Received: 13 January 2023 | Revised: 10 March 2023 | Accepted: 31 March 2023

DOI: 10.1111/jar.13104

REVIEW

JARID Journal of Applied Research in Intellectual Disabilities bild WILEY

Preventing falls at home among people with intellectual disabilities: A scoping review

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Funding information
Institute for Global Health & Wellbeing (LIFE); NIHR ARC NWC

Abstract

Background: Falls are common among people with intellectual disabilities. Many falls happen within the home. Our scoping review aimed to identify evidence for falls-risk factors and falls-prevention interventions for this population.

Method: We conducted a multi-database search to identify any type of published study that explored falls-risk factors or falls-prevention interventions for people with intellectual disabilities. Following a process of (i) title & abstract and (ii) full-text screening, data was extracted from the included studies and described narratively.

Results: Forty-one studies were included. Risks are multifactorial. There was limited evidence of medical, behavioural/psychological, or environmental interventions to address modifiable risk factors, and no evidence of the interventions' cost-effectiveness.

Conclusions: Clinically and cost effective, acceptable and accessible falls-prevention pathways should be available for people with intellectual disabilities who are at risk of falls from an earlier age than the general population.

KEYWORDS
falls, intellectual disabilities, learning disabilities, prevention

1 | INTRODUCTION

Estimates suggest 1.5 million people (2%) of the UK population has an intellectual disability with most living independently in their own homes or with the support of their families or carers (Mencap, 2022). The exact number of people with intellectual disabilities is unknown as many may not be registered or known to health and care services. The term intellectual disabilities is an internationally recognised term but other terms exist (e.g., learning disabilities in the UK). The term refers to people with a significantly reduced ability to understand new or complex information, to learn and apply new skills which results in a reduced ability to cope independently, which started before adulthood (National Institute for Health & Care Excellence, 2022). There are different types of intellectual disabilities: individuals with mild-to-moderate intellectual disabilities usually live independently in their own homes, but may require support to understand complex issues; whereas people with severe-to-

profound intellectual disabilities usually require higher levels of support (National Institute for Health & Care Excellence [NICE], 2022).

Falls are a common and serious problem for people with intellectual disabilities, with 25%–40% experiencing at least one fall per year (Brenner et al., 2014; Choi et al., 2020; Finlayson et al., 2010; Petropoulou et al., 2017; Public Health England, 2019). The Prevention of Falls Network Europe (ProFANE) define a fall as 'an inadvertent occurrence from a person falling to the floor… or some other lower level…' (Lamb et al., 2005). Falls can happen anywhere and many are unreported as they do not require hospital treatment, but estimates suggests that more than 50% of fall-related injuries requiring visits to hospital emergency departments occur inside people's homes (Choi et al., 2019). There is evidence concerning risk factors for falls in the general (older) population (Xu et al., 2022). Some of these factors may be similar for people with intellectual disabilities (Cox et al., 2010; Public Health England, 2019). However, there is limited available evidence for people with intellectual disabilities, and it may be difficult to make any meaningful comparisons from the available evidence due to the wide variation between the studies in terms of sampling methods and choices of variables tested (Finlayson, 2018). One-third of falls involving people with intellectual disabilities result in injury, with the rate of fractures being higher than in the general population (Frighi et al., 2022; Public Health England, 2019). As well as having a higher incidence of fractures, the increase starts to be seen (for all fracture types combined) approximately 15 years earlier in women and 30 years earlier in men with intellectual disabilities compared to those without intellectual disabilities (Frighi et al., 2022). The high prevalence of falls and fall-related injuries including fractures for people with intellectual disabilities from a younger age than the general population are concerns that need to be more fully understood (Cortes-Amador et al., 2019; Frighi et al., 2022; Pal et al., 2014; Sherrard et al., 2001; Wagemans & Cluitmans, 2006). This population may also require more specialist care after a fall compared to the general population (Axmon et al., 2018). Significantly, falls are a leading cause of death from unintentional injuries among people with intellectual disabilities (Choi et al., 2020). This evidence demonstrates the need for falls-prevention guidance and interventions for this high risk population group. UK guidance on falls-prevention in the general population is available (NHS, 2022; NHSinform, 2022; Office for Health Improvement & Disparities, 2022). UK guidance is also available on making reasonable adjustments to prevent falls among people with intellectual disabilities (Public Health England, 2019). However, there is a need for a greater understanding of the available evidence on falls risk factors and falls-prevention interventions among people with intellectual disabilities. This would illuminate which and whether the types of falls-prevention interventions available are clinically effective, cost-effective and acceptable for this population. Previous reviews have investigated risk factors for fall-related injuries in people with intellectual disabilities (Pope et al., 2021; Willgoss et al., 2010) and preventative strategies for fall-related injuries in this population group (Willgoss et al., 2010). Our scoping review aims to build on these reviews and provide a more up-to-date understanding of the extent and type of evidence on falls-risk factors and falls-prevention interventions for people with intellectual disabilities.

2 | METHODS

To conduct our scoping review we followed recognised guidance (Peters et al., 2020), with the protocol published on the Open Science Framework (10.17605/OSF.IO/E4V83). Our review involved a Public Adviser who advised on the development of the review's protocol, stages of the review, discussion and presentation of findings.

2.1 | Search

A multi-database search was undertaken on 06.10.2022 (see key search terms and search strategy in Appendix 1). Databases searched included: Medline (Ovid), Embase (Ovid), CINAHL Ultimate (EBSCOhost), SocINDEX (EBSCOhost), PsycINFO (EBSCOhost), Cochrane Library all databases (via Wiley), Web of Science (Indexes: SCI-EXPANDED; SSCI; AHCI; CPCI-S; CPCI-SSH; ESCI). The clinical trials registries, Clinicaltrials.gov and the International Clinical Trials Registry Platform (ICTRP) were searched to identify ongoing trials. Duplicate references were removed using EndNote. No date, language or other restrictions were applied. We included similar search terms used to describe this population, for example, learning disabilities.

2.2 | Study selection

We included any type of qualitative and quantitative study published in a peer-reviewed journal exploring risk factors for falls among people with intellectual disabilities and/or any type of fall-prevention intervention for this population. We excluded any discussion articles, commentaries or abstract-only papers. We excluded any studies relating to other forms of impairment such as dementia or brain injury. Studies published in languages other than English were collated to provide an indication of the range of international evidence available on this topic (but not included due to resource constraints for translations). Study selection involved two stages, with one reviewer screening (i) the titles and abstracts using EndNote software and (ii) the full-text manuscripts of any citations meeting the inclusion criteria. A second reviewer independently screened and checked a 20% random sample at both stages.

2.3 | Data extraction

Data extraction was undertaken by a single reviewer using a customised pre-piloted data extraction form. The data items extracted included: author; year of publication; country of origin where the study was published or conducted; study aims/purpose; study setting; study population characteristics; study methodology/methods; risk factors for falls in people with intellectual disabilities; interventions to prevent falls among this population; intervention outcomes and details; and key findings. No quality assessment of the

