Effectiveness of a multi-component intervention to reduce delirium incidence in elderly care wards

RACHEL HOLT1, JOHN YOUNG1, DAVID HESELTINE2

1Academic Unit of Elderly Care and Rehabilitation, Bradford Institute for Health Research, Bradford, West Yorkshire, UK
2York Teaching Hospital Trust, York, UK

Address correspondence to: Y. John. Tel: (+1)1274 383406; Fax: (+1)1274 382766. Email: john.young@bthft.nhs.uk

Abstract

Objective: to examine the effect of a multi-component, delirium prevention intervention on rates of incident delirium for patients admitted to specialist elderly care wards.

Design: ‘before’ and ‘after’ study.

Setting: three specialist elderly care wards in a general hospital.

Subjects: older people admitted as emergencies.

Methods: a multi-component delirium prevention intervention that targeted delirium risk factors was implemented by clinical staff. Demographic information and assessments for delirium risk factors were recorded by research staff within 24 h of admission to the ward. New onset (incident) delirium was diagnosed by daily research staff assessments using the Confusion Assessment Method and Delirium Rating Scale-Revised-98.

Results: a total of 436 patients were recruited (249 in the ‘before’ and 187 in the ‘after’ group). Incident delirium was significantly reduced (‘before’ = 13.3%; ‘after’ = 4.6%; $P = 0.006$). Delirium severity and duration were significantly reduced in the ‘after’ group. Mortality, length of stay, activities of daily living score at discharge and new discharge to residential or nursing home rates were similar for both groups.

Conclusions: a multi-component, delirium prevention intervention directed at delirium risk factors and implemented by local clinical staff can reduce incident delirium on specialist elderly care wards.

Keywords: elderly, delirium, prevention, older people

Introduction

Delirium is a syndrome of acute, fluctuating confusion, which commonly affects older people. Delirium is present in 10–15% of older people admitted to hospital [1, 2], and a further 10–40% develop the condition during their hospital stay [1, 3, 4]. Patients with cognitive impairment, hip fracture, severe illness or those aged over 65 years are at greatest risk [5]. Delirium is associated with an increased risk of death, reduced longer term function, greater risk of admission to long-term care, longer length of hospital stay [6] and family distress [7].

Many risk factors for delirium have been identified [8] and some are susceptible to modification. Incident delirium (delirium occurring after admission to hospital) can be reduced by about one-third through modification of selected risk factors [9–19]. Modification has typically required complex, multi-component interventions comprising education and structured clinical protocols directed at, for example, optimising hydration, cognitive orientation, drug reviews and mobilisation. Intervention delivery strategies have included additional staff and volunteers [16], proactive geriatric consultation [10], training family members [18] and sustained education [13, 19]. Not all studies have reported a reduction in delirium incidence [20] and a high degree of protocol adherence is a critical issue for success [21].

The existing multi-component delirium prevention literature, although encouraging, comprises ‘proof of concept’ studies largely delivered by delirium specialists. The type of care under investigation can be characterised as high quality, person-centred care. It could be argued that this is similar to...
the comprehensive geriatric assessment (CGA) care provided
to frail older people in specialist elderly care units for which
outcomes, including cognitive function, are superior to non-
specialist care [22]. The aim of our study, therefore, was to in-
vestigate the additional benefit of a complex delirium preven-
tion intervention delivered as part of routine care in the
context of a specialist elderly care hospital service.

Methods

Study design

We conducted a ‘before’ and ‘after’ study to investigate the
effects of a multi-component delirium prevention interven-
tion in a general hospital elderly care department. Three spe-
cialist acute elderly care wards (80 beds) with the same
admission and care policies participated. During the ‘before’
phase, patients received usual care (CGA and multidisci-
plinary care), and during the ‘after’ phase patients received usual
care plus the delirium prevention intervention.

The delirium prevention intervention

The intervention was developed by a national multidisci-
plinary research group. It was based on previous prevention
studies [9–11, 18] and incorporated recommended imple-
mentation strategies [23, 24]. It was designed with the aim of
enabling the local healthcare team to make changes to their
clinical practice without the requirement for additional staff.
It comprised standardised education and delirium risk factor
modification protocol materials. The likelihood of real change
is increased by including a local-modification phase in which
local staff led the implementation process [23, 24].

The intervention was in three parts:

(1) Identification of local opinion leaders or ‘champions’ to
lead the implementation of the intervention.
(2) An initial educational intervention to raise awareness,
knowledge and enthusiasm.
(3) A practice change intervention directed at delirium risk
factors.

