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Falls and catastrophic thoughts about falls predict mobility restriction in community-dwelling older people: A structural equation modelling approach

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Objectives: How and when concerns about falls emerge is not yet completely known, because these concerns are present in both people with and without a falls history. The aim of this study was to investigate the role of catastrophic beliefs about falls and previous falls in the development of concerns about falls and resulting mobility restrictions (MR).
Method: Within a cross-sectional design, 896 older people (mean age 76.2 ± 4.7) living independently in the community completed a battery of questionnaires. Self-report data was gathered on previous falls, catastrophic beliefs about consequences of a fall (Catastrophizing About Falls Scale), concerns about falls (modified Falls Efficacy Scale) and mobility restrictions during daily life (Sickness Impact Profile 68).
Results: Using structural equation modelling, we found that the number of falls in the previous year was not directly related to mobility restrictions in daily life, but via an increase of concerns about falls. Also catastrophic beliefs about the consequences of falls were related to concerns about falls and to mobility restrictions. Goodness-of-fit indices revealed that the presented model had an acceptable fit. Alternative models resulted in lesser-fit indices.
Conclusion: Both previous falls and catastrophic beliefs about falls are unique and independent predictors of concerns about falls and, subsequently, of mobility restrictions. A cognitive-behavioural perspective upon mobility restrictions may provide important additional components for treatment and prevention of excessive concerns about falls in older people.

Keywords: catastrophizing; psychological; fear of falling; path analysis; ageing; activity avoidance

Introduction

Falls are prevalent in older people, and often result in injuries that impose limitations upon daily activities and threaten autonomy. Older people are often aware of these potentially devastating consequences, and report to be concerned about falls. Such concerns are present in both those who have suffered previous falls, and in those who have not fallen (Arfken et al., 1994; Howland et al., 1998; Legters, 2002; Murphy et al., 2002; Tinetti et al., 1994). Although some level of concern about consequences of falling is thought necessary to raise awareness and to encourage people towards participation in falls prevention programmes (Janz & Becker, 1984), there is growing consensus that high levels of concern about falls may be dysfunctional and possibly lead to avoidance of fall-related activities (Brouwer et al., 2004; Delbaere et al., 2004; Friedman et al., 2002; Howland et al., 1998; Legters, 2002; Murphy et al., 2002). The resulting reduction in activity may then result in physical deconditioning (Brouwer et al., 2004; Delbaere et al., 2004; Maki et al., 1991; Myers et al., 1996), poor quality of life (Arfken et al., 1994; Lawrence et al., 1998), social isolation (Arfken et al., 1994; Howland et al., 1998; Murphy et al., 2002), depression and psychological distress (Arfken et al., 1994; Chandler et al., 1996; Howland et al., 1998).

How and when concerns about falls emerge is not yet completely understood. It seems reasonable to assume that frail individuals (Friedman et al., 2002; Maki et al., 1991; Murphy et al., 2003), with a history of frequent and/or serious falls (Arfken et al., 1994; Friedman et al., 2002; Howland et al., 1998; Murphy et al., 2003), are more likely to develop concerns about falls. Also beliefs about falls and its consequences may play a role, even in individuals without a history of falls. In this study, we explored the role of catastrophic thoughts about possible consequences of falls in explaining concerns about falls and disability. Catastrophizing, or thinking the worst of events, has proven an important variable in explaining distress and disability in chronic pain patients (Sullivan et al., 2001). The role of catastrophic thoughts about falls is

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not yet explored. Approaching concerns about falls from a similar cognitive-behavioural perspective may help in answering questions about the development of concerns about falls in older individuals, often resulting in an exacerbating cycle of activity avoidance and physical decline.

The aims of this study are (i) to evaluate the role of catastrophizing in the development of fall-related concerns and restriction in daily activities and (ii) to test a cognitive-behavioural model that describes these relationships by using structural equation modelling.

Methods

The data are drawn from the baseline phase of a randomized controlled trial, which was conducted from September 1997 to June 1999 (Van Haastregt et al., 2000).