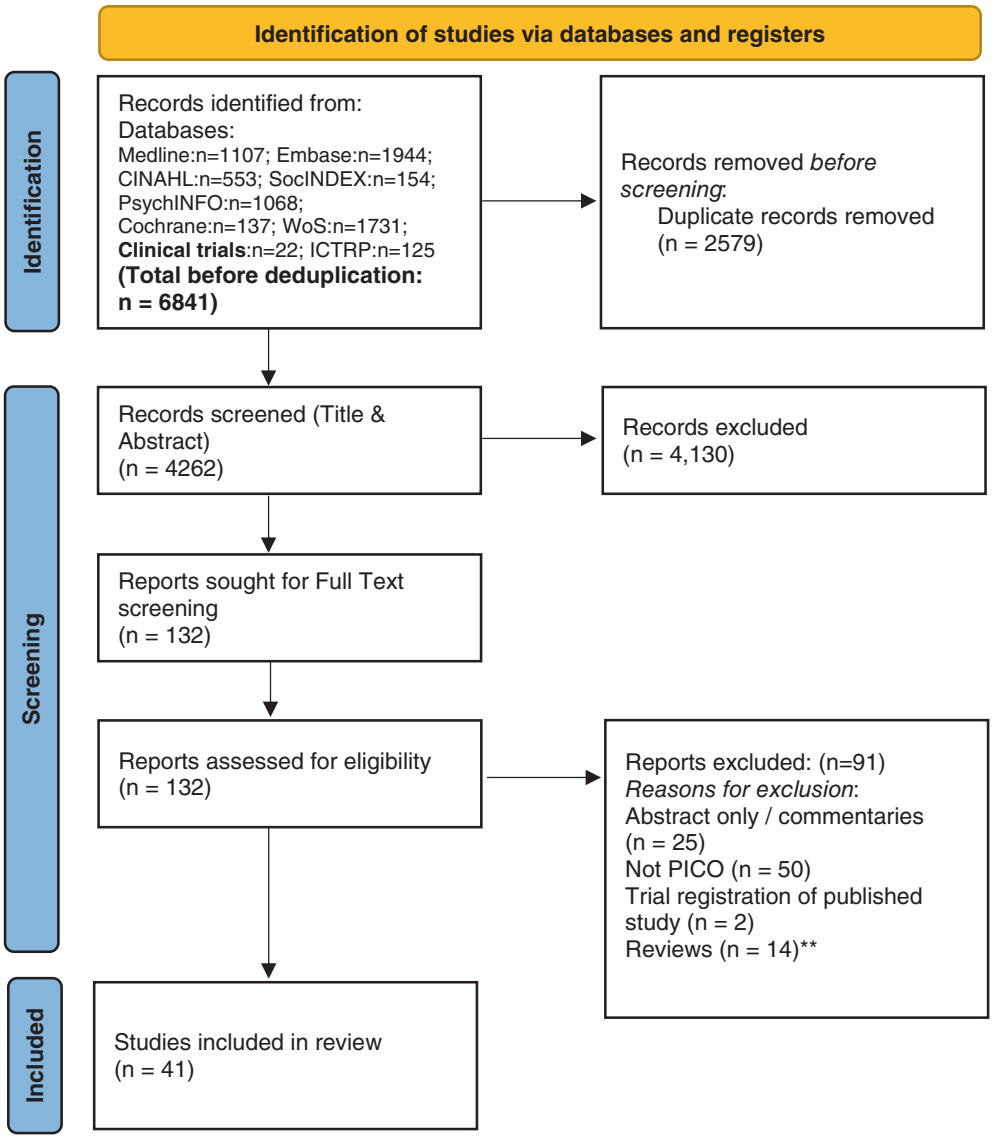

FIGURE 1 PRISMA 2020 flow diagram adapted for scoping review. **The reference lists of 14 relevant Reviews were checked to identify any other sources of data (primary studies) not already identified by the scoping review's searches. No additional primary studies were identified. *From*: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

included studies was undertaken as the purpose of a scoping review is to map and present the available evidence (Peters et al., 2020). Extracted data were discussed with the research team for accuracy.

2.4 | Data synthesis

Studies were synthesised through a structured narrative summary and tabulation of findings based on: (a) the risk factors for falls among people with intellectual disabilities; and (b) the falls-prevention interventions for this population.

3 | RESULTS

Our search strategy yielded 6841 records which, after removal of duplicate records, resulted in 4262 records. Three of the records that were excluded at the title and abstract screening stage were published in non-English languages (Dutch, German, and Spanish). Screening of title and abstracts identified 132 records for full-text paper screening. Ninety-one studies were excluded at the full-text paper screening stage because they were: abstract only/commentaries ($n = 25$); not the population or outcome of interest ($n = 50$); reviews ($n = 14$); or trial registrations ($n = 2$). No additional papers were identified through the handsearching of the reference lists of 14 relevant reviews or two trial registrations. The full-text screening resulted in 41 included studies. Figure 1 outlines the screening process for this review. Tables A1 and A2 (Appendix 2) outline the characteristics of the included studies. Twenty-seven studies explored falls-risk factors. Twenty studies investigated falls-prevention interventions. Six of these studies examined both risk factors and falls-prevention interventions.

The 41 studies were published between 2001 and 2022 with the highest number ($n = 7$) published in 2019. The country of origin varied with studies taking place in The Netherlands ($n = 8$), the USA

($n = 8$), New Zealand ($n = 7$), Australia ($n = 4$), Scotland ($n = 4$), Sweden ($n = 2$), Canada ($n = 1$), Canada and the Netherlands ($n = 1$), Germany ($n = 1$), Iran ($n = 1$), Israel ($n = 1$), Japan ($n = 1$), Slovenia ($n = 1$), Spain ($n = 1$). We found no published studies from England & Wales and Northern Ireland, or from any low-income-countries. Overall, a total of 21,794 participants with intellectual disabilities were involved in the included studies. A further 131 participants without intellectual disabilities took part in seven of the 41 studies that involved comparisons between people with intellectual disabilities and their non-disabled peers. The ages of participants with intellectual disabilities ranged from 16 to 90 years (mean age: 51.6 years) (based on 26 studies providing age related data). Sample sizes ranged from 5 to 7936 participants. Twenty-nine studies provided data for the gender of 20,671 participants: 54% ($n = 11,180$) were men and 46% ($n = 9491$) were women. Only one study provided ethnicity information (Hsieh et al., 2012) with 89% of this study's participants being Caucasian. The majority (66.5%) of participants had mild-to-moderate intellectual disabilities, and 33.5% had severe-to-profound intellectual disabilities (22 studies providing data). The majority of intervention studies were conducted within community settings ($n = 29$) and residential settings ($n = 7$). Other types of settings included medical and/or occupational therapy centres, colleges, service provider settings, and worksites. The type of studies included: effectiveness with quantitative methods ($n = 17$); descriptive with quantitative methods ($n = 15$); qualitative ($n = 6$); evaluations ($n = 2$); and one Randomised Controlled Trial.

3.1 | Risk factors for falls

Box 1 summarises the risk factors for falls among people among people with intellectual disabilities based on either statistical analysis showing significance, or self-reported or observational data. An approach used previously to organise risk factors for fall-injuries in the general population living in a community setting (Cwikel & Fried, 1992) was used to organise the falls-risk factors for people with intellectual disabilities identified by our review. Cwikel and Fried (1992) suggest the identification of demographic, medical, behavioural/psychological and environmental falls-risk factors allow for the distinction between those that are, or are not, modifiable to change or treatment, thus suggesting methods for falls-prevention.

3.1.1 | Demographic risk factors

Age is a risk factor for falls among people with intellectual disabilities (Bruckner & Herge, 2003; Chiba et al., 2009; Choi et al., 2020; Cortes-Amador et al., 2019; Cox et al., 2010; Dijkhuizen et al., 2017; Enkelaar et al., 2013; Grant et al., 2001; Hsieh et al., 2001; Hsieh et al., 2012; Pal et al., 2014; Salb et al., 2015; Wagemans & Cluitmans, 2006). Pointedly, studies highlight that falls are a problem for younger people aged 40 years and over with intellectual disabilities (Cortes-Amador et al., 2019; Pal et al., 2014; Salb et al., 2015), as well as for older people with intellectual disabilities aged 70 years and over (Hsieh et al., 2001; Wagemans & Cluitmans, 2006).

Gender: Some studies suggest that females with intellectual disabilities are more at risk of falls than their male counterparts (Hsieh et al., 2012; Pal et al., 2014), but another study found no statistical significance for gender differences (Cox et al., 2010).

Type of intellectual disability: Some studies identified protective factors for falls such as having Down syndrome compared to other types of intellectual disabilities (Finlayson et al., 2010).

3.1.2 | Medical risk factors

Pre-existing conditions related to poor balance and/or atypical gait patterns, mobility, paretic conditions, and bone/muscle weakness (including conditions such as arthritis, osteoporosis, or cerebral palsy) are falls risk factors for people with intellectual disabilities (Bahiraei et al., 2019; Bruckner & Herge, 2003; Cahill et al., 2014; Chiba et al., 2009; Choi et al., 2020; Finlayson et al., 2014; Hale et al., 2007; Hsieh et al., 2012; O'Keefe et al., 2021; Oppewal et al., 2014; Oppewal & Hilgenkamp, 2019; Pal et al., 2014; Wagemans & Cluitmans, 2006).

Epilepsy and seizures are risk factors for falls among this population (Chiba et al., 2009; Choi et al., 2020; Cox et al., 2010; Finlayson et al., 2010; Finlayson et al., 2014; Hsieh et al., 2001; Hsieh et al., 2012; Pal et al., 2014; Schoufour et al., 2015; Wagemans & Cluitmans, 2006).

Medication issues, including the use of anti-convulsant medication for epilepsy are associated with falls among people with intellectual disabilities (Axmon et al., 2018; Hale et al., 2007; Hsieh et al., 2012; Schoufour et al., 2015; Wagemans & Cluitmans, 2006).

Other identified (medical related) falls risk factors for this population include

- Sensory impairments (Bruckner & Herge, 2003; Enkelaar et al., 2013; Finlayson et al., 2014; Hale et al., 2007; Hsieh et al., 2012; Pal et al., 2014; Schoufour et al., 2015; Wagemans & Cluitmans, 2006);
- Incontinence (Finlayson et al., 2010; Hsieh et al., 2012; Pal et al., 2014; Salb et al., 2015; Ho et al., 2019);
- Foot-related issues (Salb et al., 2015);
- Weight-related issues (Pal et al., 2014).