The research team provided materials for education and prac-
tice change, which were then modified by the local opinion
leaders. The educational materials included a 30-min inter-
active lecture with a handout, a delirium quiz, a poster, re-
ference material and case vignettes. The practice change
materials comprised a delirium risk factor modification care
plan placed at the end of the patient’s bed and required
signed actions three times each day, a delirium assessment
protocol for ward doctors and an escalation flowchart for
suspected delirium for nurses.

Study participants

Patients presenting with an acute medical illness were admit-
ted from the Accident and Emergency department or direct-
ly by general practitioners to one of the three participating
specialist elderly care wards. Potential study participants were
consecutive patients admitted between October 2007 and
March 2008 (‘before’ group), and August 2008 to January
2009 (‘after’ group). As the intervention was delivered as part
of routine care, all the patients were eligible for inclusion in the
study. Patients were specifically approached for informed
consent to participate with the research assessments and for
data collection. Proxy consent was sought for patients who
lacked capacity. Patients with prevalent delirium (excluded
after baseline assessment); patients considered too unwell to
be assessed (in the opinion of clinical staff); or unable to com-
municate (dysphasia, unable to speak English); or patients for
whom consent could not be obtained within 24 h of ward
admission were excluded. Ethical approval for the study was
obtained from the local Research Ethics Committee.

Baseline assessment

The following demographic and delirium risk factor informa-
tion was collected by the lead researcher (R.H.) at base-
line: age; gender; pre-admission residence; dehydration [urea
(mmol/l) and creatinine (μmol/l) ratio >0.073]; acute illness
severity (Modified Early Warning Score >3 [25]); comorbid-
ity (Charlson score ≥4 [26]); number of medications pre-
scribed; mobility (independent or needs assistance); visual
acuity ( Snellen chart with impairment defined as <6/18 at 3
m); hearing ( hearing impaired <18/36 whispers heard on
the Whisper test [27] or use of a hearing aid) and cogni-
tive impairment using the Mini-Mental Examination Score
(MMSE) ( score <24) [28]. Prevalent delirium was detected
by assessment using the 4-item version of the Confusion
Assessment Method (CAM) (sensitivity 94%; specificity
89%) [29], followed by the Delirium Rating Scale-Revised-98
(DRS-R-98) (sensitivity 92%; specificity 85%) (309) if a CAM
score of ≥ 2 was obtained. A DRS-R-98 score of >17.75
indicated a diagnosis of delirium [30].

Process outcomes

We recorded ward staff attendance at the education sessions
and tested their knowledge about delirium and its prevention
before and after implementation of the intervention. Adherence
to the intervention was assessed as the proportion of delirium
risk factor modification care plan actions signed as completed
for each patient.

Patient outcomes

The primary outcome was the proportion of participants
developing incident delirium during the first 7 days after ad-
mission to the study ward. The time interval was restricted to
7 days to prevent exposure bias due to unequal lengths of
stay during the two periods of observation. Delirium was
detected by daily assessments (including weekends) con-
ducted by trained research assistants using the CAM and
DRS-R-98 instruments. The research assistants were blind to
the baseline assessments for delirium risk. Inter-rater reliabil-
ity was monitored 4 week during the study.
Secondary outcomes recorded at discharge from hospital were the mean duration of delirium episodes; the mean severity of delirium episodes (highest DRS-R-98 severity score); in-hospital mortality; length of stay; function at discharge assessed using the Barthel index score [31]; new discharge to long-term care and a composite ‘poor’ outcome: ‘new discharge to long-term care OR died in hospital’. Secondary outcomes recorded at 6 months after discharge were death; readmission to hospital or admission to long-term care.

**Statistical analysis**

Demographic and baseline delirium risk factors were summarised by means and standard deviations, or by proportions (%), and between-group differences examined using the Mann–Whitney U test for continuous variables and the Chi-squared test for categorical variables. The between-group difference for the primary outcome was examined using a binary logistic regression analysis with adjustment for baseline delirium risk and demographic variables. The analyses of the secondary outcomes used the Mann–Whitney U test for continuous variables and the Chi-squared test for categorical variables. The Statistical Package for Social Sciences (version 18) was used for all analyses.