Study design

Participants were recruited from six general practices in the community of Hoensbroek, the Netherlands, by means of a screening questionnaire which enquired about age, type of residence and level of mobility. The following selection criteria were then used: (1) participants had to be aged 70 years or above and reside in the community or senior centres, and (2) older people who were bedridden, fully wheelchair-dependent, or terminally ill were excluded from the study. Of a total of 1459 patients, 1310 received the screening questionnaire. Response rate was 68% ($N = 896$).

Assessments

Participants completed a self-administered battery of questionnaires to assess following constructs: falls history, catastrophic beliefs about falls, concerns about falling and mobility restrictions (MR) during daily life.

The number of *falls* in the previous 12 months was asked for two subsequent 6-month periods using a six-point scale, ranging from 'no falls' to '5 falls or more'. The total number of falls in the previous year was computed by adding the number of falls in both periods, capped at 10 falls.

Catastrophizing about consequences of falls was measured using the three items of the Catastrophizing about Falls Scale (CAFS) (Van Haastregt & Vlaeyen, 2002). Questions were 'If I fall over, I will probably break something, e.g. my hip', 'If I fall over, my health will probably never be the same', and 'If I fall over, I will probably end up in a nursing home'. Each item is scored on a four-point scale: very much agreed, agreed, not agreed, not at all agreed. Internal consistency of the scale was high with a Cronbach's α of 0.83.

Concerns about falls while performing everyday activities (e.g. cleaning the house, getting dressed, simple shopping) were measured with a modified version of the Falls Efficacy Scale (mFES) which consists of 10 questions (e.g. 'How concerned are you about falling when you clean the house?'). Each item is scored on a four-point scale: not at all concerned, a little concerned, a lot concerned, very concerned. The original Falls Efficacy Scale is reliable and valid (Tinetti et al., 1990). In the current study, Cronbach's α was 0.93.

Mobility restrictions in daily life were assessed with two subscales of a short version of the Sickness Impact Profile (SIP-68), i.e. mobility range subscale and motor control subscale. The SIP-68 is a quality of life measure that addresses observable behaviour. The Dutch version of SIP-68 has good reliability and validity in older people (De Bruin et al., 1994). The mobility range subscale consists of 10 statements, each describing a daily activity: five related to household activities (e.g. 'I don't do any household activities anymore') and five related to outdoor activities (e.g. 'I stay at home most of the time'). The motor control subscale consists of 12 statements, each describing loss of control on an aspect of daily functioning: nine related to walking and standing (e.g. 'I walk slower'), one concerning dressing (i.e. 'I can dress myself but it goes very slowly'), and two about hand function. The two latter activities were omitted because they were irrelevant for purposes of the study. An aggregated score is obtained by adding the number of statements that the participant relates with for both subscales. Cronbach's α in the current study were 0.84 for the mobility range subscale and 0.88 for the modified motor control subscale.

Statistical analyses

Statistical analyses were performed using SPSS (version 15.0) in conjunction with Analysis of Moment Structures (AMOS 7.0) Graphics. Bivariate correlations between variables were measured using Pearson's or Spearman's rho analyses, depending on quantitative or qualitative nature of the variables.

AMOS was used to examine relationships between previous falls (latent variable with two indicators), catastrophizing (latent variable with three indicators), mobility restrictions (latent variable with two indicators, i.e. two SIP-68 subscales) and concerns about falls (latent variable with two indicators, i.e. two randomly created subscales). Instead of using individual items of mFES as indicators, we created two parcels by randomly assigning items to one of the parcels. Reducing the number of indicators is preferable in analyses with large item sets (35 in current study) (Marsh et al., 1998).

Multivariate normality and linearity were evaluated by examining the normality, linearity and homoscedasticity of the individual variables and residuals. After a logarithmic transformation of mobility restrictions and an inverse transformation of the mFES,

Table 1. Means, standard deviations, internal consistency (α) and inter-correlations of all measures in study.

