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# Development and initial validation of the Falls Efficacy Scale-International (FES-I)

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## Abstract

**Background:** there is a need for a measure of fear of falling that assesses both easy and difficult physical activities and social activities and is suitable for use in a range of languages and cultural contexts, permitting direct comparison between studies and populations in different countries and settings.
**Objective:** to develop a modified version of the Falls Efficacy Scale to satisfy this need, and to establish its psychometric properties, reliability, and concurrent validity (i.e. that it demonstrates the expected relationship with age, falls history and falls risk factors).
**Design:** cross-sectional survey.
**Setting:** community sample.
**Method:** 704 people aged between 60 and 95 years completed The Falls Efficacy Scale-International (FES-I) either in postal self-completion format or by structured interview.
**Results:** the FES-I had excellent internal and test–retest reliability (Cronbach's $\alpha$=0.96, ICC=0.96). Factor analysis suggested a unitary underlying factor, with two dimensions assessing concern about less demanding physical activities mainly in the home, and concern about more demanding physical activities mainly outside the home. The FES-I had slightly better power than the original FES items to discriminate differences in concern about falling between groups differentiated by sex, age, occupation, falls in the past year, and falls risk factors (chronic illness, taking multiple or psychoactive medications, dizziness).
**Conclusions:** the FES-I has close continuity with the best existing measure of fear of falling, excellent psychometric properties, and assesses concerns relating to basic and more demanding activities, both physical and social. Further research is required to confirm cross-cultural and predictive validity.

Keywords: *quality of life, accidental falls, aged, questionnaires, elderly*

## Introduction

Fear of falling is reported by one in four older people in the community [1], with a higher prevalence among those who have fallen and people in institutional care [2–7]. Fear of falling can lead to distress and reduced quality of life, increased medication use and activity restriction, further decline in physical functioning, greater falling risk, and admission to institutional care [3, 6, 8–14].

For prevalence studies, fear of falling has often been assessed by a single categorical questionnaire item [2, 4, 6, 7, 9]. However, there is a need for questionnaire measures that are able sensitively to discriminate between different levels of fear and assess concern about different activities. These measures can be used (i) to identify individuals with excessive fear that requires intervention; (ii) to determine which activities are most feared and therefore should be targeted for rehabilitation support; and (iii) to detect accurately whether levels of fear change over time, for example following an intervention to reduce the risk or fear of falling.

The first such scale to be developed was the 'Falls Efficacy Scale' (FES) [15], which measures confidence in performing

a range of activities of daily living without falling. This scale (and its later modifications) has excellent reliability, is correlated with measures of balance and gait [14, 15], and predicts future falls and decline in functional capacity [5, 10, 13, 15, 16]. Most importantly, the FES has proven sensitive to change in fears following clinical interventions [17–20]. Nevertheless, some commentators have suggested that the original FES could be improved as a measure of fear of falling in a number of respects.

Firstly, there may not be a direct relationship between fear of falling and 'self-efficacy' or confidence in performing activities without falling; the latter may be influenced by general estimations of functional capability and less closely associated with fear and anxiety [21]. In addition, it has been suggested that the 10 category discrimination between levels of confidence employed for responses to the FES may lack meaningfulness for older people [22], who may find it difficult to decide between a 30% or 40% level of confidence that they will not fall. These issues were later addressed by the original authors, who changed the response format to four categories assessing level of concern about falling [23]. The revised instructions require respondents to indicate their level of concern about falling if they did each activity even if they are unable to actually carry out the activity for some other reason, and should therefore assess fear of falling rather than their functional abilities. However, while this version proved sensitive to change following an intervention [18] its psychometric properties have not been published.

Secondly, the items on the original FES refer almost exclusively to very basic activities of daily living that only frail or disabled people would be likely to have difficulty with, and do not include the more demanding activities which may be the principal cause for concern among higher functioning older people. Consequently, the scale is likely to be sensitive to differences and changes among the frail and disabled older population, but may be less sensitive to the concerns of more active older people, who may nevertheless be at risk of falling due to their less restricted lifestyle [24]. Several scales have been developed to address this problem in the original FES [16, 25–28], either by adding items to the original FES or by creating new scales assessing confidence or concern relating to a wider range of activities. However, to date none of these alternative versions have been as well validated as the original FES. In addition, most of these new scales retain the 10-category measure of self-efficacy that has been criticised in the original FES, and/or contain items that are not widely applicable across different cultural contexts (e.g. referring to front or rear steps at home, which not all homes have, or to using public transport or cars, which many older people may not have access to).