**Results**

A specialist nurse, a consultant geriatrician and a nurse manager (Modern Matron) were the opinion leaders in this study. The delirium risk factors targeted were: disorientation, dehydration, visual impairment, hearing impairment, constipation, pain and immobility. Ward staff members formed a working group to identify potential barriers to the intervention and develop solutions. Nurse members of the working group volunteered to act as a delirium prevention intervention ‘link’ for each of the three wards, to promote the intervention and help deliver informal education to their colleagues.

We recruited 436 participants to the study; 249 in the ‘before’ group and 187 in the ‘after’ group (Figure 1). The two groups were well matched for age but the ‘after’ group had more men and fewer patients admitted from long-term care. The risk factors for delirium were similar for the two groups with the exception of more patients with dehydration and hearing impairment in the ‘after’ group (Table 1).
### Process outcomes

Delirium education sessions were attended by 70% ($n = 131/188$) of staff. The delirium knowledge test demonstrated that 82% ($n = 27/33$) of healthcare assistants and staff nurses who completed the test had increased knowledge about delirium. Recorded adherence to the delirium risk factor modification protocols was moderate (27–57%) but semi-structured interviews with opinion leaders (not reported here) described observations of ward staff performing delirium prevention actions without signing the protocol charts. Protocol adherence was highest for reorientation and hydration, and lowest for mobility and constipation.

### Patient outcomes

The primary outcome, delirium incidence during first 7 days of admission, was significantly reduced from 13.3% in the ‘before’ group to 4.6% in the ‘after’ group ($P = 0.006$) (Table 2). The binary logistic regression analysis that adjusted for baseline imbalances between the two groups for demographic and delirium risk factors confirmed this finding with an odds ratio of 3.665 (95% confidence intervals 1.40–9.591; $P = 0.008$) for developing incident delirium in the ‘before’ compared with the ‘after’ group (Table 3). The secondary outcomes, the duration and severity of delirium, were also significantly reduced, although the differences were clinically small. There were no differences between the groups for mortality, length of hospital stay, functional ability at discharge or new long-term care admission. There were no significant differences between the groups at 6 months for mortality or new admissions to long-term care, but readmission rates in the intervention group were significantly higher.

### Discussion

In England and Wales, the evidence for the diagnosis, prevention and treatment of delirium has been reviewed by the National Institute for Health and Clinical Excellence (NICE) [5]. An important conclusion was that delirium prevention using multi-component (complex) interventions is a highly

### Table 1. Demographic and delirium risk characteristics at baseline assessment

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Before group</th>
<th>After group</th>
<th>Statistical test</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n$</td>
<td>210</td>
<td>152</td>
<td></td>
</tr>
<tr>
<td>Age (years); mean ± standard deviation</td>
<td>85.01 years; ± 6.03</td>
<td>85.8 years; ± 5.39</td>
<td>$P = 0.170$; Mann–Whitney U test</td>
</tr>
<tr>
<td>Gender (% male)</td>
<td>34.3% ($n = 72$)</td>
<td>50.0% ($n = 76$)</td>
<td>$P = 0.003$*; Chi-squared</td>
</tr>
<tr>
<td>Resident in long-term care prior to admission</td>
<td>13.3% ($n = 28$)</td>
<td>4.6% ($n = 7$)</td>
<td>$P = 0.006$*; Chi-squared</td>
</tr>
<tr>
<td>Dehydration urea/creatinine ratio $&gt;0.073$</td>
<td>68.1% ($n = 143$)</td>
<td>77.6% ($n = 118$)</td>
<td>$P = 0.046$*; Chi-squared</td>
</tr>
<tr>
<td>Cognitive impairment (MMSE score $&lt;24$)</td>
<td>56.2% ($n = 118$)</td>
<td>59.9% ($n = 91$)</td>
<td>$P = 0.484$; Chi-squared</td>
</tr>
<tr>
<td>Severe illness (MEWS $&gt;3$)</td>
<td>0.8% ($n = 2$)</td>
<td>0% ($n = 0$)</td>
<td>$P = 0.223$; Chi-squared</td>
</tr>
<tr>
<td>Co-morbidity score (Charlson co-morbidity index $\geq 4$)</td>
<td>20.5% ($n = 43$)</td>
<td>19.1% ($n = 29$)</td>
<td>$P = 0.742$; Chi-squared</td>
</tr>
<tr>
<td>Visual impairment</td>
<td>31.0% ($n = 65$)</td>
<td>28.9% ($n = 44$)</td>
<td>$P = 0.576$; Chi-squared</td>
</tr>
<tr>
<td>Hearing impairment</td>
<td>59.0% ($n = 124$)</td>
<td>71.7% ($n = 109$)</td>
<td>$P = 0.013$*; Chi-squared</td>
</tr>
<tr>
<td>Polypharmacy (&gt;6 medications prescribed)</td>
<td>50.5% ($n = 106$)</td>
<td>46.7% ($n = 71$)</td>
<td>$P = 0.479$; Chi-squared</td>
</tr>
<tr>
<td>Impaired mobility at baseline (requires assistance of staff)</td>
<td>52.4% ($n = 110$)</td>
<td>53.3% ($n = 81$)</td>
<td>$P = 0.864$; Chi-squared</td>
</tr>
</tbody>
</table>