	Mean (SD)	Range	α	2	3	4	5
1. Falls in the previous year	0.97 (1.85)	(0–10)	–	0.21	0.40	0.30	0.32
2. Catastrophizing about falls (CAFS)	8.25 (2.44)	(3–12)	0.83	–	0.54	0.35	0.38
3. Concerns about falls (mFES)	14.83 (6.51)	(10–40)	0.93		–	0.54	0.66
4. Mobility Range (SIP68)	1.49 (2.41)	(0–10)	0.84			–	0.66
5. Motor Control (SIP68)	3.30 (2.87)	(0–10)	0.88				–

Note: All correlations are significant at the 0.01 level.

assumptions regarding multivariate normality were met (Tabachnik & Fidell, 2007).

The sample was split in two groups by random selection in order to cross-validate our developed model. Model development and the associated calibration analyses were performed on 448 participants; the model was then cross-validated on the other 448 participants. Only participants with valid values on all variables were included. This was the case for 332 participants in the calibration sample and 320 participants in the validation sample.

Goodness-of-fit was investigated by Chi-square, Root Mean Square Error of Approximation (RMSEA) and Comparative Fit Index (CFI) (Byrne, 2004). These indexes each provide a different aspect of the model fit. Chi-square (χ^2) is a statistical test of lack of fit resulting from overidentifying restrictions placed on a model, and should not be significant (Byrne, 2004). To reduce the sensitivity of χ^2 to sample size, we also provide the normed chi-square, as χ^2 divided by the degrees of freedom. Values lower than 3 indicate a reasonable fit (Kline, 1998). RMSEA estimates lack of fit in a model compared to a perfect model, and should therefore be small (RMSEA < 0.08) (Hu & Bentler 1999). CFI represents relative reduction in lack of fit as estimated by comparing the existing model with a null model that assumes latent variables in the model to be uncorrelated; high values (CFI > 0.95) reflect a good model fit (Byrne, 2004). Additionally, we have also calculated the Consistent Akaike Information Criterion (CAIC), which is mostly used to select among competing models estimated with the same data. The CAIC adjusts the model chi-square to penalize for model complexity and sample size. The model with the smallest CAIC is chosen as the best model (Kline, 1998).

Results

Mean age of our participants was 76.2 years (SD = 4.7) and 58% was female ($N = 523$). On self-rated health status using a five-point scale, 60% ($N = 531$) of the sample rated their health as good, very good, or excellent. Out of a possible 17 common medical conditions, the sample had a mean of 5.3 (SD = 3.6) (data not shown). With respect to falls information, 36% ($N = 316$) of the participants reported one or more falls in the previous year, and 60% ($N = 533$) reported concerns about falling. Table 1 presents means, standard deviations, Cronbach's α's, and correlations between variables. Catastrophizing and concerns about falls were strongly associated. Both parameters were strongly correlated to mobility restrictions during daily activities as measured with two subscales of SIP-68.

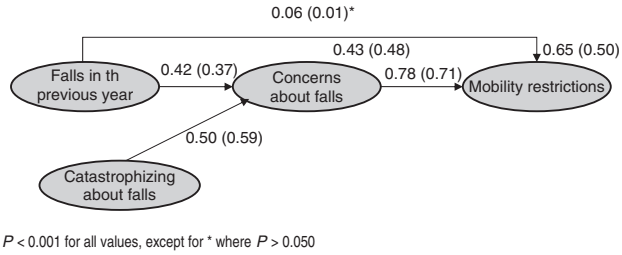

Figure 1. Output of the structural equation model. Values shown are standardized regression coefficients. Direct effects are provided next to each arrow and explained variances are provided in bold above each variable. The number that is not between brackets belongs to the calibration model; the number between brackets belongs to the validation model.

Structural equation modelling was used to examine magnitude and significance of the role of catastrophizing in predicting mobility restrictions. The model was a priori designed. First, we tested the measurement model. Goodness-of-fit indicators ($\chi^2(21) = 32.3$, $p = 0.055$; RMSEA = 0.04; CFI = 0.99) revealed that the measurement model had an excellent fit, indicating a good construct validity of all our variables. Next, we tested our theoretical model. We hypothesized that (i) falls account for concerns about falls, (ii) concerns about falls, rather than falls themselves, result in mobility restrictions, and (iii) concerns about falls and mobility restrictions can develop without a falls history through catastrophic thoughts. Standardized coefficients of our a priori model are presented in Figure 1. As expected, the direct effect of falls on mobility restrictions failed to reach conventional levels of significance ($\beta = 0.06$, ns). The standardized indirect effect of falls on mobility restrictions was 0.33. Except for the significant Chi square ($\chi^2(23) = 53.7$, $p < 0.001$), the goodness-of-fit indicators ($\chi^2/df = 2.34$, RMSEA = 0.064; CFI = 0.98) showed that the presented model had an acceptable fit with a high number of degrees of freedom.