Thirdly, none of the items of the FES (or the new scales referred to above [16, 25–28]) directly evaluate the impact of fear of falling on social life [22]. Fear of the social consequences of falling, such as embarrassment, has been shown to be as common as fear of the physical consequences (e.g. injury and disability), and independently contributes to avoidance of activity [14]. Consequently, it is important to assess fears relating to social activities since these may be the principle concern of some older people.

The purpose of this study was to modify the FES to maximise its suitability for translation and use in a wide range of different languages and cultural contexts, to select additional cross-culturally relevant items to assess more demanding and social activities, and to establish the reliability and discriminant validity of the resulting Falls Efficacy Scale-International (FES-I).

## Methods

### Subjects

A total of 704 people aged over 60 years were recruited, using a variety of methods to ensure that we sampled people of different ages, gender, socioeconomic background, levels of physical functioning and medical history, with over-sampling of populations at greater risk of falling and fall-related injury. A sample of 589 participants was recruited to a postal survey by means of advertisements placed in magazines and on internet websites, and through clubs, leisure groups, self-help groups and community organisations. A further 115 people in sheltered accommodation or attending lunch clubs for older people were recruited for face-to-face structured interviews.

### Design

The FES-I was administered by structured interview or by postal survey as part of a longer assessment. Approval for the study was obtained from the ethics committee of the School of Psychology, University of Southampton. Test–retest reliability was assessed by re-administration of the instrument one week later in a sub-sample of the first 16 respondents.

### Measures

#### *The FES-I*

The FES-I was developed through a series of meetings between members of the Prevention of Falls Network Europe (ProFaNE), an EC funded collaboration coordinating research into fall prevention. Members examined the existing items of the FES to identify any potential difficulties they might pose either for accurate translation or for applicability to their cultural context. The wording of items that posed potential problems was then revised through discussion. For example, the item 'Reaching into cabinets or closets' appeared ambiguous because of cross-cultural differences in the use of storage space and the terms employed to describe it; consequently, the activity this item assessed was standardised as 'Reaching up or bending down'.

We then selected additional items with cross-cultural face validity to assess more difficult and social activities, drawing on the literature (particularly the SAFE [22] and ABC [27]) and the professional experience of members. The resulting questionnaire comprised 16 items, including the 10 original items from the FES (with some rewording where necessary) and six new items assessing walking on slippery, uneven or sloping surfaces, and visiting friends or relatives, going to a social event or going to a place with crowds (see Table 1). We employed the revised FES instructions and response categories [23] that assess level of concern about

Table 1. Mean, standard deviation, median and factor loadings of items on the FES-I (item range=1–4)[a]

| | | | | Two factor solution | | Single factor solution |
|---|---|---|---|---|---|---|
| FES-I item[b] | Mean | Standard deviation | Median | Factor 1 loading | Factor 2 loading | Factor loading |
| 1.Cleaning the house | 1.67 | 0.96 | 1 | 0.680 | 0.414 | 0.734 |
| 2. Getting dressed/undressed | 1.50 | 0.81 | 1 | 0.812 | 0.203 | 0.702 |
| 3. Preparing simple meals | 1.32 | 0.71 | 1 | 0.829 | 0.137 | 0.788 |
| 4. Taking a bath or shower | 2.09 | 1.09 | 2 | 0.563 | 0.552 | 0.857 |
| 5. Going to the shop | 1.83 | 1.06 | 1 | 0.663 | 0.545 | 0.715 |
| 6. Getting in or out of a chair | 1.49 | 0.79 | 1 | 0.749 | 0.244 | 0.823 |
| 7. Going up or down stairs | 2.06 | 1.08 | 2 | 0.613 | 0.549 | 0.868 |
| 8. Walking around outside | 1.99 | 1.07 | 2 | 0.570 | 0.662 | 0.792 |
| 9. Reaching up or bending down | 2.14 | 1.11 | 2 | 0.509 | 0.616 | 0.784 |
| 10. Answering the telephone | 1.64 | 0.96 | 1 | 0.703 | 0.394 | 0.659 |
| 11. Walking on a slippery surface | 3.06 | 1.00 | 3 | 0.122 | 0.837 | 0.815 |
| 12. Visiting a friend/relative | 1.62 | 0.95 | 1 | 0.694 | 0.450 | 0.829 |
| 13. Going to a place with crowds | 2.13 | 1.17 | 2 | 0.501 | 0.678 | 0.763 |
| 14. Walking on an uneven surface | 2.73 | 1.07 | 3 | 0.224 | 0.882 | 0.809 |
| 15. Walking up or down a slope | 2.46 | 1.16 | 2 | 0.371 | 0.791 | 0.821 |
| 16. Going out to a social event | 1.85 | 1.06 | 1 | 0.611 | 0.549 | 0.780 |