MMSE, standardized Mini-Mental State Examination Score [28]; MEWS, modified early warning score [24].

### Table 2. Primary and secondary outcome results

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Before group</th>
<th>After group</th>
<th>Statistical test</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n = 210$</td>
<td></td>
<td>$n = 152$</td>
<td></td>
</tr>
<tr>
<td>Primary outcome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incident delirium in first 7 days</td>
<td>13.3% ($n = 28$)</td>
<td>4.6% ($n = 7$)</td>
<td>$P = 0.006$*; Chi-squared</td>
</tr>
<tr>
<td>Binary logistic regression for primary outcome</td>
<td></td>
<td></td>
<td>$P = 0.012$; odds ratio = 3.543 (95% CI: 1.313–9.561)</td>
</tr>
<tr>
<td>$n = 210$</td>
<td></td>
<td>$n = 152$</td>
<td></td>
</tr>
<tr>
<td>Secondary outcomes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of delirium during first 7 days; mean ± SD</td>
<td>0.29 days; ±0.931</td>
<td>0.06 days; ±0.287</td>
<td>$P = 0.002$*; Mann–Whitney U test</td>
</tr>
<tr>
<td>Severity of delirium during first 7 days; mean ± SD</td>
<td>16.86 ± 4.92</td>
<td>9.17 ± 7.94</td>
<td>$P = 0.005$*; Mann–Whitney U test</td>
</tr>
<tr>
<td>In-hospital mortality</td>
<td>11.0% ($n = 23$)</td>
<td>11.2% ($n = 17$)</td>
<td>$P = 0.945$; Chi-squared</td>
</tr>
<tr>
<td>Length of stay; mean ± SD</td>
<td>19.84 days; ±18.08</td>
<td>21.32 days; ±21.39</td>
<td>$P = 0.727$; Mann–Whitney U test</td>
</tr>
<tr>
<td>Barthel score at discharge; mean ± SD</td>
<td>13.67 ± 5.22</td>
<td>14.40 ± 5.35</td>
<td>$P = 0.161$; Mann–Whitney U test</td>
</tr>
<tr>
<td>New discharge to long-term care</td>
<td>8.1% ($n = 17$)</td>
<td>9.9% ($n = 15$)</td>
<td>$P = 0.558$; Chi-squared</td>
</tr>
<tr>
<td>New discharge to long-term care OR died in hospital</td>
<td>19.1% ($n = 40$)</td>
<td>21.1% ($n = 32$)</td>
<td>$P = 0.637$; Chi-squared</td>
</tr>
<tr>
<td>Six month outcomes</td>
<td>$n = 207$</td>
<td>$n = 148$</td>
<td></td>
</tr>
<tr>
<td>Dead at 6 months following discharge</td>
<td>30.9% ($n = 64$)</td>
<td>33.8% ($n = 50$)</td>
<td>$P = 0.620$; Chi-squared</td>
</tr>
<tr>
<td>Admission to long-term care at 6 months following discharge</td>
<td>13.0% ($n = 27$)</td>
<td>16.2% ($n = 24$)</td>
<td>$P = 0.416$; Chi-squared</td>
</tr>
<tr>
<td>Hospital readmission within 6 months following discharge</td>
<td>41.1% ($n = 85$)</td>
<td>54.1% ($n = 80$)</td>
<td>$P = 0.020$*; Chi-squared</td>
</tr>
</tbody>
</table>