3.1.3 | Behavioural/psychological risk factors

Ability to ambulate independently: Studies suggest that being able to ambulate independently is a significant risk factor for falls among people with intellectual disabilities (Ho et al., 2019; Hsieh et al., 2001; Wagemans & Cluitmans, 2006). Enkelaar et al. (2013) suggested carers are more vigilant and protective over people with intellectual disabilities who have poor motor control than for those who are able to ambulate independently.

BOX 1 Summary of falls risk factors for people with intellectual disabilities

Demographic	
Age (40 years and over)	Hsieh et al. (2001), Bruckner and Herge (2003), Wagemans and Cluitmans (2006), Cox et al. (2010), Hsieh et al. (2012), Enkelaar et al. (2013), Salb et al. (2015), Cortes-Amador et al. (2019), Grant et al. (2001), Dijkhuizen et al. (2017), Chiba et al. (2009), and Choi et al. (2020)
Gender (being female)	Hsieh et al. (2012) and Cox et al. (2010)
Type and/or severity of intellectual disability	Finlayson et al. (2010), Hsieh et al. (2012), Enkelaar et al. (2013), Oppewal et al. (2014), and Salb et al. (2015)
Medical	
Pre-existing conditions related to mobility, paretic conditions, bone and muscle weakness (including osteoporosis and arthritis), poor balance and atypical gait patterns	Bruckner and Herge (2003), Wagemans and Cluitmans (2006), Hale et al. (2007), Chiba et al. (2009), Hsieh et al. (2012), Cahill et al. (2014), Finlayson et al. (2014), Oppewal et al. (2014), Pal et al. (2014), Bahiraei et al. (2019), Oppewal and Hilgenkamp (2019), Choi et al. (2020), O'Keefe et al. (2021), and Frighi et al. (2022)
Medication issues	Wagemans and Cluitmans (2006), Hale et al. (2007), Hsieh et al. (2012), Schoufour et al. (2015), Axmon et al. (2018)
Epilepsy/seizures	Hsieh et al. (2001), Wagemans and Cluitmans (2006), Chiba et al. (2009), Cox et al. (2010), Hsieh et al. (2012), Finlayson et al. (2010), Finlayson et al. (2014), Pal et al. (2014), Schoufour et al. (2015), and Choi et al. (2020)
Visual and/or hearing impairments	Bruckner and Herge (2003), Wagemans and Cluitmans (2006), Hale et al. (2007), Hsieh et al. (2012), and Enkelaar et al. (2013), Finlayson et al. (2014), Pal et al. (2014), and Schoufour et al. (2015)
Incontinence	Finlayson et al. (2010), Hsieh et al. (2012), Pal et al. (2014), Salb et al. (2015), and Ho et al. (2019)
Feet/footwear issues: orthopaedic shoes	Salb et al. (2015)
Weight	Pal et al. (2014)
Behavioural/psychological	
Distractability, unpredictability, impulsivity, mood disorders, low cognition, personality and/or behavioural effects	Hale et al. (2007), Hsieh et al. (2012), Enkelaar et al. (2013), Cahill et al. (2014), Finlayson et al. (2014), Pal et al. (2014), Schoufour et al. (2015), Ho et al. (2019), and Oppewal and Hilgenkamp (2019)
Attending to personal hygiene or eating	Axmon et al. (2019)
Fear of falling	Smulders, Enkelaar, Weerdesteyn, et al. (2013a), Finlayson et al. (2014), and Bahiraei et al., (2019)
Previous history of falls	Wagemans and Cluitmans (2006), Cox et al. (2010), Pal et al. (2014), and Ho et al. (2019)
Physical activity (decreased)	Hsieh et al. (2012), Enkelaar et al. (2013), Cahill et al. (2014), and Choi et al. (2020)
Ability to ambulate freely	Hsieh et al. (2001) and Ho et al. (2019)
Misuse or non-use or unsafe or inappropriate (makeshift) use of aids and adaptations	Hsieh et al. (2012), Cahill et al. (2014), and Finlayson et al. (2014)
Environmental	
Tripping whilst negotiating obstacles/Limited spatial awareness and hazard appreciation, slowed reaction times, inability to recover	Haynes and Lockhart (2012), Smulders, Enkelaar, Weerdesteyn, et al. (2013a), Cahill et al. (2014), and Finlayson et al. (2014)
Falls more common in the home than outdoors, and environmental hazards such as out-of-place chairs. Commonly reported locations: bathroom, toilet and bedroom	Grant et al. (2001), Hale et al. (2007), Enkelaar et al. (2013), and Cahill et al. (2014)
Needing support for daily activities. Consistency of carer support in fall management	Finlayson et al. (2010), Salb et al. (2015), Cahill et al. (2014), and Choi et al. (2020)

Distractability: Other studies point to risk factors for distractability, unpredictability, impulsivity, mood disorders, low cognition, personality and or behavioural effects (Hale et al., 2007; Hsieh et al., 2012; Enkelaar et al., 2013; Cahill et al., 2014; Finlayson et al., 2014; Pal et al 2014; Schoufour et al., 2015; Oppewal and Hilgenkamp (2019)).

Other identified (behavioural/psychological) falls related risk factors for this population include:

- Attending to personal hygiene or eating (Axmon et al., 2019);
- Decreased physical activity (Cahill et al., 2014; Choi et al., 2020; Enkelaar et al., 2013; Hsieh et al., 2012);

- Fear of falling (Bahiraei et al., 2019; Finlayson et al., 2014; Smulders, Enkelaar, Weerdesteyn, et al., 2013a);
- Having a previous history of falls (Cox et al., 2010; Ho et al., 2019; Pal et al., 2014; Wagemans & Cluitmans, 2006).

3.1.4 | Environmental risk factors

Home hazards: Falls are more likely to occur inside the home rather than outdoors for people with intellectual disabilities, and commonly reported locations for falls among people with intellectual disabilities inside the home include the bathroom, toilet and bedroom (Cahill et al., 2014; Enkelaar et al., 2013; Grant et al., 2001; Hale et al., 2007). These falls involve issues such as out-of-place chairs, slippy wet floors, and/or non-use or inappropriate use of mobility aids and adaptations (Cahill et al., 2014; Finlayson et al., 2014; Hsieh et al., 2012). Tripping whilst negotiating obstacles is a problem for people with intellectual disabilities, particularly for those with limited spatial awareness (Cahill et al., 2014; Finlayson et al., 2014; Haynes & Lockhart, 2012; Smulders, Enkelaar, Weerdesteyn, et al., 2013a).

Carer support in fall management is essential for people with intellectual disabilities, and individuals in this population needing support for daily activities are at significant risk for falls (Cahill et al., 2014; Choi et al., 2020; Finlayson et al., 2010; Salb et al., 2015).

3.2 | Falls-prevention interventions

Falls prevention interventions for people with intellectual disabilities have included:

- Obstacle course training (Van Hanegem et al., 2014);
- Aquatic exercise (Nissim et al., 2019);
- Modified Otago Exercise Programme (OEP) (Hale et al., 2019; Renfro et al., 2016);
- Multi-component balance-specific exercise programme (Kovacic et al., 2020);
- Vestibular rehabilitation programme (Cortes-Amador et al., 2019);
- Tailored multifactorial risk assessment and intervention strategy (Smulders, Enkelaar, Schoon, et al., 2013b);
- Trial of lycra splinting clothing to improve balance (Finlayson et al., 2018);
- Prevention Of Falls for Adults with Intellectual Disabilities (PROFAID) intervention (Hale et al., 2016, 2019);
- Falls prevention treatment pathway (Crockett et al., 2015);
- Usual care by Therapists (Pal et al., 2013).