[a]Items 1–10 comprise the original FES items, items 11–16 the new FES-I items.
[b]Some items are abbreviated: the full wording of the final FES-I is available from the first author.

falling when carrying out each activity on a four point scale (1=not at all concerned, 4=very concerned).

### Analyses

Internal reliability of the FES-I was evaluated by calculating the Cronbach's alpha coefficient for the whole scale, by checking whether every item increased the Cronbach alpha coefficient, and by examining Pearson's correlations between items. Test–retest reliability was assessed by the intra-class coefficient between scores obtained in the main survey and at one week follow-up. The internal structure of the FES-I was examined by factor analysis, first using principal component analysis with Varimax rotation, then using oblique rotation to assess inter-correlation between factors, and finally specifying a single factor solution, to determine the unity of the scale.

ANOVA with Bonferroni *post hoc* tests was used to examine difference in scores on each item between non-fallers and those who had fallen once or more often. The mean age of the structured interview sample and postal sample was compared by independent *t*-test. Discriminant validity was assessed by using independent *t*-tests to examine between-group differences in total scores according to administration format, age, sex, occupational status and falling risk factors. Effect sizes of the FES and FES-I for these between-group comparisons were compared by normalising both scales (by dividing the total score by the number of items), and then subtracting the mean in the first group from that in the second group (see Table 2) and dividing the resulting figure by the pooled standard deviation. Hierarchical regression was employed to analyse the contribution of method of administration (postal or interview) to FES-I scores after controlling for age.

## Results

The mean age of participants was 74.7 years (SD 7.10) with an age range of 60–95, and 513 (72.9%) were women. Of the 673 people who reported classifiable occupations, 546 (76.4% of the sample) reported that they had been in managerial, professional or intermediate occupations or self-employed, while 136 (19.3%) had been in routine, semi-routine or lower technical or supervisory occupations. 328 people (46.6%) had not fallen in the past year, 209 (29.8%) had fallen once, and 165 (23.5%) had fallen more than once. Those who completed the questionnaire in face to face interview format were significantly older than those who responded to the postal survey (mean age 73.5 versus 81.3 years, $P<0.001$).

Internal reliability of the FES-I was 0.96, and test–retest reliability for the total score was also 0.96. All items contributed positively to the reliability of the scale, and inter-item correlations averaged 0.55 (range 0.29–0.79). Although the full range of responses was used for every item, there was a skew towards low levels of concern on half the items, particularly those from the original FES (see median values reported in Table 1).

Factor analysis could discriminate two factors (see Table 1). The first (which explained 36.8% of the variance) was dominated by items assessing concern about lower demand physical activities within the home (e.g. preparing meals, getting in and out of the chair) while the second (explaining 32.7% of the variance) loaded most highly on items assessing more demanding physical activities outside the home, (e.g. walking on a slippery, sloping or uneven surface). However, when oblique rotation was used these factors were correlated –0.59, and when a single factor solution was specified all items were shown to also load strongly on a unitary underlying dimension explaining 61.7% of the variance (see last column of Table 1).

Figure 1 shows the mean response to each item of the FES-I of participants who reported no falls, one fall or multiple falls in the past year. Responses differed significantly between all the groups ($P<0.05$) for every item except cleaning the house (item 1) and preparing meals (item 3). These

**Table 2.** Means and standard deviations on total FES-I Score (range 16 to 64) for sub-groups based on demographic characteristics and falls risk factors