We also tested alternative models to investigate the robustness of our original model. In a first alternative model, we explored whether mobility restrictions has

Table 2. Goodness-of-fit summary for the models tested.

	χ^2 (d*f*)	χ^2/d*f*	RMSEA	CFI	CAIC
Calibration sample					
Original model	53.75 (23)*	2.34	0.064	0.98	203.46
Alternative model 1	100.93 (23)*	4.39	0.101	0.95	250.64
Alternative model 2	201.19 (23)*	8.75	0.153	0.89	350.90
Alternative model 3	101.20 (23)*	4.40	0.101	0.95	250.91
Validation sample					
Original model	50.18 (23)*	2.18	0.061	0.98	199.09
Alternative model 1	98.14 (23)*	4.27	0.101	0.95	247.05
Alternative model 2	111.98 (23)*	4.89	0.110	0.94	260.88
Alternative model 3	62.79 (23)*	2.73	0.074	0.97	211.69

Note: *$p \leq 0.001$; RMSEA = Root Mean Square Error of Approximation; CFI = Comparative Fit Index; CAIC = Consistent Akaike Information Criterion.

an effect on falls. To address this, we simply switched the position of falls and mobility restrictions of our original model. Goodness-of-fit indices of alternative model 1 indicated an unacceptable model fit (Table 2), indicating that falls did not result from mobility restrictions. In a second alternative model, we tested whether catastrophizing may be better conceived of as a result of falls and concerns about falls. This was done by designing a model in which falls had an effect on catastrophic thoughts about falls, both directly and indirectly via concerns about falls. Catastrophic thoughts then resulted in mobility restrictions. Analyses of alternative model 2 revealed an unacceptable fit (Table 2), indicating that catastrophic thoughts do not result from falls. In a third alternative model, we tested whether catastrophizing may be better conceived of as a consequence of mobility restrictions and concerns about falls. To address this, we switched the position of falls and mobility restrictions of our second alternative model. The goodness-of-fit indices of alternative model 3 indicated an unacceptable model fit (Table 2), suggesting that catastrophic thoughts do not results from mobility restrictions. Finally, the CAIC were compared between all models. This fit index was markedly lower in the original model (CAIC = 203.46) than in the alternative models (CAIC range = 250.9–350.9), indicating that the original model can be considered as the best model.

To examine the validity of our model, we cross-validated our original model with the other half of our sample. Standardized path coefficients are presented in Figure 1. Again, the direct effect of falls on mobility restrictions failed to reach conventional levels of significance ($\beta = 0.01$, ns). The standardized indirect effect of falls on mobility restrictions was 0.26. Goodness-of-fit statistics indicated an acceptable fit (Table 2).

Discussion

The aims of this study were to evaluate the role of catastrophizing in the development of fall-related concerns and restriction in daily activities, and to develop a model that describes these relationships by using structural equation modelling. We hypothesized that catastrophic beliefs about falls predict fall-related concerns, irrespective of falls history. Both our correlational analyses and structural equation modelling are in line with this idea.