Poor balance is one of the identified risk factors for falls. Our review's findings suggest balance-specific exercise programmes may be beneficial. In a randomised controlled trial (RCT) involving 150 participants, Kovacic et al. (2020) evaluated the effectiveness of three different types of physical activity programmes on falls prevention and found that a multicomponent balance-specific exercise programme may be useful for people with intellectual disabilities who have poor balance and are at risk of falls. The main findings reported by Kovacic et al. (2020) showed that, compared with the intervention baseline, after 4 months of intervention programmes, balance skills were significantly improved among participants in all three tested groups. However, the most significant improvement was in the Multi-component Balance-Specific Exercise Programme (MBSEP) group. The MBSEP participants had the lowest reported frequency of falls and the highest (statistically significant) improvement in all of the measured tests of balance in comparison with the other two groups. Cortes-Amador et al. (2019) found that their vestibular (balance-related) rehabilitation programme could help improve balance and reduce the risk of falls among adults with intellectual disabilities. Forty-eight participants aged over 40 years and diagnosed with mild-to-moderate intellectual disabilities were randomised to an Experimental Group and a Control Group. Post-intervention only the Experimental Group improved their balance. At baseline, both the Control and the Experimental group had a high risk of falling (T0 was lower than 45 points in both groups). The Berg Scale score, used to detect the risk of falls, found significant improvements in the Experimental Group, surpassing 45 points at Time Interval 1 and at Time Interval 2. This was not the case with the Control Group. However, this study was limited as it excluded participants with poorly controlled epilepsy, with neurological or visual impairments, or those unable to walk independently. Nissim et al. (2019) found that an aquatic and an on-land Tai Chi/Ai Chi intervention (20 min sessions conducted twice a week over 14 weeks) may reduce the risk of falls in people with mild-to-moderate ID aged between 50 and 66 years. Both aquatic and on-land groups significantly improved their score after 14 weeks of intervention (fall risk was measured using a Tinetti balance assessment tool). Nissim et al. (2019) also found that the aquatic intervention improved the participants' fall risk more quickly compared to the on-land intervention group. Van Hanegem et al. (2014) reported that obstacle course training may improve balance and prevent falls among people with intellectual disabilities. Twelve months prior to participation in the intervention, 131 falls in total were recorded in the group of 39 participants. The median fall rate was 2 falls per person (range 0–29). Twelve months post intervention, 23 falls were recorded: a median fall rate of 0 falls per person (range 0–4). This was a significant reduction compared with pre-intervention (82%, $p < .001$). Finlayson et al. (2018) suggested prescribing lycra splinting socks on a case by case basis to individuals at risk of falls (due to balance and gait issues) may prevent or reduce future falls. Six of the nine participants in this trial study experienced a reduction in falls during their 6 weeks of wearing lycra splinting garments. Five of these participants had been wearing lycra splinting socks. Those who wore lycra shorts or leggings reported problems including garments being too warm to wear. However, this was a trial with a small number of participants and further research is needed to test the authors' hypothesis regarding lycra splinting socks.

The wide range of falls risk factors identified suggests that multi-component interventions delivered by multi-disciplinary approaches are needed (Finlayson et al., 2018). Crockett et al. (2015) found that 25 out

of 27 clients had a significant reduction in falls ($p < .001$) and improved balance ($p = .01$) following participation in a 12-week falls pathway service for people with intellectual disabilities to promote exercise and prevent falls. This intervention included an exercise programme, interdisciplinary referrals, and education for clients/carers. Smulders, Enkelaar, Schoon, et al. (2013b) explored the development of a tailored falls prevention assessment and intervention strategy for people with intellectual disabilities. This intervention included a falls clinic. Smulders, Enkelaar, Schoon, et al. (2013b) reported a 23% reduction in falls within 1 year of attendance. Smulders, Enkelaar, Schoon, et al. (2013b) suggested that their intervention may be feasible, but that the logistics needed further development as more attention and time needs to be given due to the multifactorial nature and need for multidisciplinary treatment of people with intellectual disabilities.

The acceptability of an intervention is an important consideration. The PROFAID intervention used education, individually prescribed lower limb strengthening and balance exercises performed daily and a weekly physical exercise such as walking (Hale et al., 2016). However, the PROFAID intervention had adherence challenges with the role of the environment being identified as key to the acceptability of the interventions (Hale et al., 2019). The modified Otago Exercise Programme (OEP) involved weekly group physiotherapy-led exercise classes for 8 weeks with each participant being enabled to participate independently at their own level (Renfro et al., 2016). The pilot OEP project found test results for people with intellectual disabilities were similar to those of older adults with no cognitive impairments. The changes were generally found to be greater for the younger group of participants <50 years, suggesting that reduction of fall risk can occur at an earlier age among people with intellectual disabilities (Renfro et al., 2016). These findings suggest that whilst the PROFAID and OEP interventions may be feasible in the prevention of falls among people with intellectual disabilities, the logistics of how such interventions can be delivered appropriately, acceptably, clinically and cost-effectively and sustainably needs further investigation (Hale et al., 2016, 2019). Pal et al. (2013) investigated Therapists' views on how to reduce the risk of falls in people with intellectual disabilities and found that a combination of participation in physical exercise, prescription of assistive mobility devices, environmental modifications, and education on safe mobility were thought to be the most useful interventions.

Studies have explored screening tools to detect the risk of falls in people with intellectual disabilities:

- Modified-Up-and-Go (MUAG) screening tool (Bruckner & Herge, 2003);
- Tinetti instrument (Chiba et al., 2009);
- Modified Berg Balance Scale (Dijkhuizen et al., 2017);
- Modified Gait Abnormality Scale (GARS-M) (Hale et al., 2010);
- Motor Control Test (MCT) (Hale et al., 2009);
- Single Leg Stance Test (O'Neal & Thomas, 2022).

Some modified risk assessment tools (e.g., GARS-M) may be helpful in the detection of falls risks, but further research is needed to confirm studies' findings and develop modifications further.

Two studies explored healthcare professionals' and people with intellectual disabilities' adherence to existing fall-prevention guidelines (Ho et al., 2020; Pal et al., 2014) and found participants' experiences did not reflect current guidelines of care for the prevention of falls, and that people with intellectual disabilities were not routinely offered access to established falls prevention pathways (Ho et al., 2020).

None of the intervention studies identified by this review included cost-effectiveness information.

4 | DISCUSSION

4.1 | Contribution to the literature

Our review has built on similar previous reviews which have investigated risk factors for fall-related injuries in people with intellectual disabilities (Pope et al., 2021; Willgoss et al., 2010) and preventative strategies for fall-related injuries in the population group (Willgoss et al., 2010). We have identified evidence that has been published since these previous reviews were conducted and we have provided an up-to-date understanding of the extent and type of available evidence on falls-risk factors and falls-prevention interventions for people with intellectual disabilities. The previous review conducted by Willgoss et al. (2010) identified increasing age, impaired mobility, epilepsy and behavioural problems as risk factors for falls among people with intellectual disabilities. Our findings highlight that falls are also a problem for younger age groups of people with intellectual disabilities. Willgoss et al. (2010) found limited evidence of falls risk factors and falls-prevention interventions for this population group ($n = 7$ articles). Pope et al. (2021) again reviewed the evidence of falls risk factors for people with intellectual disabilities by conducting updated, but date-limited searches (Feb 2009 to July 2019), and found further studies since Willgoss et al. (2010) ($n = 9$ articles). However, Pope et al. (2021) did not explore evidence for falls-prevention interventions for this population group. Our review therefore addresses this gap. Whilst we have found there has been increased research in this field ($n = 41$ articles) since the previous reviews, we have found limited evidence of clinically effective and acceptable falls-prevention interventions, including a few comparative pre-and-post intervention studies (only one RCT), and no cost-effectiveness evidence.

4.1.1 | Risk factors are multifactorial

Our review has found that risk factors for falls among people with intellectual disabilities are multifactorial and that some are similar to those experienced by the older general population but there are some important risk factor differences e.g. relating to age and the ability to ambulate independently. We found limited evidence of effective multicomponent, multidisciplinary falls-prevention interventions for people with intellectual disabilities necessary to address the multifactorial risk factors involved. The interventions identified by our review

mainly focused on single risk factor issues such as preventing falls through physical fitness and balance improvement programmes for individuals. Risk factors for falls such as tripping or slipping whilst rushing to the toilet inside the home (a key location for falls) also require environmental interventions, including home safety reviews that address toilet access and personal care safety (Axmon et al., 2018; Cahill et al., 2014; Cox et al., 2010). There may be a combination of issues associated with trips and slip-related factors (such as problems with footwear, or sensory impairments, or environmental hazards in the home) that need addressing as part of any multicomponent, multidisciplinary intervention.

Some of the risk factors involved in falls have limited scope for external modification including age, gender, a history of previous falls, and co-morbidities (Pope et al., 2021). Risk factors with the most potential for modification may form the basis for developing future falls-prevention interventions to meet the needs of people with intellectual disabilities. The range of medical, behavioural/psychological and environmental risk factors with scope for external modification that have emerged from the evidence suggest areas for possible future intervention. For example: education on assistive aids and falls-risk awareness, carers interventions, medication reviews, home hazards risk assessments, and individual risk screening tools tailored to meet the specific needs of people with intellectual disabilities. These are needed in addition to the existing (single risk factor focused) interventions identified by our review.

