < 0.001$, $h = 0.26$). "Walking near static furniture" was also significant with 7 falls (5.6%) in this group ($Z = 2.64$, $p = 0.008$, $h = 0.22$). "Standing without object interaction" and "turning near static furniture" each were reported in 6 falls (4.8%; $Z = 2.03$, $p = 0.043$, $h = 0.18$).

In GR group (76 falls), we observed 22 unique transitions with many similar reported characteristics to the CD sample. The most common reported theme was

"standing up from a static seat" (13 falls, 17.1%; $Z = 5.26$, $p < 0.001$, 95% CI: 9.5–27.7%, $h = 0.42$), significantly higher than the uniform expected rate of 3.7, followed by "walking without object interaction" (12 falls, 15.8%; $Z = 4.71$, $p < 0.001$, CI: 8.3–25.9%, $h = 0.39$). "Walking with a mobility aid" was the third most frequent scenario with 8 falls (10.5%; $Z = 2.50$, $p = 0.012$, CI: 4.6–19.8%, $h = 0.26$).

Between group comparisons demonstrated no significant difference in walking without object interaction. However, standing up from a static seat, sitting down onto a static seat, walking near static furniture, standing without object interaction, turning near static furniture and turning whilst holding an object were more commonly reported as intended movements by people living in the community. Otherwise, there were no statistically significant differences between groups.

4 Discussion

This study examined whether unstructured SNRs, alongside other data collected at the time of a fall provided a consistent pattern of reporting across CD and GR settings. Of the 270 fall reports analysed, 211 (78%) were sufficiently detailed to allow comprehensive reconstruction of fall scenarios. These narrative descriptions provided insight into how each fall unfolded from each individual's perspective, with remarkable consistency across the fall themes.

Overall, objects were reportedly involved in the majority of falls (82%), most commonly static seats, nearby static furniture, and mobility aids. This supports the recommendations from the Cochrane review on environmental interventions (Clemson et al. 2023), which shows that modifying home hazards can reduce or even prevent falls in higher-risk older adults. Our work provides insight into potential common hazards. Unlike prior studies that identified objects as static hazards or impact surfaces, we were able to gain insight into how people report interacting with objects during movement and what their intended motion was prior to a fall. In long-term care settings,

Shishov et al. (2024) found nearly one-third of falls were triggered by interaction with objects or people but were unable to capture individuals' intentions or experiences. These intentions, which often precede visible movement and may fail when initiating a task, were recoverable through our FA on narrative reports and represents a unique strength of our approach. Overall, our FA suggests that falls should be treated as failed goal-directed actions embedded in situational and environmental context not merely as isolated events.

Transfers and walking-related movements emerged as the most common fall contexts in our dataset, jointly accounting for nearly 63% of all falls. Sit-to-stand (SiTS) and stand-to-sit (STSi) transitions alone were reported in 32.7% of cases, most often involving static seats such as chairs or toilets (25.6%). This pattern was consistent across both CD and GR groups and aligns with prior studies in long-term care and community settings (Shishov et al. 2024; Robinovitch et al. 2013; Stevens et al. 2014), which identified rising and sitting as high-risk activities. While static seats may appear safe, our findings suggest they can pose substantial fall risks. Older adults may rely on compensatory strategies, such as momentum or pushing off nearby objects, to complete these transitions, which can increase vulnerability to balance loss, especially in the presence of age-related physical decline (van Der Kruk et al. 2021). Our finding may also advocate for chair rise and incorporated stability training as well as awareness to manage furniture the right way. Walking was the next most frequent pre-fall activity (∼30% of cases), and importantly, many of these falls occurred without object interaction (10.4%), suggesting intrinsic factors such as impaired balance or gait control played a key role. Other scenarios included walking with a mobility aid (6.2%), navigating around static furniture (3.8%), and stepping over obstacles (3.3%). Although mobility aids were present in 20% of all walking-related falls, this likely reflects their

dual role, as support tools and as proxies for higher frailty. These findings underline the need for tailored interventions that assess both walking capacity and aid use, ensuring devices enhance rather than compromise stability or adaptability.

Originally developed for social policy research, FA has been widely adopted in healthcare for managing large qualitative datasets while staying close to original narratives (Bryman et al. 1994; Gale et al. 2013; Ritchie and Spencer 2002; Smith and Firth 2011). The FA approach allowed us to systematically incorporate and analyse information about complexities associated with movement intention and object interaction. Nyman et al. (2013) used FA to explore outdoor falls via retrospective interviews with 44 older adults, often describing fall events near roads, bystanders, or without clear causes, and stressed the importance of outdoor environments in fall prevention. However, their data were self-reported up to two years after the event and falls were not verified, raising concerns about recall bias. Our study builds on this by applying FA to a much larger number (270) of verified real-world falls, using narratives recorded shortly after the event. Zecevic et al. (2007) introduced Seniors Falls Investigative Methodology (SFIM) as a systemic approach to reconstruct fall events and identify factors beyond the immediate cause. This method has been applied in both hospital (Watson et al. 2019) and community settings (Gotzmeister et al. 2015) to uncover complex latent risks, such as supervision and environmental disconnects. While we build on this systemic principle, our study differs by shifting focus from extended site-based reconstructions of isolated cases to deriving a generalisable framework from short narrative reports across a larger dataset. However, it is important to acknowledge that these are self or bystander reports. Although each fall was independently verified using IMU data what was reported may not fully reflect what actually happened. Future work will compare IMU data and narrative descriptions to determine how accurate the data are. We anticipate that the most complete picture of the

fall will be a combination of IMU and narrative data in FARSEEING dataset, as IMU data alone cannot capture all elements of the event either.