| | | | Group 1 | | | Group 2 | | | Effect size[a] | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Group 1 | Group 2 | Number[b] | Mean | Standard deviation | Number | Mean | Standard deviation | FES-I Items 1–10 | Total FES-I |
| Administration format | Postal | Interview | 589 | 30.92[c] | 12.15 | 115 | 34.57 | 14.50 | 0.28 | 0.29 |
| Demographic characteristics | | | | | | | | | | |
| Age | <75 | ≥75 | 367 | 29.37[d] | 11.96 | 337 | 33.86 | 12.93 | 0.33 | 0.36 |
| Sex | Men | Women | 189 | 28.69[d] | 12.02 | 513 | 32.50 | 12.69 | 0.21 | 0.31 |
| Occupational status | Higher | Lower | 546 | 30.57[d] | 12.06 | 136 | 35.42 | 13.97 | 0.35 | 0.36 |
| Falling risk factors | | | | | | | | | | |
| Falls in the past year | None | ≥1 | 328 | 26.94[d] | 10.78 | 374 | 35.54 | 12.79 | 0.71 | 0.72 |
| Chronic illness | Absent | Present | 179 | 24.77[d] | 9.99 | 506 | 33.77 | 12.50 | 0.69 | 0.76 |
| Dizziness | Absent | Present | 243 | 24.36[d] | 10.14 | 441 | 35.20 | 12.17 | 0.85 | 0.94 |
| No. medications taken | <4 | ≥4 | 452 | 29.01[d] | 11.49 | 235 | 36.40 | 13.45 | 0.60 | 0.61 |
| Psychoactive medication | Absent | Present | 599 | 30.74[d] | 12.33 | 96 | 35.79 | 13.74 | 0.40 | 0.40 |

[a]Effect sizes for group differences on items 1–10 of the FES-I (based on the original FES items) and the total FES-I score.
[b]Number of respondents coded as Group 1 for each variable.
[c]Significantly different from Group 2, $P<0.01$.
[d]Significantly different from Group 2, $P<0.001$.

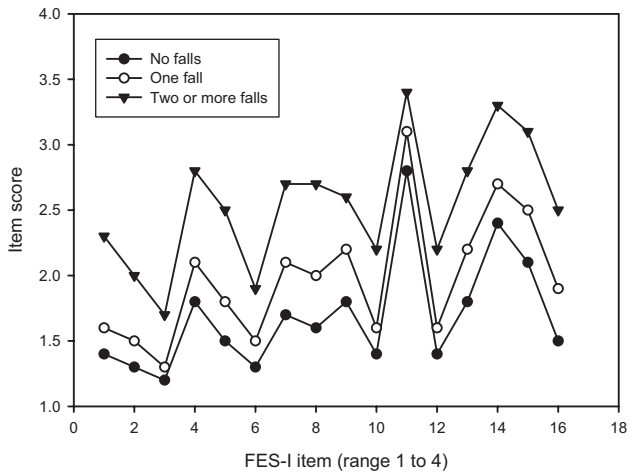


**Figure 1.** Mean score on each item by number of falls in the past year

two items could only discriminate between repeat fallers and the other two groups.

Total scores on the FES-I in different sub-groups are shown in Table 2, which demonstrates that the questionnaire was sensitive to group differences relating to demographic characteristics and fall risk factors. Scores were significantly higher in women, older participants, and those from lower occupational categories. People who reported a risk factor for falling (fall in the past year, chronic illness, dizziness, taking four or more medications, or taking psychoactive medication) also had significantly higher total FES-I scores. Although there was a difference in the total score obtained by the structured interview and postal format, this simply reflects the older age of the sample we recruited for structured interview from sheltered accommodation, since after controlling for the effect of age ($R^2$ change=0.52, $P<0.001$) the effect of method of administration had no effect at all on FES-I scores ($R^2$ change=0.000, $P>0.05$).

The final two columns of Table 2 indicate that the effect sizes for between group differences were slightly but consistently greater for the total FES-I score than for just the items adapted from the original FES.

## Discussion

Our findings confirm that the FES-I has at least as good internal and test–retest reliability as any existing measure of fear of falling [15, 16, 26, 27]. Although the term 'Falls Efficacy' has been retained in the title to acknowledge the historical development of the scale, the FES-I actually assesses 'concern' about falling, a term that is closely related to fear, but is less intense and emotional (and therefore may be more socially acceptable for older people to disclose). The addition of the new items succeeded in tapping a different set of concerns about performance of challenging activities, mainly outside the home, and factor analysis confirmed that these fears were distinct from but related to those assessed by the original FES. Responses to the new items on the FES-I were less skewed towards low concern than responses to the original items of the FES. The FES-I is therefore likely to perform better than the FES in detecting concerns relating to social activities and more demanding outdoor balance related tasks, and should prove particularly useful for evaluating fear of falling in community-dwelling populations.