4.1.2 | The importance of education

Education on falls prevention for healthcare professionals, for people with intellectual disabilities and their families/carers may help to reduce or prevent their falls, and some studies incorporated falls-related education components within their falls-prevention interventions (e.g., Crockett et al., 2015; Renfro et al., 2016). Educational-related interventions warrant further investigation (Finlayson et al., 2018; Smulders, Enkelaar, Weerdesteyn, et al., 2013a). We also found that carers have an important role in falls management for people with intellectual disabilities (Cahill et al., 2014; Enkelaar et al., 2013; Finlayson et al., 2010). There is a need for education in falls-prevention to dispel any assumptions that some people may hold, for example, that people with intellectual disabilities are 'clumsy' and that falls are 'not preventable' (Finlayson et al., 2010). Some people with intellectual disabilities who are susceptible to falls may need the support of carers to help them with day-to-day activities such as personal care, toileting, bathing (Choi et al., 2020). However, carers may also need to more closely monitor or support those individuals with intellectual disabilities who have greater mobility with the ability to ambulate independently as we found evidence which suggests people with intellectual disabilities who are younger and more mobile are at risk of falls (Cahill et al., 2014; Enkelaar et al., 2013). This is in contrast to existing UK policies and guidelines which target older people in the general population (aged 65 years and over) with poor mobility who are considered to be more susceptible to falls (Office for Health Improvement & Disparities [OHID], 2022; World Health Organisation [WHO], 2022). Significantly, people with intellectual disabilities begin to age earlier than their non-disabled peers, thereby putting them at risk of falls and needing falls-prevention interventions from an earlier age (Finlayson et al., 2018).

4.1.3 | Lack of studies on medication management

Medication issues are an identified risk factor for falls in people with intellectual disabilities (Axmon et al., 2018; Chiba et al., 2009; Hale et al., 2007; Hsieh et al., 2012; Schoufour et al., 2015; Wagemans & Cluitmans, 2006). Medication reviews for people with intellectual disabilities who also have co-morbidities such as epilepsy and who take fall-risk-inducing medication (such as anticonvulsants) may form part of an effective falls-prevention intervention (Ho et al., 2020). However, we found a lack of studies investigating medication management interventions to reduce the risk of falls in people with intellectual disabilities. Instead, medication reviews tend to be addressed incidentally by GPs as part of general annual health reviews for people with intellectual disabilities rather than as part of any specific falls-prevention intervention (Ho et al., 2020).

4.1.4 | Lack of cost-effectiveness evidence

Crucially, we found no evidence to demonstrate the cost-effectiveness of any of the interventions described. To address health inequalities and to make any health equity related improvements in this field, limited healthcare resources must be invested cost-effectively and this requires knowledge about which interventions work, how they work, how much they cost, and people's views and experiences of their design and delivery mechanisms and their accessibility and appropriateness (Jamison et al., 2006). Our findings suggest that cost-effective, complex, multicomponent falls-prevention interventions are needed for people with intellectual disabilities. The UK Medical Research Council has published a framework for developing and evaluating complex interventions (Skivington et al., 2021) which may inform the future design and development of fall-prevention interventions. The UK government has produced guidance on cost-effective commissioning of falls prevention interventions (Public Health England, 2018), and specific guidance for making reasonable adjustments in the prevention of falls in people with intellectual disabilities (Public Health England, 2019). However, our review found that the experiences of healthcare professionals, people with intellectual disabilities and carers, are not always reflected in current guidelines or frameworks for the prevention of falls. Moreover, people with intellectual disabilities are not routinely offered access to falls prevention pathways or interventions (Ho et al., 2020; Pal et al., 2014). Carers play an important role in helping people with intellectual disabilities access appropriate and acceptable interventions (Ho et al., 2020). As such, carers with lived experience need to be involved in all stages of the design, development and delivery of future interventions.

4.1.5 | More intersectionality research is warranted

Epilepsy is a risk factor for falls and 22% of people with intellectual disabilities experience epilepsy compared to 1% of the general population (Robertson et al., 2015). However, there appears to be limited falls-prevention research in this field. We also found conflicting evidence for gender differences in falls-risk factors (Cox et al., 2010; Hsieh et al., 2012), and found only one study (Hsieh et al., 2012) that included ethnicity data with the majority (over 80%) of this study's population being Caucasian. We found a lack of research for people with intellectual disabilities who have co-conditions such as hearing and/or sensory impairments. We identified only one study which explored falls-prevention interventions for people with intellectual disabilities and visual impairments (Dijkhuizen et al., 2017) which found that a modified screening tool was insufficient at predicting a risk of a fall. We suggest that more intersectionality research is required to examine health inequalities in falls-risk factors and falls-prevention interventions for sub-groups of people with intellectual disabilities. This implies exploring the impact of differences determined by age, gender, ethnicity, comorbidities and types of intellectual disabilities, particularly as the majority of identified studies (66%) included people with mild-to-moderate intellectual disabilities.

4.1.6 | The need for screening tools

Screening tools are used to identify risk factors for falls and are an important part of any multicomponent falls-prevention strategy. Modified screening tools for use in identifying risks among individuals with intellectual disabilities are being trialled but further research is needed to identify valid and reliable screening tools for this population (Bruckner & Herge, 2003; Dijkhuizen et al., 2017; Hale et al., 2007; O'Neal & Thomas, 2022).

4.1.7 | Evidence is geographically asymmetric

Globally, falls are a major public health concern (WHO, 2022); despite this, we did not identify any relevant studies from low-income countries. Whilst we found four studies set in Scotland (Crockett et al., 2015; Finlayson et al., 2010, 2014; Finlayson et al., 2018), we did not identify any studies from elsewhere in the United Kingdom. This suggests that further national and international research is required to investigate the risk factors for falls and falls-prevention interventions for people with intellectual disabilities.

4.1.8 | Multicomponent interventions for multifactorial risk factors

Our review set out to identify the risk factors for falls among people with intellectual disabilities, what interventions can prevent falls at home among this population, and what evidence underpins the clinical and cost-effectiveness of the interventions. The available evidence suggests that falls risk factors are multifactorial, and yet falls-prevention interventions appear to focus on single risk factors such as balance and mobility. The evidence on falls-prevention interventions is limited. Only a few studies have compared interventions and most of these were pre-and-post intervention studies. Therefore, more robust (RCT) comparative studies of multicomponent interventions are needed to address the multifactorial risk factors involved, particularly for medical/behavioural/and environmental risk factors emerging in a home setting (e.g., slips and trips whilst rushing to the bathroom toilet due to incontinence). Pointedly, we found no cost-effectiveness studies in this field. Cost-effectiveness evidence is required as well as evidence of the clinical effectiveness, accessibility, acceptability and appropriateness of falls-prevention interventions for people with intellectual disabilities.

4.2 | Suggestions for further development

Informed by the findings of our review, we suggest that future research tackles the need for:

- Specific attention on fall-risks for more mobile younger age groups of people with intellectual disabilities (aged ≥40 years);
- Further development of complex multicomponent, multidisciplinary falls-prevention interventions for people with intellectual disabilities; involving:
    i. the use of modified screening tools for individuals themselves and home safety risk assessments for their homes; followed by:
    ii. tailored exercise, strength and balance-related interventions;
    iii. environmental interventions to address identified hazards in the home; and.
    iv. referrals to address identified risks (e.g. referrals to Occupational Therapists for mobility aids and adaptations, to opthalmists for eyesight checks, to podiatrists for problems with footcare/footwear, and to GPs for medication reviews).
- Education and training packages for healthcare professionals, carers and people with intellectual disabilities on falls risk awareness and interventions to reduce falls and education on the safe and correct use of mobility aids and adaptations for people with intellectual disabilities;
- Cost-effectiveness studies evaluating both the clinical and economic value of falls-prevention interventions;
- Further understanding of the logistics involved in how best to deliver falls-prevention interventions in ways which are accessible, acceptable and tailored for individuals with intellectual disabilities;
- Involvement of people with intellectual disabilities and their families and/or carers in any research on this topic, considering the preferences of sub-groups with different demographic and clinical characteristics;
- The development of national and international networks and research into falls risks and falls-prevention interventions for people with intellectual disabilities.

Implications for policy and practice

The falls rate between people with intellectual disabilities and the general population is similar. However, there is a need to make existing falls-prevention pathways that are available to the general population (aged ≥65 years) more accessible and tailored for people with intellectual disabilities who are at risk of falls from an earlier age (aged ≥40 years).

4.3 | Strengths and limitations

The strengths of our scoping review are multifaceted. It was produced based on a protocol registered on the Open Science Framework (10.17605/OSF.IO/E4V83), and it used a robust multi-database search with additional reference checks. Importantly, a public adviser was involved in the review (who advised on the review's research questions and protocol, and who commented on the research findings, discussion, and the write-up). Our review provides an up-to-date understanding of the extent and type of available evidence on both (i) falls-risk factors and (ii) falls-prevention interventions for people with intellectual disabilities. Much of the available evidence has been published more recently (2019–2022) and after the publication of previous reviews. Our findings identify gaps in knowledge and outline a set of suggested areas for further development and research. Due to staffing limitations, screening and data extraction were undertaken by a single reviewer. However, a second reviewer independently screened a 20% random sample of included studies at both title & abstract screening stage and full-text paper screening stage. Moreover, the data extraction was checked by members of the review team. The range of options for the synthesis of the included studies was limited by the lack of comparative studies, and diversity of methodologies, risk factors, interventions, outcomes, sample sizes and sample characteristics. As such, we were not able to conduct any meta-analysis. Due to resource constraints for translations, we could only include studies published in English. However, we only found three non-English studies (published in Dutch, Spanish and German). No studies were identified from any low-income countries. At the same time, within the UK only studies set in Scotland were found. Despite these limitations, we have mapped and synthesised the existing evidence to identify gaps and inform the suggestions for areas for further development.