SD, standard deviation
cost-effective healthcare strategy and should be a key priority for widespread implementation in the National Health Service. Multi-component delirium prevention interventions involve assessment of patients to identify, and then modify, risk factors associated with delirium. The research literature suggests that about a third of incident delirium in hospitals could be prevented by this approach [5]. However, this recommendation is underpinned by relatively few delirium prevention intervention studies. These studies have recruited patients in medical wards [9, 18, 19], orthopaedic wards [10, 16] and oncology [17]. Four previous studies have involved patients in elderly care wards [12, 14–16]. Two studies are very small [14, 16]. The before and after study by Genticic et al. (n = 739) reported a significant 66% relative risk reduction in delirium [15]. The study by Vidan et al. (n = 542) also reported a significant reduction in delirium incidence for patients admitted to an elderly care ward in which usual care had been augmented with a multi-component delirium prevention intervention [12]. However, the comparison ward was a general medical ward. This is not ideal because the reported reduction in delirium incidence may have been related to the differences in patients’ baseline risk for delirium and/or the existing differences in care processes between the two wards. Indeed, there is reliable evidence that specialist elderly care, often referred to as CGA, is associated with superior outcomes for older people compared with general medicine ward care, including better cognitive outcomes [22].

Our study that used a quasi-experimental design has specifically addressed the additional benefit associated with a multi-component delirium prevention intervention when applied to elderly care wards delivering CGA. The intervention was individually targeted at assessed risk factors for delirium in line with the NICE guidance [5]. The observed baseline incidence of delirium for this high-risk population (average age >85 years; >50% with cognitive impairment) was 13.3%. This is at the lower end of previously reported estimates for medical in-patients [5] suggesting that the CGA care process may indeed be associated with some reduction in delirium incidence. However, an important finding from our study was that delirium incidence, duration and severity were all significantly reduced during the intervention implementation phase of the study. The reduction in delirium persisted after adjustment for differences in baseline delirium risk and demographic variables. It would be expected to be highly cost-effective according to the NICE health economic model for delirium prevention in medical patients [32]. Unfortunately, the reduction in delirium did not generalise into wider health gains such as reduced mortality or reduced need for long-term care. This is consistent with previous studies [5] and might be explained by the adverse health state of frailty. Although not assessed in our study, many of the study participants will have been frail and frailty is associated with a particularly poor outcome from an episode of delirium [33]. Frailty should be considered as an important confounder in future delirium prevention studies.

We excluded patients with prevalent delirium (delirium at baseline assessment) in order to ensure only incident delirium was being measured. The ‘before’ group was over-represented, compared with the ‘after’ group, by residency in long-term care before admission. The ‘after’ group was over-represented by male gender, dehydration and hearing impairment. These factors are weakly associated with higher delirium risk [3, 34]. However, the stronger risk factors for delirium—cognitive impairment, illness severity, visual impairment, co-morbidity burden and age [5]—were not distributed significantly differently between the groups (Supplementary data are available in Age and Ageing online, Appendix 1).

The main strengths of our study are the large number of patients recruited (n = 436), and that the intervention was delivered by existing ward staff rather than by delirium specialists. The detection of delirium is poor in routine care [35] and was standardized in our study by the use of validated and reliable instruments. Observer bias was minimized.

### Table 3. The binary logistic regression model that adjusts for baseline imbalances in demographic and delirium risk factors between the groups with an odds ratio of 3.665 (95% confidence intervals 1.401–9.591; *P* = 0.008) for developing incident delirium in the ‘before’ compared with the ‘after’ group