A limitation of the study was that the sample was self-selected, and people from higher occupational categories and with a higher than average risk of falls were over-represented. It would therefore be helpful to carry out a study in a stratified random population sample to provide normative data, and to examine correlations with factors that should be related, including perceived risk and consequences of falling, general anxiety, objective measures of balance, functional capacity, and quality of life. It will also be necessary to demonstrate the predictive validity of the scale and its sensitivity to change following interventions, and to compare these to the existing best measure of fear of falling, the FES. A major advantage of

the FES-I with respect to this process of validation is that it incorporates the original items of the FES in only a slightly modified form. This means that it is highly probable that it will have as good validity as the FES, and it will be simple in future studies to compare the performance of the original FES items with the performance of the total FES-I.

The next step in the validation of the FES-I will be to demonstrate that it has comparable reliability and validity across a range of languages and cultural settings. Translation and validation in several languages is already being undertaken by the Prevention of Falls Network Europe and will be reported shortly (see Supplementary data for final version of the FES-I, translation instructions and list of languages it has been translated into, at www.ageing.oxfordjournals.org). A major advantage of establishing a scale suitable for use in a wide range of contexts is that this will permit direct comparison between studies and populations in different countries and settings. This study suggests that the FES-I is a good candidate for this role, as it has close continuity with the best existing measure of fear of falling, its psychometric properties are excellent, and it is able to assess concerns relating to basic and more demanding activities, both physical and social.

## Key points

- In order to compare fear of falling across a range of international settings and interventions a measure of fear of falling is needed that has cross-cultural validity.
- The Falls Efficacy Scale (FES) is currently the best validated and most widely used instrument for this purpose.
- No existing scale assesses concerns about demanding activities outside the home and social activities, using cross-culturally valid items.
- The Falls Efficacy Scale-International (FES-I) addresses the limitations of the FES.
- The psychometric properties and discriminatory power of the FES-I are excellent.

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## References

1. Howland J, Peterson EW, Levin WC *et al.* Fear of falling among the community-dwelling elderly. J Aging Health 1993; 5: 229–43.
2. Afken CL, Lach HW, Birge SJ *et al.* The prevalence and correlates of fear of falling in elderly persons living in the community. Am J Public Health 1994; 84: 565–70.
3. Bruce DG, Devine A, Prince RL. Recreational physical activity levels in healthy older women: the importance of fear of falling. J Am Geriatr Soc 2002; 50: 84–9.
4. Howland J, Lachman ME, Peterson EW *et al.* Covariates of fear of falling and associated activity curtailment. Gerontologist 1998; 38: 549–55.
5. Tinetti ME, Mendes de Leon CF, Doucette JT *et al.* Fear of falling and fall-related efficacy in relationship to functioning among community-living elders. J Gerontol 1994; 49: M140–M147.
6. Franzoni S, Rozzini R, Boffelli S *et al.* Fear of falling in nursing home patients. Gerontology 1994; 40: 38–44.
7. Liddle J, Gilleard C. The emotional consequences of falls for older people and their families. Clin Rehabil 1995; 9: 110–14.
8. Delbaere K, Crombez G, Vanderstraeten G *et al.* Fear-related avoidance of activities, falls and physical frailty. A prospective community-based cohort study. Age Ageing 2004; 33: 368–73.
9. Vellas B, Cayla F, Bocquet H *et al.* Prospective study of restriction of activity in old people after falls. Age Ageing 1987; 16: 189–93.
10. Cumming RG, Salkeld G, Thomas M *et al.* Prospective study of the impact of fear of falling on activities of daily living, SF-36 scores, and nursing home admission. J Gerontol A Biol Sci Med Sci 2000; 55: M299–M305.
11. Friedman SM, Munz B, West SK *et al.* Falls and fear of falling: which comes first? A longitudinal model suggests strategies for primary and secondary prevention. J Am Geriatr Soc 2002; 50: 1329–35.
12. Maki BE. Gait changes in older adults: predictors of falls or indicators of fear? J Am Geriatr Soc 1997; 45: 3131–320.
13. Mendes de Leon CF, Seeman TE, Baker DI *et al.* Self-efficacy, physical decline, and change in functioning in community-living elders: a prospective study. J Gerontol B Psychol Sci Soc Sci 1996; 51: S183–S190.
14. Yardley L, Smith H. A prospective study of the relationship between feared consequences of falling and avoidance of activity in community-living older people. Gerontologist 2002; 42: 17–23.
15. Tinetti ME, Richman D, Powell L. Falls efficacy as a measure of fear of falling. J Gerontol 1990; 45: 239–43.
16. Hill KD, Schwarz JA, Kalogeropoulos AJ *et al.* Fear of falling revisited. Arch Phys Med Rehabil 1996; 77: 1025–29.
17. Petrella RJ, Payne M, Myers A *et al.* Physical function of fear of falling after hip fracture rehabilitation in the elderly. Am J Phys Med Rehabil 2000; 79: 154–60.
18. Wolf SL, Barnhart HX, Kutner NG *et al.* Reducing frailty and falls in older persons: an investigation of Tai Chi and computerized balance training. J Am Geriatr Soc 1996; 44: 489–97.
19. Cameron ID, Stafford B, Cumming RG *et al.* Hip protectors improve falls self-efficacy. Age Ageing 2000; 29: 57–62.
20. Tennstedt S, Howland J, Lachman M *et al.* A randomized, controlled trial of a group intervention to reduce fear of falling and associated activity restriction in older adults. J Gerontol B Psychol Sci Soc Sci 1998; 53: S384–S392.
21. McKee KJ, Orbell S, Austin CA *et al.* Fear of falling, falls efficacy and health outcomes in older people following hip fracture. Disabil Rehabil 2002; 6: 327–33.
22. Lachman ME, Howland J, Tennstedt S *et al.* Fear of falling and activity restriction: the survey of activities and fear of falling in the elderly (SAFE). J Gerontol B Psychol Sci Soc Sci 1998; 53: S43–S50.
23. Tinetti ME, Baker DI, McAvay G *et al.* A multifactorial intervention to reduce the risk of falling among elderly people living in the community. N Engl J Med 1994; 331: 821–7.
24. Stel VS, Pluijm SMF, Deeg DHJ *et al.* A classification tree for predicting recurrent falling in community-dwelling older persons. J Am Geriatr Soc 2003; 51: 1356–64.