5 | CONCLUSIONS

Our review highlights that people with intellectual disabilities experience a range of risk factors for falls. Many of these risk factors are similar to those found in the older general population. However, we also highlight some key differences including the need for tailored, acceptable, clinically and cost-effective multicomponent falls-prevention interventions to address the range of risk factors for falls. Existing falls-prevention pathways should be made available and accessible for younger and more mobile people with intellectual disabilities (aged ≥40 years) and delivered by multidisciplinary teams of healthcare professionals.

ACKNOWLEDGEMENTS

The research was funded by the Institute for Global Health and Wellbeing, University of Central Lancashire. The authors (Alison J. Doherty, Valerio Benedetto, Catherine Harris, and Andrew Clegg) are funded by the National Institute for Health and Care Research, Applied Research Collaboration North West Coast (NIHR ARC NWC). The views expressed are those of the authors and not necessarily those of the NHS, NIHR, or the Department of Health and Social Care.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data available in this scoping review is available for the studies included in the final analysis.

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How to cite this article: Doherty, A. J., Benedetto, V., Harris, C., Ridley, J., O'Donoghue, A., James-Jenkinson, L., Fidler, D., & Clegg, A. (2023). Preventing falls at home among people with intellectual disabilities: A scoping review. *Journal of Applied Research in Intellectual Disabilities*, 1–23. https://doi.org/10.1111/jar.13104

APPENDIX 1: Search strategy

Persons with Mental Disabilities/
Developmental Disabilities/
Intellectual Disability/
((learning or intellectual* or development*) adj1 (disorder* or disable* or disabilit* or impair* or deficien* or difficult* or handicap* or subnormal* or "sub-normal*")).tw.
(Mental* adj1 (retard* or handicap* or disable* or disabilit* or impair* or deficien*)).tw.
(multipl* adj1 (handicap* or disab*)).tw.
(Down* syndrome* or Prader willi or labhart willi or royer syndrome* or Williams syndrome* or Fragile x or fraxe or fraxa or martin bell or marker x or Cri-du-Chat Syndrome or De Lange Syndrome or Rubinstein-Taybi Syndrome or Trisomy 13 or WAGR Syndrome or Angelman Syndrome).tw.
((low or borderline or subnormal* or "sub-normal*") adj1 (intelligence or IQ)).tw.
or/1–8
Accidental Falls/
(Fall or falls or falling or faller* or fallen).tw.
(Slip or slips or slipping or slipped).tw.
(Trip or trips or tripped or tripping).tw.
or/10–13
9 and 14

Note: There are many cases where antiquated, non-standard, exclusionary, and offensive terms for intellectual disabilities have been used in past and present literature. Please note, the authors of this review have included such terms in their search strategies in order to conduct a comprehensive search of past and current literature for relevant studies. The authors recognise and acknowledge the inappropriate and harmful nature of these terms but wish to state that by including such terms in their search strategies, they do not agree with them.

APPENDIX 2

TABLE A1 Risk factors for falls among people with intellectual disabilities (ID)

Author/year	Study characteristics	Sample size	Gender	Age range (years)	Level of ID	Findings
Axmon et al. (2019)	Cohort study investigating risk factors for falls in adults with ID	7936	45.4% ($n = 3609$) women; 54.5% ($n = 4327$) men	Aged 55 years or more	NR	Falls are twice as common among people with ID during a vital activity such as attending to personal hygiene or eating in their place of residence compared with the general population.
Axmon et al. (2018)	Cohort study investigating risk factors for falls in adults with ID	7936	45.4% ($n = 3609$) women; 54.5% ($n = 4327$) men	Aged 55 years or more	NR	Older people with ID are more likely than their age peers in the general population to be prescribed fall-risk-increasing drugs (FRIDs) and have a higher risk of falls requiring healthcare than their age-peers in the general population. They are also prescribed FRIDs at higher doses and for longer durations. However, even without the use of FRIDs, older people with ID have a higher risk of falls.
Bahiraei et al. (2019)	Descriptive cross-sectional study investigating risk factors for falls in adults with ID	54	100% ($n = 54$) boys	16–30	Mild-to-moderate	Delayed motor development in people with ID causes decreased muscle strength, physical disorders and risk of falling.
Bruckner and Herge (2003)	Non-control, non-blinded single trial assessing risk of falls in older people with ID	18	55% ($n = 10$) women; 45.5% ($n = 8$) men	55–79	NR	Age, poor vision, history of ataxia, increased gait velocity.
Cahill et al. (2014)	Qualitative study investigating risk factors for falls in adults with ID and falls prevention interventions used by carers	9	NR	NR	NR	Decreased physical capacity, unsafe behaviours, limited hazard awareness, and the impact of others in the home on an individual's fall behaviours. Also, carers introduced modifications to reduce fall rates, for example, activity modifications, environmental modifications (grab rails, helmets), or activity restriction (locking doors, reducing outings).
Chiba et al. (2009)	Cross sectional study investigating risk factors for falls in adults with ID and a falls risk screening tool	144	50.7% ($n = 73$) women; 49.3% ($n = 71$) men	28–68	NR	Age, presence of epilepsy, and presence of paretic conditions.
Choi et al. (2020)	Cohort study investigating risk	80	55% ($n = 44$) women; 45%	Mean age 43 ± 14 years	40 mild; 35 moderate; 5 severe	Needing support with activities of daily living. Other risk factors: being older, having arthritis, rheumatism, walking problems,

(Continues)

TABLE A1 (Continued)

Author/year	Study characteristics	Sample size	Gender	Age range (years)	Level of ID	Findings
	factors for falls in adults with ID		($n = 36$) men			slower gait speed, lower leg strength, being less mobile and less involved in moderate-to-vigorous physical activity.
Cortes-Amador et al. (2019)	RCT exploring risk factors for falls in people with ID and a falls prevention intervention for people with ID	48	NR	Aged 40 years and over	48 with mild-to-moderate	Risk of falling in people with ID begins at a younger age in people with ID than in the general population.
Cox et al. (2010)	Retrospective medical audit investigating risk factors for falls in adults with ID	119	NR	Aged 18 years and over	NR	Having seizures in the past 5 years, having a history of fracture and increasing age. However, in the general population, increasing age represents a risk to people in their 70s or older, whereas in this sample, there were notable increases in falls for people in their 40s and 50s.
Dijkhuizen et al. (2017)	Qualitative study investigating risk factors for falls in adults with ID and a falls risk assessment intervention	54	38.8% ($n = 21$) women; 61.2% ($n = 33$) men	Mean age for women was 39.9 years and mean age for men was 43.8 years	7 moderate; 33 severe; 14 profound. All had visual disabilities	Age appeared to be the only variable which distinguished fall incidents from no fall incidents. Further research is needed to explore centre of gravity (CoG) and comfortable walking speed (CWS) as these were significant risk factor predictors of fall incidents.
Enkelaar et al. (2013)	Longitudinal study exploring risk factors for falls in adults with ID	78	44% ($n = 34$) women; 56% ($n = 44$ men)	Mean age 62.8 years	78 mild-to-moderate	(Mild) severity of ID; (high) physical activity; (good) visuo-motor capacity; (good) attentional focus; and (high) hyperactivity-impulsiveness. Outdoor fallers were younger, had better motor capacity, and were more physically active than the indoor fallers. Hyperactivity and impulsive behaviour was more prevalent in fallers than non-fallers. Other known risk factors for falling in the general population, like co-morbidities and medication use, could not differentiate the fallers from the non-fallers with ID. Although the numbers of co-morbidities and medication use were high, they did not differ significantly between the fallers and non-fallers in this study. Furthermore, the study's authors found no difference between fallers and non-fallers with respect to their balance and gait, even though this is considered the most important risk factor for falling among the general population. Participants with ID, however, performed considerably worse on all clinical balance and gait tests compared to their peers in the general population. The study's authors hypothesise that persons with moderately severe ID and poor motor capacity are more likely to be protected by their caregivers, thus limiting their exposure to potentially dangerous situations.
Finlayson et al. (2010)	Qualitative exploring risk factors for falls in people with ID	511	NR	NR	NR	Epilepsy; urinary incontinence; and not having Down Syndrome, that is, having Down Syndrome reduced the risk of falls. Carers viewed that the person with ID is "clumsy," that most accidents