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>Sig</th>
<th>Exp (B)</th>
<th>95% CI for Exp (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>−0.020</td>
<td>0.039</td>
<td>0.601</td>
<td>0.980</td>
<td>0.908–1.057</td>
</tr>
<tr>
<td>Gender</td>
<td>0.407</td>
<td>0.486</td>
<td>0.148</td>
<td>1.502</td>
<td>0.580–3.894</td>
</tr>
<tr>
<td>Cognitive impairment</td>
<td>−0.692</td>
<td>0.652</td>
<td>0.010</td>
<td>0.184</td>
<td>0.051–0.662</td>
</tr>
<tr>
<td>Dementia</td>
<td>−0.183</td>
<td>0.183</td>
<td>0.291</td>
<td>0.700</td>
<td>0.143–0.831</td>
</tr>
<tr>
<td>Dehydrated</td>
<td>−0.182</td>
<td>0.481</td>
<td>0.508</td>
<td>0.834</td>
<td>0.325–2.140</td>
</tr>
<tr>
<td>Visual impairment</td>
<td>−0.725</td>
<td>0.415</td>
<td>0.271</td>
<td>0.484</td>
<td>0.215–1.091</td>
</tr>
<tr>
<td>Hearing impairment</td>
<td>0.295</td>
<td>0.447</td>
<td>0.508</td>
<td>1.344</td>
<td>0.560–3.225</td>
</tr>
<tr>
<td>Acute illness</td>
<td>−1.093</td>
<td>1.822</td>
<td>0.549</td>
<td>0.335</td>
<td>0.009–11.926</td>
</tr>
<tr>
<td>Polypharmacy</td>
<td>0.258</td>
<td>0.416</td>
<td>0.355</td>
<td>1.294</td>
<td>0.573–2.923</td>
</tr>
<tr>
<td>Comorbidities</td>
<td>−0.356</td>
<td>0.506</td>
<td>0.348</td>
<td>0.700</td>
<td>0.126–1.887</td>
</tr>
<tr>
<td>Mobility</td>
<td>−1.065</td>
<td>0.484</td>
<td>0.348</td>
<td>0.345</td>
<td>0.133–0.891</td>
</tr>
<tr>
<td>Residence</td>
<td>−0.028</td>
<td>0.528</td>
<td>0.356</td>
<td>0.973</td>
<td>0.346–2.738</td>
</tr>
<tr>
<td>Group effect</td>
<td>1.299</td>
<td>0.491</td>
<td>0.008</td>
<td>3.665</td>
<td>1.401–9.591</td>
</tr>
<tr>
<td>Constant</td>
<td>1.475</td>
<td>3.713</td>
<td>0.691</td>
<td>4.370</td>
<td></td>
</tr>
</tbody>
</table>
by the delirium assessments being conducted by research assistants who were independent from the ward teams and who had not been involved with patient recruitment. The educational component of the intervention resulted in increased knowledge, especially among nurses and health care assistants. The protocol adherence reporting that was completed by the ward staff as part of routine care suggests that delivery of the delirium risk factor protocols was only moderate. However, additional qualitative data (not reported here) suggest not all delirium prevention actions were documented.

The main limitation of the study is the use of the quasi-experimental ‘before’ and ‘after’ design. All three wards implemented the intervention because the three wards were part of the same elderly care department and the risk of contamination if one ward was allocated as a control setting was considered high. It is possible that changes in practice on the study wards, not recorded by the research team, occurred between the ‘before’ and ‘after’ group data collection and contributed to the reduction in delirium seen. The calendar months during which the data were collected varied between the ‘before’ and ‘after’ groups and this may have had an impact on rates of delirium, though the rates of prevalent delirium detected were similar between the two groups.

The findings of our study, if confirmed in future studies, suggests that specialist elderly care wards should consider the introduction of multi-component delirium prevention interventions to augment existing CGA care.

**Key points**

- Delirium is common in older people admitted to specialist elderly care wards.
- It is uncertain if multi-component, delirium prevention interventions reduce incident delirium on specialist elderly care wards.
- Delirium incidence was significantly reduced following a multi-component prevention intervention on elderly care wards.

**Acknowledgements**

We gratefully acknowledge the assistance of Prof. Graham Mulley, St James’s University Hospital, Leeds, UK, the national research group who developed the initial intervention, and the staff and patients of York Hospitals NHS Foundation Trust.

**Conflicts of interest**

None declared.

**Funding**

This work was supported by a research grant from Research into Ageing.

---

**Supplementary data**

Supplementary data mentioned in the text is available to subscribers in *Age and Ageing* online.

**References**

The prevalence of sarcopenia in very old individuals according to the European consensus definition: insights from the BELFRAIL study

Delphine Legrand, Bert Vaes, Catharina Mathei, Christian Swine, Jean-Marie Degryse

IRSS Institute of Health and Society, Université Catholique de Louvain (UCL), Brussels, Belgium

Address correspondence to: D. Legrand. Tel: +32 2 7643466; Fax: +32 2 7643470. Email: delphine.legrand@uclouvain.be

Abstract

Background: the prevalence of sarcopenia varies widely between studies. The objective of this study was to assess the prevalence of sarcopenia in a representative sample of persons aged 80 years and older according to the European Working Group on Sarcopenia in Older People (EWGSOP) algorithm and the proposed cut-off values. A secondary aim was to investigate the relationship between different individual criteria and low physical performance capacity.

24. Flodgren G, Parmelli E, Doumit G et al. Local opinion leaders: effects on professional practice and health care outcomes. Cochrane Database of Systematic Reviews 1, 2007; Article number CD000125.

Received 26 October 2012; accepted in revised form 22 May 2013