Also, among the 129 falls with reported direction, backward was most common (45%), followed by forward (28%) and diagonal (18%). Directional dynamics are important for injury risk: Komisar and Robinovitch (2021) reported that transitions from sideways to backward landings reduced hip fracture risk, while the reverse increased it tenfold. Shishov et al. (2024) noted that forward falls more often involved protective contact with nearby objects, whereas backward or sideways falls led to more unintentional impacts to the head and torso. In our data, backward falls frequently reported during sit-to-stand transitions, which may limit opportunities for protective responses. Future integration of IMU trajectories will enable more precise differentiation between initial movement and landing direction, helping to clarify the rotational dynamics highlighted in prior studies.

Falls are inherently unpredictable, making real-time ecologically valid data collection almost impossible (Holliday et al. 1990). This is hindering progress across a wide range of activity in falls, including limiting the effectiveness of interventions through poor understanding of mechanism, and imprecise epidemiology that is impacted by recall bias and complexities around understanding and reporting falls (Lamb et al. 2005). Rapp et al. (2014) and Griffin et al. (2019) demonstrate that retrospective reporting of fall incidence significantly underestimates fall incidence compared to prospective methods. Narrative reports and structured data are common in fall event reports routinely collected in hospitals and care settings. Analysis of these data are likely to provide new insights into intended activity whilst falling, key transitions, and environmental risk factors which will be beneficial in developing interventions in these settings. SNRs are also commonly used in clinical examinations and may improve the tailoring of interventions.

CD participants showed more varied fall scenarios compared to those in GR settings, including turning, bending, reaching, and navigating around furniture, likely due to more diverse environments and a larger sample. In contrast, falls in rehabilitation patients were concentrated in fewer categories, with mobility aids involved in 32% of walking-related falls. Our FA supports previous findings that environmental objects, including mobility aids, can both influence fall impact and contribute to loss of balance. For example, Robinovitch et al. (2013) noted that poorly designed or misused aids may trigger falls. Komisar and Robinovitch (2021) reported that walkers and wheelchairs often featured in LTC falls and, when held, could mitigate head impact. This highlights the need not only for appropriate assistive device prescription, but also for training in their safe and effective use and redesigning for impact safety. Older adults have reported a range of contributing factors, such as divided attention, rushing, being bumped by others, unrecognised hazards, and balance impairments (Berg et al. 1997; Talbot et al. 2005). Commonly cited environmental triggers like uneven surfaces, and slips or trips (Li et al. 2006; Tinetti et al. 1995; Crenshaw et al. 2017) were also present in our study, under the Static Ground Obstacle and Dynamic Ground Obstacle classes, though they occurred less often than other object categories such as static seats, static furniture or mobility aids. Our structured but flexible FA helped reconstruct fall scenarios by tracing transitions between sub-themes, clarifying how intentions and environmental interactions led to falls. This approach offers insight into causal mechanism of falls. Future prevention efforts should build on this understanding, targeting both physical environments and the specific interactions that can destabilise older adults during everyday tasks.

5 Limitation

Several limitations must be acknowledged. Although the unstructured narrative reports were valuable for reconstructing fall scenarios, 59 out of 270 falls were excluded

due to lack of consensus during framework analysis. Additionally, fall direction was missing in 82 of the 211 included cases, limiting inferences about impact orientation. Of the 129 reports including direction information, diagonal and backward falls were most common, although we could not reliably distinguish between body rotation during descent and landing configuration. Another limitation is generalisability: our sample consisted of high-risk older adults, including rehabilitation inpatients, and may not reflect fall pattern frequencies in healthier populations. Finally, although we developed a detailed classification scheme for object interaction, other schemes (e.g., Shishov et al. (2024)) could yield alternate interpretations of the same data.

6 Conclusion

Our FA showed that falls in older adults often occurred during common goal-directed actions such as sit-to-stand, stand-to-sit, and walking, frequently involving interaction with furniture or mobility aids. By structuring each narrative report in terms of initial status, intended status, interacting object, and fall direction, we uncovered potential mechanisms of fall risk, including events in private areas typically missed by video-based studies. These insights reinforce and extend past findings, supporting targeted prevention. In community settings, reducing risks may involve adjusting furniture layout and addressing movements like turning near objects. In rehabilitation, where mobility aids were more involved, ensuring proper device use and training is key. Overall, falls are not random, but failed intentional actions shaped by physical and environmental context. Prevention must reflect this complexity.

Additional information

Ethics approval and consent to participate: Each institution contributing study data to the FARSEEING metadatabase applied for ethical approval covering the respective study. The process of data collection combining different sources in the

FARSEEING metadatabase was additionally examined and approved by the Ethical Committee of the University of Tübingen (495/2012BO2) and the data protection office of the federal state of Baden-Württemberg, Germany (T 1500/231). All information entered to the metadatabase is completely anonymized. Informed consent was obtained from all participants and/or their legal guardians at the primary data collection sites (Klenk et al. 2016).

Competing interests: The authors declare that they have no competing interests.

Clinical trial number: Not applicable.

Availability of data and materials: The datasets used and/or analysed during the current study are available from the authors on reasonable request.

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Authors' contributions: NT developed the analytical framework. GW and SP assisted in carrying out the framework analysis and coding. NT, SL and GW drafted the manuscript. SL, WY, and CB provided senior supervision. LS was responsible for the collection of narrative reports. NT, GW, SP, JK, CB, LS, LC, LP, WY, and SL reviewed and approved the final manuscript.

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