TABLE A1 (Continued)

Author/year	Study characteristics	Sample size	Gender	Age range (years)	Level of ID	Findings
						are not preventable, and that the person with ID is more likely to fall at particular times of the year (Autumn/Winter).
Finlayson et al. (2014)	Qualitative to explore risk factors for falls in people with ID	113	46% ($n = 52$) women; 54% ($n = 61$) men	20–77	49 Mild; 23 severe; 25 profound	Use/non-use and misuse of assistive aids/adaptations/technology; epilepsy/seizures; feeling dizzy; poor mobility/balance; environmental factors e.g. slippy wet floors, and being distracted. Also, individuals with ID can develop a fear of falling which can be just as, or more, debilitating.
Grant et al. (2001)	Descriptive epidemiological study investigating risk factors for falls and fall related injuries among people with ID	114	44.5% ($n = 51$) women; 55.5% ($n = 63$) men	18–77	68 Mild-to-moderate;46 severe/profound	Age: Serious fall injuries are more common in young adults with ID than the elderly—unlike populations of non-disabled people. Serious fall injuries occurred most frequently in bathroom and outdoor settings. Persons with comorbid symptoms were statistically significantly more likely to suffer a serious fall injury.
Hale et al. (2007)	Pilot study of an outcome measure to test balance in people with ID who have experienced a fall	20	30% ($n = 6$) women; 70% ($n = 14$) men	Aged 18 years and over	20 Profound	Concurrent medical problems, medication, environment, movement impulsiveness, and visual impairments.
Haynes and Lockhart (2012)	Observational study exploring slip detection and recovery responses in people with ID	15 in an ID group; matched with 15 participants without ID in a control group	27% ($n = 4$) women with ID; 73% ($n = 11$) men with ID	Mean age 38.5 years (±10 years)	1 Mild; 4 moderate; 7 severe; 3 profound	Deficient slip detection or an insufficient recovery response.
Ho et al. (2019)	Prospective observational cohort study exploring risk factors for falls in people with ID	78	41% ($n = 32$) women; 59% ($n = 46$) men	Mean age 52.5 years	41 with ID; 10 with Down Syndrome	A history of falls. Participants were also more likely to sustain a fall if they had epilepsy, displayed challenging behaviour and were ambulant.
Hsieh et al. (2001)	Longitudinal, epidemiological cohort study investigating risk factors for falls in adults with ID	268	50% ($n = 134$) women; 50% ($n = 134$) men	31–88	9 with no ID; 40 mild ID; 28 moderate; 183 severe	Age: more likely to be older, to be ambulatory and to have higher levels of adaptive behaviour. Individuals who were 70 years of age or older, who were ambulatory and had seizures on a monthly basis had the highest risk of falls.
Hsieh et al. (2012)	Longitudinal, epidemiological cohort study investigating risk	1515	44.8% ($n = 680$) women; 55.2%	18–86	NR	Being female, having arthritis, having a seizure disorder, having polypharmacy, using walking aids, and having difficulty lifting or carrying over 10lbs. While controlling for age, gender, level of

(Continues)

TABLE A1 (Continued)

Author/year	Study characteristics	Sample size	Gender	Age range (years)	Level of ID	Findings
	factors for falls in adults with ID		($n = 835$) men			intellectual disability, Down syndrome, and cerebral palsy, the overall model was significant. Having a higher level of intellectual disability; having arthritis; a heart condition; back pain; and urinary incontinence; using a walking aid; and having difficulty walking 3 blocks were risk factors for falls in adults with intellectual disability who did not have a seizure disorder.
O'Keefe et al. (2021)	Observational exploring gait variability and association with falls	30	NR	Aged 50 years and over	30 with Fragile X	Stride velocity variability under face paced gait was significantly associated with the number of self-reported falls.
Oppewal et al. (2014)	Longitudinal cohort to assess the predictive value of physical fitness for falls in older adults with ID	724	49% ($n = 360$) women; 51% ($n = 364$) men	Mean age of non-fallers: 60.7 years. Mean age of 1–2 fallers: 61.5 years. Mean age of 3 or more fallers: 63.2 years	724 with borderline to profound ID	Gait speed was the only physical fitness component that significantly predicted falls, but did not remain significant after correcting for confounders. Falls at baseline and not having Down syndrome were significant predictors for falls.
Oppewal and Hilgenkamp (2019)	Cross sectional to assess dual task effect on gait in adults with ID and if the dual task effect is predictive of for falls in this population	31	22.6% ($n = 7$) women; 77.4% ($n = 24$) men	20–68	15 Mild; 16 Moderate	Dual tasking affects gait in adults with ID. More research is needed to better understand the predictive value of gait for falls. Distractors should be considered with adults who have ID as dual tasking affects their gait and may increase their risk of falls.
Pal et al. (2014)	Prospective observational cohort study to collect fall related data and to report on the development of tools to collect fall risk data	135	48% ($n = 65$) women; 52% ($n = 70$) men	22–71	NR	Epilepsy/seizures; medical conditions (diabetes, high blood pressure); orthopaedic conditions (arthritis, previous hip surgery); vision problems; mood disorders (anxiety); difficulties with communication; problems with hearing; problems with balance; behavioural issues; physical disability; gait problems; incontinence; weight issues; and other issues (constipation, pressure sores). The mean age of fallers among people with ID was 42 years. Fallers had a history of previous falls and fractures and a higher occurrence of epilepsy, orthopaedic-related conditions, gait and balance problems and behavioural issues than non-fallers, and more fallers were female. Although many participants had orthopaedic conditions and gait abnormalities, few participants used walking devices. The location of falls included: indoors ($n = 98$; 78%); bathroom/toilet: ($n = 18$; 18%); bedroom ($n = 23$; 24%); lounge ($n = 43$;

TABLE A1 (Continued)

Author/year	Study characteristics	Sample size	Gender	Age range (years)	Level of ID	Findings
						44%); outdoors ($n = 26$; 21%). Most falls occurred during the daytime (57%) and indoors.
Salb et al. (2015)	Longitudinal cohort to investigate the characteristics of falls in adults with ID over a broad age range	147	75.5% ($n = 111$) women; 24.5% ($n = 36$) men	21–89	55 Mild-to-moderate; 92 severe/profound	Orthopaedic shoes.
Schoufour et al. (2015)	Observational prospective study to analyse the ability of the frailty index to predict falls (and other conditions) in people with ID	632	50% ($n = 316$) women; 50% ($n = 316$) men	Aged 50 years and over	NR	Epilepsy, visual deficits, behavioural problems, and polypharmacy.
Smulders, Enkelaar, Weerdesteyn, et al. (2013a)	Prospective to investigate the fall rate, circumstances, and consequences of falls in older adults with mild-to-moderate ID	82	41.5% ($n = 34$) women; 58.5% ($n = 48$) men	51.6–84.6	82 Mild-to-Moderate	Most falls occurred during walking and the most important reason for falling was tripping. Generally, tripping is due to failure to recover balance while negotiating an obstacle. Indeed, the participants reported that there were obstacles in the environment for 80% of falls due to tripping. No sex-related differences in fall rate observed. No effect of age on the fall rate but this might be due to the fact that the study only included participants over the age of 50 years. However, they did find age-related differences in relation to the fear of falling.
Wagemans and Cluitmans (2006)	Epidemiological to investigate risk factors for falls and fractures in adults with ID in residential settings	338	72% ($n = 243$) women; 28% ($n = 95$) men	20 years and over	NR	Epilepsy, antiepileptic drugs, fractures in past, ambulating, aging, visual impairment, and hemiplegia. The study's authors found no significant relation between falling and Down syndrome, diplegia, sex, hypotonia, orthopaedic problems, hearing impairments, use of psychopharmacological medications or use of antihypertensive drugs.