**25.** Lusardi MM, Smith EV. Development of a scale to assess concern about falling and applications to treatment programs. J Outcome Meas 1997; 1: 34–55.
**26.** Parry SW, Steen N, Galloway SR *et al.* Falls and confidence related quality of life outcomes measures in an older British cohort. Postgrad Med J 2001; 77: 103–8.
**27.** Powell LE, Myers AM. The Activities-specific Balance Confidence (ABC) Scale. J Gerontol A Biol Sci Med Sci 1995; 50: M28–M34.
**28.** Velozo CA, Peterson EW. Developing meaningful fear of falling measures for community dwelling elderly. Am J Phys Med Rehabil 2001; 80: 662–73.

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# Relations between undernutrition and nosocomial infections in elderly patients

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## Abstract

**Background**: hospital-acquired infections and malnutrition are of major concern in public health in elderly patients. However, the interactions between these two entities are not well established.
**Objectives**: to determine the incidence of nosocomial infections (NI) and its association with malnutrition.
**Subjects**: 185 hospitalised older adults aged 81.6 ± 0.6 years old were nutritionally assessed on admission by measurement of anthropometric variables, serum nutritional proteins and evaluation of dietary intake. During hospitalisation, patients' progress was closely monitored, particularly for the detection of nosocomial infections.
**Results**: the incidence rate of NI was 59% and the global infection rate was 7.6/1000 bed days. The most common infection site was the urinary tract ($n=63$). The nutritional status of the population was studied by comparing three groups defined according to the absence (group I, $n=116$), presence of one infection (group II, $n=38$) or presence of more than one infection (group III, $n=31$). All but one anthropometric parameters varied among the three groups. Total energy intake also varied among the three groups. The group I had higher daily nutrient intake than the other two groups (respectively $P=0.004$ and $P<0.0001$). Albumin, transthyretin, and C-reactive protein levels differed significantly among the three groups (respectively $P<0.0001$, $P<0.0001$ and $P=0.0003$). Age, energy intake, length of hospital stay and the presence of a urinary catheter were independent risk factors of nosocomial infection.
**Conclusion**: our findings show that patients with multiple NI were older, showed an altered nutritional status, a prolonged recovery, more frequently had urinary catheters and more discharge placement.

Keywords: *malnutrition, nosocomial infection, elderly*

## Introduction

Hospital-acquired infections are of major concern in public health. They are a frequent complication of hospitalisation and are associated with high morbidity, mortality rate and costs [1, 2]. Malnutrition is known to impair immune function, particularly cell-mediated immunity [3, 4]. Several studies have reported infections as a complication of malnutrition in different populations of patients, mainly in surgical units [5–10]. Less attention has been paid to elderly