Our results suggest that falls do not directly lead to radical behavioural changes in daily activities, but that affective-cognitive variables – being concerned about falls in this study – mediate this process. Accepting this idea, it is likely that having experienced falls is not necessary to become trapped into a vicious circle of concern, avoidance and disability. Indeed, several studies found a positive correlation between falls and fear-related avoidance of activities (Delbaere et al., 2004; Howland et al., 1998; Murphy et al., 2002; Tinetti et al., 1994), whereas others showed that avoidance behaviour was not dependent upon previous falls, but was related to concerns about falling (Cumming et al., 2000; Myers et al., 1996). In our study, we suggest that catastrophic beliefs about consequences of falls in itself may, independent from a falls history, create concerns about falls and lead to mobility restrictions. The resulting structural equation model proved to have a good fit. Alternative models investigated whether catastrophic thinking could also be seen as a consequence of falls or of mobility restrictions. However, the non-significant direct effect of falls on catastrophizing (Alt model 2: $\beta = -0.03$, ns) and of mobility on catastrophizing (Alt model 3: $\beta = -0.11$, ns) suggests that catastrophic thinking can be accepted as an independent predictor. These findings further highlight the importance of catastrophic beliefs about falls as a potentially important antecedent of fall-related concerns and mobility restrictions. In sum, this study suggests that both previous falls and catastrophic beliefs about falls are unique and independent predictors of concerns about falls and, subsequently, of mobility restrictions.

As yet, it remains largely unknown what causes catastrophic beliefs about falls. From our data, it is clear that catastrophic beliefs are not simply the result of previous falls or mobility restrictions. There may be some pre-dispositional factors such as anxiety and

negative affectivity (Keogh, 2005). Concerns about falling have been suggested to be an expression of generalized anxiety (Howland et al., 1998; Lawrence et al., 1998) and neuroticism (Mann et al., 2006). In addition, beliefs that a person holds regarding falls (e.g. related injuries, social embarrassment, damage to personal identity (Yardley & Smith, 2002)), including beliefs stemming from previous fall events, will influence the extent to which falls risk is catastrophically interpreted. Further longitudinal research is mandatory to identify the causes of catastrophic beliefs about falls, and to clarify other psychological factors that may help our understanding of individuals who develop high levels of concern about falls.

Our results suggest that concerns about falling can best be understood from cognitive-behavioural perspective (Tennstedt et al., 1998). When an older adult has fallen or has experienced possible falls risk, the individual appraises the experience. Ideally, it is appraised as undesirable and unpleasant, and the individual will change his/her behaviour as a function of his/her own physical capabilities. However, some individuals interpret falls as a catastrophe. Catastrophizing may then lead to high levels of concerns about falls and mobility restrictions, and may thereafter spiral into a self-perpetuating fear-avoidance cycle that promotes and maintains activity limitations, disability (Sullivan et al., 2001) and possibly falls. Our findings further suggest that cognitive-behavioural inter-ventions aimed at resolving current concerns and fears are likely to be effective in dealing with older people who are disabled because of excessive concerns about falling, as shown by Tennstedt et al. (1998). Inspired by effective treatments in chronic pain research (Vlaeyen & Linton, 2000), a promising approach for individuals with exaggerated concerns of falling could be graded exposure to activities of which they expect an increased risk of falling, combined with education on the adverse effects of too much protective avoidance behaviours. Future work is required to investigate the effectiveness of this approach in falls and fear of falling interventions.

There are some limitations to this study. First, the design is cross-sectional, making it impossible to make firm conclusions about causal relationships between variables. Prospective and longitudinal research is warranted to confirm causality. Promising are results of a prospective study by Cumming et al. (2000), who reported that low falls efficacy was related with greater declines in ability to perform in daily activities at follow up. Future studies should record prospective data on both falls and related injuries, as well as on concern about falls and mobility restrictions. Also, in order to better understand the underlying mechanisms, other confounding factors such as anxiety (Howland et al., 1998; Lawrence et al., 1998) and personality (Mann et al., 2006) should also be included. Second, all data were self-reported. It is known that this may result in shared-method variance (strong associations between variables owing to similar methods of measurement) and social desirability biases by denying difficulties in performance. Third, our measure for catastrophizing about falls, i.e. CAFS, is a new instrument, and more studies are needed to demonstrate its reliability and validity. However, despite its short form (three items only) internal consistency is excellent (Cronbach's α of 0.83) and the measurement model indicated that it is a separate construct. Despite its limitations, this study contributes to a better understanding of disability in older people, and points to novel treatment approaches in disabled older people with excessive concerns of falling.

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