TABLE A2 Falls prevention interventions for people with intellectual disabilities (ID)

Author/ year	Study characteristics	Sample size	Gender	Age range (years)	Level of ID	Findings
Bruckner and Herge, (2003)	Non-control, non-blinded single trial assessing risk of falls in older people with ID	18	55% ($n = 10$) women; 45.5% ($n = 8$) men	55–79	NR	The Modified-Up-and-Go (MUAG) screening tool was found to be reliable but not valid. A reliable and valid screening tool to assess the risk of falls in this population needs to be identified and investigated.
Cahill et al. (2014)	Qualitative study investigating risk factors for falls in adults with ID and falls prevention interventions used by carers	9	NR	NR	NR	Carers introduced modifications to reduce fall rates e.g., activity modifications, environmental modifications (grab rails, helmets), or activity restriction (locking doors, reducing outings).
Chiba et al. (2009)	Cross sectional study investigating risk factors for falls in adults with ID and a falls risk screening tool	144	50.7% ($n = 73$) women; 49.3% ($n = 71$) men	28–68	NR	The Tinetti instrument may be an effective tool to detect an increased risk of fall in this population.
Cortes-Amador et al. (2019)	RCT exploring risk factors for falls in people with ID and a falls prevention intervention for people with ID	48	NR	Aged 40 years and over	48 with mild-to-moderate ID	The Vestibular Rehabilitation Programme may improve balance and reduce the risk of falling in people with ID.
Crockett et al. (2015)	Service evaluation of a falls prevention intervention for people with ID	50	52% ($n = 26$) women; 48% ($n = 24$) men	28–81	18 mild; 28 moderate; 4 severe	Physiotherapists have a key role in promoting exercise to prevent falls within a multidisciplinary falls service for people with ID. Further work is needed to address non-compliance issues.
Dijkhuizen et al. (2017)	Qualitative study investigating risk factors for falls in adults with ID and a falls risk assessment intervention	54	38.8% ($n = 21$) women; 61.2% ($n = 33$) men	Mean age for women was 39.9 years and mean age for men was 43.8 years	7 moderate; 33 severe; 14 profound. All had visual disabilities	The modified Berg Balance Scale (BBS) had no additional predictive contribution and was not sufficient for measuring balance or predicting a risk of a fall in persons with ID and a visual impairment.
Finlayson et al. (2018)	Series of experiments to explore trials of lycra splinting clothing to prevent falls among people with ID	9	55.5% ($n = 5$) women; 44.5% ($n = 4$) men	20–59	9 with mild-to-moderate	Prescribing lycra splinting socks on a case by case basis, to individuals with ID who fall due to gait/balance issues, may be likely to bring about positive outcomes to prevent or reduce falls in people with ID but further research is needed to test this hypothesis.
Hale et al. (2010)	Intervention study to explore the feasibility of a falls-prevention risk assessment tool for use in a population of people with ID	9 persons with ID. 11 physiotherapists	NR	42–71	NR	The Modified Gait Abnormality Rating Scale (GARS-M) may be a reliable fall-prevention risk assessment tool for use in a population of persons with ID. However, this was a small study sample and further research is needed to confirm the study's findings.

TABLE A2 (Continued)

Author/ year	Study characteristics	Sample size	Gender	Age range (years)	Level of ID	Findings
Hale et al. (2009)	Intervention study exploring the use of a Test to assess the automatic reactions to postural perturbations in people with ID as a potential falls prevention intervention	7 persons with ID. 13 adults without ID	NR	Mean age 58 years (±12 years)	NR	The Motor Control Test (MCT) tests the speed of a person's automatic reactions to sway induced by unexpected brief translations of the support surface. Participants with ID had slower responses to postural perturbations than the control participants. However, the small sample size precluded analysing the statistical significance of this finding. Some adults with ID, who have a history of falling, may have delayed responses to postural perturbations. This could be targeted in physiotherapy interventions aimed at improving balance capabilities and thereby preventing falls.
Hale et al. (2019)	Multiple case study to compare two falls prevention interventions for adults with ID	7	NR	NR	NR	Two falls prevention interventions were tested: Prevention of Falls for Adults with ID (PROFAID) and the Otago Exercise Programme (OEP). The OEP was achievable and acceptable to participants. Adherence was good. In contrast, the PROFAID intervention participants had differing levels of ID and adherence was variable. Further research is needed into how strength and balance interventions can be delivered in an appropriate, effective and sustainable way for people with ID.
Hale et al. (2016)	Mixed methods study exploring acceptability, utility and feasibility of a falls-prevention intervention for adults with ID	29	55% ($n = 16$) women; 45% ($n = 13$) males	29–71	9 mild; 11 moderate; 6 severe; 3 profound	Some evidence for the benefit, acceptability, utility, and feasibility of the Prevention of Falls for Adults with ID (PROFAID) intervention. However, further studies are needed to confirm this study's findings.
Ho et al. (2020)	Qualitative (interviews) to explore whether participants' experiences reflected current guidelines for falls prevention in older adults	21 (comprising 5 older adults with ID, one parent, one nurse, and 14 disability) support workers)	NR	NR	NR	Participants' experiences did not reflect current guidelines of care for falls prevention for older adults (Australian Commission on Safety & Quality in Healthcare, 2009; Moncada & Mire, 2017). Even reporting an injurious fall to a health professional did not trigger screening of falls risk, falls management and referral to relevant falls prevention services. Participants had limited knowledge about falls prevention. Barriers: not being offered access to established falls prevention pathways. Enablers: individualisation of falls prevention strategies.
Kovacic et al. (2020)	Quasi-experimental to evaluate the efficacy, after 16 weeks, that three different physical activity programmes had on	150	50% ($n = 75$) women; 50%	18–>50	150 with mild-to-moderate ID	Multicomponent balance-specific exercise programmes with a significant socio-gerontological component on active aging could be a useful intervention for adults

(Continues)

TABLE A2 (Continued)

Author/ year	Study characteristics	Sample size	Gender	Age range (years)	Level of ID	Findings
	balance and on fall reduction in adults with ID		($n = 75$) men			with ID who have poor balance and who experience frequent falls.
Nissim et al. (2019)	Quasi-experimental to examine the effects of an aquatic motor intervention on fall risk (and memory) in older people with ID	41	56% ($n = 23$) women; 44% ($n = 18$) men	50–66	41 with mild-to-moderate ID	Fourteen weeks of an aquatic or on-land (Tai Chi/Ai Chi) intervention may help reduce fall risk in older adults with ID. The aquatic intervention improved their fall risk quicker compared to the on-land motor intervention group.
O'Neal and Thomas (2022)	Observational to examine the relationship between falls and single-leg stance	178	39% ($n = 70$) women; 61% ($n = 108$) men	18–69	NR	The Single Leg Stance test and the cut-off scores used may not be the most appropriate for identifying people at risk of falling in this population.
Pal et al. (2014)	Prospective observational cohort study to collect fall related data and to report on the development of tools to collect fall risk data	135 participants with ID. 33 individuals from stakeholder organisations	48% ($n = 65$) women; 52% ($n = 70$) men	22–71	NR	Three methods for collecting fall-related data were developed: (Axmon et al., 2019) a tick box form listing potential fall risks (fall risk form); (Brenner et al., 2014) a tick box form to collect information on each individual fall (falls incident form); and (Choi et al., 2019) a falls calendar on which only the day of the fall is recorded. These had good face and content validity and utility, and were acceptable to those using them. Evaluating the tool was not feasible because falls are random events precluding test–retest reliability testing, and interrater reliability is problematic. Currently, there is no reliable way of confirming the incidence of falls in people with ID.
Pal et al. (2013)	Qualitative to explore the experiences of therapists in trying to reduce fall risk in people with ID	8 occupational therapists	100% ($n = 8$) women	NR	NA	Four main fall prevention strategies were identified that therapists thought to be most useful, including environmental modifications, participation in physical activity and exercise, prescription of assistive mobility devices, and education on safe mobility. Education was felt to be an important part of fall prevention strategies. Education needs to be provided verbally as well as written in plain language and illustrated with photographs and reinforced with frequent repetition. Therapists advocated a multifactorial approach.
Renfro et al. (2016)	Quasi-experimental to validate a falls prevention intervention for adults with ID	15	67% ($n = 10$) women; 33% ($n = 5$) men	18–>70 years 46.7% were aged 50 years and over	NR	Results from this pilot suggest that the modified Otago Exercise Programme (OEP) is associated with improvements in strength, balance and aerobic ability in people with ID and or Developmental Disorders (DD) and that participants reported no falls during the study period. Future studies involving more

TABLE A2 (Continued)

Author/ year	Study characteristics	Sample size	Gender	Age range (years)	Level of ID	Findings
						participants with longer lengths of participation and follow-up are needed to confirm findings.
Smulders, Enkelaar, Schoon, et al., (2013b)	Process evaluation to develop, implement, and evaluate a falls clinic for people with ID	26	54% ($n = 14$) women; 46% ($n = 12$) men	53–73	17 mild; 9 moderate	The proposed falls clinic for persons with ID may be feasible. It was seen as useful by professionals, participants, and caregivers.
Van Hanegem et al. (2014)	Quasi-experimental to evaluate whether obstacle course training can improve mobility and prevent falls in people with ID	39	46% ($n = 18$) women; 54% ($n = 21$) men	Mean age 55.1 years (±10.7 years)	9 mild; 7 moderate; 21 severe; 2 profound	Compared with the baseline assessment, Performance Oriented Mobility Assessment scores and walking speed improved significantly, in parallel with a substantial reduction in the rate of falls. Furthermore, the number of fall-related fractures decreased, suggesting that both severe and non-severe falls were prevented.